Progetti PRIN 2022 e PRIN 2022 PNRR

Politecnico di Torino

Al Politecnico oltre 17 milioni di euro dai bandi PRIN per la ricerca di eccellenza

Il **Politecnico** è fortemente impegnato nel campo della ricerca di base di eccellenza e per la creazione di una sempre maggiore connessione tra gli organismi di ricerca italiani.
Lo dimostra la grande partecipazione dei gruppi di ricerca dell'Ateneo ai bandi per i **Progetti di Rilevante Interesse Nazionale** (PRIN 2022 e PRIN 2022 PNRR), emanati dal Ministero dell'Università e della Ricerca e finanziati con fondi del Piano Nazionale di Ripresa e Resilienza. Lo testimonia poi l'ottimo risultato ottenuto, con **più di 17 milioni di finanziamento ottenuti dall'Ateneo**, nello specifico 11,7 dal bando PRIN 2022 e 5,4 dal PRIN 2022PNRR.
In totale, **227 delle ambiziose proposte di team di ricercatori di eccellenza** in cui è coinvolto il Politecnico saranno finanziate, **più del 40% delle proposte presentate;** di queste, 91 sono guidate dall'Ateneo. Ulteriore ottimo segnale per la ricerca svolta dal Politecnico è il **grande successo dei giovani ricercatori e ricercatrici**, leader di circa il 40% dei progetti finanziati all'Ateneo.
Obiettivo dei Bandi è infatti la **promozione del sistema nazionale della ricerca e la collaborazione tra università e centri di ricerca**, in linea con gli obiettivi del PNRR. Il supporto è dedicato a **progetti di ricerca** che spaziano nell'ambito dei **tre macrosettori individuati dallo European Research Council della Commissione Europea**: *Scienze Fisiche e Ingegneria, Scienze della Vita, Scienze Sociali e Umanistiche*. Date le specializzazioni del Politecnico di Torino, l'Ateneo collabora a 170 progetti del primo settore ERC, a 19 di Scienza della Vita e 38 di Scienze Sociali e Umanistiche.
"La ricerca al Politecnico di Torino mantiene il suo livello di eccellenza, sia a livello quantitativo che qualitativo – sottolinea il professor **Matteo Sonza Reorda, Vice Rettore alla Ricerca del Politecnico** – *Lo conferma l'ottimo risultato conseguito dai nostri team di ricercatori e ricercatrici nella partecipazione ai bandi PRIN, per questa tornata sostenuti anche dal PNRR. I progetti presentati da ricercatori e ricercatrici dell'Ateneo hanno avuto un elevato tasso di successo, a conferma della qualità della nostra ricerca e della nostra capacità di elaborare proposte di grande qualità per nuove attività di ricerca. Anche grazie ai progetti PRIN continuiamo a esplorare nuovi ambiti e individuare nuove soluzioni, che spesso diventano con il tempo il punto di partenza per attività di ricerca a carattere più applicativo. In questo modo il Politecnico di Torino continua a coniugare ai massimi livelli ricerca di base e ricerca applicata."*
Di seguito, si riportano le informazioni principali relativa ai progetti finanziati dall'Unione Europea – Next Generation EU nell'ambito del Bando PRIN 2022 PNRR D.D. 1409 del 14/09/2022, Ministero dell'Università e della Ricerca (64 progetti) e nell'ambito del Bando PRIN 2022 PRIN 2022 D.D. D.D. N. 104 MUR del 02/02/2022 (165 progetti).

Politecnico di Torino

I progetti PRIN 2022 PNRR finanziati dall'Unione Europea – Next Generation EU nell'ambito del Bando PRIN 2022 PNRR (D.D.1409 del 14/09/2022, Ministero dell'Università e della Ricerca)

CyberResilience - Cyber resilience: markets, investments and regulation

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Laura Abrardi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Ruolo PoliTo:

Coordinatore

Abstract

This project aims to investigate the factors influencing the exposure of firms and consumers to cyber risk, the economic incentives of firms to invest in cybersecurity, and their interplay with the environment in which firms operate (specifically, the market structure and the digital infrastructure). The focus is to understand the role of regulation, by designing the optimal policy tools that can spur investments in cyber security while avoiding potentially unintended effects, and by analyzing the effects of the privacy regulation currently in place. In particular, the project has two main goals: i) To understand and analyze the factors affecting the exposure to cyber risk of firms and consumers. We aim to explore both the contextual factors arising externally of the firm's environment, and factors stemming within firms, because of their own strategy. As to the external factors, we will focus on hackers' behavior, on the role of advanced digital infrastructure on firms' resilience to cyber risk, as well as on individuals' potentially risky online activities. As internal factors, we will analyze how the exposure to cyber risk affects firms' strategies in terms of prices, innovation activity, data collection, and investment in cybersecurity. We explore how these decisions depend on the market conditions in which firms operate, on their exposure to previous attacks, on the services they use (e.g., cloud service providers), and on how intensively their business relies on data. ii) To identify policy tools through which firms and regulatory authorities can design implementable policies to protect individuals and firms online as well as to spur investments in cybersecurity. The work will provide insights on the interplay between investments in cybersecurity and regulatory instruments such as optimal liability structure, platform interoperability

(e.g., as now possible by the EU Digital Markets Act), and content moderation policies mandating platforms to delete content hurting fundamental rights. The research team involves scholars joining expertise on digital economics, regulation and industrial organization, in addition to specific experience on the economics of cybersecurity and privacy. The project is structured in different, yet intertwined, subtasks and includes both theoretical and empirical analyses. On the theoretical side, we will leverage on models on platform and data economics from the industrial organization literature. On the empirical side, we can leverage on a unique dataset matching information on the availability of advanced digital infrastructure at the municipality level in Italy; and firm-level data from the Bank of Italy survey on firms' exposure to cyber risk and their investments in cybersecurity. Moreover, data on online traffic is obtained by the marketing firm Similarweb, and this data will be used for the completion of at least two deliverables on online safety.

Persone coinvolte

- Laura Abrardi (Responsabile Scientifico)
- Carlo Cambini (Componente gruppo di Ricerca)
- Laura Rondi (Componente gruppo di Ricerca)

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **LIBERA UNIVERSITA' DI BOLZANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' DEGLI STUDI DI UDINE**

Parole chiave

Settori ERC

SH1_9 - Industrial organisation; strategy; entrepreneurship

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 230.312,00
Contributo totale progetto:	€ 230.312,00
Costo totale PoliTo:	€ 92.674,00
Contributo PoliTo:	€ 92.674,00

Politecnico
di Torino

Finanziato
dall'Unione europea
NextGenerationEU

Ministero
dell'Università
e della Ricerca

Italiadomani
PIANO NAZIONALE
DI RIPRESA E RESILIENZA

AsCoT-SCE - Assessing Compliance of IoT API for Security Critical Environments

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luca Ardito

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022598LMZ

Ruolo PoliTo:

Partner

Abstract

The fast evolution of (Internet-of-Things) IoT devices and the increasing number of applicative fields in which such devices are involved is rapidly pushing toward a paradigm where third-party developers develop services and applications for collaborative IoT devices. This model, which has already proven successful in mobile systems (e.g., Android and iOS), is pushing standardization consortia, such as W3C, to propose integration frameworks presenting a high level generalized and structured way to represent resources and functionalities offered by IoT devices such as smart cameras, smart TVs, smart doorbells, etc. These frameworks act as an integration point for both third-party application developers, aiming at providing smart services, and device producer developers, implementing device-specific functionalities and API, willing to make them available to third-party developers. By using these frameworks, such as Web of Things, FIWARE, IFTTT, and OpenHAB, to name a few, third-party app developers can invoke their generic code functionalities, such as “change on TV channel 5”, without worrying about the actual brand and model of smart TV in a specific home. Given the early stage of development of some of these frameworks, there is not a mechanism to certify the correct and security-compliant integration between a device-specific API and a generic functionality. This is highly undesirable because there might be a mismatch between an invoked functionality and the performed behaviour. Considering the physical dimension of the IoT environment, such a mismatch can cause unexpected behaviours and risks related to privacy, security, and even safety. The AsCoT-SCE project aims to develop a set of mechanisms and methodologies to be used as building blocks for a certification framework. The developed methodologies will provide a structured representation of IoT functionalities through ontologies, their semantics in terms of behavioural policies expressed in a logical language, a set of guidelines for the compliant

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implementation of such functionalities, a representation of such implementation through manifest, whose integrity is verifiable, and, finally, model checking techniques to verify the compliance of the integration (association between functionality and proposed implementation) and the compliance with respect to specific requirements of safety, privacy, and security. The project will perform research activities on these topics developing a proof-of-concept prototype for a Smart Home environment. The Smart Home is a representative and impactful application of IoT technologies, on which the partners can leverage their experience acquired with an ongoing H2020 project (SIFIS-Home GA #952652), improving the possibility of exploitation on both activities.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI URBINO "CARLO BO"**

Parole chiave

Settori ERC

PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems PE6_3 - Software engineering, operating systems, computer languages PE6_1 - Computer architecture, pervasive computing, ubiquitous computing

Budget

Costo totale progetto:	€ 310.928,00
Contributo totale progetto:	€ 245.451,00
Costo totale PoliTo:	€ 63.927,00
Contributo PoliTo:	€ 57.589,00

MILK_O - FROM EXPIRED MILK TO GOODS: upcycling milk protein to biodegradable 3D-printable Objects for packaging application

Durata:

12/10/2023 - 11/10/2025

Responsabile scientifico:

- Rossella Arrigo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Ruolo PoliTo:

Partner

Abstract

FROM EXPIRED MILK TO GOODS: upcycling milk protein to biodegradable 3D-printable Objects for packaging application

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi di Milano** - Coordinatore

Parole chiave

Settori ERC

LS9_5 - Food sciences (including food technology, nutrition)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 322.617,00
Contributo totale progetto:	€ 241.188,00
Costo totale PoliTo:	€ 77.045,00
Contributo PoliTo:	€ 57.985,00

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Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Gum-Gut - The microbiome along the gum-gut axis: biobank creation, multiOMICS phenotyping and effect of periodontal treatment (the Gum-Gut Project).

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Gabriella Balestra

Tipo di progetto:

Ricerca Nazionale – PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022YEX5R

Ruolo PoliTo:

Partner

Abstract

Growing scientific evidence suggests that the oral cavity and the gastrointestinal tract do act as a functional and pathologic continuum. Indeed, there is a need for a deeper characterization of the microbiome-host interaction in these two interconnected anatomical niches in health and disease, together with a longitudinal assessment of potential changes after microbiome-targeted interventions. Therefore, scope of this research is to integrate and compare distinctive multi-specimen, multiOMICS profiles of subjects with oral health and patients with severe periodontitis in order to achieve a better understanding of the physiopathology of the gum-gut axis for future precision medicine applications.

Persone coinvolte

- Gabriella Balestra (Responsabile Scientifico)
- Samanta Rosati (Componente gruppo di Ricerca)

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi di Firenze**
- **Università degli Studi di TORINO** - Coordinatore

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Ministero dell'Università e della Ricerca
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- **Università degli studi di Trento**

Parole chiave

Settori ERC

LS2_6 - Molecular genetics, reverse genetics and RNAi LS2_4 - Metabolomics

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 229.426,00
Contributo totale progetto:	€ 229.426,00
Costo totale PoliTo:	€ 23.145,00
Contributo PoliTo:	€ 23.145,00

CRiStAll - Climate Resilient Strategies by Archetype-based Urban Energy Modelling

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Ilaria Ballarini

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

P2022HYTTE

Ruolo PoliTo:

Coordinatore

Abstract

The rising of ambient temperature consequent to global climate change has been identified as one of the main drivers of the building overheating, which determines higher energy demand and worsening of the indoor environmental quality. Overheating has also set new challenges for societies regarding risk and vulnerabilities for the human health. Besides the warming induced by long-term climate change, population in urban areas also experiences local warming with temperature higher than in the surrounding rural areas, due to the so called Urban Heat Island (UHI) effect. Though it has been widely acknowledged that the UHI has significant impact on building energy performance, only a limited number of studies succeeded to accurately quantify this variation, because of the challenges in acquiring climatic data at microscale and in modelling the drivers of UHI taking into account buildings and surroundings interactions. Compared to the Building Energy Modelling (BEM) used for single building simulation, the potentiality offered by the Urban Building Energy Modelling (UBEM) that applies to buildings at a larger scale, fails to effectively address the UHI, due to the scarcity of data with both finer spatial resolutions (i.e., climatic data at microscale) and larger spatial coverage of the outcomes (i.e., detailed mapping of urban areas). In addition, literature studies point out that investigating the UHI impacts on the building energy behaviour in the context of combined future climate change and urbanisation would be recommended in future researches. The CRiStAll project aims to overcome these research gaps by creating high spatial resolution climatic datasets, in which future weather files – generated assuming the IPCC (Intergovernmental Panel on Climate Change) scenarios – coupled with typical urban context configurations of Italian building archetypes, will be used to assess the UHI effects in short, mid and long-term. The analysis will be carried out for different Italian climatic zones and considering several urban context configurations at microscale, got by varying urban canyon parameters and assuming

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building archetypes of different use categories, construction periods, geometry and types of technical building systems. The urban configurations are then used to assess the climate resiliency of strategies that will include external surfaces treatment, passive and active building technologies. Numerical simulations will be performed using an UBEM tool implemented with typical urban configurations; the resulting Key Performance Indicators (KPIs) will concern both the building energy performance and the indoor/outdoor thermal comfort. The adoption of typical urban configurations would allow to increase the spatial coverage of the outcomes, thus providing public authorities with the possibility to map the UHI intensity for different urban areas, which would support informed decisions on energy policies for the forthcoming years.

Persone coinvolte

- **Ilaria Ballarini** (Responsabile Scientifico)
- **Vincenzo Corrado** (Componente gruppo di Ricerca)

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **LIBERA UNIVERSITA' DI BOLZANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI TRIESTE**

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 218.606,00
Contributo totale progetto:	€ 218.606,00
Costo totale PoliTo:	€ 93.606,00
Contributo PoliTo:	€ 93.606,00

HYDREAM - Tailoring the HYDrophilic-hydrophobic Reaction zone for the Electrochemical nitrogen reduction reaction to AMmonia

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Federico Bella

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022YXHXH5

Ruolo PoliTo:

Coordinatore

Abstract

This project focuses on the development of a gas/liquid/solid three-phase interface (TPI) that endows electrodes with enhanced performance for target electrochemical reactions involving gases, due to its ability to mediate local interfacial environments and inhibit side reactions. Such a TPI concept is starting to be considered by the scientific community due to its promising potentialities in several strategic research fields, e.g. electrocatalyzed reduction of CO2, O2 and N2, fuel cells, sensors for liquid and gas substrates, anti-corrosion systems, etc. The main goal is to tailor the TPI within a double hydrophilic-hydrophobic reaction zone, bearing a controlled grade of hydrophilicity at the microscale. The achievement of the co-existence of hydrophilic-hydrophobic conditions within the electrocatalyst/electrode will permit a compromise between efficient gas transport to the electrocatalyst and good contact of the electrocatalyst with the electrolyte (i.e., to provide the needed protons for the reduction reaction). HYDREAM activity will explore these key experimental points: - Design of heterogeneous electrocatalysts able to show hydrophobic-hydrophilic conditions in the reaction zone. - Formulation of non-aqueous liquid electrolytes showing optimal electrode wettability, reactant solubility and mass transport. - Advanced physico-chemical characterization to assess specific materials features and electrochemical reaction aspects at the nanoscale. - Exploitation of TPI concept in a highly significant case study, i.e. the electrochemical N2 reduction reaction (E-NRR) to NH3 under mild conditions. The E-NRR represents the Holy Grail in the current industrial chemistry scenario, since it would permit decentralizing NH3 production in a process fed by air, water and renewable energy. The E-NRR is thus a hot research topic, but it is accompanied by a wide list of experimental operative hurdles, concerning the preparation/formulation of electrocatalysts and electrolytes, the

engineering of electrochemical reactors and interfaces, and the overall process analysis in terms of costs and environmental impact. This project will show how the TPI concept can be a precious tool in this scenario. HYDREAM consortium joins 3 research units (RUs), i.e. POLITO (leader), UNIPD and UNIME. The project is intended to start at TRL-1 and reach TRL-3 in 24 months, and its targets are in sound consonance with the SUNERGY initiative of the European Commission, well aligned with the Green Deal objectives. Great attention will be also devoted to the training of young researchers and to the creation of an Italian interdisciplinary pool of young scientists able to place soon at the forefront of this emerging topic within the international scenario.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' DI MESSINA**

Parole chiave

Settori ERC

PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors PE4_4 - Surface science and nanostructures PE4_10 - Heterogeneous catalysis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 288.468,00
Contributo totale progetto:	€ 220.529,00
Costo totale PoliTo:	€ 108.089,00
Contributo PoliTo:	€ 75.735,00

PYGEOM - Polyhedral Galerkin methods for engineering applications to improve disaster risk forecast and management: stabilization-free operator-preserving methods and optimal stabilization methods

Durata:

30/11/2023 - 30/11/2025

Responsabile scientifico:

- Stefano Berrone

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022BH5CB

Ruolo PoliTo:

Coordinatore

Abstract

The proposal concerns the development of numerical methods suitable for simulations for safety assessments in several fields of civil and environmental engineering. Civil structures are subject to aging and the evolution of the surrounding environment increases the possibility of dramatic events. Moreover, most natural catastrophic events are hardly predictable and local or global human activities can strongly impact the stability of the environment surrounding civil structures, for example by changing the hydrogeological properties of the soil. This project aims to develop new numerical tools suitable to tackle all the engineering models and the physical phenomena needed to describe such catastrophic events overcoming usual difficulties such as, for example, mesh generation problems, mesh adaptation problems, mesh quality problems, and incompressibility conditions. The Virtual Element Method (VEM) is a polygonal/polyhedral Finite Element Method that was developed for this aim. Although its great success in managing many of the overmentioned problems, some issues still affect its applicability in fields like non-linear elasticity, elastoplasticity, viscoplasticity and in many engineering fields that deal with strongly non-linear problems, strongly anisotropic problems or problems governed by uncommon differential operators. The main issue is related to the non-consistent stabilization term needed by these methods to get well-posed discrete problems for the simulation. This project will focus on stabilization-free VEMs with the aim of retaining the key features of VEM but without the side-effect of the pollution introduced by the stabilizing terms. Stabilization-free VEMs can be developed for general

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

discretizations, but for some specific engineering applications, “ad hoc” methods can be more effective and will be developed. Stabilization-free methods are preferable for low-order methods, whereas for high-order methods can be less effective. For high-order methods, optimal stabilizations requiring a low computational cost will be investigated in the project. Stabilization-free VEMs will be derived and applied to elasticity, elastoplasticity and Richards equations for modelling unsaturated soils. Moreover, optimal cheap stabilization methods, mainly for high-order VEMs and optimal preconditioner and solvers will be investigated from a mathematical viewpoint. These mathematical tools will be applied to understand slope and soil stability and to forecast natural catastrophic events like landslides and to water resources conservation and preservation simulating the roots-soil interaction in unsaturated and fractured porous media. The developed methods will be useful for simulations in the field of geothermal energy exploitation and storage that can help reducing the human impact on the earth's environment.

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI MILANO BICOCCA**

Parole chiave

Settori ERC

PE1_17 - Numerical analysis PE1_21 - Application of mathematics in industry and society PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Budget

Costo totale progetto:	€ 230.449,00
Contributo totale progetto:	€ 230.449,00
Costo totale PoliTo:	€ 91.501,00
Contributo PoliTo:	€ 91.501,00

COBAM - Dense Eutectic Ceramic Oxide By Additive Manufacturing: sustainable-by-design materials and technologies (ECOBAM)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Federica Bondioli

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022Y4TP5 (codice progetto)

Ruolo PoliTo:

Coordinatore

Abstract

Dense Eutectic Ceramic Oxide By Additive Manufacturing: sustainable-by-design materials and technologies (ECOBAM)

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Budget

Costo totale progetto:	€ 300.000,00
Contributo totale progetto:	€ 300.000,00
Costo totale PoliTo:	€ 110.395,00
Contributo PoliTo:	€ 110.395,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

GREEN UP - GREEner Nanomaterials for Upconversion in Photocatalytic applications

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Barbara Bonelli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

20222FXNAP

Ruolo PoliTo:

Coordinatore

Abstract

Photon upconversion (UC), a process where two or more low-energy (NIR, Vis) photons are converted into one high-energy photon, has been receiving a lot of interest in many fields, from photovoltaics (PV) to bioimaging, medical therapies, 3D printing, photodetectors, but yet little in photocatalysis, although upconverted (recycled) photons could be exploited by a photocatalyst, improving its efficiency. Currently, most UC processes rely on Lanthanides-based nanoparticles (Ln NPs), which suffer from weak and narrow absorption, high thresholds (W/cm2 to kW/cm2), low abundance (most Ln deposits are outside Europe), and often undergo doping quenching effects. This calls for new UC systems. GREEN UP aims at developing a new generation of UC hybrid nanomaterials (NMs) relying on Triplet-Triplet Annihilation (TTA) to exploit solar light especially, but not exclusively, for photocatalysis. Compared with Ln NPs, such NMs have the great advantage of working with non-coherent and relatively low-intensity incident light (ca hundreds of mW/cm2), making them particularly promising for solar applications. In our new cutting-edge photocatalytic system, non-toxic metal-based quantum dots (QDs) will be adopted as sensitizers/enhancers. Organic moieties with tailored optical properties will be pre-selected as transmitters and annihilators/emitters by quantum mechanics. Nanostructured TiO2 will be adopted as support/receiver for solar photocatalysis. RU1 (Politecnico di Torino, POLITO) will produce by wet-chemistry methods (hot-injection) sensitizers with finely tailored and controlled properties, i.e. organic/inorganic interface, absorption range, etc. (Sustainable) template-free wet-chemistry methods based on pH control and/or use of ligands, followed by mild thermal treatment and/or supercritical CO2 extraction, will be adopted to obtain nanostructured TiO2. RU2 (Università di Cagliari, UNICA) will use mechanochemical methods to synthesize metal-based sensitizers under solvent-less conditions and to fabricate nanostructured TiO2 powders with suitable phase composition. RU3 (Università dell'Insubria, UINS) will carry out a computational

screening on a set of organic moieties that are promising candidates to be used as transmitter and annihilator species by RU1 and RU2. Low-scaling methods such as KS-DFT and TD-DFT will be used, after being benchmarked using multireference wave function-based methods. On the most promising candidates, RU3 will evaluate the support effect on the annihilator properties. As a result, RU3 will identify the annihilator that more efficiently can be coupled with the sensitizer(s) in NIR-Vis and Vis-UV TTA-UC systems with TiO2 as support/receiver. The systems synthesized in GREEN UP will be evaluated according to these success criteria: i) range of upconverted photons and ii) enhancement of TiO2 photocatalytic activity towards CO2 reduction and degradation of emerging contaminants under solar light.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DELL'INSUBRIA**
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI**

Parole chiave

Settori ERC

PE5_6 - New materials: oxides, alloys, composite, organic-inorganic hybrid, nanoparticles

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 6. Garantire a tutti la disponibilità e la gestione sostenibile dell'acqua e delle strutture igienico-sanitarie

Budget

Costo totale progetto:	€ 228.982,00
Contributo totale progetto:	€ 203.707,00
Costo totale PoliTo:	€ 76.936,00
Contributo PoliTo:	€ 70.344,00

BSYNC - Probing the interindividual synchronization during cooperative motor tasks at the brain, spinal, and muscular levels

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Alberto Botter

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022TSYBJH

Ruolo PoliTo:

Partner

Abstract

Spontaneous interpersonal synchronization is a ubiquitous phenomenon, but its neural substrates and physiological control laws are still unclear. Movement synchronization of people cooperating in a motor task and brain synchronization of socially interacting participants are well known phenomena. However, whether an unconscious synchronous movement is generated by a synchronization between the dyad's brain activity, which propagates as a synchronous input to the periphery, is unknown. Moreover, current literature only provides indirect evidence of the effects of interpersonal brain synchronization in terms of motor performance improvement. In this project we propose two complementary approaches to investigate, for the first time, the neural substrates underlying the interpersonal coordination and its relationship with motor performance. We will first study, in two solo protocols, how cortically originated brain controls drive a motor action during isometric force generation tasks, by analyzing the common oscillations between EEG and EMG signals, both at the muscular and single motor unit levels. Then, two collaborative protocols, a static force generation task and a postural task, will probe how participants' brain activity changes during motor interaction and whether human-human interaction induces participants' brain activity and motor neuron firings synchronization. The effect of the collaboration will be assessed by comparing the brain networks identified during the cooperative task and a similar solo task. Interpersonal synchronization of the brain activity and of the motoneuron firing will be tested through coherence analyses. After having characterized the neurophysiological basis of interpersonal brain synchronization in the context of motor control, we will design a strategy to interfere with the activation of the underlying neural network by transcranial direct current stimulation (tDCS) in humans. tDCS is a non-invasive brain stimulation approach which exploits a low-

intensity direct current (1-2 mA) stimulation thorough scalp-attached electrodes to modulate the activity of targeted cortical areas. Exploiting tDCS protocols that effectively modulate the interpersonal brain synchronization would allow to envisage its application in neurorehabilitation. The innovative and interdisciplinary research scheme proposed in this project will allow, for the first time, to study cortico-muscular coupling, both at the muscular and motorneuronal level, and to characterize the neural basis underlying inter-personal synchronization occurring during a human-human motor task. The approaches proposed in this project would lead to striking advancements in neuroscience, as well as to a potential definition of innovative paradigms for neurorehabilitation.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **HUMANITAS University**
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI MESSINA** - Coordinatore

Parole chiave

Settori ERC

LS5_9 - Systems neuroscience LS5_8 - Behavioural neuroscience (e.g. sleep, consciousness, handedness)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 205.250,00
Contributo totale progetto:	€ 205.250,00
Costo totale PoliTo:	€ 58.565,00
Contributo PoliTo:	€ 58.565,00

DeepAirborne – Advanced Modeling, Control and Design Optimization Methods for Deep Offshore Airborne Wind Energy

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Giovanni Bracco

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. P2022927H7

Ruolo PoliTo:

Partner

Abstract

Airborne Wind Energy Systems (AWES) convert wind power into electricity with an autonomous tethered aircraft, or kite. The term "airborne" refers to the absence of a static structure to support the energy-harvesting element. Rather, an active control system stabilizes a periodic trajectory in the air in order to produce power. This implies low use of energy-intensive materials and simple construction and installation, obtaining low capital cost and environmental impact. A potentially game-changing solution, AWE is attracting the attention of public and private stakeholders. It has been estimated that, in the EU, 100% of electricity demand could be supplied by AWES exploiting 1% of land, and a recent sector study predicts that, with enough public support to research and commercialization, by the early 2030s AWES could reach an average price competitive with other established technologies, at the same time widening the amount of locations where renewable generation could be economically viable. However, while for inland systems the development stage is rather advanced, the same cannot be said for the offshore application: to date, there is no comprehensive study on the design, modeling, control and optimization of deep offshore AWES. On the other hand, this is the most appealing technology, with the promise to harvest electricity from a vast resource at competitive cost and with high social acceptance. The challenges are huge, due to the complexity arising from the interactions of waves, mooring system, platform, surface station, tether, kite, and automation system, leading to many open questions and exposing significant gaps in our scientific knowledge. Addressing these challenges calls for a synergetic, multidisciplinary research effort that no single group can handle. Through the collaboration of two research units with deep expertise in offshore engineering and airborne wind energy, this project will fill the said gaps, by delivering a rigorous methodology and an open toolchain for design optimization of deep offshore AWES.

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In the process, the team will research and develop novel approaches to model and simulate interacting phenomena at very different time-scales, to design hybrid, hierarchical and distributed nonlinear control systems, and to globally solve complex design optimization problems with high search-space dimension. The resulting methods, models, and software tools will be a world first, with positive impact for the scientific community, industry, and society. Moreover, through two case studies, the project will deliver a new assessment of the energy generation performance (annual yield, availability, capacity factor, etc.) of deep offshore AWES: substantiated by the rigorous modeling approach, such an assessment will be more realistic than the current ones and either confirm the effectiveness of the technology, or highlight potential bottlenecks, in either case providing a significant added value to all stakeholders.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE7_1 - Control engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 227.928,00
Contributo totale progetto:	€ 227.928,00
Costo totale PoliTo:	€ 113.964,00
Contributo PoliTo:	€ 113.964,00

GAIA - Green cellulose-bAsed fire safe and lightweight Insulating mAterials

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Federico Carosio

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022YKTR5

Ruolo PoliTo:

Coordinatore

Abstract

Societal demand towards the concepts of circular bioeconomy is reflected by the need for new sustainable materials produced by green processing routes. In addition, scarce raw materials availability linked to the current geo-political situation has led to a growing interest in the reusing, recycling and upcycling of biomass. Unfortunately, there are no options for a true upcycling of this resource and the current production of biomass waste is increasing year by year (e.g 250 million ton/yr of by-products and waste from food sector). The field of insulating materials represents a potential opportunity for the proper upcycling of biomass waste. Indeed, current state of the art materials show some sustainability and safety issues related to the use of petrol-derived solutions with dangerous flammable characteristics. Ministero dell'Università e della Ricerca MUR - BANDO 2022 PNRR Conventional approaches to solve these problems are aimed at the production of porous material based on natural fiber. Such approach is currently suffering from two major constraints. The poor fiber-fiber interaction does not allow for the production of a self-standing 3D structure and requires the use of polymer binders or thermoplastic synthetic fibers thus considerably limiting the overall fiber content and the sustainability of the resulting material. The intrinsic flammable characteristic of natural fibers, and employed binders, makes them extremely dangerous from the safety point of view. It is thus apparent that the field of green materials is in need for an innovative breakthrough capable of overcoming the limitations of the state of the art and address the development of high performing and easy to upscale materials. The GAIA project addresses this challenge by exploiting the potentialities of a novel approach recently developed by the principal investigator for the production of green biobased lightweight materials from layer-by-layer functionalized natural fibers. Lignocellulosic waste is selected as a source for natural fibers. Electrostatic complexation of bio-based components is used

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a green approach to material development. These materials will combine high mechanical strength, excellent thermal stability and flame retardancy thanks to the achieved control over the nano and micro structure. Low impact and easy to upscale panel production processes will be developed. The project main objectives are specified as follows: 1. To establish suitable/reliable routes for the extraction of functional natural fibers from lignocellulosic waste 2. To successfully develop fiber surface functionalizations and foaming approaches capable of enabling the production of low-density insulating materials 3. To produce sustainable lightweight materials from functionalized fibers capable of replacing petroleum-based solutions The proposed approach will allow for the production of advanced materials where functional properties such as mechanical properties, flame retardancy and sustainability are optimized.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 299.837,00
Contributo totale progetto:	€ 299.837,00
Costo totale PoliTo:	€ 103.169,00
Contributo PoliTo:	€ 103.169,00

RESISTING - Reconnecting Social innovation with InSTitutions in urban plannING

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Nadia Caruso

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Codice identificativo progetto:

P2022YZTB7

Ruolo PoliTo:

Partner

Abstract

For decades, social innovation – voluntary, non-statutory, citizen-led initiatives providing services or goods, beyond the State – has been increasingly commended for offering enormous potential by both academic and policy discourses. However, it has often become a convenient concept for local governments to justify their disengagement from tackling a wide range of problems around exclusion, deprivation, and lack of well-being, through public action. Despite many agreeing on the fact that local communities can unrealistically find alone progressive and long-lasting solutions for deep-rooted problems, we still miss a comprehensive and critical understanding of the relationship between SI and institutions in urban planning, and how to overcome current drifts. Three major missed opportunities have been identified in the current state-of-the-art: first, the investigation of the SI-institutions relationship from a spatial standpoint, providing a critical discussion of how relational patterns overlap with the socio-spatial distribution of disadvantages; secondly, an oversimplification and romanticism around most of the narratives; thirdly, the analysis of the enabling role of institutions to the emergence, evolution, and effectiveness of socially innovative practices, and the possibilities that institutions themselves can learn by engaging with SI, impacting urban planning. Building the research endeavour on these three major missed opportunities, relying on the extensive experience of a high-skilled, under-40, and mostly female research group, RESISTING will work on bridging the current knowledge gaps surrounding social innovation by repositioning the pivotal role of institutions in the SI debate. To do so, RESISTING will develop an original comparative analysis at several levels – regional and sub-regional, within diverse local governments and policy settings in Veneto, Piedmont, and Sicily – to clearly assess factors shaping the SI-institutions relationship, how these relational patterns emerge, and overlap with the socio-spatial distribution of disadvantages, and what are the conditions for institutional learning, from an urban planning perspective. RESISTING will blend spatial analysis through

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an interactive GIS mapping platform, with in-depth interviews, discourse analysis, participant observation, and institutional ethnographies, producing a repository of open data, and leading to both methodological and technological innovations. Results' dissemination will include public engagement (training workshops), involving key actors within the SI-institutional nexus. Finally, RESISTING will act toward the internationalization of the Italian research system and the improvement of the scientific community, not only through high-impact publications, but also through the organization of an international conference that will be the testbed for discussing the advancement of knowledge in the field, and future research steps.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CATANIA**
- **UNIVERSITA' IUAV DI VENEZIA** - Coordinatore

Parole chiave

Settori ERC

SH3_1 - Social structure, social mobility

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 315.145,00
Contributo totale progetto:	€ 265.263,00
Costo totale PoliTo:	€ 88.288,00
Contributo PoliTo:	€ 74.314,00

NSECE - Unlocking the potential of New Space Economy for Circular Economy

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Federico Caviggioli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Ruolo PoliTo:

Partner

Abstract

This project focuses on the opportunities that the transition of the traditional Space Industry towards the New Space Economy - an industry reconfiguration triggered by several trends at the global level (e.g, satellite miniaturization, launch activities liberalization, interoperability between satellite and digital data) – may exhibit for meeting the Sustainable Development Goals (SDGs) outlined by the United Nations in the 2030 Sustainable Development Agenda. Specifically, the project aims at developing new theoretical models for the integration of a sustainable-oriented paradigm in the creation of value in industrial activities, receiving the global call which identified Space as a potential "SDG agent". Drawing upon extant literature, the research will offer a multi-layer theoretical model for 1) the design of Sustainable-Oriented Ecosystem, shedding light of the renewed roles of actors and their mutual interaction within the overall structure; 2) the design of innovative Sustainable-Oriented Business Models, offering an activity-based perspective centered in the specific actors belonging to the ecosystem; and 3) the combined use of different converging technologies to enable the abovementioned Sustainable-Oriented structures. Relying upon a mixed method approach, Research Units will leverage on their long-lasting research experience in the three identified areas to advance knowledge in these fields, adopting an original and innovative approach centered in the achievement of Sustainable Development Goals. Doing so, the project will also show how the reconfiguration of one of the industries considered an excellence of the Made-In-Italy might serve as use-case of flexibility and openness towards the reconfigured needs of the overall global community.

Persone coinvolte

- Federico Caviggioli (Responsabile Scientifico)
- Alessandra Colombelli (Componente gruppo di Ricerca)
- Antonio De Marco (Componente gruppo di Ricerca)

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- **Giuseppe Scellato** (Componente gruppo di Ricerca)
- **Elisa Ughetto** (Componente gruppo di Ricerca)

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI BARI**
- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

SH1_9 - Industrial organisation; strategy; entrepreneurship SH1_10 - Management; marketing; organisational behaviour; operations management SH2_6 - Sustainability sciences, environment and resources

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 245.977,00
Contributo totale progetto:	€ 245.977,00
Costo totale PoliTo:	€ 77.939,00
Contributo PoliTo:	€ 77.939,00

SAT4SHM - Quantifying the effects of Structure-Soil-Structure interaction on structural modal parameters by combining Earth Observation data with on-site dynamic monitoring: an enhanced vibration-based Structural Health Monitoring approach – SAT4SHM

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Rosario Ceravolo

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P20227N3CK

Ruolo PoliTo:

Partner

Abstract

Vibration-based Structural Health Monitoring (SHM) systems aim at predicting the insurgence or deterioration of damages from anomalous variations of the structural modal parameters. For historical and cultural heritage structures these systems stand out among the available approaches thanks to their non-invasiveness, relatively low cost, and ease of installation. These advantages are partially counteracted by the sensitivity of modal parameters to Environmental and Operational Variability (EOV) which can hinder the identification of damages. Additionally, it is frequent practice in SHM to discard the elastic coupling between the structure and the soil by assuming that buildings vibrate as they are fixed at their bases. This assumption neglect also the variation of modal parameters due to the dynamic interaction of closely-space buildings. Overall, these simplifications increase the possibility of anomalies misdetection and the occurrence of false alarms. To overcome the current limitations of Vibration-based SHM, in the SAT4SHM project we propose an integrated framework able to quantify the effect of Structure-Soil-Structure interaction on the dynamic response of buildings by accounting for the dependency of soil properties on environmental parameters. The latter are extracted from available earth observation data in the form of satellite images, thus avoiding the introduction of extra sensing devices on the structures. The proposal includes a work package of coordination and management (WP1), and four technical (WPs). In WP2, we aim at exploiting satellite images to extract soil parameters which can influence the elastic response of soils.

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The parameters to be analysed include but are not limited to the subsidence (sub), the Land Surface Temperature (LST) and the Soil Water Index (SWI) and use them into a purposely developed constitutive model of the soil. In WP3, we will investigate the effect of such parameters on the Soil-Structure Interaction (SSI) by considering the derived soil model, discussing critically their impact on the structural modal parameters and their effect on vibration-based SHM. In addition, we will derive synthetic dynamic models of the buildings, namely impedance functions, which can effectively provide the forces at the base of a building during its vibration, to be used later in WP4. In WP4, we will extend a recent multiple scattering formulation (MSF) to estimate the modal data of buildings interacting trough an elastic soil. The extension will consist in the consideration of the novel soil model to link remote sensing parameters to the Structure-Soil-Structure Interaction (SSSI) paradigm. Finally, in WP5 we plan to apply the pipeline of steps developed in WP 2-3-4 to two case studies, the Sanctuary of Vicoforte, the largest oval masonry dome in the world, and the Two Towers of the city of Bologna.

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Partner

- **Alessandro Marzani, Università di Bologna** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 224.995,00
Contributo totale progetto:	€ 224.995,00
Costo totale PoliTo:	€ 108.014,00
Contributo PoliTo:	€ 108.014,00

CSI-Future - Joint Communication and Sensing: CSI-Based Sensing for Future Wireless Networks (CSI-Future)

Duration:

30/11/2023 - 29/11/2025

Principal investigator(s):

- Carla Fabiana Chiasserini

Project type:

PNRR – Mission 4

Funding body:

MINISTERO (Ministero dell'Università e della Ricerca)

Project identification number:

P2022FP9W3

PoliTo role:

Partner

Abstract

Analysis and modeling the transmission channel is a fundament of transmission theory with the key goal of enabling channel equalization and optimal information decoding. Modern wireless communications, based on OFDM modulations and (massive) MIMO technologies, achieve unprecedented transmission speed and efficiency exploiting the description of the channel through the CSI, enabling the receiver to greatly improve the performance.Transmission theory focuses on short term channel modeling, within the so-called coherence time, which is the essential descriptor that enables optimal decoding. In the past decade, however, the research community has discovered that the long term behavior of the channel, which is normally not useful for transmission performance, yields useful information on the propagation environment leading to the idea of joint communication and sensing (JCS).

Structures

- DET - Department of Electronics and Telecommunications

Partners

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI BRESCIA** - Coordinator
- **UNIVERSITA' DEGLI STUDI DI VERONA**

Keywords

ERC sectors

PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.)

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Politecnico di Torino

Sustainable Development Goals

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Total cost:	€ 239,074.00
Total contribution:	€ 239,074.00
PoliTo total cost:	€ 72,229.00
PoliTo contribution:	€ 72,229.00

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Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

PREDICT - Adverse cardiovascular events in coronary Plaques not undeRgoing pErcutaneous coronary intervention evaluateD with optIcal Coherence Tomography. The PREDICT machine-learning risk score

Duration:

18/10/2023 - 17/10/2025

Principal investigator(s):

- Claudio Chiastra

Project type:

Nationally funded research - PRIN

Funding body:

MINISTERO (Ministero dell'Università e della Ricerca)

Project identification number:

2022497RZ4

PoliTo role:

Partner

Abstract

Acute coronary syndrome (ACS) most commonly arises from thrombosis of coronary artery lesions that angiographically appear mild, typically with non-flow limiting stenosis, but pathologically contain large plaque burden with an organized lipid-rich necrotic core that is separated from the lumen by a thin fibrous cap. These thin cap fibroatheromas place patients at risk for future unstable angina, acute myocardial infarction (MI) and cardiac death, and they have been termed vulnerable plaques (1-3). In this context, optical coherence tomography (OCT) has emerged as one of the most promising tools to assess patients with coronary lesions and to detect key features of plaques at high risk for rupture and consequently responsible of future cardiovascular events (4-6). However, whether prophylactic revascularization of non–flow-limiting vulnerable plaques might improve patient prognosis is unknown (7). To date, the diagnostic yield of invasive and noninvasive imaging techniques in predicting future major adverse cardiovascular events (MACE) among patients with vulnerable plaques remain low and the treatment of non-flow limiting stenosis with high-risk features is still controversial (8). Although the presence of high-risk coronary lesion features confer a higher and exponential risk of adverse events, there are no available imaging and clinical based risk scores that predict the risk of MACE at follow-up in patients with non-flow limiting coronary artery stenosis. The aim of our project is to predict with the aid of artificial intelligence (AI) and machine learning techniques the natural history of non-flow limiting coronary artery stenoses, and to develop and validate a machine learning risk score capable of estimate the risk of MACE during follow-up based on the OCT findings observed at the coronary

plaques not undergoing percutaneous coronary intervention (PCI) and the clinical characteristics of the patients (9,10). We will collect information on all the coronary lesions not undergoing PCI evaluated by performing OCT in non-culprit vessels of patients presenting with ACS at the index procedure. All the OCT runs will be digitalized and analyzed with the aid of AI. The OCT appearance of the coronary plaques will be analyzed with AI and related with the risk of MACE during follow-up (a composite of cardiac death, and myocardial infarction). A predictive risk AI model based on the OCT images of the coronary plaques and the clinical characteristics of the patients will be developed to estimate the risk of the incidence of MACE at follow-up. State-of-the-art machine learning algorithms, including convolutional neural networks, random forests, and support vector machines, will be exploited and we will calculate the area under the curve (AUC) of the receiver operating characteristic curve for the internal validation dataset to select a probability threshold, which we will apply to the testing dataset.

Structures

- DIMEAS - Department of Mechanical and Aerospace Engineering

Partners

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università Cattolica del Sacro Cuore**
- **Università degli Studi di Napoli Federico II**
- **Università degli Studi di Torino** - Coordinator

Keywords

ERC sectors

LS4_7 - Cardiovascular diseases LS4_1 - Organ physiology and pathophysiology PE6_7 - Artificial intelligence, intelligent systems, multi agent systems

Sustainable Development Goals

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Total cost:	€ 220,702.00
Total contribution:	€ 187,479.00
PoliTo total cost:	€ 49,800.00
PoliTo contribution:	€ 41,529.00

URBAN GENERATION: A design approach for climate change adaptation and mitigation

Duration:

30/11/2023 - 29/11/2025

Principal investigator(s):

- Giacomo Chiesa

Project type:

Nationally funded research - PRIN

Funding body:

MINISTERO (MIUR)

Project identification number:

P2022AEN9Y

PoliTo role:

Partner

Abstract

Dense urban areas account for more than 80% of global Gross Domestic Product and by 2050 will host around 70% of global population. But while reducing the impact of anthropogenic activities by lowering the emissions deriving from transportation and building energy use and preserving underdeveloped lands and habitats at the same time, metropolitan areas are facing relevant issues related to their vulnerability to climate and disaster risk, poor human and ecosystems health, and the environmental impact they cause by themselves (e.g. 70% of global greenhouse gas emissions). Regenerative design strategies - among which Nature-based Solutions (NBS) - play a significant role in climate change adaptation and mitigation, overall improving the environmental quality of dense urban areas by decreasing greenhouse gas emissions, reducing the Urban Heat Island (UHI) effect, improving air quality, managing storm-water, fostering biodiversity and improving human wellbeing. Besides, by increasing the energy performance of buildings they can reduce energy and resources consumption related to heating and cooling demand, thus being effective solutions for climate change mitigation and adaptation. The potential role of NBS in urban areas depends on several factors, among which weather conditions, urban morphology, and what environmental issue needs to be specifically addressed. Moreover, their interaction with buildings and their potential effect on heating and cooling demand requires multi-scalar and multi-criteria analyses and simulations. However, due to poor integration of specialized disciplines within the architectural design process, such evaluations are hardly carried out by designers at an early stage, when strategic choices yet need to be made. The URBAN GENERATION project aims at developing a methodology with a specific design tool to select NBS and generate site-specific early-design solutions addressing climate change adaptation and mitigation. Site selection and site data collection will be carried out by integrating satellite and ground

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data with meteorological sensors. Moreover, a parametric workflow including a computer-aided multi-criteria evaluation tool will enable a holistic evaluation of the design solutions and the selection of the most performative ones, depending on Key Performance Indicators. In this sense, the overall goal of URBAN GENERATION is to provide designers with advanced tools and analyses to inform their early stage decisions using an iterative design process, from district to building scale.

Structures

- DAD - Department of Architecture and Design

Partners

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI GENOVA** - Coordinator

Keywords

ERC sectors

PE8_11 - Sustainable design (for recycling, for environment, eco-design) SH2_9 - Urban, regional and rural studies SH2_7 - Environmental and climate change, societal impact and policy

Sustainable Development Goals

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Total cost:	€ 266,087.00
Total contribution:	€ 266,087.00
PoliTo total cost:	€ 112,823.00
PoliTo contribution:	€ 112,823.00

RECOVERY: pREcise Cardiac Organ-on-chip modeling to improve extracellular VEsicle-based paracrine therapy against myocaRdial Injury

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Valeria Chiono

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. P2022S94EZ

Ruolo PoliTo:

Partner

Abstract

Cardiac fibrosis is a maladaptive remodeling of the myocardium hallmarked by contraction impairment and excessive extracellular matrix deposition (ECM). The disease progression, nevertheless, remains poorly understood and present treatments are not capable of controlling the scarring process. This is partly due to the absence of physiologically relevant, easily operable, and low-cost in vitro models, which are of the utmost importance to uncover pathological mechanisms and highlight possible targets for anti-fibrotic therapies. In classic models, fibrotic features are usually obtained using substrates with scar mimicking stiffness and/or supplementation of morphogens such as transforming growth factor ß1 (TGF-ß1). Qualities such as the interplay between activated cardiac fibroblasts (CFs) and cardiomyocytes (CMs), or the mechanically active, three-dimensional (3D) environment, are, however, neglected or obtained at the expense of the number of experimental replicates achievable. Paracrine modulation of cardioprotective and anti-fibrotic effects to enhance myocardial repair has attracted increasing interest in the last years, with specific focus on the role of soluble factors released by stem and progenitor cells. Particularly, the stem/progenitor cell secretome – i.e. cell-secreted paracrine factors, including both soluble individual molecules and membrane-bound extracellular vesicles - has been proposed as a novel therapeutic candidate in regenerative medicine. Nanoscale cell-derived extracellular vesicles (EVs) are critical component of the stem cell secretome and have been reported as curative boosters to significantly enhance cardiac reparative mechanisms while decreasing scarring, in several preclinical models of myocardial infarction, ischemia-reperfusion injury. Notably, the secretome of human perinatal stem cells - such as the human amniotic fluid-derived stem cells or hAFSC – is enriched with bioactive EVs able to exert relevant cardioprotective and anti-fibrotic

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effects on murine myocardium after severe ischemic injury. However, their effect in vivo may be impaired by an uncontrolled release to the insulted region. To overcome these shortcomings, RECOVERY will engineer a fully human cardiac Organ-on-Chip (OoC) model where cardiac micro-tissues can be subjected to cyclical stretching inducing a fibrotic phenotype. The OoC device will embed online recording capabilities so to continuously monitor both the cardiac electrophysiology and the onset of fibrotic ECM deposition via electrical impedance evaluation. The cardiac OoC device will be used to validate a new method to deliver hAFSC-EVs as advanced therapy medicinal products to treat cardiac fibrosis. Particularly, injectable hydrogels based on modified natural polymers will be developed promoting an optimal controlled and sustained delivery of embedded hAFSC-EVs.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI GENOVA**

Parole chiave

Settori ERC

LS7_6 - Gene therapy, cell therapy, regenerative medicine PE8_13 - Industrial bioengineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 224.971,00
Contributo totale progetto:	€ 224.971,00
Costo totale PoliTo:	€ 73.630,00
Contributo PoliTo:	€ 73.630,00

BREATH - A bioprinted alveolar lung-on-chip device to assess the role of inhaled pollutants towards pulmonary fibrosis onset

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Gianluca Ciardelli

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot.P202255TET

Ruolo PoliTo:

Partner

Abstract

Pulmonary fibrosis (PF) is a lung disease characterized by the progressive impairment of lung function and poor prognosis, with an estimated median survival of 2–3 years from the time of diagnosis. Recently, the correlation between long-term exposure to harmful substances that damage the lungs, such as tobacco smoke, air pollution, and certain occupational chemicals, and PF progress has emerged. However, there is lack of evidence on the pollutant potential role on the onset of PF and the resulting devastating events. Therefore, there is an urgent need for relevant in vitro models that can capture fundamental aspects of lung physiology and pathology and replicate the irritants deposition and distribution after pollutants exposure. BREATH proposes a bioengineering in vitro strategy based on the manufacturing of a 3D bioprinted alveolar lung-on-chip (ALOC) platform, to successfully reproduce the curved microstructure, the native extra cellular matrix (ECM) function, the differentiated epithelium at the air–liquid interface (ALI), and the breathing events of the pulmonary alveoli, which are the basic units enabling gas exchanges in the human lung. To fulfill this goal, the three Research Unit (RUs) involved in BREATH will: (i) perform an epidemiological analysis to select specific pollutants responsible for PF onset, which will be pre-screened onto an optimized 2.5D in vitro lung model; (ii) design and manufacture a 3D acinar microenvironment with residing curved alveolar sacs, by Freeform Reversible Embedding of Suspended Hydrogels (FRESH) 3D extrusion bioprinting, which will be integrated into a PDMS-based microfluidic organ-on-chip device to reproduce the ALI and the cyclic inhalation/exhalation movements, to simulate the breathing process; (iii) expose the ALOC to single or multiple external insults, by using nanoparticles-loaded aerosol, with the aim of mimicking the physiological inhalation conditions of PF disease etiology. PF key events including inflammation, aberrant epithelial repair, impaired barrier integrity, dysregulated

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fibroblast activity and transdifferentiation will be quantitively measured by means of established assays. Within BREATH, via the combination of bioprinting and organ-on-chip technologies, our model will provide a useful tool for mimicking physiological inhalation condition and in situ-like deposition. The outcomes will help predict inflammation severity upon inhalation exposure of pollutants, thus increasing the knowledge on PF onset and the effect of lung exposure to specific pollutants. In a long term perpspective, the platform should facilitate the safety assessment of chemicals, as well as the development and efficacy testing of innovative drugs, as the recent pandemic also highlighted. Thus, satisfying the EU requests that push towards the development of suitable alternatives and for the full implementation of the 3R's principles (Replacement, Reduction and Refinement of Animal Testing).

Persone coinvolte

- **Gianluca Ciardelli** (Responsabile Scientifico)
- **Monica Boffito** (Componente gruppo di Ricerca)

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 225.000,00
Contributo totale progetto:	€ 225.000,00
Costo totale PoliTo:	€ 75.121,00
Contributo PoliTo:	€ 75.121,00

OASIS 4 ENERGY - A novel market design for the optimal allocation of multiple ancillary services in future low inertia power networks

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Pietro Colella

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

P2022MLE3L

Ruolo PoliTo:

Partner

Abstract

The integration of large shares of Renewable Energy Sources (RES) in future power systems is concerning most of the system operators worldwide. Besides the uncertainty and the variability characterizing most of their outputs, RES may not be able to provide ancillary services, such inertial response and fast frequency response, in their standard configuration. This increases the risk of activating expensive demand disconnection schemes or causing a black out. The current framework for the optimal and secure integration of RES in power systems is limited by three major factors: 1) The optimal allocation of frequency response services does not recognize the reduction in inertial response. Also, current methodologies do not consider the actual transient dynamic response of generators to frequency variations since they rather implement fixed ramping characteristics as for current market products. 2) The current market design for frequency-related ancillary services does not allow the trading of inertial response. This condition fosters a market malfunctioning since such an important feature for the system is out of market-reward mechanisms. Moreover, the overall auction price for long term contracts to deliver frequency response may not align with actual economic value for the system, preventing the market participants from receiving the right reward. 3) Current system scheduling methodologies do not consider competing aspects concerning the provision of multiple ancillary services from different assets, simultaneously. The fundamental objective of this project is to address the three research gaps and limitations highlighted above. The first objective is the development of a novel security-constrained optimal power system scheduling model where the transient dynamics of the response to frequency changes of the most relevant assets of the system are modelled by means of a more realistic and accurate formulation. In particular, the dynamics of the frequency response provision of synchronous generators will

integrate the intrinsic features of the typical governor response of these units rather than translating them into a simplistic linearly-evolving ramping up response. The second objective aims to develop a market clearing platform which acknowledges the actual value for energy and all the ancillary services. This will increase the fairness and transparency of the energy costs sustained by end users and will provide right signals to the market participants and will improves the operation and planning of the system. Also, the proposed market design would incentivise each participant to submitt truthful biddings. The third objective of this project is to model and simulate, at the same time, the aggregate behaviour of different types of flexible technologies to study the optimal repartition of the contributions to system requirements for ancillary services among different of flexible assets.

Persone coinvolte

- **Pietro Colella** (Responsabile Scientifico)
- **Enrico Pons** (Componente gruppo di Ricerca)

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' STUDI TRENTO** - Coordinatore

Parole chiave

Settori ERC

PE7_12 - Electrical energy production, distribution, application PE7_3 - Simulation engineering and modelling PE7_2 - Electrical engineering: power components and/or systems

Budget

Costo totale progetto:	€ 245.698,00
Contributo totale progetto:	€ 245.698,00
Costo totale PoliTo:	€ 118.746,00
Contributo PoliTo:	€ 118.746,00

Pandemic&Trade - Pandemic shock and the sustainability of international trade flows

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Anna D'Ambrosio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

P20227AWSW

Ruolo PoliTo:

Coordinatore

Abstract

This research proposal addresses the environmental impact of economic downturns, taking the COVID-19 shock as a natural experiment. While the COVID-19-imposed lockdowns had important short-term environmental effects (Elsaid et al. 2021), the implications of the COVID-incepted economic crisis may bear long run sustainability implications (Hepburn et al., 2020; OECD, 2021). Indeed, the shrinking margin of firms decreases the resource buffer and increases the incentives to cut on input costs, which may lead firms to reallocate their input portfolio towards lower-quality inputs, with potential implications for their longer-term sustainability (Antweiler et al., 2001; Copeland and Taylor, 2004). If ``greener'' inputs are more expensive than polluting inputs, the production technology of affected firms may have become more polluting (e.g., Frankel & Rose, 2005; Egger et al., 2021). At the same time, the sudden halt imposed by the pandemic to economic activities may have represented an opportunity to revise the production technology and to reduce inefficiencies, including the use of polluting inputs, in line with classical arguments of the Porter Hypothesis (PH; Porter and Van den Linde, 1995; see also e.g., Devece et al. 2016). In particular, the increased transaction costs arising from the pandemic may have reduced the incentives for firms to vertically dis-integrate, reduced the incentives to offshore production and possibly even to outsource domestically. The environmental impacts of these changes may be relevant if the pandemic represented an opportunity to invert decisions initially motivated by ``pollution haven'' considerations (Levinson and Taylor, 2008), bringing production back to countries with stricter environmental regulations and reducing the environmental costs of cross international transportation. Empirically, this proposal exploits the COVID-19 pandemic as a shock that exogenously imposed a temporary halt to production depending on whether the firm's industry was classified as ``essential'' vs. ``non-essential''. The exogenous assignment of firms to essential/non-essential sectors can be exploited in a diff-in-diff approach (cfr. Di Porto et al., 2022, Goodman-Bacon and Marcus 2020). Firms more

strongly affected by temporary closures had to face production slowdowns, value-chain disruptions, and revenue erosion, hence will have stronger reasons to revise their production strategies. To measure input adoption, we will critically rely on the availability of unique population data on Italian firms' international imports. Under some circumstances, imports may represent a valid measure of input adoption (Brunel, 2019). Drawing on detailed information about the value and the sectoral and product classification of imports, we will be able to derive a fairly accurate measure of "greenness" of the imports and to verify the underlying assumption that ``green'' inputs are more expensive than ``dirty'' ones and study whether Italian firms reacted to the COVID-19 shock by adjusting their input choices. As such, the results will not only inform about the likely environmental impacts of economic downturns, but also speak to the broader debate about the trade-off between ``growing and greening" the economy (e.g., Brandi et al, 2020).

Persone coinvolte

- **Anna D'Ambrosio** (Responsabile Scientifico)
- **Luigi Benfratello** (Componente gruppo di Ricerca)

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Parole chiave

Settori ERC

SH1_12 - Agricultural economics; energy economics; environmental economics SH1_2 - International trade; international business; international management; spatial economics SH1_9 - Industrial organisation; strategy; entrepreneurship

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 259.240,00
Contributo totale progetto:	€ 259.240,00
Costo totale PoliTo:	€ 123.348,00
Contributo PoliTo:	€ 123.348,00

MADLIGHT - Metastatic potential of cancer cell aggregates in deformable matrices controlled by light

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Emiliano Descrovi

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P2022H7JXT

Ruolo PoliTo:

Partner

Abstract

Metastatic potential of cancer cell aggregates in deformable matrices controlled by light

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore

Parole chiave

Settori ERC

LS3_3 - Cell cycle and division LS1_1 - Molecular interactions PE2_9 - Optics, non-linear optics and nano-optics

Budget

Costo totale progetto:	€ 299.285,00
Contributo totale progetto:	€ 299.285,00
Costo totale PoliTo:	€ 134.642,00
Contributo PoliTo:	€ 134.642,00

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

AI-ENVISERS - Artificial Intelligence for ENVIronmental impact minimization of SEismic Retrofitting of Structures (AI-ENVISERS)

Durata:

30/11/2023 - 13/01/2025

Responsabile scientifico:

- **Fabio Di Trapani**

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P20227KKF5

Ruolo PoliTo:

Partner

Abstract

In Italy, more than 6 million buildings are characterized by unacceptable seismic risk. A possible solution is Demolition andre-Construction (D&C), but it is associated with environmental issues (waste, exploiting raw materials, CO2 emissions). BuildingsSeismic Retrofitting (BSR) is an alternative to D&C and represents a primary policy objective for governments aiming at minimizing earthquake losses while improving the civil security for society. Unfortunately, besides lowering seismic risk, the implementation of BSR at a territorial scale can have negative environmental repercussions. Several approaches were investigated for BSR by adopting more or less environmentally friendly techniques and materials. Traditionally, BSR design is performed without any consideration for the environmental harm and the territorial scale application. Green and sustainable materials are especially promising in this regard and can be adopted for several BSR applications. Some recent pioneering studies attempted to qualify and quantify the environmental impact of BSR mainly by adopting Life CycleAssessment. However, although BSR techniques were largely investigated, the development of an efficient computational frameworkfor the environmental impact minimization of seismic retrofitting of structures is not available yet. Such knowledge can be useful for the optimization of BSR by taking also into account environmental criteria, and it is the premise for the consequent actions forenhancing societal resilience and disaster risk management while reducing the environmental impact of the construction sector. In fact, if not adequately regulated, BSR can have a detrimental impact on the environment. The development of such a framework demands cutting-edge applications of Artificial Intelligence (AI) for the definition and optimization of meta-models based on deep learning. Following the above considerations, AI-ENVISERS

aims at reaching sustainable seismic risk reduction. The main challenge is to provide clear tools for the environmental impact minimization of the seismic retrofitting of buildings through the aid of computational intelligence techniques. In this context, AI-ENVISERS proposes the development of an efficient computational framework for the environmental impact minimization of seismic retrofitting of structures at both single-building and territorial scales based on computational intelligence techniques. Specifically, the research will focus on these tasks: 1.development of a complete database containing mechanical and environmental variables for BSR mainly focusing on sustainable approaches; 2.development of a novel computational framework based on AI for the multi-objective optimization of risk and environmental impact; 3.application of the framework at a territorial scale; 4.definition of guidelines and "good practices" for sustainable seismic risk reduction.

Persone coinvolte

- **Fabio Di Trapani** (Responsabile Scientifico)
- Gabriele Bertagnoli (Componente gruppo di Ricerca)
- Giuseppe Carlo Marano (Componente gruppo di Ricerca)

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI ROMA TRE** - Coordinatore

Parole chiave

Settori ERC

PE8_11 - Sustainable design (for recycling, for environment, eco-design) PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_4 - Computational engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 224.363,00
Contributo totale progetto:	€ 224.363,00
Costo totale PoliTo:	€ 56.000,00
Contributo PoliTo:	€ 56.000,00

SUP-CHAIN-DIS - SUPPLY CHAIN DISRUPTIONS, FINANCIAL LOSSES AND THEIR PREVENTION

Durata:

30/11/2023 - 30/11/2025

Responsabile scientifico:

- Fabio Fagnani

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

P2022XT8C8

Ruolo PoliTo:

Partner

Abstract

Recent international events such as the diffusion of Covid-19 and the consequent lockdowns as well as the war between Russia and Ukraine are having important consequences on industrial production in several sectors, putting its resilience in danger. The crisis originated in the real sector, namely, in the production of goods, and has spilled over to the financial sector, namely, to the production of financial services from banks and other intermediaries. The fragility of real networks has then affected financial networks, causing losses and bankruptcies all over the ecosystem. Our aim is to contribute to the resiliency of the overall economic system, as follows: a) connecting supply chains and financial networks; b) with the full network in sight, studying the consequences of supply chain disruptions on the whole ecosystem, including default cascades c) building credit risk models which are directly connected to the systemic problems in production and supply chains d) designing early warning systems, e) studying reconstruction, resilience and protection mechanisms, whose joint action can mitigate the effects of future disasters. Reconstruction and resilience mechanisms include network optimization, diversification and repatriation of outsourced activities; protection mechanisms include mutualization and insurance contracts. In the latter category we include provisions that mutualize the loss, and possibly entail a local or supranational state intervention. We will calibrate the models and examine whether hedge against future systemic disasters can be implemented through public-private partnerships (PPP). To reach the above aims, we put together a team with multidisciplinary background, such as Statistics, Network Science, Game Theory, Operations Research, Finance, and Actuarial Science. The first step in the agenda is to nest supply chain and financial networks, considering not only the industrial, but also the financing relationships of firms belonging to the former, and adding their financial counterparts, as well as consumers, to study the cascade effects of supply disasters. The second consists in evaluating the ex-ante default probabilities of the ecosystem and to study its credit fragility. The third involves highlighting early

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warning signals, as well as possible remedies to fragility, using optimization and game theory on networks. The fourth step consists in designing diversification and pooling measures for risks that aim to increase the resiliency of such integrated networks, using and pricing financial contracts. We apply our methods to case studies, i.e., actual value chains, to analyze their current input-output connections as well as financial ties and their fragility, and to show how their resilience can be increased using risk pooling and suitably designed protection mechanisms.

Persone coinvolte

- **Fabio Fagnani** (Responsabile Scientifico)
- **Giacomo Como** (Componente gruppo di Ricerca)
- **Patrizia Semeraro** (Componente gruppo di Ricerca)

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **LUISS GUIDO CARLI**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore

Parole chiave

Settori ERC

SH1_4 - Financial economics; banking; corporate finance; international finance; accounting; auditing; insurance SH1_8 - Microeconomics; game theory

Budget

Costo totale progetto:	€ 269.696,00
Contributo totale progetto:	€ 269.696,00
Costo totale PoliTo:	€ 24.170,00
Contributo PoliTo:	€ 24.170,00

WADERE - Development of thermally-driven sorption process for WAtER DEsAlinAtion using low-grade REnEWAblE EnERgy

Durata:

28/09/2023 - 26/09/2025

Responsabile scientifico:

- Matteo Fasano

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022PSPA8R

Ruolo PoliTo:

Partner

Abstract

The demand of fresh water is constantly growing worldwide. So far, this need is satisfied through high exergy-inputs, driven by electricity or high-temperature source. The development of innovative low-exergy solutions is then urgent. By a holistic approach, the WADERE project intends to develop and pre-validate at lab-scale (TRL3) a thermally-driven sorption process to provide desalinated water using low-grade heat sources (

Strutture coinvolte

- CWC - CWC - CleanWaterCenter@PoliTo
- DENERG - Dipartimento Energia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' DEGLI STUDI DI TRIESTE**

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering

Obiettivi di Sviluppo Sostenibile

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(Sustainable Development Goals)

Obiettivo 6. Garantire a tutti la disponibilità e la gestione sostenibile dell'acqua e delle strutture igienico-sanitarie|Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 228.497,00
Contributo totale progetto:	€ 197.496,00
Costo totale PoliTo:	€ 58.081,00
Contributo PoliTo:	€ 52.030,00

PROTECTED - By-PROducts based innovative TEchnologies for green and low Cost acTivE wounD dressings

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Sara Ferraris

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Ruolo PoliTo:

Partner

Abstract

Proper wound management plays a pivotal role in preventing post-surgical complications, thus reducing hospitalization time and costs. An ideal active dressing should i) support mechanical stress, ii) absorb exudate, iii) reduce bleeding, iv) prevent infections and v) prevent inflammation. None of the available active dressing cover these needs and their high costs make them inaccessible to most of population. So, PROTECTED aim at the ambitious goal to provide innovative technologies for active dressing enabling the use of raw materials within a virtuous product chain based on the conversion of industrial by-products into high value products through green and sustainable technologies. Due to the low cost of materials, dressings will be inexpensive and accessible for most of the population. The base material is discarded wool; via green synthesis keratin is extracted, and nanofibers are electrospun or 3D printed. The re-use of discarded wool allows converting by-products into new high added value materials. To bestow antioxidant, antibacterial and anti-inflammatory properties, polyphenolic extracts from different green sources will be obtained using hydroalcoholic mixtures. The use of agri-food by-products allows to convert by-products into new bioactive compounds. In addition, polyphenols protect skin from UV irradiation as well as they hold a pH-dependent color change, which can be exploited as fast and easy detection tool to recognize the raise of an infection. This tool can reduce the hospitalization time due to professional nursing, thus reducing the Public Health costs. The chemical manipulation of the polyphenolic extracts by the introduction of heavy chalcogens (e.g. S and Se) or the reactions with amino acids (e.g. lysine) may also offer unexplored opportunities in the polyphenols' properties' knowledge. The keratin surface-functionalization will be obtained by means of green procedures using water solutions. From the Scientific point of view, PROTECTED is expected to provide significant technological advances in the basic knowledge of coupling polyphenols with proteins, a still poor explored field in literature. Finally, given the keratin biomechanical properties and the bioactivity of the polyphenols, a

deep biological characterization will validate their potential exploitation in the wound management. In conclusion, the PROTECTED technologies are expected allowing for i) antibacterial, ii) anti-inflammatory and iii) pro-regenerative properties. The coupling of polyphenols and keratin from industrial by-products allows matching the Strategic Topic of Circular Economy, Health Cluster “Health technologies, new tools and digital solutions are applied effectively thanks to their inclusive, secure and ethical development, delivery and integration in health policies and health and care systems” as shematized in the Figure 1 below.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DEL PIEMONTE ORIENTALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**

Parole chiave

Settori ERC

PE5_3 - Surface modification PE5_7 - Biomaterials, biomaterials synthesis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 298.483,00
Contributo totale progetto:	€ 298.483,00
Costo totale PoliTo:	€ 64.981,00
Contributo PoliTo:	€ 64.981,00

PLA-VIT - Sustainable-by-design PLA vitrimers

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Alberto Fina

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P20229KM4Z

Ruolo PoliTo:

Partner

Abstract

Sustainable-by-design PLA vitrimers

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE5_15 - Polymer chemistry

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 234.238,00
Contributo totale progetto:	€ 234.238,00
Costo totale PoliTo:	€ 77.000,00
Contributo PoliTo:	€ 77.000,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

SOFFHICE - SOFC Hybridization with Internal Combustion Engine fuelled by Natural gas for maritime applications (SOFFHICE)

Durata:

30/11/2023 - 28/02/2026

Responsabile scientifico:

- Marta Gandiglio

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022K3TMP

Ruolo PoliTo:

Coordinatore

Abstract

the ground to zero-emission solutions (e.g., H2 and fuel cells - FCs), some transition solutions must be identified. Natural gas (NG - also stored on board as Liquified, LNG) is gaining more and more interest. It is therefore important to target energy systems efficiency maximization and emissions minimization. To this end, the Internal Combustion Engines (ICEs), powered by NG, and FCs, like Solid Oxide Fuel Cells (SOFC), already largely investigated for terrestrial application, could be suitably integrated. SOFFHICE aims to investigate the retrofit of a (operating in lakes or among Italian minor islands) with a short-distance ferry high efficiency NG driven SOFC+ICE energy system for propulsion and hoteling.

Persone coinvolte

- Marta Gandiglio (Responsabile Scientifico)
- Paolo Marocco (Componente gruppo di Ricerca)

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI GENOVA**

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Politecnico di Torino

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment SH2_8 - Energy, transportation and mobility

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 294.595,00
Contributo totale progetto:	€ 224.595,00
Costo totale PoliTo:	€ 90.740,00
Contributo PoliTo:	€ 90.740,00

PINPOINT - Perovskite-Inspired materials-based iNdoor PhotovOltaics for powering the Internet of Things

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Teresa Gatti

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Perovskite-Inspired materials-based iNdoor PhotovOltaics for powering the Internet of Things)

Ruolo PoliTo:

Coordinatore

Abstract

Perovskite-Inspired materials-based iNdoor PhotovOltaics for powering the Internet of Things

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 90.324,00
Contributo totale progetto:	€ 90.324,00
Costo totale PoliTo:	€ 90.324,00
Contributo PoliTo:	€ 90.324,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

OMNIA-PARK - Objective monitoring of axial symptoms in Parkinson's disease: quantitative assessment in daily life based on the use of wearables, video sensing and artificial intelligence (OMNIA-PARK)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Marco Ghislieri

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P20223R3R4

Ruolo PoliTo:

Partner

Abstract

Parkinson's disease (PD) is the second most prevalent neurodegenerative disorder in the aging population. It is characterized by many motor and non-motor symptoms, with a different impact on patients' daily life activities, independence, and quality of life. In addition to the typical cardinal motor symptoms, namely bradykinesia, rigidity, and tremor, more commonly affecting the limbs, another group of motor symptoms involving the axis of the body and called axial motor symptoms comes out during the course of the disease. These symptoms proved to be main determinants of reduced independence and quality of life, and can also be a cause of mortality as the primary source of falls and aspiration pneumonia. Moreover, axial symptoms are poorly or not responsive to common therapeutic strategies and are often recognized when their consequences appear, like falls or aspiration pneumonia. A big effort of the research community in the last years has pointed toward the development of e-Health tools for a more granular and accurate detection and quantification of motor symptoms and their fluctuations not only in-clinic but also during patients' daily life in a more continuous and ecologic way. However, accurate and reliable detection and monitoring of axial symptoms has been partly overlooked and remains a research priority. Against this background, in this project, we aim at developing a system for the detection and monitoring of freezing of gait, postural abnormalities and postural instability, speech issues, and dysphagia using portable technological devices including video cameras, surface EMG probes, and motion sensors. Based on the team's expertise and preliminary data, we plan to set an adequate system for the quantification of the 4 main axial symptoms, test it on patients in a clinical setting,

and export it in an home-like environment, with the final goal of prompting a technological tool for the long-term, ecological, and quantitative detection and assessment of axial symptoms in PD. The research team, composed of a multidisciplinary, heterogeneous but complementary expertise, has the knowledge and the experience to set up the research setting, test adequate technologies and data analysis algorithms based on their previous research, and develop a system to be validated not only in a research setting but also at patients' home for accurate detection and quantification of PD axial symptoms.

Persone coinvolte

- **Marco Ghislieri** (Responsabile Scientifico)
- **Gabriella Olmo** (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica
- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

LS5_11 - Neurological disorders (e.g. Alzheimer's disease, Huntington's disease, Parkinson's disease)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 245.000,00
Contributo totale progetto:	€ 245.000,00
Costo totale PoliTo:	€ 45.010,00
Contributo PoliTo:	€ 45.010,00

AIMS: Artificial Intelligence to Monitor our Seas

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Giuseppe Giorgi

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero Università e della Ricerca)

Codice identificativo progetto:

Prot. P2022587FM

Ruolo PoliTo:

Coordinatore

Abstract

The AIMS project (Artificial Intelligence to Monitor our Seas) has the vision to develop and validate novel Artificial Intelligence (AI) algorithms to unlock the true potential of remote monitoring and enable a faster transition to a climate neutral society and economy: the AI algorithms will leverage the advantages of usual monitoring methodologies of the features of waves and offshore wind, and eventually overcome their intrinsic limitations. The value and resolution of sparse measurements of satellites and unevenly-distributed in-situ instruments will be increased, hence leading to a significant reduction of the cost and execution time of data collection, ultimately making knowledge wider and more accessible. The main field of application of AIMS is the sea, because it is a challenging environment where monitoring is difficult, long and expensive; a better knowledge of the ocean is paramount for climate science and contributes to fill knowledge gaps, as identified in the IPCC. In addition, ocean monitoring is crucial for the renewable energy sector, since offshore wind is one of the main pillars of the clean energy transition in Italy and Europe [9]. AIMS will enable much faster and cheaper surveys for site selection, permitting, design and monitoring, which are among the main obstacles that prevent the proliferation of offshore renewables. Albeit the main focus of AIMS is on the sea, the proposed AI algorithms are agnostic to the specific application, so impacts are expected across diverse fields and disciplines. AIMS considers and integrates heterogeneous data, coming from both satellites and in-situ measurements, making the developed methodologies flexible and transferable. AIMS achieves its objective via a multi-disciplinary approach, various sources of data and numerical techniques, focusing on wave height and period, and wind speed. A solid dataset will be built with satellite observations, consolidated numerical downscaling hindcasts, and in-situ measurements, including both moored wave buoys (spatial-static data in a grid layout), and gliders (spatial-varying data). Such a uniquely complete dataset, openly shared, will enable a pervasive development of a family of AI algorithms,

highlighting their different fitness to various applications. AI algorithms will be developed for i) space and time gap-filling, and ii) inferring the wave period, not directly measured by satellites. A stage-gate approach will be defined for the development of AI algorithms, where quantitative performance metrics are evaluated to rank and discern among various candidates. Finally, active dissemination activities will ensure contamination in various fields of science and industry, to maximise the impact beyond the project. AIMS contributes to the PNRR in M2C2 accelerating the installation of offshore renewable energy (Investment 1.3 and Reform 1.1), and M1C2 fostering digitalization and the use of space assets and space economy (Investment 4).

Persone coinvolte

- **Giuseppe Giorgi** (Responsabile Scientifico)
- **Paolo Brandimarte** (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale
- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI ROMA TRE**

Parole chiave

Settori ERC

PE6_11 - Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video) PE10_8 - Oceanography (physical, chemical, biological, geological)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*|Obiettivo 14. Conservare e utilizzare in modo durevole gli oceani, i mari e le risorse marine per uno sviluppo sostenibile

Budget

Costo totale progetto:	€ 273.694,00
Contributo totale progetto:	€ 273.694,00
Costo totale PoliTo:	€ 142.952,00
Contributo PoliTo:	€ 142.952,00

NEXT-CITIES - Next cities for whom? Imaginaries, resources and inequalities in urban fragments

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Francesca Governa

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022WMKRP

Ruolo PoliTo:

Partner

Abstract

This research aims at exploring Urban Fragments (UF) in five Italian cities – Bologna, Cagliari, Milano, Napoli, Palermo. Starting from the PNRR framework – where Italian urban issues are mainly considered in terms of urban renewal following a mainstream approach based on some keywords (such as smartness, resilience, sustainability, and creativity), our purpose is to define a scattered understanding of those cities, overcoming the idea (and the desire) of the urban as an "integral whole". Today urban issues, as climate change and socio-economic inequalities, ask for a methodological innovation as well a new stance in order to shed light upon the fragmented and conflictual nature of the urban realm, reinforcing "the idea of the urban world as incomplete, multiple, and always in the process" (McFarlane, 2022, p. XIX). To approach the UF beyond a any technocentric perspective, and to examine their affective, emotional, sensorial, more-than-human dimensions (Lorimer, 2010), the project adopt qualitative, multi-scalar and multi-layered research methodologies. In particular, the project will set and tune with direct observation, interviews, focus-groups, creative and audio-visual methods, auto-ethnography, immersive bodily approaches. By using partecipative and creative methodologies, the research proposal aims to share the PNRR principles of social empowerment and moving beyond the purely academic research to reach wider social need. The results we expect to achieve are the following. First, to build a critical analysis of policies and practices of urban renewal, urban regeneration and recovery of the 5 Italian cities, focusing on multispecies ecosystem processes; second, to define a multi-actor methodological path building an alternative reading of spatial fragility, which defines/redefines the liminal spaces of contact and exchange (of lives, actors, economies, etc.); third, to enter into the folds of the PNRR and understand the relationships between the dominant narratives it produces and the counter-narratives coming from UFs. In line with the third strategic axis of the PNRR, i.e. social inclusion, and with the plan's

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

mission linked to the green revolution and ecological transition, the project also aims to highlight territorial gaps and inequalities accentuated by the pandemic, helping to identify new ways of bridging them through action-research practices. The final outputs (an online platform to spread knowledge outside the academy, a book, scientific papers) will gather the variety of approaches and the diversity of the UFs, as they will emerge from the work of each RU and from RUs' joint discussions.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi di CAGLIARI** - Coordinatore

Parole chiave

Settori ERC

SH2_11 - Human, economic and social geography SH2_9 - Urban, regional and rural studies

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 265.898,00
Contributo totale progetto:	€ 265.898,00
Costo totale PoliTo:	€ 31.619,00
Contributo PoliTo:	€ 31.619,00

LocClima - Impact of LOCal conditions on the change of Italian microCLIMAtes (LocClima)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Jost-diedrich Graf Von Hardenberg

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P202292C4C

Ruolo PoliTo:

Partner

Abstract

Current global warming is associated with changes at the regional scale in the frequency of occurrence and in the amplitude of weather and climate extremes, with a growing toll in terms of damages and impact on our society. Administrators at the local scale are faced with the difficulties associated with the occurrence of extreme events, and with uncertainties in their future projections, making the development of strategies for adaptation challenging, yet extremely necessary. In the Italian context, these climate change related risks are associated in particular with urban and mountain areas. At the same time, the scientific understanding of the role played by urbanisation and elevation processes for the intensity and frequency of extreme events, and their possible changes in a warming climate, are still under investigation, also due to the limited availability of relevant climate information at small scales and in complex terrains. This project will use recent high-resolution observational and climate modelling data to investigate the role of local surface boundary conditions and mechanisms controlling extreme events, providing practical tools (in the form of maps, data and software) to help their detection, assessment and the evaluation of associated risk.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI MILANO BICOCCA** - Coordinatore

Politecnico di Torino

Parole chiave

Settori ERC

PE10_2 - Meteorology, atmospheric physics and dynamics PE10_3 - Climatology and climate change

Budget

Costo totale progetto:	€ 299.905,00
Contributo totale progetto:	€ 299.905,00
Costo totale PoliTo:	€ 79.823,00
Contributo PoliTo:	€ 79.823,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Innovative multiscale approaches, possibly based on Fractional Calculus, for the effective constitutive modeling of cell mechanics, engineered tissues, and metamaterials in Biomedicine and related fields

Durata:

30/11/2023 - 28/02/2026

Responsabile scientifico:

- Alfio Grillo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022KHFNB

Ruolo PoliTo:

Coordinatore

Abstract

This project aims at bringing strong improvements in the theoretical, computational and experimental comprehension of biological materials and in the design of engineered tissues and bio-inspired or biomimetic materials that play a relevant role in cancer research and in transplant surgery. To achieve these goals, the project relies on a constructive and original combination of advanced methods of mathematical physics, numerics, and analysis with the most modern experimental techniques in the fields of interest. The methodologies that will be developed by the two research units involved in the project are expected to provide new mathematical infrastructures and innovative experimental protocols at the service of biomedicine and health industry in order to meet the scopes of the “strategic emerging topic Human Wellbeing”. More in detail, the principal objectives of this proposal are: - Development of theoretical paradigms for a flexible and theoretically rigorous formulation of the mathematical models connected with the research themes of the project. To this end, methodologies and concepts of differential geometry as well as analytical and continuum mechanics will be harmonized. - Formulation of physically consistent benchmark problems capable of reproducing the most essential features of the research questions posed by the project. This will require a careful study of the multiscale nature of the considered research themes, and the elaboration of analytical techniques, based e.g. on asymptotic homogenization or other up-scaling methods, for tracing the scale-transfer of the most relevant physical effects and for determining the effective properties of the investigated materials. - Supply robust computational strategies for the highly complex mathematical problems arising from the mathematical models that will be

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Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

proposed. - Conduction of low scale studies capable of resolving both the rate behavior and the damage of tissues at the cell level. - Elaboration of experimental protocols for testing the bio-inspired materials and metamaterials addressed by the project. - Within the research on cancer, particular attention will be given to the development of models capable of capturing the visco-elasto-plastic properties of cellular aggregates by employing fractional integro-differential operators and strain-gradient theories of plasticity. - Within the research on engineered tissues, the focus will be on articular cartilage and, in particular, on the study and design of the internal structure of metamaterials, especially for what concerns the distribution and orientation of collagen fibers, with the purpose of improving their resemblance to the native tissue. The mechanical characterization of the considered metamaterials will be obtained through asymptotic homogenization methods.

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **POLITECNICO DI BARI**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE1_12 - Mathematical physics PE1_21 - Application of mathematics in industry and society PE1_17 - Numerical analysis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 224.883,00
Contributo totale progetto:	€ 224.883,00
Costo totale PoliTo:	€ 104.315,00
Contributo PoliTo:	€ 104.315,00

BioPhET - Bioresorbable Photonics Enabling-Technologies for innovative companies in health and biomedical sector (BioPhET)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Davide Luca Janner

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P2022ACLS2

Ruolo PoliTo:

Partner

Abstract

Photomedicine is a well known tool that largely contributed to the advancement of healthcare during the last 30 years, especially in the fields of cancer, skin diseases and wound infections. A particularity of light-tissue interaction is that it can be used both for diagnostic purposes and as a treatment, thus making photonic tools extremely promising for the realization of theranostic devices. As light penetration in biological tissues is generally low, because of several light-absorbing and light-scattering elements, it is often necessary to use optical fibers to bring light to deep tissues and organs, for both diagnostic and therapeutic purposes. Unfortunately, materials used for the realization of optical fibers generally show a poor biocompatibility because of the cytotoxic action intrinsic to certain materials, and of their mechanical properties, which may trigger a significant foreign-body response in the host organism. The goal of the BioPhET project is to develop and demonstrate innovative photonics technologies based on the use of bioresorbable optical materials (i.e. materials that are naturally decomposed and absorbed by the host organism within a certain time-frame), that will enable an unprecedented set of opportunities for innovative companies working in the health and biomedical sectors. The opportunities enabled by the bioresorbable technologies investigated in the project range from bioresorbable therapeutic devices (based on photodynamic therapy, photothermal therapy and/or photobiomodulation) to integrated optical sensors (glucose monitoring, oxygenation, infections, etc…), optically controlled cell growth and differentiation, with the possibility to enable, in a longer term, also optically controlled migration of cells in vivo, and bioresorbable optogenetic implants. To achieve such an ambitious goal, we will take advantage of the expertise of 3 research groups, guaranteeing to the project the required knowledge in the fields of optical design, optical fabrication and

biological application of photonic technologies. The project is organized in 5 work-packages (see part B.1.2) and activity will focus on the realization of two different demonstrators. The first one is based on a fiber-type structure, and will target a multifunctional device allowing for drug release from a microfluidic channel inside the fiber optics, combined with a light-delivery fiber core that will monitor the therapy by integrating the function of optical coherence tomography. The second device is based on planar bioresorbable substrates and aims at creating an innovative optical smart platform for scaffolding, where light exposure can be actively used to promote cell growth and differentiation or to induce localized therapeutic effects, either directly or by triggering highly localized drug release.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PAVIA** - Coordinatore

Parole chiave

Settori ERC

LS9_8 - Biomimetics PE7_11 - Components and systems for applications (in e.g. medicine, biology, environment) PE2_9 - Optics, non-linear optics and nano-optics PE5_7 - Biomaterials, biomaterials synthesis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 239.280,00
Contributo totale progetto:	€ 239.280,00
Costo totale PoliTo:	€ 114.000,00
Contributo PoliTo:	€ 114.000,00

FusEUrope - European cooperation in nuclear fusion research: from history to future policy design

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Roberto Lalli

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

P20223BAFW

Ruolo PoliTo:

Coordinatore

Abstract

FusEUrope is a multidisciplinary analysis of the history of techno-scientific cooperation in nuclear fusion energy research for pacific uses in Europe in relation to the process of European political integration, from its early phases at EURATOM in 1957 up to the establishment of ITER (International Thermonuclear Experimental Reactor) in 2007. The results of the historical & epistemological analyses will be used to frame a multi-national survey in five EU countries on the public acceptability of controlled thermonuclear research, which will identify policy recommendations the EU level. Nuclear fusion is considered a future viable solution for a sustainable provision of large amounts of energy with relatively minor environmental impact, and historians have claimed nuclear fusion research to be central in the European integration process. Yet, the history of European cooperation on fusion research has been rarely addressed by professional historians. Its long-term history is terra incognita and no attempt has been made to connect the history of science to the history of international relations. Also, nuclear fusion not only faces the hurdle of developing a technology considered "always 20 years away", but it must also overcome a strong "double bias" against large infrastructure projects & nuclear energy. Win over public support represents the largest non-technical challenge in fusion energy development, and therefore identifying the conditions under which public acceptability is achieved is critical, yet severely under-studied. We plan to address these shortcomings by pursuing six research objectives: RO1 Create historical maps of international cooperation in nuclear fusion energy research and identify key actors, groups, and techno-scientific objects using quantitative tools based on network theory as well as qualitative methods based on close reading and oral history; RO2 Elucidate the role of fusion energy research in the foreign policy of major European

states; RO3 Identify key moments of negotiations and understand the interplay of techno-scientific and political agendas in their resolutions; RO4 Determine the basic options that the actors involved in the nuclear fusion research had available for designing social environments capable of promoting their techno-scientific aims; RO5 Analyze the causal impact on public opinion of alternative fusion cooperation designs derived by RO1-4 through a survey experiment; RO6 Produce policy recommendations based on the results of RO5. Once completed, the project will fill a knowledge gap in the historiography of science and of European integration. The results of the survey will inform EU policy-making and communication strategies on fusion energy, successfully translating historical analysis into actionable policy recommendations.

Persone coinvolte

- **Roberto Lalli** (Responsabile Scientifico)
- **Francesco Nicoli** (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione
- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI MILANO**
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **Università degli Studi di MACERATA**

Parole chiave

Settori ERC

SH6_14 - History of Science, Medicine and Technologies SH6_10 - Global history, transnational history, comparative history, entangled histories SH2_5 - International relations, global and transnational governance

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 16. Promuovere società pacifiche e inclusive per uno sviluppo sostenibile

Budget

Costo totale progetto:	€ 263.926,00
Contributo totale progetto:	€ 263.926,00
Costo totale PoliTo:	€ 164.944,00
Contributo PoliTo:	€ 164.944,00

POSEIDON - multitemPOral SEagrass mapping and monitoring of posIDONia meadows and banquettes for blue carbon conservation (POSEIDON)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Andrea Maria Lingua

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P20228HTLC

Ruolo PoliTo:

Coordinatore

Abstract

POSEIDON aims to study, develop and test new methodologies to provide knowledge, ultra-high- and beyond ultra-high-resolution mapping and monitoring for the conservation of Posidonia Oceanica (PO) and related meadows and banquettes in the Mediterranean area. The project stems from the recommendation of international organizations (European Environmental Directives, Mediterranean PO Network, International Partnership for Blue Carbon, Intergovernmental Oceanographic Commission of UNESCO in the Save the Wave project). It will follow a specific workflow, accurately reported in the next sections, to improve the actual knowledge of the PO in view of the blue carbon conservation. There is an increasing concern about conservation status of subtidal ecological systems due to the Climate Change effects and extreme events that globally affect coastal areas interacting with local anthropogenic disturbances; we are assisting at increasing demand for high, very-high and ultra-high resolution products with metric and radiometric contents. Although many geomatics instruments, techniques and methods for study and monitoring are already available for the terrestrial areas, for the underwater context (more than 70% of Earth), the challenge is still open. Starting from new integrated survey methods and legacy data, the PO will be mapped to understand the evolution of the banquettes and meadows and extract indicators and trends useful from improving the actual knowledge. Furthermore the produced information will be stored and shared in a webGIS and in a dedicated app for distributing data on PO meadows to avoid unexpected damages during sailing and other activities. POSEIDON will address mission M2 of the Italian PNRR (Green revolution and energetic transition) according to component C4 (Landscape and water resources protection), scopes M2C4.1 (Boosting the forecasting capacity of climate change effects) and M2C4.3

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

(Safeguarding the air quality and biodiversity through the protection of green areas, ground and marine areas), investments I3.2 (Digitalization of Natural parks) and I3.5 (Restoration and protection of the seabed and marine habitats). The project's scopes are in line with the PNRR objectives for the restoration and protection of the marine habitats that will translate into the safeguard and recovery of at least 20 percent of the seabed and marine habitats in Italian waters. This objective is crucial to achieve the EU target of protecting diversity and promoting the sustainability of fishing activities, tourism and blue growth. POSEIDON will work for protecting the marine habitats to prevent the disappearance of the Mediterranean ecosystems (M1, M5 in B.1.2), increasing tourism and knowledge of the analyzed areas (M4, M6 in B.1.2), and improving the research using new technological instruments and tools (M2, M3 in B.1.2). The following image shows the logical schema of POSEIDON links, from needs and gaps to targets.

Persone coinvolte

- **Andrea Maria Lingua** (Responsabile Scientifico)
- **Paolo Felice Maschio** (Componente gruppo di Ricerca)
- **Marco Piras** (Componente gruppo di Ricerca)
- **Filiberto Chiabrando** (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design
- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI SASSARI**
- **UNIVERSITA' DEGLI STUDI ROMA TRE**

Parole chiave

Settori ERC

LS8_8 - Environmental and marine biology PE6_12 - Scientific computing, simulation and modelling tools PE10_8 - Oceanography (physical, chemical, biological, geological)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 5. Raggiungere l'uguaglianza di genere ed emancipare tutte le donne e le ragazze|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 10. Ridurre l'ineguaglianza all'interno di e fra le nazioni|Obiettivo 14. Conservare e utilizzare in modo durevole gli oceani, i mari e le risorse marine per uno sviluppo sostenibile

Budget

Costo totale progetto:	€ 111.826,00

Contributo totale progetto:	€ 111.826,00
Costo totale PoliTo:	€ 111.826,00
Contributo PoliTo:	€ 111.826,00

Crafted in Stone and Recorded on Paper: The Architectural and Archival Heritage of the Smaller Italian Municipalities (12th-20th Centuries). Historical Research and Digital Enhancement.

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Andrea Longhi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022YT2YJ

Ruolo PoliTo:

Partner

Abstract

Italian municipalities are keepers of a vast building heritage, the result of centuries of history. Since the end of the 12th century, communal governments have built, transformed, and preserved a rich landscape of public architecture. Through perseverance and adaptability, communal institutions projected themselves in building programs conducted in different timescales. Communal governments created complex structures to finance and control the construction of these buildings: thus, the processes related to the physical dimension of architecture have intersected with the development of bureaucratic procedures for managing public heritage. Both have resulted in the production of a vast heritage of documents aimed at guaranteeing the legitimacy of technical and creative processes: for centuries, administrations and citizens alike identified themselves with the construction of the civic palace and the establishment of the communal archives. This research project tackles these two aspects (a history that is both ‘crafted in stone’ and ‘recorded on paper’) with the aim to understand and promote buildings and documentary deposits that can describe and make sharable histories linked to the culture of 'good government' of Italian cities. Carried out by five Units, the research will focus on the analysis of the so-called ‘centri minori’ by considering paradigmatic geographies in the history of north-central Italy. The starting point is the historiographical definition of ‘quasi-città’ (Chittolini 1990), from here the research project will turn towards the so-called ‘aree interne’ or areas that have been marginalized in the wake of more recent settlement phenomena. The five Units will identify documents that help interpret, decode, and describe the heritage of built and common areas (squares, streets, etc.) of several case studies. The

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project involves the building of a geo-referenced database, which will be the main working tool, as well as one of the most significant research outputs: the data on both 'stone' and 'paper' construction sites will become a common heritage, contributing to a greater awareness of complex historical processes and a stronger cohesion in civil society. The project will enable the digitization of a selection of neglected or endangered documents. To such an end, the framework of the 'PND del patrimonio culturale' will be considered fundamental. The project also envisages the organization of public discussions aimed at opening a debate in the scientific community while strengthening the interdisciplinary character of the research, involving local authorities, archives and Soprintendenze. The final objective of the project, in addition to the publication of a volume and monographic essays in Open Access, is to pour its results into a website that will become a reference point for a wide and varied public, providing knowledge that can open new perspectives on the study and management of Italy's cultural heritage.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 295.476,00
Contributo totale progetto:	€ 230.641,00
Costo totale PoliTo:	€ 30.746,00
Contributo PoliTo:	€ 24.000,00

ANATOMY - A Unitary Mathematical Framework for Modelling Muscular Dystrophies

Durata:

30/11/2023 - 28/02/2026

Responsabile scientifico:

- Tommaso Lorenzi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

P2022Z7ZAJ

Ruolo PoliTo:

Partner

Abstract

Muscular dystrophies (MDs) are a group of more than 30 genetic diseases characterised by progressive weakness and degeneration of the skeletal muscles that control movement. Amongst these, Duchenne muscular dystrophy (DMD) accounts for approximately 50% of cases, with an incidence of 1 out of every 5,000 live male births. Although numerous therapeutic approaches have been attempted to restore muscle function, there is currently no cure for MDs. Owing to species-specificity and inter-patient variability in disease onset and progression, along with the scarce availability of clinical data, an important source of support to biomedical research on MDs may come from mathematical models, which enable extrapolation beyond scenarios that can be investigated through experimental and clinical studies, thus offering the possibility to tease apart the molecular and cellular processes underlying this rare form of muscle disorders and facilitating the identification of new treatment possibilities. Yet, only few mathematical models for MDs have been developed to date and the existing models do not allow for systematic mathematical representation of the spatial and evolutionary cell dynamics that underpin the progression of MDs. Filling such a knowledge gap is a timely challenge, crucial for making progress in research areas where mathematical models offer innovative sustainable tools and digital solutions that can concretely help tackling major public health problems. The present project aims to fill this knowledge gap by establishing a novel unitary mathematical framework for modelling MD onset and progression, with particular focus on DMD. The models constituting such a framework, which will address limitations of existing mathematical models of MDs, will be calibrated and validated via the integration with clinical data from magnetic resonance imaging scans of MD patients. This will be accomplished through the development of novel computational methods for biomedical image segmentation and state-of-the-art uncertainty quantification methods to capture uncertainties linked to both clinical factors and

possible bottlenecks in data acquisition processes. Undertaking the research activities underlying this project will require tackling a series of mathematical challenges, which will be overcome by harnessing the range of skills from across three teams of researchers with complementary mathematical expertise and know-how, who will work in close collaboration with biomedical experts in MDs and DMD. The application of the cutting-edge modelling approaches, analytical and statistical techniques, and numerical and computational methods that will be developed in this project will create interdisciplinary impact by advancing our theoretical understanding of MDs, informing new approaches for DMD treatment, and having the potential to open unexplored directions of mathematical modelling of other myopathies.

Persone coinvolte

- **Tommaso Lorenzi** (Responsabile Scientifico)
- **Chiara Giverso** (Componente gruppo di Ricerca)
- **Nadia Loy** (Componente gruppo di Ricerca)
- **Lamberto Rondoni** (Componente gruppo di Ricerca)
- **Andrea Tosin** (Componente gruppo di Ricerca)

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PALERMO**
- **UNIVERSITA' DEGLI STUDI DI PAVIA** - Coordinatore

Parole chiave

Settori ERC

PE1_20 - Application of mathematics in sciences PE1_11 - Theoretical aspects of partial differential equations PE1_18 - Scientific computing and data processing

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 225.288,00
Contributo totale progetto:	€ 225.288,00
Costo totale PoliTo:	€ 96.690,00
Contributo PoliTo:	€ 96.690,00

NOVAPACK - NOVel solutions based on natural resources for sustainable Antimicrobial food and biomedical PACKaging: a circular economy approach (NOVAPACK)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Giulio Malucelli

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P2022K7CWJ

Ruolo PoliTo:

Coordinatore

Abstract

The research proposal aims at designing and producing novel biopolymer systems containing functional extracts (namely, antimicrobial and antioxidant products derived from lactic acid fermentation of agricultural wastes and by-products) for disposable food and biomedical packaging applications, hence fulfilling the current circular economy concept. To this aim, antioxidant, antibacterial, and possibly biodegradable polymer systems will be designed and prepared either by melt compounding or by layer-by-layer deposition. In particular, the main target of the project is to provide a proof of concept of the suitability of the polyphenols, organic acids, and peptides recovered from selected lactic acid-fermented agricultural wastes and bio-products (namely, tomato peels and seeds, melons, and legumes) as efficient antimicrobial and antioxidant additives for the design of novel disposable packaging for food and biomedical purposes. To this aim, first, lactic acid bacteria strains will be identified among the University of Parma Culture Collection (UPCC) for carrying out lactic acid fermentation processes on the selected agri-food wastes/by-products. Then, an extract of the fermented biomass containing a mixture of key bioactive compounds will be obtained ìusing low environmental impact water/ethanol mixtures and finally freeze-dried. Sustainable bio-based polymers (namely poly(3-hydroxybutyrate-co-3-hydroxyhexanoate), polylactic acid, polybutylene adipate terephthalate, and bio-based low-density polyethylene) will be selected for preparing films by casting or blown film extrusion. The extracts will either be incorporated at different loadings using melt compounding processes into the films, or layer-by-layer coated on the same substrates. Then, both the bulk and the layer-by-layer treated films will be thoroughly characterized as far as their morphology, biodegradability, thermal, mechanical,

antioxidant, and antimicrobial properties are considered. In parallel, the layer-by-layer approach will be exploited for depositing antimicrobial and antioxidant assemblies on the aforementioned bio-based polymers processed as thin films. A schematic representation of the overall process is depicted in Figure 1. Figure 1: Flow chart of the NOVAPACK process, highlighting the main steps of the project with the related milestones (M) Specifically referring to the antimicrobial/antioxidant behavior, both in-vitro and in-situ tests will be carried out. Finally, a continuous pilot plant demonstrator of the layer-by-layer functionalization will be designed and simulated and a proof of concept will be provided. The project results will be disseminated in scientific, technical, and social contexts by means of gold open-access journals, workshops, social media, and fairs, to share the results with the whole packaging world.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 299.783,00
Contributo totale progetto:	€ 299.783,00
Costo totale PoliTo:	€ 53.740,00
Contributo PoliTo:	€ 53.740,00

DSooE - Dialoguing Species - Designing Common Worlds through Ethnographies

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Alvise Mattozzi

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022JS9HM

Ruolo PoliTo:

Partner

Abstract

One of the Principles for ecosystem restoration adopted by the UN Environment Program states that it should strive to integrate all types of knowledge – including, but not limited to, indigenous, traditional, local and scientific ways of knowing – and practices in order to achieve greater kinship with nature, cooperation and effectiveness. The research project "Dialoging Species - Designing Common Worlds through Ethnography", in short DSooE (as Zoe, i.e. "life", in Greek), develops a protocol for the design of technologies enabling various species to share habitats in non-competitive ways, thus allowing ecosystem preservation and restoration. Such protocol entails the integration of various types of knowledge through ethnographic research. DSooE engages with two critical questions: - Is it possible for humans to keep inhabiting the world they share with other species without harming them, but on the contrary, Thriving with them? - Is it possible to do it without giving up what has always characterized humans, namely the fact that they are a habitat changing and a technology equipped species? In order to provide an answer to these questions and consequently develop the protocol for more-than-human inclusive design, DSooE expands Social Studies of Science and Technology's research practices, especially those concerned with the dialogue between design and social sciences. Therefore, a multi-sited and multi-species ethnographic fieldwork related to the understanding of how fish and wolves relate, adapt to or reject technologies designed with the aim of allowing them thriving will be conducted in combination with a case studies analysis of cutting-edge more-than-human design projects, ranging from engineering constructions to service design. The fieldwork looks at a fluvial laboratory and at alpine pasture livestock protection in two Italian areas. The case studies analysis considers how design is approaching more-than-human socialities, by visiting design studios around Europe. Building on the approaches that design and social sciences have developed to address more-than-human concerns, ethnography is the main way

to develop these enquiries. It will be, as well, a methodological principle for the protocol for more-than-human inclusive design. Methodologically, field research with animals is oriented towards Tsing's model of “critical description”, the one with humans is framed around expert interviews. Through the fieldworks a total of 86 interviews, of formal and informal character, will be collected. A systematic comparison among the various aspects and domains addressed by the project will be carried throughout the project. The members of the team can count on a deep reciprocal understanding gained through years of co-teaching in the Master in Eco-Social Design of Unibz. This pioneering study is based on a novel methodological approach, able to deliver a new scalable framework relevant for environmental policies in Italy and EU.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Parole chiave

Settori ERC

PE8_10 - Industrial design (product design, ergonomics, man-machine interfaces, etc.) SH3_13 - Science and technology studies

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell’ecosistema terrestre

Budget

Costo totale progetto:	€ 119.057,00
Contributo totale progetto:	€ 119.057,00
Costo totale PoliTo:	€ 119.057,00
Contributo PoliTo:	€ 119.057,00

ImPACT-AI - Development of inclusive quantitative photoacoustic imaging solutions enabled by ethical artificial intelligence

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Kristen Mariko Meiburger

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022C338Z

Ruolo PoliTo:

Partner

Abstract

Photoacoustics (PA) is a rapidly emerging imaging modality thanks to its inherent functional and metabolic capacity, sensitivity, depth penetration, non-invasiveness and radiation-free measurement of optical tissue properties. Hemoglobin is an active absorber of light and hence an ideal chromophore that enables quantitative PA-based analysis of vasculature in terms of morphology, network complexity and functional metabolism, i.e., blood oxygenation. Current limitations to PA imaging include artefact-ridden images when using traditional linear ultrasound probes (LUPs) for detection, or the need of ad-hoc detectors. Another challenge for PA imaging is that variations in skin tone, hence melanin content, can alter measurements between subjects in ways that the imaging device was not designed to anticipate. If ignored, this produces inaccurate functional information such as blood oxygenation levels based simply on the different skin color. ImPACT-AI aims to provide new PA imaging tools and artificial intelligence (AI) digital solutions for the inclusive quantitative imaging of vasculature in terms of complexity and functional oxygenation saturation analysis. Innovative methods for PA volume imaging using a LUP will be developed and innovative multi-angle illumination of the imaged area will be explored for high-resolution and artefact-reduced volumetric and functional PA imaging. The artificial intelligence methods will be developed by strictly following an “ethics by design” approach. AI methods, such as generative adversarial networks (GANs) and fully convolutional networks (FCNs), will be employed to optimize and enhance the acquired photoacoustic images. AI methods will be employed to automatically provide morphological and metabolic information about the acquired photoacoustic volumes. As a result of this project, new knowledge will be gained on how AI can enhance and enable photoacoustic imaging systems using a

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common LUP for detection and how an ethical and inclusive development process of AI techniques can compensate potential biases that could emerge due to skin tone variations. The project begins at an in-silico level designing, developing, and testing the new methodologies on simulated data. Then, the activity will advance towards in-vitro studies that consider phantoms. We will develop customized phantoms in compliance with the criteria defined by the International Photoacoustic Standardisation Consortium (IPASC). Our aim is the development of a reliable and low-cost platform that may even outclass the use of animals in terms of costs, repeatability, reproducibility, and serve as ground-truth to the AI solutions. The partnership of ImPACT-AI is a multidisciplinary team of experts in biomedical engineering, biophotonics, signal and image processing, and material science, thus providing an ideal synergy of background knowledge, tech know-how, case scenarios and outreach potential for the best scientific and socioeconomic impact.

Persone coinvolte

- **Kristen Mariko Meiburger** (Responsabile Scientifico)
- **Filippo Molinari** (Componente gruppo di Ricerca)

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI BARI** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE6_7 - Artificial intelligence, intelligent systems, multi agent systems PE6_11 - Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 240.000,00
Contributo totale progetto:	€ 240.000,00
Costo totale PoliTo:	€ 72.000,00
Contributo PoliTo:	€ 72.000,00

BREADCRUMBS - Building up Robust and Efficient routing Algorithms for Drones by integrating Connectivity and Risk awareness in an Urban air Mobility Bvlos Scenario

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Michela Meo

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022k7ERB

Ruolo PoliTo:

Partner

Abstract

Unmanned Aerial Vehicles (UAVs) or drones are nowadays used for countless applications such as good delivery, smart agriculture, search and rescue, monitoring, and so on. In these applications, though, drones can be actually employed only if there is a pilot in the Visual Line of Sight (VLoS). This aspect heavily constrains the operativity of the UAVs, limiting their effectiveness while employed in the aforementioned applications. In order to unlock the full potentiality of these flying devices, UAVs should automatically and autonomously perform flights Beyond Visual Line of Sight (BVLoS). Currently, also due to the lack of rules, drones cannot regularly fly BVLoS yet, and the main reason is that “safety” and “UAV control” are two big concerns not addressed yet. The safety analyzes the consequences for the ground people if any kind of malfunctioning hits the UAVs, while the UAV control is required in order to constantly command and control the mission at any time. Hence, with the objective to enable the BVLoS for UAVs, we aim to address these two concerns. In this project, we will start assessing the possible risks by combining the onboard UAV sensors and the available ground maps (e.g., population density, terrain), in order to create a proper risk awareness, and to guide the drones in safer paths with respect to the application prerequisites. We will also investigate how to realize a reliable UAV control, letting the UAVs and the ground base be continuously and seamlessly connected. Since it would not be sustainable nor feasible to build a new communication infrastructure for BVLoS, we will leverage on the available ground cellular infrastructure used by billions of devices (plus the satellite one) to ensure a suitable connectivity, although there are some required application parameters to guarantee, like bandwidth, or latency. So, risk awareness and

connectivity are two enabling technologies that will be studied here for allowing BVLoS flights. In this project, we propose to plan BVLoS UAVs flights by focusing on a few key missions as follows: i) suburban missions: UAVs are used for collecting images/data or for performing aerial work such as spraying on agriculture or monitoring corridors like rivers, electricity, and gas pipelines; and ii) urban missions: UAVs are used for structural health monitoring of buildings, traffic monitoring, food/beverage, small parcel mail, or biomedical goods delivery. In suburban missions, we will i) analyze the link quality and constraints offered by the cellular networks; ii) analyze the risk of UAVs; and iii) propose routing algorithms that consider both connectivity and risk assessment processes. In urban missions, we will i) optimize the Quality of Service (QoS) of the communications; ii) evaluate the security and safety robustness; and iii) devise advanced UAV routing and scheduling algorithms extended also to multiple UAVs.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA DEGLI STUDI DI FIRENZE**
- **UNIVERSITA DEGLI STUDI DI PERUGIA**
- **UNIVERSITA' DEGLI STUDI DI PERUGIA** - Coordinatore

Parole chiave

Settori ERC

PE6_6 - Algorithms, distributed, parallel and network algorithms, algorithmic game theory PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 240.000,00
Contributo totale progetto:	€ 240.000,00
Costo totale PoliTo:	€ 64.000,00
Contributo PoliTo:	€ 64.000,00

NEURO-MUSEUM - a NEUROaesthetic bridge between minds and Museums: the Use of Spatial cognition and Emotions for the accessibility, inclusivity and Understandability of the Meaning of cultural heritage

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Valeria Minucciani

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022F72NJ

Ruolo PoliTo:

Coordinatore

Abstract

NEURO-MUSEUM starting assumption are: - Cultural heritage can foster human growth, in promoting integration, social inclusion and human well-being; - To gain these objectives, cultural learning in museums must find different and innovative forms; - Cultural learning in museums is strictly related to "individual, transformative encounter" and "personal appropriation; - What moved visitors will be more vividly remembered, then processed by them, becoming a very personal asset; Ministero dell'Università e della Ricerca MUR - BANDO 2022 PNRR - Emotions' role is crucial in cognitive processes: they overcome differences, eliminating cultural gaps and difficulties, and are an "inclusive tool"; - Emotional responses to the museum environment are influenced not only by the displayed objects nor by the information apparatus, but also by the spatial environment and its atmosphere; The main challenge lies in overcoming the usual concept of accessibility and inclusion intended as the possibility for everyone to have THE SAME cultural encounter and learning experience (which in itself is not possible,) but rather the possibility for everyone to have THEIR OWN experience related to cultural heritage. The project therefore focuses on the museum environment and intends to test visitors' reactions during the visit at both neurophysiological and cognitive levels. It doesn't focus on disabilities, but instead on capabilities and possibilities; among these, the ability to be moved is common to all. Hence, external stimuli can be transformed into internal embodied experiences. The goals of this project are therefore: - to rework theoretical aspects of the current state of research from a multidisciplinary perspective (museography, heritage science, neuropsychological and cognitive sciences); - to identify measurable

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Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

elements, and connected indicators, to be used in designing solutions and in assessing results; - to set a core experimental activity through at least two parallel pilots (each consisting of several experiments) to observe: 1) emotional responses in real spaces, comparing different spatial and cultural environments related to similar collections; 2) emotional responses in simulated environments, comparing responses to specific sensory components; and to comment on the connection between emotional and cognitive responses; - to develop a reliable theoretical model, where experiments and result can be replicated in other contexts; - to study different publics: regular, occasional and disaffected audiences (whatever the reasons), in order to include all of them, with particular consideration for the latter. - to investigate the empathic design principles[16], not for 'dedicated' solutions, but for multilevel, polysemic solutions to arouse emotions according to the most diverse channels. The project results will have a long impact, lasting beyond the project itself, being related to general context, including all audiences and referring to design principles.

Persone coinvolte

- **Valeria Minucciani** (Responsabile Scientifico)
- **Michela Benente** (Componente gruppo di Ricerca)

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

SH5_7 - Museums, exhibitions, conservation and restoration SH4_4 - Neuropsychology

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 228.113,00
Contributo totale progetto:	€ 228.113,00
Costo totale PoliTo:	€ 118.113,00
Contributo PoliTo:	€ 118.113,00

REVHEAL - Structural Rehabilitation of Vaults in Heritage Asset Learning: collapse identification and design of compatible strengthening systems supported by adaptive 3D models

Duration:

30/11/2023 - 29/11/2025

Principal investigator(s):

- Alessia Monaco

Project type:

Nationally funded research - PRIN

Funding body:

MINISTERO (MUR)

Project identification number:

P2022ZJWS3

PoliTo role:

Coordinator

Abstract

The structural strengthening of heritage assets is a leading sector in many European countries, including Italy, where there are high percentages of ancient masonry buildings provided with curved horizontal structures with complex geometry. REVHEAL will focus on the safety assessment of cross masonry vaults and the design of risk mitigation strategies in compliance with the traditional conservation criteria. The project will analytically identify the collapse mechanisms by using innovative technologies supported by 3D user-oriented digital models. Two main objectives will be achieved. First, a methodology for the detection and classification of the expected failure mode of cross-vaulted structures will be proposed. Second, appropriate risk mitigation strategies will be proposed, through the design and modelling of suitable reinforcing systems aiming at preventing structural collapses and loss of human lives. Focus will be given to natural Textile Reinforced Matrix (TRM) composites and their mechanical properties, whose understanding represents an open issue. REVHEAL will start from some preliminary numerical studies performed on masonry cross vaults with radial and diagonal patterns. These studies apply to some limited cases of vaults with dry joints and blocks not experiencing internal crushing. Then, an experimental campaign on small-scale vaults will be performed to validate the existing models and develop new models related to vaults that can experience failure either along not-aligned joints or within the voussoirs. The project will also provide the validation of the proposed models through real-scale tests on two pilot masonry cross vaults subjected to cyclic shear loads. The two vaults will have radial and diagonal brick patterns and will present the backfill at the extrados. The test on each vault will include two stages. The former will aim at loading the not

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

strengthened vault till the attainment of a significant damaging condition; the latter will investigate the behaviour until failure of the pre-damaged vault after repairing with natural TRM systems. The experiments on both scale specimens will be supported by 3D digital models based on accurate point clouds and multi-scale approximated surface objects. Advanced technologies and methods for data acquisition and parametric modelling strategies for approximation will be proposed and validated. The latter will allow to investigate the relationships between model accuracy and suitability for FEM performance estimation. REVHEAL will lead to the proposal of abacuses and guidelines for both assessing static and seismic risk scenarios and determining proper strengthening interventions. High-level approximation models for predicting the capacity and ductility improvement of strengthened vaults will be also proposed. Finally, REVHEAL will validate the proposed approach against the case study of the Palazzata of the Santuario Regina Montis Regalis in Vicoforte in Italy.

People involved

- **Alessia Monaco** (Principal Investigator)
- **Emiliano Matta** (Component of the research team)
- **Giulia Sammartano** (Component of the research team)

Structures

- DAD - Department of Architecture and Design

Partners

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinator
- **UNIVERSITA' DEGLI STUDI DI BRESCIA**

Keywords

ERC sectors

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Sustainable Development Goals

Obiettivo 5. Raggiungere l'uguaglianza di genere ed emancipare tutte le donne e le ragazze|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Total cost:	€ 224,924.00
Total contribution:	€ 224,924.00
PoliTo total cost:	€ 115,424.00
PoliTo contribution:	€ 115,424.00

FOCAL - FIBER OPTIC SENSORS AS A PLATFORM FOR CANCER DIAGNOSIS AND IN VITRO MODEL TESTING

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Giorgia Montalbano

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P2022Y4TP5 (codice progetto)

Ruolo PoliTo:

Partner

Abstract

FIBER OPTIC SENSORS AS A PLATFORM FOR CANCER DIAGNOSIS AND IN VITRO MODEL TESTING

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components PE4_4 - Surface science and nanostructures PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 300.000,00
Contributo totale progetto:	€ 300.000,00
Costo totale PoliTo:	€ 112.900,00
Contributo PoliTo:	€ 112.900,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

22q11DS - Role of 22q11.2 deletion syndrome (22q11DS) haploinsufficency in driving cardiac extracellular matrix changes and mechanical sequelae using a Tbx1 mutant mice model: mechanistic insight and detection of potential therapeutic targets

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Umberto Morbiducci

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

P2022ZXAJ9

Ruolo PoliTo:

Partner

Abstract

22q11.2 deletion syndrome (22q11.2DS) is the most common human chromosomal microdeletion, causing neurological diseases, thymus hypoplasia, hypoparathyroidism, anomalous craniofacial features, skeletal/connective and/or cardiac defects1. The pharyngeal/structural cardiac phenotype is caused by TBX1 gene haploinsufficiency, but additional genes, like DGCR8 and PRODH, within the deleted region may contribute to other aspects of the clinical presentation However haploinsufficiency alone and gene-modifiers-factors do not define the 22q11.2DS direct/undirect contribution of common pathogenetic mechanism of cardiac tissue anomaly and damage caused by mechanical and ECM modifications. In previous studies (by us and other groups, including preliminary data included in B.2 section) it has been demonstrated that loss of Tbx1 induces alteration of ECM deposition in multiple tissues, an impaired extracellular matrix (ECM)-integrin-focal adhesion (FA) signaling and that TBX1 is required to maintain the integrity of ECM-cell interactions in the cardiac progenitors niche, which is critical for cardiac outflow tract development2–5. Alteration of the ECM status has been further confirmed in in vitro and in vivo models, and that revealed that 10% of them are ECM-related genes belonging to the matrisome network6–8 . Interestingly, metabolomic studies have shown an increased plasma proline levels (hyperprolinemia) in approximately 50% of 22q11.2DS patients9 as compared to controls. Proline, an amino acid essential for the COL synthesis, is a prominent feature of the metabolic signature of the patients, suggesting a possible multi-tissue alteration of the ECM. Based on this preliminary

observation, we hypothesized that gene haploinsufficiency determines downstream biochemical and mechanical alterations of the ECM properties which in turn are responsible of the pathological maladaptation also observed in 22q11.2DS patients. To address this hypothesis, we have assembled a multidisciplinary team and we will use a mouse model carrying TBX1 deletion to evaluate the molecular mechanisms behind the observed maladaptive changes e explore potential pharmacological treatment to rescue the diseased phenotype. Specifically, we propose three specific aims: a) The first will assess genetic and molecular mechanisms that lead to ECM alterations in the mutant models; b) the second will address the biomechanical properties of the mutant cardiac tissue and its potential role in development of the disease; c) the third aim will evaluate whether pharmacological intervention on the ECM synthesis may be a potential rescue approach of the in vivo phenotype. By the end of the proposed project we should established the specific molecular and biomechanical signature caused by the mutation as well as lay down the basis for further exploitation of potential pharmacological approaches.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"** - Coordinatore

Parole chiave

Settori ERC

LS7_1 - Medical engineering and technology

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 239.273,00
Contributo totale progetto:	€ 239.273,00
Costo totale PoliTo:	€ 73.576,00
Contributo PoliTo:	€ 73.576,00

Upcycling Architecture in Italy. Forging and Promoting a Renewed Building Culture

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Gabriele Neri

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022KSYY9

Ruolo PoliTo:

Coordinatore

Abstract

The research aims to contextualize, analyze, file, re-elaborate, and disseminate the theory and practice of the Upcycling of building Topicality and motivations The research frame is encouraged by current factors - many of which are related to contemporary energy and environmental crises, exacerbated by the current geopolitical situation - including the stimulus of EU policies on the rational use of building materials, the aging of the Italian built heritage, and the rise in the prices of building materials. In this perspective, the research project is part of the strategies of the European Green Deal and the proposal for a "New European Bauhaus" and concerning this call, the "Environmental Quality" axis, with specific reference to "Cluster 2: Culture, Creativity and Inclusive Society", point no. 3 and no. 4. Strategic objectives: • Historical/theoretical framework: a different point of view on European culture of construction (1945-2022) • Filing of Best Practices at the European level (1945-2022) • Definition of a critical theory on the subject • Theoretical/design analysis and re-elaboration: identification of models/principles of use that can be repeated nationally in Italy. • Dissemination of a widespread culture of Upcycling in Italy Innovativeness: • Application of the Upcycling principles to the specific scale of the building. • Analysis of the technical, compositional, and aesthetic potential/criticalities of an architectural design consistent with the circular economy principles. • Experimentation of updated and calibrated narrative/storytelling/dissemination methods for heterogeneous audiences. Expected outcomes: D1) Production of historical and theoretical frameworks to support the understanding of the phenomenon, as: - D1.1 Theoretical frameworks - D1.2 Design Workshop D2) Production of open databases to support the design practice in terms of Upcycling and DfD, as: - D2.1 European Atlas of Upcycling Best Practices 1945-2022. - D2.2 Italian Manual of the Upcycling Architect. - D2.3 Upcycling E-learning

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platform (MOOC for different audiences).

Persone coinvolte

- Gabriele Neri (Responsabile Scientifico)
- Lorenzo Savio (Componente gruppo di Ricerca)

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI ROMA - TOR VERGATA**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 230.258,00
Contributo totale progetto:	€ 230.258,00
Costo totale PoliTo:	€ 78.000,00
Contributo PoliTo:	€ 78.000,00

THERmIR - Continuous THERmal monitoring with wearable mid-InfraRed sensors.

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Erik Piatti

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca (MUR))

Codice identificativo progetto:

P2022AHXE5

Ruolo PoliTo:

Partner

Abstract

Body temperature (BT) is one of the most important vital signs for evaluating human health. Abnormal BT patterns are key indicators for the prognosis of various illnesses and the most common symptoms of defensive immune responses. The early identification of these patterns, however, requires systems capable of continuous monitoring of the core body temperature (CBT). This task cannot be pursued by simple wrist bracelets or single skin temperature probes that can largely underestimate the value and fluctuations of CBT, which is instead typically measured by invasive thermometers. A possible strategy to improve the prediction accuracy of skin temperature measurements entails the use of multiple probing points with insulated temperature sensors to mitigate environmental effects and prevent local heat loss at the measured site. Early attempts towards this goal have involved multiple thermistors connected to a fixed measurement setup, thus mitigating the discomfort of the patients, but not solving the issues of low system portability and flexibility. Thus far, exploratory solutions in this direction relied on stitchable and flexible devices based on adhesive thermistors, conductive materials whose resistance changes as the temperature is varied. Despite the conceptual simplicity of this method, the need to conformally adapt to the skin introduces a significant challenge: the stretchable conductor needs to consistently retain its sensitivity upon large and frequent stretching events. THERmIR proposes an alternative solution that relies on the development of wearable and stitchable optical temperature sensors, capable of monitoring skin temperature by harvesting the infrared radiation emitted by the human body, whose emissivity spectrum is maximum in the mid-infrared (mIR) range. We will employ large-area graphene grown by chemical vapor deposition as the active material to devise efficient optical temperature sensors. This strategy allows for the scalable realization of skin-like, flexible, non-invasive thermometers that can be applied to multiple locations on the skin, minimizing the discomfort and

maximizing the system efficiency and portability. The three research units involved in the project will gather their complementary expertise to pursue the research objectives: CNR will design, fabricate and characterize the high performance mIR photodetectors; POLITO will analyze the mIR absorption in graphene at a microscopic level and UNIVE will perform biocompatibility tests and quantify the thermometer's figures of merit under flexural strain. We envision that the proposed technology will represent a solid building block for future medical diagnostics based on continuous BT monitoring, and also open new opportunities for applications in strategic domains, such as Internet-of-things sensors and wearable biometric platforms, where system accuracy, reliability and low SWaP (Size, Weight, and Power) are undisputed benefits.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI VENEZIA - CA' FOSCARI**

Parole chiave

Settori ERC

PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components PE3_4 - Electronic properties of materials, surfaces, interfaces, nanostructures, etc.

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 296.197,00
Contributo totale progetto:	€ 296.197,00
Costo totale PoliTo:	€ 10.045,00
Contributo PoliTo:	€ 10.045,00

GUARDIAN - Design of Dual Action Filter for Indoor Air Treatment

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Marco Piumetti

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Ruolo PoliTo:

Coordinatore

Abstract

In recent years, many studies have focused on the importance of reducing not only CO2 emissions from industries but also other more harmful compounds, such as VOCs, in the atmosphere. For some time, the focus has been on strategies to purify the outdoor air by reducing the concentrations of these pollutants. However, scientific studies have confirmed that indoor pollution may be more dangerous and that prolonged exposure to these compounds, even at low concentrations, can cause damage to human health. In addition to VOCs, bacteria, commonly found in indoor environments, can cause health issues. The main aim of the GUARDIAN (desiGn of dUal Action filteR for inDoor aIr treAtmeNt) project is the design and development of innovative and sustainable catalysts for the abatement of both gaseous pollutants, in particular VOCs and CO, and bacteria with the ambitious objective of achieving their complete removal at low temperature for indoor air purification to improve the air breathed inside offices and domestic places. The removal of pollutants for indoor air purification is a key point to ensure the health and well-being of people in enclosed and confined environments. In this context, catalytic oxidation at low temperature (mainly at room temperature) represents a challenging route that can be exploited. This is an important research objective since mastering activity, selectivity and realizing a single pot process to remove not only gaseous pollutants but also bacteria that commonly can be found in indoor contexts is a formidable techno-economic challenge from the application perspective. This project aims to address in a unifying vision and approach the concept of catalytic oxidation of VOCs, CO and other pollutants with the inactivation of microbial species using sustainable materials based on heterogeneous catalysis. The ambitious goal of the GUARDIAN project is to offer a unique possibility to join high-quality researchers on these aspects to explore the problem of indoor pollution from a multifaceted perspective and to prepare the bases for applications in EU projects. The project proposes a different and more effective concept for knowledge integration. It will best use the different multidisciplinary competences to explore new directions through a synergistic

approach. The project involves two research units (Politecnico Torino - POLITO; University of Napoli (Federico II) - UNINA) and includes the preparation, chemical-physical characterization and evaluation of the antimicrobial and catalytic properties of materials; the evaluation of possible synergies between the synthesized materials and the realization of a composite “cartridge” as a prototype device for scale-up; and finally, the evaluation of the environmental sustainability and economic feasibility of the materials produced for possible applications in the occupational and healthcare context.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_2 - Chemical engineering, technical chemistry PE4_10 - Heterogeneous catalysis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età|Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 223.028,00
Contributo totale progetto:	€ 223.028,00
Costo totale PoliTo:	€ 125.190,00
Contributo PoliTo:	€ 125.190,00

STARGATE - Stacked power architectures for next generation mobile and space communications in European gallium arsenide technology (STARGATE)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Chiara Ramella

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022ARPHM

Ruolo PoliTo:

Coordinatore

Abstract

In the last decades, people are experiencing a technological revolution that is driving them into a future of innovations in most aspects of life. The recent advances in 5G/6G communication systems offer high data-rate and capacity with low latency that will enable potentially revolutionary advancements in telemedicine, virtual reality, IoT, industry 4.0, smart energy, autonomous cars, smart agriculture and more, with great benefit for society and environment. In order to make this revolution a reality, the wireless infrastructure must be hugely expanded, not only on Earth, but also resorting to Space links, and thoroughly rethought, moving on higher carrier frequencies in the millimeter-wave to terahertz range. This scenario will be enabled, among other technologies, by the development of efficient and cost-effective high-frequency integrated circuits. From a practical point of view, this means that we need technologies and architectures able to satisfy the challenging specifications of such integrated circuits in terms of output power, gain, and linearity at such high frequencies and that may operate in Space environment. In this project, we propose to face the problem from the architectural point of view, by developing innovative device structures able to overcome the limitations of the existing ones, relying on a European GaAs technology, which advantages are maturity, linearity, reliability and Space qualification, along with availability of a resilient fully-EU supply chain. Goal of this project is pushing even further the exploitation of GaAs technology, by merging its good high-frequency performance with the innovative architecture known as Stacked Cell, which can become a key enabling solution as higher-voltage/higher-power macro-devices, suitable for replacing single transistors in PA design for the intended applications. The project includes (1) theoretical analysis activities, aimed at investigating the main advantages, design challenges and potential limits/issues of the

Stacked cell architecture and of its modeling as a macro-device, as well as developing innovative cell concepts, models and layouts, targeting a significant advancement of knowledge and demonstrating the potential cell capabilities, (2) design activities and MMIC fabrication and (3) experimental characterization activities adopting a commercial EU GaAs process, aimed at model extraction and validation as well as at cell performance assessment in a real technology. Merging advanced design, characterization and modeling capabilities is the main strength of the proposing research team, whose skills cover all the challenging points of the project. The outcomes of the project will lead European foundries in a strategic position, by being the first to develop innovative GaAs solutions for the high-frequency Space market.

Persone coinvolte

- **Chiara Ramella** (Responsabile Scientifico)
- **Marco Pirola** (Componente gruppo di Ricerca)

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PAVIA**
- **UNIVERSITA' DI MILANO BICOCCA**

Parole chiave

Settori ERC

PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components PE7_3 - Simulation engineering and modelling PE7_6 - Communication technology, high-frequency technology

Budget

Costo totale progetto:	€ 221.718,00
Contributo totale progetto:	€ 221.718,00
Costo totale PoliTo:	€ 94.895,00
Contributo PoliTo:	€ 94.895,00

PROT-mBIOMA-AD - A computational pipeline for the analysis of the role of proteins from unknown species in shotgun metagenomics data: application to the study of gut microbiota in a mouse model of Alzheimer's disease.

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Angela Re

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022AFS8P

Ruolo PoliTo:

Partner

Abstract

The aim of this computational project is to investigate from a functional point of view the protein repertoire of genomes deriving from shotgun metagenomics experiments. We will specifically focus on the study of microbiota from a mouse model of Alzheimer's disease, with the ultimate goal of elucidating the role of proteins inferred by reconstructed genomes of unknown species. Nowadays, shotgun metagenomics allows the comprehensive reconstruction of the set of genomes present in a certain biological sample. Most of the currently available bioinformatics tools are mainly focused on the characterization of reconstructed genomes in terms of the gene repertoire, taxa identification and classification. However, relatively little was developed so far for the characterization of the set of proteins annotated on reconstructed genomes, especially in the context of neurodegenerative diseases such as Parkinson's and Alzheimer's disease.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

LS2_10 - Bioinformatics LS2_11 - Computational biology LS2_13 - Systems biology

Obiettivi di Sviluppo Sostenibile

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Politecnico di Torino

(Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 222.285,00
Contributo totale progetto:	€ 222.285,00
Costo totale PoliTo:	€ 121.285,00
Contributo PoliTo:	€ 121.285,00

AFLA_LOC - Innovative portable tools for the detection of aflatoxigenic isolates of Aspergillus sect. Flavi in agricultural soils

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Carlo Ricciardi

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P2022CBHZK

Ruolo PoliTo:

Partner

Abstract

starting from agricultural soil samples, to identify specifically and through PCR-amplicons toxigenic isolates of Aspergillus flavus producer of the carcinogenic aflatoxins and rotting agents of different plant products including hazelnut and maize. In particular, the Lab on a chip will consist of two main modules: one for sorting Aspergillus spores thanks to nanoporous silica microbeads functionalized with antibodies capable of first 'capturing' the fungal spores and then of releasing their nucleic acids in an extractive buffer at high temperature; one in which part of the solution obtained is used for real time PCR amplification of nucleic acids. The “nano” module is coupled to a suspended microchannel resonator that acts like an extremely tiny and sensitive balance in measuring microbeads’ mass variation due to spore capturing and to DNA extraction. The 'PCR' module is coupled to a photo sensor capable of quantifying the fluorescence emitted during the amplification reaction. The modules are linked by microfluidic channels and electronically controlled. This portable device will allow the detection of the presence of Aspergillus flavus strains producing aflatoxins in the hazelnut and maize supply chain, providing means for enhancing the safety of these crucial food chains.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"** - Coordinatore

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Politecnico di Torino

Parole chiave

Settori ERC

LS9_9 - Biohazards (including biological containment, biosafety, biosecurity)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 2. Porre fine alla fame, raggiungere la sicurezza alimentare, migliorare la nutrizione e promuovere un'agricoltura sostenibile

Budget

Costo totale progetto:	€ 299.234,00
Contributo totale progetto:	€ 299.234,00
Costo totale PoliTo:	€ 54.750,00
Contributo PoliTo:	€ 54.750,00

Urban co-production and inclusive planning in marginalised contexts. Are Living Labs and the University capable of enhancing the active citizenship of fragile inhabitants?

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Cristiana Rossignolo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022CM4WA

Ruolo PoliTo:

Partner

Abstract

The research project will investigate the limits and opportunities of implementing co-production and empowerment spaces in marginalised urban territories. While co-production may encourage the reactivation of a dialectic between public institutions, experts and society, most recent Italian and European experiences have faced difficulties in marginalised urban environments characterised by highly diverse socio-economic conditions. These territories often find themselves between de-politicised, technicist and procedural approaches and highly radical claims. Given such a tensioned field, it seems crucial to question what are the tools most suitable for effective co-production and what role academia can play in it. The research question concerns indeed also the role of the University and whether it can contribute to open spaces for participatory planning and co-production at the local level. The research will be carried out by three Operating Units (O.Us.) in specific marginalised contexts of Milan, Rome and Turin. These urban areas share some common features, such as lack of access to 'full citizenship' and development despite various public policies; active involvement of local inhabitants and stakeholders despite deprived conditions; the presence of Urban Living Labs (ULL) and other experimental forms for direct inclusion of fragile citizens; and the University involvement in public engagement attempts. The research question is investigated through four main goals and a series of objectives leading to specific findings. The first goal it to investigate empirical and theoretical circumstances where marginality or inclusion is generated concerning access to citizenship. The second goal is to find out which spaces and features are most suitable for effective co-design regarding the inclusiveness of fragile individuals and communities at the local level. The third goal is to investigate the University's

role in the three research contexts and focuses on the characteristics and limits of situated research and university public engagement. The fourth goals aims at taking the two years of research as a learning opportunity at different levels, in terms of empirical insights - concerning both policies and practices in local contexts and the Univerisity's role - and theoretical advancement on these incipient but crucial topics in the academic debate. The research will add to the current knowledge on the assesment of different forms of citizenship in marginalised urban areas and on the implementation of ULLs in such territories. It will also aim at providing operative indicators for the public administration and the local actors engaged in alleviating the conditions of the most fragile urban communities.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

SH2_9 - Urban, regional and rural studies

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 266.089,00
Contributo totale progetto:	€ 266.089,00
Costo totale PoliTo:	€ 83.045,00
Contributo PoliTo:	€ 83.045,00

SUERTE TO GREEN - Models and methods for SUstainable Energy Road Tunnels in microgrid Environment able TO provide Grid service and External ENergy

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Angela Russo

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

P2022PA5XX

Ruolo PoliTo:

Partner

Abstract

The project concerns the electric loads (lighting and air treatment systems) installed in the road tunnels that are highly energy consuming and, at the same time, crucial for safety of drive and people. Supplying the tunnel electric loads is a complex problem because the binomial safety-sustainability must be always optimized. The objective of the project is to develop the models and a systematic method that allow estimating the technical and economic viability of energy autonomous and productive road tunnels (APROT), as emblematic of the highest target of sustainability. The APROT will operate according to the microgrid paradigm: a finite grid, connected at a Point of Common Coupling (PCC) to public grid, that supplies electric loads by local energy resources constituted by renewable generation units and a storage system. In function of the real operating conditions (traffic, weather conditions, incidents, external light level, etc), the produced energy is optimally managed to cover internal loads, external loads, to exchange energy with the grid for selling it and/or for furnishing ancillary services. To be candidate as an APROT, a road tunnel needs to respect minimal efficiency conditions on the energy consumptions (EC) and adequate levels of performance (PE). The project will develop the models of electric loads of road tunnels for monitoring their actual state in terms of both items, EC and PE, with a benchmarking approach. For every type of tunnel (one lane, multiple lanes, one-way traffic, two-way traffic), the baseline of reference will be modeled on the plane (EC, PE), and the distance of a tunnel from the baselines will provide an effective tool to select the set of tunnels eligible as APROT. The bidimensional models will allow to define proper energy label of tunnels for an immediate visualization of the operating conditions of the tunnel and for benchmarking activities. A successive step concerns

the analysis of the generating capacity from renewable sources at the sites where the previously selected tunnels are located. Advanced forecasting models of the renewable source production, weather conditions, economic parameter changes will be developed to derive the input data for the successive step aimed to optimally size the renewable generating units and the storage system. An Energy Management System (EMS), properly developed for the APROT management, optimizes the operations to minimize the energy cost in compliance with the drive safety Norms on the basis of the input information from the generation units, storage systems, load request, price signals of energy and/or ancillary services to the grid. In the corresponding different scenarios of possible conditions, the feasibility will be estimated with different grades of confidence by the statistics of economic and financial indices.

Persone coinvolte

- **Angela Russo** (Responsabile Scientifico)
- **Enrico Carpaneto** (Componente gruppo di Ricerca)

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CASSINO E DEL LAZIO MERIDIONALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI NAPOLI 'PARTHENOPE'**

Parole chiave

Settori ERC

PE7_2 - Electrical engineering: power components and/or systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 240.000,00
Contributo totale progetto:	€ 240.000,00
Costo totale PoliTo:	€ 49.400,00
Contributo PoliTo:	€ 49.400,00

3DPRINting of multi-material parts for cranial implants

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Alessandro Salmi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Codice identificativo progetto:

P2022PMMWX

Ruolo PoliTo:

Partner

Abstract

Additive Manufacturing is assessed as a competitive solution for fabricating customized and high-added-value products. For this reason, AM finds in the Medical sector one of the most prolific fields of application. Nevertheless, some aspects still need to be enhanced in biomedical applications. This project will develop new AM solutions to overcome these limits. In particular, for fabricating parts made of heterogeneous materials, from polymers to metals, including customized biomedical, biocompatible and functionalized. The case study selected for the project is related to Cranioplasty. Cranioplasty is a common procedure performed to repair cranialdefects. When autologous bone is not available, a reconstruction with alloplastic materials can be realized. Customized cranial implants with PEEK (Polyether ether ketone) or titanium are valuable choices, achieving good aesthetic results. Indeed, their cost remains high. PMMA is often used to perform cranioplasty. It is biocompatible, easily shapeable and low-cost. The novel engineered solution developed in the project consists in an implant made of a metal core embedded in polymeric shell that guarantees the required mechanical-biological properties. In fact, the polymeric material will be functionalized to enhance its biological interactions, to reduce the risk of post-surgery complications and to promote the osteointegration. Because of the complexity of the problem, the product design involves many challenges such as anatomical fidelity, medical graded and functionalized materials, mechanical resistance, tissues reconstruction and interactions. Moreover, different fabrication process will be investigated: direct printing of implants, mold casting (e.g. of PMMA), implant production using rigid or flexible molds (e.g. made of silicone). The Project involves partners with complementary skills and extensive backgrounds. Through an interdisciplinary approach, they will merge AM processes for customized materials, and the research value will be demonstrated by clinical cases with 2 levels of interest: planned and emergency surgeries. They share the same production

approach in terms of types of product, design and production strategy. In fact, they need an implant and, eventually, a phantom of the patient for pre-surgery planning. Anatomical detailing and material requirements are calibrated on level of interest and clinical urgency. Parallel activities will be performed: i) biomaterials fabrication, customized mechanical and medical properties (antibacterial, drug release, in-vivo degradability, osteoconductivity, bioactivity); ii) process development and optimization; iii) development of implants for actual clinical cases; iv) validation of the implants by surgeons. The continuous contribution of surgeons will allow to identify actual and significant clinical case-studies to demonstrate the consistency of the project results.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI BRESCIA** - Coordinatore
- **UNIVERSITA' DI FERRARA**
- **UNIVERSITA' DI ROMA - TOR VERGATA**

Parole chiave

Settori ERC

PE8_9 - Production technology, process engineering PE8_10 - Industrial design (product design, ergonomics, man-machine interfaces, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 225.001,00
Contributo totale progetto:	€ 225.001,00
Costo totale PoliTo:	€ 56.123,00
Contributo PoliTo:	€ 56.123,00

PRIORITY. Shaping the Prosecution Organisational Model of Criminal Reports

Durata:

30/11/2023 - 30/11/2025

Responsabile scientifico:

- Marco Scianna

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022P84H7

Ruolo PoliTo:

Partner

Abstract

As the offices of public prosecutors do not have sufficient resources to handle all the crime reports they receive, the public prosecutors are forced to indicate, in the organisational plans of the office, what reports are to be given priority. Law no. 71/2022 established that these priority indications shall be made, from now on, in compliance with general criteria to be set by the Parliament. This aims at levelling out as much as possible the prosecutors' choices throughout the Country, as well as ensuring compliance with the constitutional principles of trial efficiency and mandatory prosecution. This research intends to provide the Parliament and public prosecutors with effective tools to apply the new rules. The work is composed of several parts and includes numerous units to portray local and regional features and to ensure an in-depth analysis of possible problems arising from the aforementioned rules. The first phase of the research will focus on collecting data on how Italian public prosecutors' offices currently make priority choices. The cataloguing of organisational plans will be followed by specific questionnaires and by an analysis of software used in the judicial system for the effective management of the workload. The second phase will be devoted to processing the data collected locally and to identifying problematic profiles to be investigated by the units. The analysis will be carried out by looking both at the state of the art in doctrine and jurisprudence, as well as at the most relevant civil law and common law systems suitable for comparison. In the third phase, the results will be analysed to provide institutions with proposals for managing crime reports flows. This activity will lead to: a) a regulatory model for identifying the general criteria for the definition of priorities; b) a prototype to organise public prosecution offices on the basis of said priorities; c) a mathematical model and the related software to implement the aforementioned organisational plans. The last phase will be devoted to dissemination. The proposals will be presented and discussed with representatives of the Parliament and the judiciary. The findings will

also be published and updated on a dedicated website, as well as disseminated within the scientific community through the organisation of conferences and the publication of a collective work.

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DELL'INSUBRIA**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI URBINO "CARLO BO"**
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Mostra di più

Parole chiave

Settori ERC

PE1_21 - Application of mathematics in industry and society SH2_4 - Legal studies, constitutions, human rights, comparative law

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 242.942,00
Contributo totale progetto:	€ 242.942,00
Costo totale PoliTo:	€ 9.525,00
Contributo PoliTo:	€ 9.525,00

WATACO - WAll Turbulence Active COntrol

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Jacopo Serpieri

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. P20227T9A3

Ruolo PoliTo:

Coordinatore

Abstract

The WAll Turbulence Active COntrol (WATACO) project aims at achieving reduction of the drag exerted by a turbulent flow on the flow-exposed surfaces by means of active flow control (AFC) techniques. The flow types considered are both internal (pipe and channel flows) and external (boundary layer flows) with or without an external pressure field and explore a broad range of Reynolds numbers. The project considers both an experimental and a numerical research approach. The considered flow forcing will be provided by wall-mounted dielectric barrier discharge (DBD) plasma actuators (PAs) arranged into streamwise-aligned arrays and lain out such to induce a crossflow-oriented flow along the positive and negative direction alternatively. This configuration leads to an induced flow similar to the one caused by oscillating the flow-exposed wall. This forcing, when performed on turbulent flows, has shown huge values of net power saving, thus largely overtaking passive flow control approaches, due to the hindering of the turbulence-generation mechanisms and related friction drag reduction (Ghaemi, 2020, Physics of Fluids). WATACO deploys a research group, from two research institutions (Politecnico di Torino and Università di Bologna), with extended expertise on both the project's areas of research: flow control and, in the specific wall-turbulence control, and plasma actuators science. The group members feature younger and expert researchers which have already worked together in previous projects and showed a very good degree of cooperation. The project PI is Jacopo Serpieri, from PoliTO, who has considerable experience with PAs for AFC for both internal and external flows. The project co-PI is Artuto Popoli, from UniBO, expert in the fields of plasma-actuators science and electrical engineering. The project aims at developing the flow actuators to be then deployed in a channel flow and a boundary layer flow facility as well as in the world unique CICLoPE pipe flow facilities. The experiments will encompass a variety of flow diagnostics aimed at both global-effect and local-in detail investigations of the actuation outcomes. Furthermore, numerical simulations, for the channel-flow case, will also be carried

out making use of a high-accuracy (DNS), computationally affordable (minimum box) code. These simulations will implement reliable body force fields generated by the PAs. These fields will be retrieved by the solution of the drift-diffusion problem describing the DBD discharge by means of accurate simulations eventually validated by ad hoc experiments. Finally, the experimental activities on the external flow, subject or not to an external pressure field, will shed light on the performance of the considered actuation when developing flows are operated. Pressure drag manipulation, along with the friction drag, is likely to occur and needs to be assessed towards a correct evaluation of the efficiency of the deployed AFC.

Persone coinvolte

- **Jacopo Serpieri** (Responsabile Scientifico)
- **Gioacchino Cafiero** (Componente gruppo di Ricerca)
- **Gaetano Iuso** (Componente gruppo di Ricerca)

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE8_1 - Aerospace engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 224.852,00
Contributo totale progetto:	€ 224.852,00
Costo totale PoliTo:	€ 107.852,00
Contributo PoliTo:	€ 107.852,00

LINUS - LIviNg the UniverSity city: student housing as driver of changes

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Loris Antonio Servillo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022T4ACB

Ruolo PoliTo:

Coordinatore

Abstract

Cities reinforcing their role as Higher Education Hub are experiencing transformation processes that stress their societies, environment, and economies, posing the well-being of their citizens at stake. In particular, in certain urban areas in Northern Italy, the Higher Education Institutes became key players, acting as magnets for the off-site student population and economic investments, particularly in the real estate sector. This process has seen a series of urban changes and policy narratives accommodating a series of university-led transformations, in particular to the housing sector, with broader consequences for the cities. While the 'town & gown' literature has mainly focused either on the positive role of the universities as a factor of growth in the knowledge economy paradigm, or on the negative externalities of students' growing presence as particular forms of gentrification, very few are known in terms of the relation between city and university, especially in Italy, and how this relationship affects the student housing dynamics. The complex critical interaction between urban strategies and universities' agenda, housing supply and demands, and struggles for affordable accommodations remains a black box, despite deeply affecting student life and in general the social sustainability of the city. The research project LINUS - LIviNg the UniverSity city, addresses this gap focusing on the student housing dynamics as a driver of urban changes, in which Higher Education Institutes' attracting policies and the relevant growth of student population in the city stress the accommodation supply. LINUS' research agenda investigates four cities characterized by the growing pressure on students (Bologna, Milano, Padova, Torino), whose struggle to find adequate housing living conditions is reaching critical levels because of shortages or competing conditions with short-term accommodation supply. The role of universities and their attraction capacity is placed in relation to the city's urban strategies and student mobilities, pointing at the weakness of a local (university and city) system that struggles to have a clear understanding of the needs of its student

population. Student housing is addressed in terms of (a) drivers of urban changes, (b) disrupting factors in the broader housing sector, and (c) causes of specific student-dwelling trajectories. Consequently, LINUS looks at how the universities could set up a monitoring system and operate in a socially responsible way as regards student housing and to foster social inclusion for all citizens, whether part of a permanent or mobile population. An interdisciplinary consortium characterized by four research units brings together competencies in urban studies, spatial planning, urban sociology, and human geography. Members of the units have a long-lasting interest in the topic and have stabilized their cooperation in a recent workshop, which was the trigger for the project design.

Persone coinvolte

- **Loris Antonio Servillo** (Responsabile Scientifico)
- **Marco Santangelo** (Componente gruppo di Ricerca)

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Parole chiave

Settori ERC

SH2_9 - Urban, regional and rural studies SH2_11 - Human, economic and social geography SH3_1 - Social structure, social mobility

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 296.649,00
Contributo totale progetto:	€ 265.928,00
Costo totale PoliTo:	€ 95.770,00
Contributo PoliTo:	€ 85.037,00

SUPERDRIVE - Superconductive Synchronous Machine Drives for High-Power Applications

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Alberto Tenconi

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022XSK2M

Ruolo PoliTo:

Partner

Abstract

High rated-power machine drive applications for either off-shore wind generations or propulsion systems require high-efficiency and high compactness to deal with limited space availability and smart utilization of the energy source. Further, fault tolerance is often required to increase reliability. Prompted by these challenging requirements, researchers are seeking new technological solutions for high-power electric drives. In such an effort, machine designs without rare-earth based permanent magnets call for the use of novel excitation systems, such as a direct current (DC) fed superconductive winding, and multi-phase (M/PH) machine drive arrangements are pursued to achieve the required fault tolerance. The scope of the SUPERDRIVE project is developing scientific knowledge and viable solutions for permanent magnet free electrical drive systems for high-power applications. As shown in Figure A.1, the project will focus on synchronous machine with DC-fed superconductive excitation winding and novel power electronic converter with multi-level (M/L) topology to be used in high-power applications with capability to operate even in electrical faults conditions. In the proposed drive, the superconductive field winding is fed by a modular M/L Dual Active Bridge (DAB) converter to deal with the extremely low total harmonic distortion (THD) required for the DC supply of the machine superconductive winding. The project will be carried out by means of the close cooperation of two expert research groups: Roma Tre University (URM3) and Politecnico di Torino (POLITO). The POLITO research group will investigate synchronous machine arrangements having superconductive field winding (supermachine) to the goals of avoiding the use of rare-earth permanent magnets, increasing the capability of handling faults occurring in either the machine winding or the power converter and improving the machine power density and efficiency. URM3 research group will deal with the design of a M/L converter having fault tolerance and providing suitable control for the machine torque and speed. The URM3 unit will also develop a modular M/L DAB

converter for the DC supply of the machine superconductive winding. Further to that, control algorithms will be developed for both detecting and managing fault conditions within the drive and for regulating the field current. The two Units will share a common approach regarding the SUPERDRIVE architecture, as well as for design tools. Objectives will be achieved through developing suitable design methods and simulation models. In addition, research activities will be devoted to validating the theoretical studies by means of a laboratory set up with reduced scale prototypes of both the power electronic converters and superconductive synchronous machine. Hence, the project will include experimental activities devoted to validation of the design methods and simulation results.

Persone coinvolte

- **Alberto Tenconi** (Responsabile Scientifico)
- **Andrea Cavagnino** (Componente gruppo di Ricerca)
- **Sandro Rubino** (Componente gruppo di Ricerca)
- **Silvio Vaschetto** (Componente gruppo di Ricerca)

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI ROMA TRE** - Coordinatore

Parole chiave

Settori ERC

PE7_2 - Electrical engineering: power components and/or systems

Budget

Costo totale progetto:	€ 239.470,00
Contributo totale progetto:	€ 239.470,00
Costo totale PoliTo:	€ 112.000,00
Contributo PoliTo:	€ 112.000,00

CMP - The landscape of the medieval Carthusian Monasteries in Piedmont: between history and enhancement.

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Carlo Mario Tosco

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022PZ5YJ

Ruolo PoliTo:

Partner

Abstract

The project intends to investigate the dynamic relationship between the medieval (12th-15th century) Piedmontese Carthusian monasteries and the environment; a relationship that has given rise to a certain type of landscape whose permanence can still be traced and enhanced today. The Carthusian monasteries in the Piedmont area built in the medieval centuries (12th-15th) will be examined, listed here in order of foundation: Casotto; Pesio; Montebenedetto/Losa; Buonluogo; Mombracco The project intends to highlight a specific temporal stratification, that of the Middle Ages, and a specific landscape, that of the Carthusian monasteries in Piedmont, and to verify their permanence over the centuries. The intention is therefore to analyse the way in which an institution - the Charterhouse - has interacted with its environment and been influenced by it, creating a cultural landscape. At the centre of the analysis is not a single subject, taken individually, but a relationship, that between man and the environment - seen not as a mere passive background - observed in its becoming over time. The intention is to look at events through a critical anthropocentrism, which, rather than excluding or ignoring man, attempts instead to understand the dynamic interactions between societies and ecosystems. The approach to landscape study must be interdisciplinary, i.e. involve active communication between knowledge, the intersection of expertise and the integration of research objectives. In this way, the research project may not be aimed exclusively at pure investigation but may imply repercussions on the protection, conservation choices, management and valorisation of cultural heritage. In this context, research takes on a social service value offered to users and in particular to resident populations. The heritage of landscapes is an asset that it is primarily up to the historian to enhance. The protection of cultural heritage passes through its recognition and cognitive deepening. The project intends to bring

together different categories of sources - material sources (natural morphological features, orographical and hydrographical layouts, buildings, infrastructures) as well as archive sources - in the effort of an interdisciplinary investigation: the landscape thus becomes a place of confrontation, of conflicts of criticism where the range of "facts" to be verified widens because the data to be taken into account on the basis of interdisciplinary stimuli increases. The results of the search will be fed into a archive of Carthusian sources. The archive will be integrated into an openaccess online platform: each Carthusian monastery will be given a fact sheet with historical, historical-architectural information; 2d drawings and 3d virtual models. The project is divided into four Milestones: Data acquisition/Data processing/Data synthesis/Project Management.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università Cattolica del Sacro Cuore** - Coordinatore

Parole chiave

Settori ERC

SH6_7 - Early modern history SH6_3 - General archaeology, archaeometry, landscape archaeology SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 299.614,00
Contributo totale progetto:	€ 224.711,00
Costo totale PoliTo:	€ 88.550,00
Contributo PoliTo:	€ 66.413,00

MadABio - Sustainable rubber composite MAterials by Dynamic covalent networks And BIO-fillers – MadABio

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Alessandra Vitale

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022JML9F

Ruolo PoliTo:

Coordinatore

Abstract

MadABio (Sustainable rubber composite MAterials by Dynamic covalent networks And BIO-fillers) deals with the modification of liquid rubbers (LRs) and bio-fillers to design recyclable composites due to reversible crosslinking. Conventional LRs (i.e., low molecular weight elastomeric products in liquid form) harden by an irreversible curing reaction, and thus cannot be reprocessed, becoming non-recyclable waste at the end of their life. The use of bio-based fillers as a substitute for traditional fillers (e.g., carbon black) could further reduce the environmental impact of rubber composites. The project aims at developing recyclable LR compounds with increased renewable content, to address the issue of recyclability and sustainability of rubber products. The project has four research objectives: (i) the synthesis of modified LRs suitable for reversible curing processes exploiting dynamic covalent network chemistries, such as epoxy-diacids, or Diels-Alder reactions; (ii) the synthesis of functionalized bio-fillers (e.g., lignin) by using novel coupling agents, making them compatible and able to form dynamic bonds with the reversible LR matrices; (iii) the preparation of recyclable and reprocessable rubber composites made of reversibly crosslinked LRs and functionalized bio-fillers; (iv) the demonstration of circular and renewable product concepts in one use case by the fabrication of reprocessable rubber materials for flexible electronics. The obtaining of a recyclable rubber material reinforced by a bio-filler is a cutting-edge research not yet reported in scientific literature. Having the aim of developing sustainable-by-design advanced materials and technologies, MadABio is totally coherent with the European Strategic Topic “Circular economy” and the related Cluster 4 “Digital, Industry and Space”. Moreover, the results obtained by MadABio for LRs and bio-fillers are likely to be transferable to the preparation of recyclable/reprocessable high molecular weight elastomers for tires and other rubber

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products (e.g., for automotive industry). Substituting conventional curing and overall providing sustainable alternatives for rubber compounding, thus promoting the transition to circular economy, is the long-term outcome expected from MadABio.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE5_6 - New materials: oxides, alloys, composite, organic-inorganic hybrid, nanoparticles PE5_15 - Polymer chemistry PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 300.000,00
Contributo totale progetto:	€ 300.000,00
Costo totale PoliTo:	€ 131.255,00
Contributo PoliTo:	€ 131.255,00

ARCO - Active radiative coolers (ARCO)

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Francesco Scotognella

Tipo di progetto:

PNRR – Missione 4

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

P2022XTBCW

Ruolo PoliTo:

Partner

Abstract

Passive Daytime Radiative Coolers (PDRCs) are photonic systems that passively achieve sub-ambient cooling even when subjected to direct sunlight illumination [1,2]. PDRCs consist of a combination of an optical layer having high reflectivity in the visible/near infrared (VIS-NIR) range with another optical layer characterized by selective radiation emissivity in the transparency window of the atmosphere, located at 8-13 µm. PDRCs are, by all means, a disruptive technology with tremendous potential for climate mitigation measures [3,8]. Since their introduction in 2014, huge global efforts have been undertaken for optimizing all aspects of PDRCs, from their cooling performance to their durability and fabrication cost [9,10]. One of the greatest improvements still awaiting, however, is the possibility to actively tune the optical response of PDRCs by means of external stimuli, allowing to reversibly switch their optical response between a radiative-cooling or a thermal-absorbing state [11,12]. Such an improvement would allow scientists to make the most of the PDRC performances in a wide range of atmospheric and climatic conditions, ultimately making PDRCs suitable as an energy-saving technology under real-world conditions. The objective of ARCO is the search and implementation of novel materials and concepts for achieving stimuli-responsive PDRC systems, and the realization of a prototype of active PDRC. The system we propose to achieve this goal is a photonic multilayer composed of a metallic substrate with absorbance in the short-wavelength visible range, topped by an active distributed Bragg reflector (DBR) with voltage-tunable photonic band gap. The two subsystems will be covered by a microstructured polymer-based composite IR-emissive layer. Modulating the photonic band gap of the DBR will allow to mask/unmask the metallic substrate absorption, thereby switching between a state where there is net electromagnetic-energy absorption and a thermal-emissive state, where the system will achieve radiative cooling.

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Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE5_6 - New materials: oxides, alloys, composite, organic-inorganic hybrid, nanoparticles

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 236.462,30
Contributo totale progetto:	€ 236.462,30
Costo totale PoliTo:	€ 76.949,00
Contributo PoliTo:	€ 76.949,00

Politecnico di Torino

I progetti PRIN 2022 finanziati dall'Unione Europea – Next Generation EU nell'ambito del Bando PRIN 2022 (D.D. 104 del 02/02/2022, Ministero dell'Università e della Ricerca)

GLOSSA: A "GLOcal" knowledge System for Sustainability Assessment of urban projects

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Francesca Abastante

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022JPWKCS

Ruolo PoliTo:

Coordinatore

Abstract

This research proposes a knowledge-system to support decisions in urban transformation projects, consistent with the development framework outlined by the PNRR (National Research Programme) and coherent with the Sustainable Development Goal 11 (SDG11) aiming at fostering the sustainable development of Italian cities. The research responds to a precise need originated by the exceptionality of the current moment: the presence of conspicuous funds available to Public Administrations (PAs) that make possible the desired sustainability transition. Nowadays the challenge is to identify scientifically sound and operationally feasible procedures that support public decision-makers (DMs) in this domain. It is important to underline that there is already a global and European strategy for the pursuit of sustainable development (2030 Agenda) and governments are responsible for following, developing and reviewing this Agenda at global, national and regional levels (United Nations, 2015) promoting an efforts' coordination to implement the SDGs (Official Journal of the EU 2018). In this shared global framework, regional and local authorities are free to choose whether and how to adapt their activities to achieve sustainable development. In the perspective of inserting itself in this already structured context, the research presented here poses in innovative terms starting from the use of existing and new methods and indicators. The research proposes a "GLOcal knowledge System for the Sustainable Assessment of urban projects" (GLOSSA), in which global indicators are localized and adjusted at both national and local levels, to support measuring progress towards sustainable development. Indeed, both in line with the 2030 Agenda and the objectives and missions of the PNRR, the measurement

and localization of indicators is recognized as a means to overcome economic, social and environmental challenges through coordination among state, regional and local levels. GLOSSA is conceived as an open-source toolbox shaped by two integrated parts: 1) a module for supporting PAs and planners/designers in the assessment and monitoring of urban transformations, 2) a tool for communication/dissemination of results and educational activities. Within this framework, the objective of the research is threefold: ? to support PAs and planners/designers in the identification of urban areas to be transformed as well as in the design of urban transformations projects. ? to support PAs in the assessment phase of urban transformation projects that will be submitted. ? to monitor the performance of funded projects. The GLOSSA is shaped through three core outcomes in methodological, technical and educational terms to have concrete impacts on the Italian territory. The triple objective connotes the research proposal as solidly academic and distinctly oriented to give its contribution to face the real challenges of our cities, especially from the point of view of public decisions.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**

Parole chiave

Settori ERC

SH2_6 - Sustainability sciences, environment and resources SH2_9 - Urban, regional and rural studies

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 208.946,00
Contributo totale progetto:	€ 201.902,00
Costo totale PoliTo:	€ 84.128,00
Contributo PoliTo:	€ 80.852,00

Effects of bilateral subthalamic nucleus deep brain stimulation on gait analysis and muscle synergies of patients affected by advanced Parkinson's disease during dual-task walking

Duration:

18/10/2023 - 17/10/2025

Principal investigator(s):

- Valentina Agostini

Project type:

Nationally funded research - PRIN

Funding body:

MINISTERO (Ministero dell'Università e della Ricerca)

Abstract

Deep Brain Stimulation of the subthalamic nucleus (STN-DBS) is a well-established surgical therapy for patients with advanced Parkinson's disease (PD) and motor complications that cannot be adequately managed with medication. Instrumented gait analysis already proved succesfull for objectively evaluating alterations of locomotor patterns in a wide variety of neurological and neurodegenerative disease, including PD. Only recently, the study of motor modules, through the muscle synergy theory, revealed its potential in clinics for understanding the basic mechanisms through which the Central Nervous System (CNS) coordinate different motor tasks. In particular, it is possible to reconstruct the group of muscles that synergistically cooperate and the time-dependent neural commands that drive it. The aims of this project are: (1) evaluating the effects of bilateral STN-DBS on the motor control strategies of PD patients during dual-task walking, (2) defyning and validating a clinical protocol to quantify the functional changes of PD patients through a complete gait analysis and muscle synergy analysis. The assessments will be conducted before STN-DBS surgery, and at 3 months and at 12 months after it, by recording non-invasively the electromyography (EMG) activity of the main muscles involved in gait. New medical knowledge will be acquired for the management of PD patients.

Structures

- DET - Department of Electronics and Telecommunications
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partners

- **Politecnico di TORINO**
- **Prof. LANOTTE Michele Maria Rosario, Università degli Studi di Torino**

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Politecnico di Torino

Keywords

ERC sectors

LS5_11 - Neurological disorders (e.g. Alzheimer's disease, Huntington's disease, Parkinson's disease) PE6_11 - Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video)

Sustainable Development Goals

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Total cost:	€ 295,167.00
Total contribution:	€ 203,690.00
PoliTo total cost:	€ 152,140.00
PoliTo contribution:	€ 102,618.00

MOTOWN - Motown: Smart Production Planning and Control for Manufacturing of Electric Vehicle Powertrain in Industry 4.0 Environment

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Arianna Alfieri

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'università e della Ricerca)

Codice identificativo progetto:

20228XEHRE

Ruolo PoliTo:

Partner

Abstract

Manufacturing industries are facing radical changes under the technological acceleration of Industry 4.0, with new key technologies enabling companies to extract valuable knowledge from field data. In this new context, current Manufacturing Execution Systems (MESs) need to be extended toward advanced Production Planning and Control (PPC), to allow for the efficient online management of shop floors. The automotive sector is being reformed by the growing market of Electric Vehicle (EV), and industries must be able to adapt to the changes in technologies and processes while operating in a highly variable environment. Indeed, EV manufacturing systems are characterized by high levels of automation, customized products, and volume uncertainty. Production systems are complex and characterized by non-linear product routings and high randomness. Also, the adoption of new and not consolidated manufacturing technologies causes such processes to have higher defective rates than in the classical automotive industry. The Motown project deals with real-time PPC for the next generation MESs in manufacturing industries. Particular attention is given to the EV sector and to the production of the electric motor. The main project contribution is a context-aware short term decision-making framework for high quality manufacturing, to create value along the data-chain from sensors to actuators. To enable this short-term decision support system, Motown proposes to build and constantly update digital models from shop-floor data to allow a continuous improvement of the decision-support models. The project also develops, for demonstration purpose, an Internet of Things architecture to support the real-time alignment of digital representations with the shop floor and ensure the effectiveness of the data-driven approach. A set of real cases from the EV industry will be studied to drive the research activities and verify the obtained results. In addition, a physical and

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miniaturized manufacturing system will be used to test the developed architecture, tools, and models, in a laboratory environment. Expected results are in terms of new models, methods, and algorithms implemented in a real-time Internet-of-Things-compatible architecture. These results can bring value to not only EV motor production systems, but also to the broader European manufacturing industry. The impact of the project is relevant and wide in terms of new research patterns, increase in companies' competitiveness, and digitization of shop floors. Last but not least, Motown will have an environmental impact by making EV production more economically sustainable because of the reduction of defective parts, and as a consequence, it will support the diffusion of electric mobility.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE6_7 - Artificial intelligence, intelligent systems, multi agent systems PE6_12 - Scientific computing, simulation and modelling tools PE6_10 - Web and information systems, database systems, information retrieval and digital libraries, data fusion

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 310.374,00
Contributo totale progetto:	€ 214.914,00
Costo totale PoliTo:	€ 66.392,00
Contributo PoliTo:	€ 37.152,00

AsCoT-SCE - Assessing Compliance of IoT API for Security Critical Environments

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luca Ardito

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022598LMZ

Ruolo PoliTo:

Partner

Abstract

The fast evolution of (Internet-of-Things) IoT devices and the increasing number of applicative fields in which such devices are involved is rapidly pushing toward a paradigm where third-party developers develop services and applications for collaborative IoT devices. This model, which has already proven successful in mobile systems (e.g., Android and iOS), is pushing standardization consortia, such as W3C, to propose integration frameworks presenting a high level generalized and structured way to represent resources and functionalities offered by IoT devices such as smart cameras, smart TVs, smart doorbells, etc. These frameworks act as an integration point for both third-party application developers, aiming at providing smart services, and device producer developers, implementing device-specific functionalities and API, willing to make them available to third-party developers. By using these frameworks, such as Web of Things, FIWARE, IFTTT, and OpenHAB, to name a few, third-party app developers can invoke their generic code functionalities, such as “change on TV channel 5”, without worrying about the actual brand and model of smart TV in a specific home. Given the early stage of development of some of these frameworks, there is not a mechanism to certify the correct and security-compliant integration between a device-specific API and a generic functionality. This is highly undesirable because there might be a mismatch between an invoked functionality and the performed behaviour. Considering the physical dimension of the IoT environment, such a mismatch can cause unexpected behaviours and risks related to privacy, security, and even safety. The AsCoT-SCE project aims to develop a set of mechanisms and methodologies to be used as building blocks for a certification framework. The developed methodologies will provide a structured representation of IoT functionalities through ontologies, their semantics in terms of behavioural policies expressed in a logical language, a set of guidelines for the compliant implementation of such functionalities, a representation of such implementation

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through manifest, whose integrity is verifiable, and, finally, model checking techniques to verify the compliance of the integration (association between functionality and proposed implementation) and the compliance with respect to specific requirements of safety, privacy, and security. The project will perform research activities on these topics developing a proof-of-concept prototype for a Smart Home environment. The Smart Home is a representative and impactful application of IoT technologies, on which the partners can leverage their experience acquired with an ongoing H2020 project (SIFIS-Home GA #952652), improving the possibility of exploitation on both activities.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI URBINO "CARLO BO"**

Parole chiave

Settori ERC

PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems PE6_3 - Software engineering, operating systems, computer languages PE6_1 - Computer architecture, pervasive computing, ubiquitous computing

Budget

Costo totale progetto:	€ 310.928,00
Contributo totale progetto:	€ 245.451,00
Costo totale PoliTo:	€ 63.927,00
Contributo PoliTo:	€ 57.589,00

MILK_O - FROM EXPIRED MILK TO GOODS: upcycling milk protein to biodegradable 3D-printable Objects for packaging application

Duration:

12/10/2023 - 11/10/2025

Principal investigator(s):

- Rossella Arrigo

Project type:

Nationally funded research - PRIN

Funding body:

MINISTERO

PoliTo role:

Partner

Abstract

FROM EXPIRED MILK TO GOODS: upcycling milk protein to biodegradable 3D-printable Objects for packaging application

Structures

- DISAT - Department of Applied Science and Technology

Partners

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi di Milano** - Coordinator

Keywords

ERC sectors

LS9_5 - Food sciences (including food technology, nutrition)

Sustainable Development Goals

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Total cost:	€ 322,617.00
Total contribution:	€ 241,188.00
PoliTo total cost:	€ 77,045.00
PoliTo contribution:	€ 57,985.00

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3DCer4Dent - 3D printing and digital twinning ceramic restorations for dentistry (3DCer4Dent)

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Alberto Audenino

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022K4A3H2

Ruolo PoliTo:

Partner

Abstract

We are in an era of digital transformations where the adoption of emerging technologies is reshaping dental care by replacing manual processes with digital procedures and updated technologies [1]. The great challenge of modern prosthetic dentistry is to find materials whose biomechanical behavior is the most similar to natural enamel when subjected to functional and parafunctional loads [2]. In addition, the minimization of tooth preparation times to restore affected dentition would strongly simplify treatment procedures and their invasiveness, while providing patients stable results overtime which is a fundamental requisite. The currentdisrupting technological time facilitates innovation and creativity, and 3D-printing has much to contribute by providing new technologies for fabricating dental devices, based on additive manufacturing [3]. These new manufacturing capabilities require a completely new design paradigm in order to be able to fully exploit their potential. The prosthetic components for teeth restoration must be designed not only studying their shape, but also its mechanical behavior which can now be tuned thanks to the possibility of 3D printing both various solid materials and materials with cellular structures, with designed, variable anisotropy and porosity [4]. In this scenario, metal-free adhesive materials produced through additive manufacturing techniques could bring major benefits to modern dentistry, but they are still affected by a major drawback that is being confined almost exclusively to resin materials, which are indicated for provisional restorations, mainly [5]. The project is aimed to overcome this limit, gaining knowledge on the biomechanical behavior and design workflow to 3D print ceramic-based materials, such as zirconia and silica-based ceramics [6], thanks to the collaboration with companies which are introducing new technologies to 3D print innovative materials, and which need the feedback from practitioners and engineers on the respective performance, and optimization. The ambitious goal of the 3DCer4Dent project is not only to test, both with basic and

applied research, the biomechanical characteristics of ceramic materials processed through AM, but also to create a simulated virtual model capable of predicting the mandibular kinematics (Multibody) and the effects of functional and parafunctional loads on dental prostheses and supporting tissues. To achieve such goals, a multi-disciplinary coordination activity will be established, linking reference laboratories in Italy with capacities on biomechanical evaluation of bio-materials (UniTO and PoliTO), to reference groups on multi-model and finite elements analysis (UniPG and UniCT) and companies producing 3D printers and printable resins and ceramics, such as DWS, Lithoz and New Ancorvis, which will explicitly support the project by providing testing materials to be developed and improved before entering in the market.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CATANIA**
- **UNIVERSITA' DEGLI STUDI DI PERUGIA**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore

Parole chiave

Settori ERC

LS7_1 - Medical engineering and technology PE8_13 - Industrial bioengineering PE8_10 - Industrial design (product design, ergonomics, man-machine interfaces, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 306.719,00
Contributo totale progetto:	€ 207.182,00
Costo totale PoliTo:	€ 61.263,00
Contributo PoliTo:	€ 42.339,00

I-PRINT-MY-BONE - Artificial Intelligence-based design of 3D PRINTed scaffolds for the repair of critical-sized BONE defects

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- **Francesco Baino**

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca (MUR))

Ruolo PoliTo:

Partner

Abstract

PRIN - I-PRINT-MY-BONE

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering PE8_4 - Computational engineering

Budget

Costo totale progetto:	€ 327.494,00
Contributo totale progetto:	€ 249.810,00
Costo totale PoliTo:	€ 116.923,00
Contributo PoliTo:	€ 94.221,00

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FLEX-GEN - FLEXi-fuel high-efficiency linear piston engine for future power GENerators

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Mirko Baratta

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022988F33

Ruolo PoliTo:

Partner

Abstract

The proposed research FLEX-GEN aims to provide innovations in the Free Linear Piston Generator (FLPG) technology, considered as mid- and long-term sustainable solution for power generations and power units for mobile applications. FPLG has the potential of high net efficiency (>50%), low pollutant emissions (depending on the configuration), and a high flexibility to operate with all sustainable fuels. Therefore, the main aim of the proposal FLEX-GEN is to develop models, simulation tools and prototypes of innovative combustion systems (e.g. ultra-lean pre-chamber) that could maximize the sustainability of the FLPEGs both for genset and mobile applications.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.) PE7_2 - Electrical engineering: power components and/or systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 242.658,00
Contributo totale progetto:	€ 196.577,00
Costo totale PoliTo:	€ 76.505,00
Contributo PoliTo:	€ 62.923,00

DiQuT - Dipolar Quantum Simulator of Topological Phases

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luca Barbiero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e dello Sviluppo)

Codice identificativo progetto:

2022523NA7

Ruolo PoliTo:

Partner

Abstract

Topology has emerged over the years as one of the most powerful theoretical tools to interpret physical phenomena. While its applications to physics have a long history, topological insulators and superconductors have been at the forefront of more recent research activity. The main reason is that topologically-protected edge states and zero-energy Majorana modes arising in topological insulators and superconductors, respectively, appear as ideal candidates for the transfer and storage of energy or information on the one hand, and quantum computation robust against decoherence, on the other hand. Topological insulators have already been investigated in a variety of experimental platforms, but the theoretical understanding of the effects interaction in these systems is still at an early stage. For topological superconductors and superfluids, instead, it is even their physical realization to be essentially still lacking. This is because such states of matter require fermionic particles to pair up into non-zero angular momentum states, primarily in the p-wave channel. Unfortunately, materials that naturally exhibit such a pairing are scarce in nature. With QuDiT, we plan to construct a versatile novel experimental platform that will grant access to both topological p-wave superfluids and to unexplored interacting topological phases on lattice geometries, where the combination of non-local interactions and topology could be analyzed in a controlled way. The novel platform will consist of a Bose-Fermi mixture of magnetic atoms. The highly non-local character of dipole-dipole interactions, the full tunability of additional short range Bose-Fermi and Bose-Bose interactions, as well as the trapping geometry, will allow us to engineer topological fermionic pairing and to access strongly correlated topological regimes. One experimental and two theoretical units will join their diverse and complementary expertise in this effort. The experimental activity will be mainly devoted to the construction of the novel apparatus, while theory will explore in detail the possibilities to produce and control topological phases, paving the way towards their

experimental achievement and providing novel predictions. The successful accomplishment of QuDiT will produce a long-lasting advance in our understanding of topological phases, and in their application to novel quantum technologies, with both short- and long-term impacts. In addition, QuDiT will establish a strong synergy between three competitive research groups working at the frontiers of ultracold gases, superfluid and topological matter, reinforcing the national scientific community, and making the three units even more competitive for the participation to the Research and Innovation programs of the European Commission

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **CNR-INO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Unibo**

Parole chiave

Settori ERC

PE2_8 - Ultra-cold atoms and molecules

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 4. Fornire un'educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti

Budget

Costo totale progetto:	€ 305.250,00
Contributo totale progetto:	€ 209.746,00
Costo totale PoliTo:	€ 62.345,00
Contributo PoliTo:	€ 62.345,00

MIRABILIS - MId infRAred laBel free Interferometric detectorLess Imaging photonic circuitS

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Paolo Bardella

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell' Università e della Ricerca)

Codice identificativo progetto:

2022FLMN3K

Ruolo PoliTo:

Partner

Abstract

MIRABILIS aims to design, simulate, and experimentally demonstrate a Mid-Infrared (MIR) single-pixel sensor enabling tissue imaging in reflection mode at the Amide-II wavelength region. The sensor addresses the challenging goal by pairing two forefront advanced technologies within a small-footprint Photonic Integrated Circuit (PIC): detectorless, optical-feedback-based imaging in Quantum Cascade Lasers (QCL) and scanless single-pixel compressed sensing. Optical feedback allows for detectorless imaging, inasmuch the illumination (laser) source acts also as the detector of the radiation backscattered by the target. The intensity and phase of that field carry information about the real and the imaginary dielectric susceptibility of the target. The feedback signal can be analyzed via voltage change at the laser terminals. Removing the need of a separate detector for sensing is especially interesting in the MIR, where detectors are neither cheap, compact nor particularly sensitive. This would be the first time that optical feedback imaging in MIR QCLs would be integrated in PICs. Being the QCL a point-like detector, conventional imaging proceeds via raster-scanning the target surface, thus adding mechanical and scattering noise to the increased complexity of the setup. On the contrary, scanless imaging is achieved by illuminating the target via a sequence of randomly distributed light patterns. The feature of the target to be imaged is recovered by analyzing the light intensity collected by a bucket detector via optimized compressed sensing algorithms, thus performing Single-Pixel Imaging (SPI). An Artificial Intelligence approach to SPI based on Deep Neural network will be developed to allow for real time imaging. Spectral features of the Amide-II absorption band around 1600 1/cm are considered diagnostically relevant signatures for important pathologies like epithelial cancers [BAK18]. Even if a monochromatic image cannot provide discriminatory information, it is common

practice in automated spectroscopy to consider only few wavelengths of the collected spectra corresponding to relevant spectral signature [BAS14]. New techniques like multiwavelength MIR microscopy will translate direct imaging of a sample tissue into medical practice. The MIR SPI in PIC at 1600 1/cm addressed by MIRABILIS delivers the first channel of a modular device for multispectral and multimodal miniaturized probe appealing for on-sample sensing, including healthcare applications, e.g., in local or endoscopic probes, or surgical field real-time inspection, (overcoming intraoperative biopsies and histopathology assessment.) The project is relevant for the advancement of knowledge in the field of physics, chemistry, and engineering, it addresses ambitious goals and takes innovation challenges in laser dynamics, optical circuit integration and molecular spectroscopy.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI BARI** - Coordinatore
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI BARI ALDO MORO**

Parole chiave

Settori ERC

PE2_9 - Optics, non-linear optics and nano-optics PE2_11 - Lasers, ultra-short lasers and laser physics PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components

Budget

Costo totale progetto:	€ 295.168,00
Contributo totale progetto:	€ 209.846,00
Costo totale PoliTo:	€ 113.220,00
Contributo PoliTo:	€ 93.918,00

GEOREFIT - Closing knowledge gaps on energy geostructures for retrofitting of buildings and infrastructures (GEOREFIT)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marco Barla

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022544NX8

Ruolo PoliTo:

Coordinatore

Abstract

Geothermal energy provides a massive, renewable, distributed and green energy potential. It offers the additional great advantage of being stable, with respect to atmospheric conditions, and cost-competitive. The geothermal energy at the near-surface is pervasively available and thus optimal for local harvesting and distribution at both single building and district scales. GEOREFIT project will focus on the thermal activation of geotechnical structures for heating and cooling of buildings or infrastructures. There are innovative possibilities of using conventional geotechnical structures as thermally “active” elements with a potentially great impact on the thermal energy sector in line with UN Sustainable Development Goals 7, 11 and 13. While activation of newly built geostructures has been investigated in the past, the GEOREFIT project will focus on retrofitting buildings and infrastructures. Infrastructures in Italy are undergoing extensive inspection and reparation to cope with the aging and deterioration of structural elements, such as bridge foundations, tunnel linings, etc. Also, buildings are currently being renovated extensively thanks to government incentives (so called ‘Superbonus 110%’). The reparation and renewal work constitute a unique opportunity for a major upgrade of the geostructure itself, which may include thermal activation. To explore these aspects and close persisting knowledge gaps that hinder wide practical application in Italy, the GEOREFIT project will use a three-pronged approach by addressing soil structure Thermo-Hydro-Mechanical interaction and energy performance by laboratory testing, in situ experimental testing and advanced numerical modelling. The project will benefit from already existing unique experimental sites. Together with available laboratory facilities and computational skills and software, these will enable to get insight on the relevant issues of different energy geostructures. Eventually, by investigating

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technological innovation in the field of new materials and embedded sensors for smart applications, the project will envisage the goal of enhancing the retrofitting process to obtain a technological leap of the structure/infrastructure which also includes its energy use.

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI MILANO**
- **UNIVERSITA' DEGLI STUDI DI PERUGIA**

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 278.058,00
Contributo totale progetto:	€ 197.155,00
Costo totale PoliTo:	€ 84.052,00
Contributo PoliTo:	€ 57.950,00

ARCADE - Accident Risk reduCtion of vulnerAble roaD usErs: an interdisciplinary – multiperspective approach

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marco Bassani

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università della Ricerca)

Codice identificativo progetto:

20228CNNMH

Ruolo PoliTo:

Partner

Abstract

The ARCADE Project proposes a revolutionary multi perspective simulative approach aimed at (i) identifying the causes of road collisions involving Vulnerable Road Users (VRU), and (ii) evaluate effective safety countermeasures, thus reducing the accident risk in the urban environment. In the ARCADE Project, VRU stands for pedestrians, cyclists, motorcyclists, and new electric two-wheelers (E2Ws) i.e. pedelecs, speed pedelecs, e mopeds, and e-scooters. The aims are fully consistent with Horizon Europe and national research programs, as well as the Road Safety initiative of the European Union (EU Road Safety Policy Framework 2021-2030; Next steps towards "Vision Zero"; Directive (EU) 2019/1936 of the European Parliament and of the Council of 23 October 2019 amending Directive 2008/96/EC on road infrastructure safety management) and the Italian Parliament and Government (National Road Safety Plan 2030; National Recovery and Resilience Plan - PNRR) which have as one of their main objectives the decrease of accidents and fatalities involving VRUs. Specific project aims include the: - identification of behavioural, psychophysiological and road geometric contributing factors for road crashes involving VRU (Aim #1); - definition of effective safety countermeasures accounting for cost and time implications for their implementation on urban roads (Aim #2). Project main features consist of: - a multi-technique approach combining observational and simulation methods to evaluate the effectiveness of safety countermeasures specifically designed for three hazardous road locations (HRL) selected as case studies; - a multi-perspective assessment of the interaction between road users through driving/riding/walking simulations of the same conflicting road scenario; - a multi disciplinary integration of expertise in Road Engineering (UniRomaTre and PoliTO) and Psychometrics and Human Psychophysiology

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(UniPD). The main expected scientific results include: - causality process assessment of critical events that involve VRU; - detection of conflicting patterns and how they depend on the geometric configuration, lighting and traffic conditions, psychophysiological characteristics of road users; - identification of the most effective Surrogate Safety Measure (SSM) and the corresponding critical threshold for the driver-VRU interaction, to be used for the evaluation of risk conditions; - evaluation of the effects of safety countermeasures on conflicting road user behaviour; - guidance on quality requirements regarding urban road safety management for VRU. Additional expected results include new and/or implemented driver/rider/ped behavioural models including road, environmental, and human factors to improve algorithms for new vehicle generations with increasing levels of automation. Public Administrations of Rome, Turin, and Padua will be actively involved as stakeholders and final beneficiaries of research products.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' DEGLI STUDI ROMA TRE** - Coordinatore

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment SH4_5 - Attention, perception, action, consciousness

Budget

Costo totale progetto:	€ 274.289,00
Contributo totale progetto:	€ 197.501,00
Costo totale PoliTo:	€ 94.738,00
Contributo PoliTo:	€ 65.547,00

Convection characterization via synergistic geo and leo satellite observations

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alessandro Battaglia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università della Ricerca)

Codice identificativo progetto:

2022JHEM2M

Ruolo PoliTo:

Coordinatore

Abstract

Convection is a vital process which helps to redistribute energy in the Earth atmosphere with different implications in terms of large-scale atmospheric circulation and vertical uplift of water vapor, aerosol, and trace gases. This process is often conducive to cloud formation affecting the production of high clouds in the form of cloud anvils, which represent a key element in the high cloud radiative feedbacks and provide a substantial amount of precipitation often connected to severe weather events worldwide. Nevertheless, the topic still deserves detailed studies as it also underpins the convection representation in weather and climate models, where progresses are required in understanding of convective mass flux (CMF) within storms and its representation. In this respect recent works illustrated the benefits of merging the highly temporally resolved measurements from GEO platforms and the detailed, range-resolved snapshots provided by spaceborne radars in LEO orbit, and the usefulness of a synergistic use of passive and active sensors from the A-train satellite constellation for the CMF estimate. The intent of this project is to further explore this concept benefiting from two new satellite missions, the EarthCARE (EC) mission with the high sensitivity 94-GHz Cloud Profiling Radar (CPR) with Doppler capability and METEOSAT Third Generation platforms with the Flexible Combined Imager sensor. Through their synergistic exploitation the project will elaborate two science products (SP). SP1 will be devoted to CMF estimates from EC with GEO IR observation support for CPR dealiasing, and SP2 will estimate the anvil total mass and ice water path (IWP) probability density functions via a deep learning algorithm applied to series of GEO IR images and trained with the ESA Level 2 IWP EC multi-instrument. It is worthy of remark that products like these are not foreseen in the scheduled product portfolio of the two missions. SP1 and 2 will be generated for the first 6 months of EC mission, providing a convection dataset that will be further substantiated by environmental properties and EUMETSAT NWC SAF products of

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convection and high resolution wind. The effectiveness of the NWC SAF products will be evaluated in the first phase of the project in the frame of the TRACER field campaign aimed at an unprecedent characterization of the lifecycle of convective cloud systems and the dynamics of updraft and downdrafts by a suite of satellite, ground-based, and modeling instruments. Finally, a list of convective case studies fully characterized via SP1, SP2, environmental properties, and NWC SAF products will be selected and analysed to 1) evaluate the impact of environmental properties on CMF in tropical and extra-tropical convective storms as a function of storm type and lifecycle; 2) evaluate the relationship between anvil clouds and CMF and upper level divergences; 3) correlate the lightning activity with the upper level dynamic of thunderstorms.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE10_2 - Meteorology, atmospheric physics and dynamics PE10_14 - Earth observations from space/remote sensing

Budget

Costo totale progetto:	€ 369.685,00
Contributo totale progetto:	€ 249.988,00
Costo totale PoliTo:	€ 172.893,00
Contributo PoliTo:	€ 129.641,00

HYDREAM - Tailoring the HYDrophilic-hydrophobic Reaction zone for the Electrochemical nitrogen reduction reaction to AMmonia

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Federico Bella

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022YXHXH5

Ruolo PoliTo:

Coordinatore

Abstract

This project focuses on the development of a gas/liquid/solid three-phase interface (TPI) that endows electrodes with enhanced performance for target electrochemical reactions involving gases, due to its ability to mediate local interfacial environments and inhibit side reactions. Such a TPI concept is starting to be considered by the scientific community due to its promising potentialities in several strategic research fields, e.g. electrocatalyzed reduction of CO2, O2 and N2, fuel cells, sensors for liquid and gas substrates, anti-corrosion systems, etc. The main goal is to tailor the TPI within a double hydrophilic-hydrophobic reaction zone, bearing a controlled grade of hydrophilicity at the microscale. The achievement of the co-existence of hydrophilic-hydrophobic conditions within the electrocatalyst/electrode will permit a compromise between efficient gas transport to the electrocatalyst and good contact of the electrocatalyst with the electrolyte (i.e., to provide the needed protons for the reduction reaction). HYDREAM activity will explore these key experimental points: - Design of heterogeneous electrocatalysts able to show hydrophobic-hydrophilic conditions in the reaction zone. - Formulation of non-aqueous liquid electrolytes showing optimal electrode wettability, reactant solubility and mass transport. - Advanced physico-chemical characterization to assess specific materials features and electrochemical reaction aspects at the nanoscale. - Exploitation of TPI concept in a highly significant case study, i.e. the electrochemical N2 reduction reaction (E-NRR) to NH3 under mild conditions. The E-NRR represents the Holy Grail in the current industrial chemistry scenario, since it would permit decentralizing NH3 production in a process fed by air, water and renewable energy. The E-NRR is thus a hot research topic, but it is accompanied by a wide list of experimental operative hurdles, concerning the preparation/formulation of electrocatalysts and electrolytes, the

engineering of electrochemical reactors and interfaces, and the overall process analysis in terms of costs and environmental impact. This project will show how the TPI concept can be a precious tool in this scenario. HYDREAM consortium joins 3 research units (RUs), i.e. POLITO (leader), UNIPD and UNIME. The project is intended to start at TRL-1 and reach TRL-3 in 24 months, and its targets are in sound consonance with the SUNERGY initiative of the European Commission, well aligned with the Green Deal objectives. Great attention will be also devoted to the training of young researchers and to the creation of an Italian interdisciplinary pool of young scientists able to place soon at the forefront of this emerging topic within the international scenario.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' DI MESSINA**

Parole chiave

Settori ERC

PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors PE4_4 - Surface science and nanostructures PE4_10 - Heterogeneous catalysis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 288.468,00
Contributo totale progetto:	€ 220.529,00
Costo totale PoliTo:	€ 108.089,00
Contributo PoliTo:	€ 75.735,00

GAMPA - Geometric-Analytic Methods for PDEs and Applications

Durata:

28/09/2023 - 28/02/2026

Responsabile scientifico:

- Elvise Berchio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022SLTHCE

Ruolo PoliTo:

Coordinatore

Abstract

The aim of this project is to develop the theoretical analysis of PDEs and related optimization issues recently emerging from several new directions. Our ultimate goal is to bring together highly motivated researchers willing to employ their competences to tackle theoretical, and application-oriented challenging problems. The project will be carried out according to the following lines of research: 1. GLOBAL ANALYSIS OF PDEs: nonlinear elliptic or parabolic, nonlocal, gradient flows, in non-euclidean frameworks (manifolds, graphs, metric spaces). 2. QUALITATIVE PROPERTIES OF SOLUTIONS: geometry, shape, regularity, asymptotics, for elliptic and evolution equations (e.g., aggregation-diffusion, anisotropic parabolic, reaction-convection-diffusion equations). 3. QUANTITATIVE FUNCTIONAL INEQUALITIES: Sobolev, Poincaré, Hardy-type, Brunn-Minkowski, Borell-Brascamp-Lieb inequalities; in euclidean and non-euclidean frameworks (manifolds, graphs, Finsler metrics). 4. OPTIMIZATION ISSUES AND APPLICATIONS: spectral functionals optimization (with respect to shape or weights) for second and fourth-order elliptic operators; first and second-order free-discontinuity problems; related applications, e.g., to mathematical models for bridges. The above topics have been thought to be closely interconnected in such a way that approaching them with synergy will bring several mutual benefits. As a matter of example, the planned global and qualitative analysis of diffusion problems (items 1-2) will benefit from the study of related elliptic problems, e.g., existence results for semilinear PDEs will have significant consequences for the well-posedness of degenerate diffusions. On the other hand, the development of suitable functional inequalities (item 3) will be fundamental for some of the proposed researches (items 1-2), e.g., in the study of the geometry of solutions or to appropriately set up anisotropic problems; vice versa, suitable PDE tools will be employed to prove sharp functional inequalities. Similarly, the optimization issues of item 4, despite being mostly motivated by applications, will bring challenging

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theoretical problems, e.g., for higher order operators or functionals; on the other hand, the analytic and geometric arguments developed in items 1-3, may be exploited in a number of applied models, see the detailed description below. To conclude, we stress that a common thread of the project will also be the analysis of PDEs and inequalities in non-euclidean frameworks, such as manifolds or graphs. Clearly, such analysis will benefit from the tools developed in the euclidean setting and the expertise gained by the components of the project in more classical contexts. Furthermore, working in nonstandard frameworks will lead to further insights, even in the euclidean case, by pointing out hidden connections and deeper dynamics of the equations, relating them to intrinsic properties of the ambient space.

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI FIRENZE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI 'PARTHENOPE'**

Parole chiave

Settori ERC

PE1_11 - Theoretical aspects of partial differential equations PE1_8 - Analysis PE1_5 - Geometry

Budget

Costo totale progetto:	€ 254.250,00
Contributo totale progetto:	€ 187.500,00
Costo totale PoliTo:	€ 70.250,00
Contributo PoliTo:	€ 52.000,00

PULSAR - Empowering UV Led technologies for high-efficiency disinfection: from semiconductor-level research to SARs-Cov-2 inactivation

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Francesco Bertazzi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20225YYLEP

Ruolo PoliTo:

Partner

Abstract

The SARS-CoV-2 pandemic has shown that UV-based sterilization methods, alternative to conventional chemical techniques, are needed to inactivate viruses in large environments, like classrooms, planes, and hospitals. Conventional UV-emitters (mercury tubes) cannot be widely adopted, due to their large size, low efficiency, short lifetimes, and complex disposal procedures due to Hg content. The goal of this project is to substantially contribute to the development of high-efficiency UV LED emitters, and to investigate the use of UV LEDs for virus inactivation. For the first time, will use a bottom-up approach, from semiconductor fabrication/research, to device modeling, to illuminator design, to testing in the field.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PADOVA** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PALERMO**

Parole chiave

Settori ERC

PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components

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Politecnico di Torino

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 264.243,00
Contributo totale progetto:	€ 197.741,00
Costo totale PoliTo:	€ 85.600,00
Contributo PoliTo:	€ 57.600,00

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Italia di mezzo. Designing the urban-territorial transition

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Janira Vassallo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Ruolo PoliTo:

Partner

Budget

Nominativo	Coordinatore/Ente	CUP	Cofinanziamento	Contributo MUR	Totale
VASSALLO Janira	LANZANI Arturo Sergio Politecnico di MILANO	E53D23010200006	16.038	53.023	69.061

ZeTON - Zero-Touch end-to-end Optical Networks (ZeTON)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Andrea Bianco

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022YA59ZJ

Ruolo PoliTo:

Partner

Abstract

The upcoming massive deployment of NextGen/IoT devices together with the definition of new services are expected to impact the broadband connectivity portfolio, with the 39.1% of connections faster than 100 Mb/s and the double of devices connected by 2023. The increase of connected devices and traffic is expected to push optical network capacity beyond its current limit. The ZeTON project targets the design and Proof of Concept (PoC) demonstration of a novel end-to-end integrated optical transport architecture based on optical transmission and switching. Novel data-plane devices, deployed together with disaggregated optical transmission system, are envisaged to achieve agility and to support for massive traffic loads. At the basis of this new paradigm, novel optical white box architectures, using pluggable optics, are conceived. We strongly believe that the proposed solutions represent the next technological evolution to deal with the traffic demand and service requirements of NextGen mobile networking in a cost-effective manner. ZeTON will focus on multidomain scenarios, following the optical-continuum paradigm, by fosting the removal of fix boundaries between network segments. Thus, the control plane functionalities will be extended to support novel data-plane nodes and the new "domain-less" network architecture. ZeTON will explore the coordination of the data-plane elements, extending the concepts of SDN service orchestration and provisioning. The control plane will be devised in the context of the Zero-Touch Networking (ZTN), relying on physical layer abstraction, impairment modelling and a telemetry-based monitoring system, enabling the intent-based autonomous networking and the application of Machine Learning (ML)-driven network operation for network self-diagnosis. ZeTON research activities and objectives will be disseminated in international journals and conferences in the form of peer-reviewed papers and PoC tesbed deployments, highlighting the benefits of the proposed solution from both the infrastructure and end user perspective. The experimental validation will be

performed based on the partners expertise, integrating and extending tools/frameworks developed and maintained by the partners, and lab environment already in place in the involved research units. The involved software components will be released open-source and maintained on a public ZeTON git repository. ZeTON will have a clear impact on the society, following the evolution of NextGen devices and novel network services with increased bandwidth, and connectivity needs (e.g., extremely low latency, high reliability and low power consumption). Finally, the ZeTON consortium includes 5 major and well-reputed academia (SSSA, PoliMi, PoliTo, UniBo, UniRoma1), combining several years of experience on the topics and technologies related with the project (Optical Networks, Software Optical Defined Networking, ML, QoT/QoE), thus guaranteeing project success.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI MILANO**
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Scuola Superiore di Studi Universitari e Perfezionamento Sant'Anna** - Coordinatore
-

Parole chiave

Settori ERC

PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 249.021,00
Contributo totale progetto:	€ 199.883,00
Costo totale PoliTo:	€ 55.965,00
Contributo PoliTo:	€ 40.565,00

BIGMECH - Knowledge-generation framework combining a novel Biomimetic Investigation platform and hiGh throughput screening for unravelling bone MECHanotransduction mechanisms in view of precision orthopedic medicine

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Cristina Bignardi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20222F7M2A

Ruolo PoliTo:

Coordinatore

Abstract

The ambition of the BIGMECH project is to build a pioneering knowledge-generation framework unravelling for the first time the cell-scale signaling pathways and the tissue-scale effects induced in bone tissue by native-like physical stimuli combined with PEMF stimulation. For this purpose, the main technological aim will be the optimization of a novel biomimetic investigation platform, based on a smart bioreactor system and 3D scaffold-based bone tissue models. In detail, a perfusion bioreactor will be upgraded for enabling in vitro adaptive dynamic culture of 3D constructs under tunable and combinable physical stimuli (shear stress, intermittent pressure, PEMF stimulation) and real-time monitored conditions. Unique 3D-printed scaffolds, mimicking the complex bone microarchitecture, will be developed and, seeded with mesenchymal stem cells, will be cultured within the bioreactor for developing reliable 3D bone tissue models. The biomimetic platform will then be used for applying native-like physical stimuli without and with PEMF stimulation on the 3D bone tissue models. High throughput transcriptomics will reveal intracellular signaling events triggered by the imposed physical stimuli. Transcriptomic data will be treated by high performance machine learning (ML) tools for decrypting complex networks and for extracting the relationships between gene expression and applied physical stimuli. As main scientific result, a novel mechanotransduction Knowledge Base will be released as open and free database. The combination of the pioneering biomimetic investigation platform, cutting-edge high throughput screening, and high performance ML tools will enable reaching a thorough understanding of the correlations between applied biophysical stimuli and biological response, with the

final aim to define the rationale basis for improved biophysical stimulation treatments, in view of precision orthopedic medicine.

Persone coinvolte

- **Cristina Bignardi** (Responsabile Scientifico)
- **Diana Nada Caterina Massai** (Componente gruppo di Ricerca)
- **Alfredo Benso** (Responsabile Scientifico di Struttura)
- **Aldo Canova** (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica
- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale
- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DEL PIEMONTE ORIENTALE**

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering PE6_13 - Bioinformatics, biocomputing, and DNA and molecular computation systems, cyber-physical systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 249.944,00
Contributo totale progetto:	€ 197.456,00
Costo totale PoliTo:	€ 168.918,00
Contributo PoliTo:	€ 130.267,00

NA2GO - NAvigation TO GO

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Piero Boccardo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022C9N4RE

Ruolo PoliTo:

Coordinatore

Abstract

Terrestrial navigation play a central role in Environmental Applications, e.g. in terms of Sustainable Development for Transportation. Remote Sensing and Geodesy provide enabling technologies for sustainable mobility aiming to raise the awareness of Accessibility needs in Urban Transportation and to improve Transit performance. Advanced Public Transport systems are the main levers for the growth of positioning systems that can help create a more inclusive Transportation System. Mobile-device based GNSS data collection points to exciting options for travel Surveys. Satellite positioning allows to address the dynamic properties of travel behaviour by capturing detailed spatial and temporal conditions throughout the traveling path. Nevertheless, with increasing reliance on GPS Data, a major technical issue is the quality of positioning service. In particular, access to Global Positioning System (GPS) raw measurements, as well as other Global Navigation Satellite Systems (GLONASS, Galileo, BeiDou), acquired by Smartphones is a strong motivation to investigate their employment for high-accuracy Navigation. Multi-GNSS and multi-frequency Satellite Data support high-accuracy positioning within the mass market. Exploiting Geodetic satellites to bring high accuracy to all devices, the Performance Assessment and implementation of GNSS techniques are meaningful. High accuracy can be fulfilled by low-cost receivers coupled with inertial Sensor and dedicated GNSS Antennas, utilizing GPS Networks. In addition, considering the current availability of authoritative and Opens Source geodata, incorporating essential mobility geometric features and their attributes, a Central Positioning Aggregator Engine can store and aggregate data coming from different sources. In the meantime, many other data source are available (e.g. Floating Car Data, video sequences for Image Interpretation, etc.). Consequently one of the major challenges in Transportation Planning and mobility management is to transfer different data into a unified Information System that preserves access to legacy data, allowing further processing and analysis. In the next future, protocols based on vehicle On Board Unit and CPAE one-to-one

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communication, will enable the possibility to monitor real-time flows allowing users to obtain information to be able to modify their movements, both to guarantee a personal advantage, but more generally a collective one. This collective advantage, measurable in terms of Travel Time, Environmental Impact, etc., will lead to the definition of new mobility policies based on a paradigm of flow optimization dynamically balanced on current traffic conditions. In this project, the main aim is to highlight how geospatial technologies can support sustainable mobility, paying particular attention to three different domain of application: MaaS policies, Restricted Traffic Areas dynamic management and private vehicles positional data analysis to extract driving experiences.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE10_14 - Earth observations from space/remote sensing

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 204.763,00
Contributo totale progetto:	€ 197.261,00
Costo totale PoliTo:	€ 106.013,00
Contributo PoliTo:	€ 98.511,00

BIONIC - BInders with high iONIc Conductivity for fully sustainable Li-ion cells

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Silvia Bodoardo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. 202254AF3F

Ruolo PoliTo:

Partner

Abstract

In line with Battery2030+ Large Research Initiative [1, 2], BIONIC proposal aims to study green and innovative binders also including self-healing (SH) functionalities for next generation Li ion batteries. Batteries with very high energy densities, being at the same time inherently reliable and safe, will allow electric vehicles to travel longer distances and open to a multitude of future applications needed for the energy transition. While the three R principle (Reduce, Reuse, and Recycle) of a circular economy will be the guiding principle for future technology development, smart battery functionalities will revolutionize both the performance and safety of battery systems. Among the smart functionalities that should be considered, the use of self-healing binders together with nanostructured anode particles will result in batteries with a longer lifetime, higher capacity and safety. The development of self-healing and self-adapting materials will take the battery lifetime and performance to new levels. The project will focus on the optimal design and realization of new eco-friendly low-cost polymer binders for battery anodes. The project aims at the following main objectives: 1) computational study of different self-healing binders leading to an in-deep understanding of the structural and chemical mechanisms involved in the self-healing process; 2) theoretical and experimental comparison of the relevant properties of different binders; 3) identification of binder modifications that could lead to a better performance; 4) Test and characterization of the resulting electrodes and cells; 5) test of the predictive capability of the simulations. The computational scheme is based on a new multi-scale protocol including studies of anode charge and discharge simulations with conceptually different binders using classical molecular dynamics and Reax-FF force fields followed by a DFT refinement of the lowest energy structures. The calculated properties (stability, adhesion to anode surfaces, ionic diffusion, rheological properties) will be compared to the experimental results of physicochemical analysis (adhesion and cohesion tests, rheological tests,

scanning electron microscopy, different kind of spectroscopies, thermogravimetric and differential calorimetry analyses, etc.), and electrochemical characterization (cyclic voltammetry, galvanostatic charge/discharge cycles, impedance spectroscopy) of the binder and of the electrode. The knowledge acquired in this project can be transferred to other types of battery electrodes and will impact the Italian companies in the sector, already established and under reorganization, to become leaders in the field of smart batteries. This project will be pivotal in the creation of an Italian leadership in the EU research connected to the Battery 2030plus framework and the green energy future actions.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI MODENA E REGGIO EMILIA** - Coordinatore

Parole chiave

Settori ERC

PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors SH2_6 - Sustainability sciences, environment and resources

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un’occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 248.642,00
Contributo totale progetto:	€ 200.039,00
Costo totale PoliTo:	€ 72.065,00
Contributo PoliTo:	€ 59.841,00

GREEN UP - GREEner Nanomaterials for Upconversion in Photocatalytic applications

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Barbara Bonelli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

20222FXNAP

Ruolo PoliTo:

Coordinatore

Abstract

Photon upconversion (UC), a process where two or more low-energy (NIR, Vis) photons are converted into one high-energy photon, has been receiving a lot of interest in many fields, from photovoltaics (PV) to bioimaging, medical therapies, 3D printing, photodetectors, but yet little in photocatalysis, although upconverted (recycled) photons could be exploited by a photocatalyst, improving its efficiency. Currently, most UC processes rely on Lanthanides-based nanoparticles (Ln NPs), which suffer from weak and narrow absorption, high thresholds (W/cm2 to kW/cm2), low abundance (most Ln deposits are outside Europe), and often undergo doping quenching effects. This calls for new UC systems. GREEN UP aims at developing a new generation of UC hybrid nanomaterials (NMs) relying on Triplet-Triplet Annihilation (TTA) to exploit solar light especially, but not exclusively, for photocatalysis. Compared with Ln NPs, such NMs have the great advantage of working with non-coherent and relatively low-intensity incident light (ca hundreds of mW/cm2), making them particularly promising for solar applications. In our new cutting-edge photocatalytic system, non-toxic metal-based quantum dots (QDs) will be adopted as sensitizers/enhancers. Organic moieties with tailored optical properties will be pre-selected as transmitters and annihilators/emitters by quantum mechanics. Nanostructured TiO2 will be adopted as support/receiver for solar photocatalysis. RU1 (Politecnico di Torino, POLITO) will produce by wet-chemistry methods (hot-injection) sensitizers with finely tailored and controlled properties, i.e. organic/inorganic interface, absorption range, etc. (Sustainable) template-free wet-chemistry methods based on pH control and/or use of ligands, followed by mild thermal treatment and/or supercritical CO2 extraction, will be adopted to obtain nanostructured TiO2. RU2 (Università di Cagliari, UNICA) will use mechanochemical methods to synthesize metal-based sensitizers under solvent-less conditions and to fabricate nanostructured TiO2 powders with suitable phase

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composition. RU3 (Università dell'Insubria, UINS) will carry out a computational screening on a set of organic moieties that are promising candidates to be used as transmitter and annihilator species by RU1 and RU2. Low-scaling methods such as KS-DFT and TD-DFT will be used, after being benchmarked using multireference wave function-based methods. On the most promising candidates, RU3 will evaluate the support effect on the annihilator properties. As a result, RU3 will identify the annihilator that more efficiently can be coupled with the sensitizer(s) in NIR-Vis and Vis-UV TTA-UC systems with TiO2 as support/receiver. The systems synthesized in GREEN UP will be evaluated according to these success criteria: i) range of upconverted photons and ii) enhancement of TiO2 photocatalytic activity towards CO2 reduction and degradation of emerging contaminants under solar light.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DELL'INSUBRIA**
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI**

Parole chiave

Settori ERC

PE5_6 - New materials: oxides, alloys, composite, organic-inorganic hybrid, nanoparticles

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 6. Garantire a tutti la disponibilità e la gestione sostenibile dell'acqua e delle strutture igienico-sanitarie

Budget

Costo totale progetto:	€ 228.982,00
Contributo totale progetto:	€ 203.707,00
Costo totale PoliTo:	€ 76.936,00
Contributo PoliTo:	€ 70.344,00

Vestibulodynia at high resolution: omics approach to improve diagnosis

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Carla Bosia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022CLTAYH

Ruolo PoliTo:

Partner

Abstract

Vulvooowhat? Despite affecting 1 out of 8 women, vulvodynia is unknown to most people. Vulvodynia is, by recent definition, vulvar pain without an identifiable origin. When the pain and symptoms are limited to the vestibule, this is known as vestibulodynia (VBD), which is the most common form. VBD compromises, partially or totally, the sexual life of women and, depending on the severity, can affect other daily actions, such as urinating, sitting, wearing tights, doing sports, sometimes even walking. The VBD diagnosis is a “diagnosis of exclusion”, meaning that it is diagnosed when all the other possible diseases have been ruled out. VBD is not a rare disease, but it rather is a high frequency women’s health condition, neglected and hard to diagnose due tolack of diagnostic markers. This absence increases the diagnostic delay up to 7 years, thus 1) inducing a chronicization of the symptoms 2) worsening the symptoms and 3) strongly affecting the quality of life of patients, often condemning them to social isolation and severe depression. Taking in consideration previous studies that reported localized metabolomic alterations in vagina and vulvar vestibule rather than systemic effects, it is inexcusable that in the NGS era, there are no studies in the literature of the transcriptome of the vestibular cells. In order to fill this gap, we plan to perform transcriptomic analysis integrated with the state-of-the-art single cell omic analysis on vestibular cells from VBD patients and healthy controls to unbiasedly identify specific VBD markers. Moreover, considering the different pathogenesis and the range of symptoms and severity of the disease, with these markers we also aim at stratifying different groups of VBD, laying the foundation for a real personalized medicine. This analysis has never been performed on VBD patients with this global approach and at such high resolution. The results of our project will help the clinicians in VBD diagnosis, in therapy direction and in the earlier identification of patients with higher risk to develop chronic VBD, thus helping to build a preventive strategy to avoid the progression and chronicization of

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the disease.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore

Parole chiave

Settori ERC

LS2_2 - Transcriptomics

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 229.590,00
Contributo totale progetto:	€ 216.989,00
Costo totale PoliTo:	€ 40.000,00
Contributo PoliTo:	€ 40.000,00

AMPHYBIA - Advanced Metamaterials from PHYsics and BIomechanics of Axolotls

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Federico Bosia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022ATZCJN

Ruolo PoliTo:

Partner

Abstract

Nature has always been a source of inspiration for scientists and the in-depth study of natural systems requires an interdisciplinary approach. In the animal kingdom, insects, fish, reptiles and amphibians are considered relatively simple living beings. However, they have developed extremely specialized survival strategies across the eras, by evolving, selecting and adapting their structures to optimize specific functions, thus exhibiting disparate and sometimes astonishing abilities that allow them to improve locomotion, adhesion, growth and repair processes in unparalleled ways, adapting to extreme environments and to escape predators. Salamanders are prominent among these animals with extreme capabilities. These extraordinary amphibians have already inspired advanced bio-mimetic robots for their uncommon ability to switch to three-fold locomotion modes, allowing efficiently land and water displacements by coordinating leg movements and spinal undulations. In particular, axolotls –a neotenic salamander species– are unique adult vertebrates able to regenerate entire limbs and an impressive repertoire of complex structures and organs, that have great interest in regenerative biology and medicine. Additionally, the axolotl skin is also the sole known biological material (except for the cow mammary gland) to be auxetic, i.e. having a Negative Poisson Ratio (NPR). This counter-intuitive mechanical property is extremely infrequent in living structures and essentially encountered only in man-made foams, re-entrant truss-like micro-structures and artificial wrapped fabrics. Surprisingly, although NPR is very rare in nature, it remains to be understood which advantages could be gained by axolotls from skin auxeticity. Therefore, starting from preliminary analyses and recent literature, the Project AMPHYBIA aims to theoretically investigate, by using nonlinear elasticity applied to growing continua and the expertise on bioinspired metamaterials of the applicants, how the special locomotion and regeneration capabilities of axolotls could be significantly enhanced by their auxetic skin. Preliminary calculations indicate NPR

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

as a key factor in minimizing both the residual stresses accompanying tissue (re)growth and deviatoric elastic energy cyclically stored during movement, with direct effects on scar-free healing processes and on some as yet unexplained mechanisms of autotomy. By exploring the link between the skin auxeticity and unique axolotl skills, the project could contribute to a different (physical and biomechanical) view of the multiscale interplay among cellular mechanisms, growth and tissue mechanical properties, with potential implications in conceiving new classes of bio-inspired self-repairing, wrinkling-free and fatigue-evading metamaterials.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore
- **UNIVERSITA' STUDI TRENTO**

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 231.708,00
Contributo totale progetto:	€ 197.293,00
Costo totale PoliTo:	€ 60.578,00
Contributo PoliTo:	€ 51.098,00

BSYNC - Probing the interindividual synchronization during cooperative motor tasks at the brain, spinal, and muscular levels

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Alberto Botter

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022TSYBJH

Ruolo PoliTo:

Partner

Abstract

Spontaneous interpersonal synchronization is a ubiquitous phenomenon, but its neural substrates and physiological control laws are still unclear. Movement synchronization of people cooperating in a motor task and brain synchronization of socially interacting participants are well known phenomena. However, whether an unconscious synchronous movement is generated by a synchronization between the dyad's brain activity, which propagates as a synchronous input to the periphery, is unknown. Moreover, current literature only provides indirect evidence of the effects of interpersonal brain synchronization in terms of motor performance improvement. In this project we propose two complementary approaches to investigate, for the first time, the neural substrates underlying the interpersonal coordination and its relationship with motor performance. We will first study, in two solo protocols, how cortically originated brain controls drive a motor action during isometric force generation tasks, by analyzing the common oscillations between EEG and EMG signals, both at the muscular and single motor unit levels. Then, two collaborative protocols, a static force generation task and a postural task, will probe how participants' brain activity changes during motor interaction and whether human-human interaction induces participants' brain activity and motor neuron firings synchronization. The effect of the collaboration will be assessed by comparing the brain networks identified during the cooperative task and a similar solo task. Interpersonal synchronization of the brain activity and of the motoneuron firing will be tested through coherence analyses. After having characterized the neurophysiological basis of interpersonal brain synchronization in the context of motor control, we will design a strategy to interfere with the activation of the underlying neural network by transcranial direct current stimulation (tDCS) in

humans. tDCS is a non-invasive brain stimulation approach which exploits a low-intensity direct current (1-2 mA) stimulation thorough scalp-attached electrodes to modulate the activity of targeted cortical areas. Exploiting tDCS protocols that effectively modulate the interpersonal brain synchronization would allow to envisage its application in neurorehabilitation. The innovative and interdisciplinary research scheme proposed in this project will allow, for the first time, to study cortico-muscular coupling, both at the muscular and motorneuronal level, and to characterize the neural basis underlying inter-personal synchronization occurring during a human-human motor task. The approaches proposed in this project would lead to striking advancements in neuroscience, as well as to a potential definition of innovative paradigms for neurorehabilitation.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **HUMANITAS University**
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI MESSINA** - Coordinatore

Parole chiave

Settori ERC

LS5_9 - Systems neuroscience LS5_8 - Behavioural neuroscience (e.g. sleep, consciousness, handedness)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 205.250,00
Contributo totale progetto:	€ 205.250,00
Costo totale PoliTo:	€ 58.565,00
Contributo PoliTo:	€ 58.565,00

TReE - Supporting the Transition to Ecological Economy in Italian cities Regeneration: circular model tools for reusing architecture and infrastructures

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marta Carla Bottero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022TN5M7F

Ruolo PoliTo:

Coordinatore

Abstract

This research is aligned to the PNRR framework (Piano Nazionale di Ripresa e Resilienza), and in particular to opportunities related to the management and adaptive reuse design/planning of cultural built heritage (Mission 1) in the perspective of the implementation of circular economy in cities and urban areas (Mission 2 and 5) (Macarthur, 2015; Williams, 2021). The main challenge is to address operative needs concerning the ecological and digital transition in the historic built environment, finding effective and efficientsolutions and managing the multidimensional issues related to the maintenance of cultural identity, as well as ensuring stakeholders' involvement in the design/planning decision process. The TReE project represents the operational implementation of the Horizon 2020 CLIC project (https://www.clicproject.eu), funded by the European Commission (5 M€; scientific coordinator L. Fusco Girard and co-coordinator A. Gravagnuolo) to identify: "innovative circular financial, business, governance models" to support the adaptive reuse of cultural built heritage, demonstrating the economic, environmental and social convenience (Fusco Girard,2021; Pintossi et al., 2021). CLIC was concluded in February 2022 with the following evaluation: "the project has delivered exceptional results with significant immediate and potential impact, achieving objectives at satisfactory and in some case excellent level. The project has a great potential to continue to be significantly relevant, for further experiments towards innovative applications". Following the CLIC project, and in parallel with the new Horizon 2020 project Be.CULTOUR (www.becultour.eu) led by CNR (4 M€, Gravagnuolo & Fusco Girard), TReE offers the interpretation of the circular adaptive reuse paradigm to

cultural built heritage and its effective management, implementing the “circular city model”, which mimics the nature organization structure of trees/forests, that receive energy from the sun and contribute to the decarbonization through a perfect metabolism. TReE aims at demonstrating the multidimensional convenience of reusing existing built heritage adopting the circular economy model through the transmission of cultural identity, the generation of economic benefits and the introduction of solution for natural resources management. The objective of TReE is to develop and validate multidimensional and multicriteria evaluation tools to support decision making in adaptive reuse processes towards circular and sustainable cities, considering that the evaluation approaches currently used in the cultural heritage sector are deemed unsatisfactory (HM Treasury, 2020; Sagger et al., 2021). The evaluation will be applied to three case studies in Italy representing diverse heritage assets, providing a replicable tool for introducing the principles/criteria of the circular city in the design/planning processes, becoming fundamental in the promotion of new governance capacities.

Persone coinvolte

- **Marta Carla Bottero** (Responsabile Scientifico)
- **Nadia Caruso** (Componente gruppo di Ricerca)
- **Elena De Angelis** (Componente gruppo di Ricerca)

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 207.368,00
Contributo totale progetto:	€ 187.328,00
Costo totale PoliTo:	€ 70.996,00
Contributo PoliTo:	€ 62.470,00

TRIALs - Transformative Resilience for Inner Areas and Local communities. Strategies and actions for disaster risk reduction and post-disaster recovery

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Grazia Brunetta

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022T7TMSM

Ruolo PoliTo:

Partner

Abstract

The project TRIALs is underpinned by studies developed in recent years on the Inner Areas, the multi-risk condition, and resilience. The proposal moves from Central-Italy Inner Areas, where the research group collected, processed, and shared a wide range of data and research projects on the hydro-geological, environmental, infrastructural, economic, and socio-demographic context, and its development scenarios. This capital of knowledge and information represents the project's starting point. Inner Areas become a reference for the Italian sustainable and resilient restart in the Plan for Recovery and Resilience frame. In a critical perspective of spatial planning, resilience is a broad concept whose final purpose is to prevent and manage unforeseen events and improve territorial systems' environmental and social quality to foster innovation. This perspective highlights an evolutionary approach defined as transformative resilience, helping to maintain and quickly return to functions, adapt to change, and transform the components that limit the capacity for evolution in response to present and future shocks. The proposal innovates planning guidelines for building back better. The guidelines will be based on places' potential defining territorial development scenarios under the banner of transformative resilience. The Italian path to transformative resilience is hindered by a gap between land-use planning and planning for managing the recovery process, drawn up each time from scratch. The proposal moves from the most recent research advancements on the potential of local biographies and participatory techniques. In this frame, planning by scenarios experiments a resilience-in-action, offering communities a perspective to identify future developments in a multirisk age. Interaction among experts is crucial for the project. Five RUs develop the project offering specific competencies oriented to the

urban planning perspective. Experts in mathematics, architectural technology, real estate management, sociology and communication, building science, drawing, and earth science will transfer their knowledge to the project. These are wide-ranging skills ensuring sharing between RUs and a high degree of multidisciplinary collaboration. TRIALs'll apply on two municipalities as pilot experiences, Norcia and Camerino. The elements that will make the experience replicable in other Inner Areas with multi-hazard problems are: the territorial perspective adopted helps to go beyond the simple search for innovation within a specific economic cluster or a particular community; the project's structure combines context analysis and the available/desirable innovation opportunities with an actual application on two case studies; the in-depth examination of national issues with significant implications at local levels (multi-risk dimension, construction of community biographies, participatory action research, raise resilience to hazards).

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio
- R3C - R3C - Responsible Risk Resilience Centre

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA DEGLI STUDI DI CAMERINO - DIP. PROGETTAZIONE COSTRUZIONE DELL'AMBIENTE (PROCAM) - COLLE DELL'ANNUNZIATA** - Coordinatore
- **UNIVERSITA' DI CHIETI-PESCARA "G. D'ANNUNZIO"**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

SH2_10 - Land use and regional planning SH2_6 - Sustainability sciences, environment and resources SH2_9 - Urban, regional and rural studies

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 192.984,00
Contributo totale progetto:	€ 163.213,00
Costo totale PoliTo:	€ 53.255,00
Contributo PoliTo:	€ 41.884,00

MODEM - Next-generation multiscale MOdelling of Dense EMulsions for enhanced multiphase flow processes

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Antonio Buffo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MIUR)

Codice identificativo progetto:

20229WJBPS

Ruolo PoliTo:

Partner

Abstract

We aim at providing a novel framework for the study of dense liquid-liquid emulsions. Dense emulsions are at the crossroads between academic research and practical applications (e.g., polymer production, crude oil recovery/transportation, liquid-liquid extraction processes) and their modeling poses major challenges. These are due to a partial knowledge of the complex multiscale physics that stems from the interaction between fluid dynamics and interfacial phenomena, translating into poor model predictions under realistic process conditions. One example is the drop size distribution (DSD), that determines the efficacy of controlled delivery systems in personal care and pharmaceutical products, or the final properties of polymer particles produced via emulsification. No physics-based model is available for the coalescence and breakup kernels needed to evaluate the DSD evolution and predict the rheological properties of the emulsion. To advance current knowledge and build the proposed framework, we will combine sophisticated computational methods with state-of-the-art experimental techniques (PIV, electrical resistance tomography, laser diffraction analysis), blending technology-driven objectives with original research developments. We will carry out simulations at the near-interface scale considering a sharp-interface approach to investigate the bulk rheology produced by collective drop behavior in viscous flow, and a diffuse-interface approach to investigate breakup and coalescence of large drops in turbulence. Both formulations will account for the effect of additives (surfactants, salts) on surface tension. To go beyond the current state of the art, we will focus on dense systems with drop volume fractions up to 50%. The simulation outcomes (e.g., breakup/coalescence efficiencies) will be then transferred for the first time at the equipment scale, where drop dispersion will be simulated without resolving the interface. This will be achieved via direct coupling of the flow solver

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with a population balance model, allowing for the reconstruction of the DSD from its moments. The resulting simulation tool will be made openly available to interested users. To validate the numerical results, a detailed experimental characterization of mixtures of immiscible or partially-miscible liquids, treated under different operating conditions, will be carried out in dedicated lab-scale equipment, obtaining local data from the drop scale (DSD) up to the equipment scale (concentration distribution maps) as well as global parameters (like the overall power consumption). A product of the joint numerical and experimental activities will be the development of design guidelines for novel mixing-separation equipment for liquid-liquid extraction processes.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI UDINE**

Parole chiave

Settori ERC

PE8_2 - Chemical engineering, technical chemistry PE8_5 - Fluid mechanics, hydraulic-, turbo-, and piston engines

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 375.718,22
Contributo totale progetto:	€ 249.075,58
Costo totale PoliTo:	€ 89.763,89
Contributo PoliTo:	€ 49.403,00

GREENER - draG REduction inducEd by siNusoidal shapEd Riblets

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Gioacchino Cafiero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022ZJB3L4

Ruolo PoliTo:

Coordinatore

Abstract

Innovative riblet geometries for the friction drag reduction will be investigated in this project via a combination of state-of-the-art experimental techniques and numerical simulation. For conventional airborne vehicles, friction drag represents the most significant share in the drag breakdown, accounting for nearly 50% during cruise. Reducing this share even of a few points has an immediate impact on the carbon footprint of the air transport system. If on one hand this would reduce the fuel consumption, the strong push towards a fully electric aircraft poses the problem of the autonomy and weight of the batteries that need to be stored onboard. The results of this project aim at pushing the boundaries of the understanding of the fluid mechanics of turbulent boundary layers when manipulated with micro-roughness. A novel non-intrusive experimental approach based on IR Thermography will be developed and validated against existing and well assessed techniques, such as load cell measurements and Particle Image Velocimetry. On the other hand, an efficient approach to the numerical simulation of complex flows where the geometry manipulation can be efficiently represented by appropriate boundary conditions will be developed, implemented, and compared with the experimental data. The outcomes of the project will represent a leap forward for the scientific community interested in wall bounded flows, drag reduction and, as a direct consequence, on mitigating the carbon footprint of the air transport system. Two research units will be involved in this project: Politecnico di Torino (PoliTo) and Università di Napoli Federico II (UniNa). The experimental activities will be carried out at Politecnico di Torino, with the support of UniNa, while the numerical simulations will be performed by the research unit at UniNa. The project will have a significative and strong scientific impact on a considerable number of areas including experimental methods, numerical simulation, and the physical understanding of wall bounded flows developing on

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rough surfaces.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**

Parole chiave

Settori ERC

PE8_1 - Aerospace engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 298.767,00
Contributo totale progetto:	€ 196.300,00
Costo totale PoliTo:	€ 170.601,00
Contributo PoliTo:	€ 121.956,00

e-CAPTURE - Eco-geomorphic CArbon Pumping from rivers To blUe caRbon Ecosystems

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Carlo Vincenzo Camporeale

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

20222W5WXC

Ruolo PoliTo:

Coordinatore

Abstract

Although only 1% of the Earth's surface is covered by inland waters, their collective contribution to global carbon fluxes is substantially similar to terrestrial and marine ecosystems. Rivers and tidal systems are in fact formidable activators for atmospheric CO2 sequestration. However, as invoked during the EGU 2017 Bagnold Medal Lecture (E. Wohl), there is a tremendous need for modelling and quantification in River Carbon Science. The underlying idea of the project is that the riverine-estuarine system behaves as a combined virtuous cycle that catalyses the gross primary production, namely the carbon sequestered from the atmosphere. Within this virtuous cycle, the high fluvial morphological activity enhances the functioning of Blue Carbon Ecosystems (BCE). Under the overview of a multidisciplinary integrated approach (involving skills from morphodynamic modelling, remote sensing, field and laboratory analysis) we address the carbon cycle within the framework of a novel “Carbon Continuum”, from inland to coastal wetlands. The project is composed of 3 Research Units (RU) and 1 Sub-unit, with an overall staff of 4 researchers, 4 postdocs specifically recruited for the project and 3 PhD students from other projects, and it is organised with a multiscale approach aiming to analyse the overall carbon budget of two selected watersheds: Amazon and Tagliamento (NE Italy). The project foresees joint collaborations among the RUs, with staff exchanges, transfer of knowledge and use of in-house resources of the RUs.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

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Parole chiave

Settori ERC

PE10_17 - Hydrology, water and soil pollution PE10_9 - Biogeochemistry, biogeochemical cycles, environmental chemistry PE10_14 - Earth observations from space/remote sensing

Budget

Costo totale progetto:	€ 260.643,00
Contributo totale progetto:	€ 199.405,00
Costo totale PoliTo:	€ 93.760,00
Contributo PoliTo:	€ 72.160,00

UTMOST FDD: an aUToMated, Open, Scalable and Transparent Fault Detection and Diagnosis process for air-handling units based on a hybrid expert and artificial intelligence approach. From experimental open data to transfer model learning for the enhancement of energy management and indoor environmental quality in buildings

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alfonso Capozzoli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della ricerca)

Codice identificativo progetto:

20228LSLLR

Ruolo PoliTo:

Coordinatore

Abstract

Heating Ventilation and Air-Conditioning (HVAC) systems equipped with air-handling units (AHUs) are frequently operated in faulty conditions due to lack of proper maintenance, failure of components or incorrect installation. Faulty operation in AHUs leads to uncomfortable indoor environment, poor indoor air quality and significant wastes of energy and money. To this purpose, Fault Detection and Diagnosis (FDD) processes make it possible to automatically recognize fault occurrence and identify the causes and the location of fault, contributing to enhance both energy efficiency and indoor environmental quality. This project mainly aims to develop an automated, open, scalable and transparent FDD process for AHUs based on a hybrid expert and artificial intelligence-based approach. The project will start by creating a reference dataset based on experimental campaigns characterized by high resolution measurements of both normal and faulty operation of a typical existing monitored AHU (serving a 4x4x3.6 m3 test room) under different modes and weather/load conditions. The experimental dataset will represent a fundamental source of knowledge for assessing the real impact of several typical faults in terms of operating cost, energy consumption, GHG emissions and indoor comfort/air quality. Moreover, the dataset will be exploited to validate a digital twin capable to mimic the operation of the AHU in both faulty and normal conditions; the simulation model will make it possible to conduct robust fault impact scenarios and to extend the operating ranges of training measured data. Both the experimental and simulation datasets will

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be made publicly available on a data repository well-recognised by researchers, thus opening the opportunity for the scientific community to perform replicability and benchmark studies on FDD processes for AHUs. Novel hybrid FDD strategies including both data-driven and knowledge-based models will be then developed based on the obtained datasets. The hybrid FDD framework will make it possible to exploit the potentialities of physics-based models for the description and interpretation of faults occurrence and artificial intelligence techniques to extract non-trivial knowledge from experimental and simulated data. Finally, the transferability and scalability of the conceived FDD strategy, exploiting ontology schema and applying a transfer learning framework with reference to a target AHU different from the one used for the development of the FDD strategy itself will be tested. The project will represent a cutting-edge experience thanks to the proposed holistic approach aiming to the resolution of the main challenging issues in the field of FDD for AHUs. The flow of activities can be replicated also for other AHUs with the aim of supporting an easier penetration of advanced automatic FDD tools in the automation industry as a key and low-cost solution to enhance energy management in buildings.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **Università degli Studi della Campania Luigi Vanvitelli**

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering PE7_3 - Simulation engineering and modelling PE6_7 - Artificial intelligence, intelligent systems, multi agent systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 273.465,00
Contributo totale progetto:	€ 189.078,00
Costo totale PoliTo:	€ 136.149,00
Contributo PoliTo:	€ 96.437,00

ConStRAINeD - Convergence and Stability of Reaction and Interaction Network Dynamics (ConStRAINeD)

Durata:

28/09/2023 - 28/02/2026

Responsabile scientifico:

- Daniele Cappelletti

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022XRWY7W

Ruolo PoliTo:

Coordinatore

Abstract

The project Convergence and Stability of Reaction and Interaction Network Dynamics (ConStRAINeD) deals with specific Continuous-Time Markov Chain models of interacting individuals called Stochastic Reaction Networks (SRNs). The state space is the number of available individuals of different kinds, and transitions are encoded by a finite set of allowed reactions, which can be arranged as the edges of a reaction graph. SRNs are often utilized as models in biochemistry, epidemiology and ecology. The aim of ConStRAINeD is to provide new theoretical insight on SRNs which are crucial to unlock a deeper understanding in important applications. ConStRAINeD has two main objectives: Objective 1: developing theorems connecting the structure of the reaction graph (RG) with the positive recurrence of the model, as well as with an exact description of the stationary distributions. Objective 2: introducing peculiar spatial dependencies. ConStRAINeD will extend the setting of SRN to cases in which spatial positions of particles are taken into account by introducing a random graph of interaction and diffusion dynamics. The effect that this has on the large volume dynamics will be studied. All the objectives concern theorems based mainly on the structure of the RG and therefore independent on the specific rate parameters. This choice is motivated by the fact that the exact rates of changes in biological, epidemiological or ecological systems are rarely known with precision. Hence, results that hold for any choice of parameters are both impactful and mathematically interesting.

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI PISA**

Parole chiave

Settori ERC

PE1_13 - Probability PE1_20 - Application of mathematics in sciences

Budget

Costo totale progetto:	€ 234.249,00
Contributo totale progetto:	€ 187.374,00
Costo totale PoliTo:	€ 159.699,00
Contributo PoliTo:	€ 112.824,00

CLAIRE - Clean LArge-scale energy harnessing with perovskite/silicon three terminal heterojunction bIpolar tRansistor solar cEIls

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Federica Cappelluti

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022SEHFHR

Ruolo PoliTo:

Coordinatore

Abstract

Silicon photovoltaics (PV) cover about 90% of today PV market with record efficiency cells close to their theoretical limit of 30%. Perovskite (PVK) / Si tandem extends this limit up to 42% and is one of the more fast advancing and promising technologies to ensure competitiveness and sustainability of PV. High-efficiency and low-cost clean PV energy enabled by PVK/Si technology will be pivotal to reach the zero climate impact goal set by the United Nations and Europe by 2050 and to increase the European energy independence, in particular in countries like Italy with high PV potential owing to its favorable geographical position. Two and four terminal PVK/Si tandems (2T and 4T) are the most investigated, with demonstrated efficiencies up to 29.8% on heterojunction Si cells, but suffer from sub-optimal energy yield due to the series connection (2T) and complex manufacturing at device/module level (4T). The CLAIRE project proposes a novel monolithic architecture for PVK/Si cells based on the heterojunction bipolar transistor (HBT) structure, which brings two striking advantages: 1) It is an inherently 3 terminal (3T) double junction solar cell with efficiency and resilience to spectral variations equal to the 4T one, hence providing the highest possible energy yield in any location. 2) It avoids the use of recombination layers, maximizing the light harvesting and, above all, minimizing shunts when upscaling to large areas. Differently from other 3T solutions proposed so far, the CLAIRE tandem relies on the most common Si PV technologies that will largely dominate the PV market in the next tens of years, hence maximizing the exploitation potential. CLAIRE will prove the feasibility of the HBT PVK/Si architecture with small-area prototypes on planar and textured Si substrates, with a net efficiency gain of at least 5% over the Si baseline cell, and will demonstrate the upscaling of the technology to large areas. In particular, the project will test new

deposition techniques on textured Si substrates, developing an innovative close space sublimation process as a scalable deposition method for the perovskite layer. The project brings together two research teams from Politecnico di Torino and Università di Roma Tor Vergata with a strong background on solar cell technology and extensive experience in international projects. CLAIRE enjoys the in-kind participation of ENEA (Italian Agency for new technologies, energy, and sustainable development) and ENEL-3SUN. ENEA will provide customized Si-homojunctions for the development of small-area demonstrators, and ENEL-3SUN will provide bifacial Si HTJ cells for demonstrating the technology over large area commercial cells. With its simplicity and cost-effectiveness, the CLAIRE 3T HBT PVK/Si tandem can make a high impact in the PV field providing a new architecture to go well beyond the 30% limit of single gap solar cells and building upon the existing industrial PV chain for rapid exploitation.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI ROMA - TOR VERGATA**

Parole chiave

Settori ERC

PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 219.213,00
Contributo totale progetto:	€ 199.911,00
Costo totale PoliTo:	€ 90.193,00
Contributo PoliTo:	€ 70.891,00

0DISTA - 0-Dimensional Schemes, Tensor Theory, and Applications

Durata:

28/09/2023 - 28/09/2025

Responsabile scientifico:

- Enrico Carlini

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. 2022E2Z4AK

Ruolo PoliTo:

Partner

Abstract

The decomposition of tensors is a procedure which is ubiquitous in many new technologies related with Artificial Intelligence, Algebraic Statistics, Quantum Physics, Network Theory. The goal of the decomposition process is the separation of elementary components which appear as a mixture in several (biological, chemical, social, linguistic,...) phenomena among the most studied in modern Science. Several branches of Mathematics propose approaches for the study of efficient methods of decompositions, as well as for their theoretical aspects. In recent times researchers realized that deep methods of Algebraic Geometry can be useful to produce sensible advances in the study of the decomposition process. A decomposition can be seen a set of points in a projective space, or in a product of projective spaces, whose images in standard classical maps (Segre maps or Veronese maps) generate the tensor under investigation. It follows

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CATANIA**
- **UNIVERSITA' DEGLI STUDI DI SIENA** - Coordinatore

Politecnico di Torino

Parole chiave

Settori ERC

PE1_4 - Algebraic and complex geometry PE1_20 - Application of mathematics in sciences

Budget

Costo totale progetto:	€ 186.750,00
Contributo totale progetto:	€ 154.500,00
Costo totale PoliTo:	€ 44.400,00
Contributo PoliTo:	€ 37.650,00

GREEN-MID-PLACE - GREEN-MIcrofluiDic PLAtform for advanced organ on Chip culturEs (GREEN-MID-PLACE)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Irene Carmagnola

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022CAKEW9

Ruolo PoliTo:

Partner

Abstract

Organ-on-Chip (OoC) technology provides advanced instruments for bioengineers and biologists due to its small scale, potentially suitable for recapitulating the intricate micro-environment of human tissues in a controlled and tunable manner. OoC platforms are usually fabricated from raw materials obtained from non-renewable sources thus slowing the transition to truly green and sustainable manufacturing processes and materials in the biomedical field. GREEN-MID-PLACE refers to the implementation of a microfluidic dynamic model for stem cell growth and differentiation, characterized by being eco-sustainable from the processing and materials point of view. The manufacturability of bio-based polymers in subtractive (laser ablation) processes will be systematically explored and mapped. The whole fabrication routs of the OoC will involves other eco-friendly techniques such as flat-die extrusion, dry chemistry surface etching and low-temperature thermal sealing of the layers. The microfluidic platform designed via CAD software and optimized via CFD analysis. Controllable micropumps will offer the right spatiotemporal chemical and physical environment as well as the mechanical stimuli for human bone marrow mesenchymal stem cells (BMSC) growth and differentiation towards bone or adipose tissue. The OoC design will consist of two culture chambers separated by a 2D or 3D biopolymeric scaffold specifically designed to be co-cultured with BMSC and endothelial cells. The scaffold fabrication protocols will compare or combine different materials and processing techniques such as electrospinning, electrowriting, and 3D bioprinting in order to find the best solution for the cell cultures. Furthermore, innovative direct deposition approaches into the OoC platform will be implemented in order to avoid the use of solvents and adhesive (additional materials), minimizing the need for operators handling to drastically simplify production (thus saving energy) and avoiding contamination issues, frequently observed in conventional manufacturing The "green" OoC platforms will be tested as a potential tool for

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studying the cellular mechanisms related to osteoporosis diseases and testing new potential compounds for the prevention and treatment of the osteoporotic process. In particular, the effect of polyphenols in the microfluidic system will be compared with the effect of polyphenols on BMSC differentiation in static conditions in order to validate the dynamic system efficacy resulting in a new potential tool with potential impact on the prevention and treatment of the osteoporotic process. Therefore, the potential applications of GREEN-MID-PLACE include biological sample handling, analyte sensing cell-based assay, tissue engineering, molecular diagnostics, drug screening, and personalized medicine.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PALERMO** - Coordinatore

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering PE1_1 - Logic and foundations

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 268.600,00
Contributo totale progetto:	€ 197.500,00
Costo totale PoliTo:	€ 57.050,00
Contributo PoliTo:	€ 42.850,00

TWINCRAFT - Digital Twin for Human Centered Design of Future Aircraft

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Erasmo Carrera

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022LXKA3R

Ruolo PoliTo:

Coordinatore

Abstract

The project “Digital Twin for Human Centred Design (HCD) of Future Aircraft” aims to develop HCD procedures based on the use of high-fidelity virtual replicas of real aircraft, often referred to as Digital Twins (DTs). The development of the new design procedures will focus onto two main targets based on the integration of liveware as the most important part of DTs: 1. the improvement of the cabin comfort for the passengers and the crew; 2. the improvement of safety in aircraft operations. With regards to the first goal, it is well established that Airliners are paying great attention to the influence of Noise and Vibrations - N&Vs on the comfort of passengers, viewing comfort as one of the main aircraft quality indicators. On the other hand, N&Vs can deeply affect pilots at their workplace inside the cockpit by increasing their psychophysical fatigue, particularly in the case of long haul flights. Pilot fatigue is one of the most critical issues in aviation human factors, since it can lead to a degradation of the pilot performance thus increasing the likelihood of pilot error. For this reason, pilot fatigue is considered to be one of the leading causes of aircraft accidents and incidents and the monitoring of pilot condition and performances is one of the main goals to improve aviation safety. Thus, in the framework of a HCD philosophy, flight simulator, extended reality and refined numerical tools for multiscale structural analyses are integrated to obtain DTs of the real aircraft allowing the improvement of the cabin/cockpit comfort as well as aviation safety. To achieve this goal, the project will be articulated into 3 main phases: 1. implementation of a virtual cabin/cockpit environment by means of extended reality, allowing to evaluate the objective and subjective comfort perception of the different implemented layout by both passengers and crew; 2. multi-scale analysis of innovative materials to be used in aircraft structures and vibroacoustic simulation to evaluate the noise reduction with respect to standard materials. By doing so, it will be possible to develop innovative passive treatments for lining panels of cockpit and cabin. 3. use of a full

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flight simulator for: • a deep understanding of the influence of noise and vibration on the pilot performances and on the passenger comfort; • the evaluation of the different virtual cabin/cockpit layout during simulated flight and the different effects on comfort; • the evaluation of the pilot workload and performance under enhanced comfort conditions in terms of noise reduction coming from the possible use of passive treatments for lining panels. For this purpose, the project will exploit the expertise of dedicated research groups coming from the Politecnico di Torino (POLITO, coordinator), Università di Bologna (UNIBO) and Università degli Studi di Enna Kore (UNIKORE).

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA di BOLOGNA**
- **UNIVERSITA di ENNA**

Parole chiave

Settori ERC

PE8_1 - Aerospace engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 262.840,00
Contributo totale progetto:	€ 195.095,00
Costo totale PoliTo:	€ 76.000,00
Contributo PoliTo:	€ 56.000,00

MAG - Multilinear Algebraic Geometry

Durata:

28/09/2023 - 27/09/2025

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022ZRRL4C

Ruolo PoliTo:

Partner

Abstract

Multilinear maps are ubiquitous in mathematics, especially in their symmetric version representing both homogeneous polynomials and symmetric tensors. The vastness of interests that they open penetrates the depths of algebraic, geometric and numerical research which by their nature take roots in classical algebraic geometry and find an outlet in highly relevant open problems such as complexity theory. In this project we aim to study the geometry of these spaces describing multilinear phenomena, with a focus on secant varieties and the connected concept of rank harmonizing the whole project around one of the most important unsolved problems in complexity theory like the complexity of Matrix Multiplication (MaMu). The interest in these multilinear phenomena is increasing due to their interdisciplinary nature, which is spread over several fields of Mathematics (Multilinear Algebra, Commutative Algebra, Algebraic Geometry, Combinatorics, Numerical Analysis). Tensors are nowadays widely used in several emerging technologies: Signal processing, Machine learning, Algebraic statistics, Game Theory, Complexity. We list here the four main topics whose related specific targets will be detailed in the next sections: 1. Complexity of Matrix Multiplication 2. Identifiability 3. Zero-dimensional schemes and cactus varieties 4. Critical points of distance function and low rank optimization Common tools in the four above items are vector bundles and projective geometry. We also employ symbolic computational methods joint with methods from Numerical Algebraic Geometry. The goal of this project is to obtain financial support for the continuation of the research in the algebraic and geometric aspects of tensors theory, as well as the production of algorithms and the consequent software for tensor analysis. We plan to use the funding to: - support promising young researchers to undertake the main tasks of the present project, by providing them with post-doc grants in the Universities involved in the project; - enhancing the collaboration among researchers in the group, by supporting their mobility and by organizing meetings among them; - support the worldwide participation of members of the group to meetings of top level on the topic and organize similar events in Italy; - invite outstanding foreign researchers in the field, for delivering advanced courses in the topics of the project and for performing joint research with members of the group.

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Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI FIRENZE** - Coordinatore
- **UNIVERSITA' DI FERRARA**
- **UNIVERSITA' STUDI TRENTO**

Parole chiave

Settori ERC

PE1_4 - Algebraic and complex geometry

Budget

Costo totale progetto:	€ 246.000,00
Contributo totale progetto:	€ 186.000,00
Costo totale PoliTo:	€ 61.000,00
Contributo PoliTo:	€ 46.000,00

DATA FUSION BASED DIGITAL TWINS FOR STRUCTURAL SAFETY ASSESSMENT

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Paolo Castaldo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022AALXSM

Ruolo PoliTo:

Coordinatore

Abstract

This project aims at addressing some research challenges improving the engineering knowledge in the safety assessment of structural systems through a tightly-knit interdisciplinary collaboration among research units belonging to structural engineering (i.e., “Politecnico di Torino”, “Università di Bologna”, “Università degli Studi di Roma - Tor Vergata” and “Università degli Studi di Napoli - Federico II”) and mechanical measurements (i.e., “Politecnico di Milano”). As for experimental tests of both ordinary and pre-stressed reinforced concrete structural elements, the proposed project is finalized to investigate the fusion between different measurement techniques from different sensors for a more effective updating of the non-linear structural digital twins, taking into account the various uncertainty sources. This improvement can lead to a more reliable assessment of both the safety level of the structural elements and the definition of the pre-alert thresholds with respect to structural damage. The project is composed of 5 work packages. Three work packages deal with, respectively: image processing, optical fibers and MEMS (Micro Electro-Mechanical Systems). Another work package is focused on sensor data fusion by all the research groups. The last one involves all the research units for the definition and updating of the structural models, for an improved safety assessment. The project can lead to advantages with positive effects in terms of human safety, economic and social impacts. Indeed, it is possible to improve the use of economic resources with the definition of any intervention priority with respect to both space and time. These impacts are compliant with the sustainability and circular economy principles: in fact, a proper check and an informed maintenance strategy can lead to a huge spare of resources and construction materials.

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Persone coinvolte

- Paolo Castaldo (Responsabile Scientifico)
- Luca Giordano (Componente gruppo di Ricerca)

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 237.790,00
Contributo totale progetto:	€ 196.710,00
Costo totale PoliTo:	€ 58.302,00
Contributo PoliTo:	€ 45.662,00

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Med4CRRT - PRECISION MEDICINE IN RENAL REPLACEMENT THERAPY FOR CRITICALLY ILL PATIENTS

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Valentina Alice Cauda

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

Prot. 2022XTBJ55

Ruolo PoliTo:

Partner

Abstract

Continuous renal replacement therapy (CRRT) is frequently applied in critically ill patients with acute kidney injury to counteract fluid overload and to remove wasted solutes retained due to kidney dysfunction. Indeed, during CRRT plasma water and solutes are removed from the patient's blood, being forced through the semipermeable membrane of the hemodiafilter. The ultrafiltration coefficient (Kuf) and the sieving coefficient (SC) are those performance characteristics that quantify the membrane capability of being crossed by plasma water and solutes. Unfortunately, Kuf and SC decrease unpredictably (and often undetectably) during the treatment due to membrane fouling (i.e., an unquantifiable phenomenon that always occurs during CRRT), leading to undertreatment and affecting the patient's outcomes. New bedside, realtime, inexpensive, and feasible methods to quantify Kuf and SC and their overtime reduction are needed to tailor CRRT to the patient's actual needs, with the ultimate goal of efficiently removing plasma water (to counteract fluid overload) and purifying wasted solutes. Furthermore, since a significant number of CRRT is performed in septic patients, the transmembrane antibiotic removal should be precisely controlled. The amount of antibiotic loss in the effluent is virtually unknown in most CRRT prescribed in critically ill septic patient. The inability to quantify antibiotic clearance and restore transmembrane leakage by increasing antibiotic dosage severely worsens patient outcomes. A bedside method to realistically estimate the transmembrane loss of antibiotics during CRRT may support physicians to precisely and dynamically readjust antibiotic posology with the ultimate goal to reach clinically relevant pharmacokinetic/pharmacodynamics targets. This project aims at improving precision medicine in the field of CRRT performed on critically ill patients in the ICU. The effects of membrane fouling will be explored in terms of Kuf (workpackage 1, WP1) and SC (WP2) reduction overtime. Behind the identification and prevention of membrane fouling, the concept of a more precise ability to maintain

control over transmembrane clearance will be explored for CRRT antibiotic removal (WP3). Through multidisciplinary cooperation among four academic centers allowing the engineering, biological and pharmacological analysis of clinical and technological data obtained from bedside practice, this project will: 1)Define and clinically validate a new method for instantaneous Kuf estimation during CRRT (WP1); 2) Define and clinically validate a data-driven based method to predict Kuf reduction overtime due to membrane fouling (WP1); 3)Design a decision support system that can help physicians to readjust the CRRT prescription to prevent Kuf reduction overtime (WP1); 4)Define and clinically validate an innovative method for SC profiling during CRRT (WP2); 5) Define and clinically validate a new method to estimate transmembrane antibiotic removal (WP3).

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli studi dell'Aquila**
- **Università degli Studi di FIRENZE** - Coordinatore
- **Università degli studi di Torino**

Parole chiave

Settori ERC

LS7_2 - Diagnostic tools (e.g. genetic, imaging) LS7_1 - Medical engineering and technology

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 213.640,00
Contributo totale progetto:	€ 194.726,00
Costo totale PoliTo:	€ 49.563,00
Contributo PoliTo:	€ 44.586,00

TUrBO: the next 100,000+rpm synchronous reluctance motor drives

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Andrea Cavagnino

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Codice identificativo progetto:

202292E4FS

Ruolo PoliTo:

Coordinatore

Abstract

The 'TUrBO: the next 100,000+rpm synchronous reluctance motor drives' aims to develop new technologies for high-speed ac motor drives, exceeding the effective speed barrier of synchronous reluctance machines by at least four times. In this scenario, the PI and his team believe that TUrBO will reduce the market penetration of PM-based ac motor drives also in the 100-200krpm speed range, characterizing many applications nowadays, starting from appliances up to advanced industrial and transportation electrification solutions. The PM-free concept is the 'pathway' for a cleaner production of an ac motor and a more manageable approach to end-of-life material recycling. However, the optimal electromechanical conversion achievable with the proposed winding arrangement and the dedicated inverter topology is also strategic for a direct engagement with the challenges set by the European Green Deal and with the United Nations' sustainable development goals indicated in Fig. 1. The project will push the synchronous reluctance motor drives well beyond the present technological barriers by developing an unexplored combination of advanced multi-material additive manufacturing technologies, unconventional high switching frequency power electronic converters for open-end winding, supplemented with dedicated and high-performance control algorithms. Power density, temperature, efficiency, life cycle assessment and cost issues will be methodologically approached in a synergic and multi-disciplinary way by the research team. The TUrBO electrical drive will be designed, produced and tested during the 24-month long project, exploring two key peculiarities: - an additively-manufactured quasi-solid rotor constituted by two different metallic materials for exploiting magnetic anisotropy and rotational speeds above 100krpm. The power target for the motor is around 1kW, approximately equal to 100krpm time 100milliNm; - a dual inverter system with a floating capacitor bridge to supply a PM-free synchronous reluctance motor with open-ends windings, ensuring low current distortion, unity power factor for the main

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inverter and exploiting the maximum motor terminal voltages for the broadest field weakening region. At the end, thanks to the data collected by the full scale TUrBO demonstrator, the PI and his team will prove that the symbiotic interconnection of these innovative technologies is the solution to achieve high efficiencies with extreme compactness, to reach the challenging targets of 100,000+rpm synchronous reluctance motor drive applications.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE7_2 - Electrical engineering: power components and/or systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età|Obiettivo 4. Fornire un'educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti|Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*|Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell'ecosistema terrestre

Budget

Costo totale progetto:	€ 288.000,00
Contributo totale progetto:	€ 200.000,00
Costo totale PoliTo:	€ 164.000,00
Contributo PoliTo:	€ 112.000,00

VISIONARY – Advanced VISual feedback for neurorehabilitatION systems based on virtuAl RealitY

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Andrea Cereatti

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. 202275443W

Ruolo PoliTo:

Partner

Abstract

mechanisms underlying the recovery and the effectiveness of treatments are often not completely unraveled. Neuromotor rehabilitation plays a crucial role in the reduction of disability with a positive impact on quality of life and social reintegration, also contributing to the reduction of the huge economic burden for the families and the national health system. For this reason, biomedical engineering research is striving to develop new technologies to this aim. Although robotics-based interventions have shown great potential, these solutions are still complex and expensive, which limits their widespread adoption. At the same time, low-cost systems exploiting simple bodyweight exercises, albeit adopting virtual reality (VR) and motion tracking tools, do not usually go beyond the conventional movement/task-oriented exercises. On these premises, the VISIONARY project aims at bringing bodyweight neuromotor rehabilitation beyond the conventional approaches, by studying the impact of advanced visual feedback in exercises featuring VR, for the improvement of the neural control of upper-limb movements. The project will conceive a new generation of bidirectional body-computer interfaces in which the information collected in real-time about upper-limb biomechanics and muscular activity, becomes a hidden actuator of the controlled virtual object in the VR. This approach will project each person in a virtual scenario characterized by physical laws, unknown to the participant, applied to the controlled object guiding to achieve the correct execution of the exercise and targeting specific changes of individual motor and muscle strategies. Visual effects applied to the controlled objects will include attractors, (visco)elastic fields, non-linear space distortions, and changes in its visibility. This innovative feedback will go beyond the current approaches, includingerror augmentation, targeting only final performance. Neuromotor recovery has many aspects in common

with the learning of motor skills: if opportunely programmed, these interfaces could help reshape compensatory motor strategies normally adopted to contrast the impairment, which leads to serious problems in the long term. This is particularly relevant in unsupervised rehabilitation, where corrections and feedback must be provided by automatic systems. By pursuing the adoption of unobtrusive affordable technologies, whose use can be widespread both in clinical settings and at home, for long-term rehabilitation programs, the project will overcome the limitations that relegate current expensive rehabilitation technologies to elite clinics. The technologies and methods developed in VISIONARY will be validated on unimpaired volunteers to assess adaptation and retention, and pilot-tested on a small cohort of people with spinal cord injury and stroke.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI GENOVA**

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering PE8_10 - Industrial design (product design, ergonomics, man-machine interfaces, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 315.891,00
Contributo totale progetto:	€ 256.683,00
Costo totale PoliTo:	€ 81.982,00
Contributo PoliTo:	€ 63.151,00

E-MIMIC - Empowering Multilingual Inclusive Communication (E-MIMIC)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Tania Cerquitelli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022WEFCFP

Ruolo PoliTo:

Coordinatore

Abstract

Today we observe two interrelated trends: (1) a significant increase in attention to inclusive languages, promoted by academia and policy makers, and (2) unprecedented successes in artificial intelligence and deep learning. The latter is considered one of the most important general-purpose methodologies and has played an important role in automating various language tasks but could also have a significant impact on advancing and promoting inclusive communication. Unfortunately, the proliferation of automated machine translation and conversational agents has further exacerbated the problem of non-inclusive texts. Because they generally rely on English-language, non-gender-specific document corpora, their ability to produce inclusive texts is quite limited. Innovative intelligent systems are urgently needed. This project, called E-MIMIC (Empowering Multilingual Inclusive Communication), is a joint effort of the Deep Learning Natural Language Understanding and Linguistics research communities with the goal of promoting and ensuring equality and inclusion in communication, thus contributing to a more inclusive, innovative, and reflective society. E-MIMIC relies on an innovative use of deep-learning methods for natural language processing trained on a new corpora of formal communication produced by Italian and French linguists in this project. The approach is groundbreaking because for the first time, high-risk concepts such as linguistic and discursive criteria for inclusive communication, data labeling of new corpora of formal communication, and strong human involvement in the data-driven methods are integrated into the core of deep-learning methods for natural language processing to automatically identify non-inclusive text snippets, suggest alternative forms, and produce inclusive text reformulations. Linguistic and discursive criteria for modeling diversity in a community (e.g., gender, special needs, age, ethnicity, and religion) and their intersectionality will be defined to fully represent them in formal communication. These criteria are being used by a large group of linguists to characterize a new

corpora of formal communication that various institutions (our universities and public administrations) provide us, and to propose alternative reformulations that reflect the color nuances of our society. Novel strategies for training deep-learning models for natural language processing will be coupled with human-in-the-analytics analysis loop strategies to ensure fair, privacy-friendly, and responsible data processing and to provide fair and unbiased models capable of correctly recognizing natural languages. Finally, an intelligent user interface will be developed to effectively interact with E-MIMIC, highlight portions of text that should be rewritten, see the rank of alternative forms, and create comprehensive text rewording. Using E-MIMIC, we aim to make inclusive communication accessible to a wide range of users.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI ROMA - TOR VERGATA**

Parole chiave

Settori ERC

PE6_7 - Artificial intelligence, intelligent systems, multi agent systems SH4_9 - Theoretical linguistics; computational linguistics SH4_11 - Pragmatics, sociolinguistics, discourse analysis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 5. Raggiungere l'uguaglianza di genere ed emancipare tutte le donne e le ragazze

Budget

Costo totale progetto:	€ 309.877,00
Contributo totale progetto:	€ 250.000,00
Costo totale PoliTo:	€ 135.478,00
Contributo PoliTo:	€ 116.968,00

ARCHIM3DES – ARchaeological and Cultural Heritage documentation In Marine environment using advanced 3D mEtric Survey techniques

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Filiberto Chiabrando

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20223W24AB

Ruolo PoliTo:

Partner

Abstract

"There are more ships lying at the bottom of the sea than there are sailing on it" (Matvejevic, 2007). This project aims to study, develop and test innovative archaeometry technologies and methodologies to provide knowledge, high-resolution surveys, monitoring for "in situ" preservation and enhancement for the ancient shipwrecks at different depths. In particular, the ancient shipwrecks (beached wrecks, low-medium depth, high depth) from Protohistorical to Mediaeval age are the most challenging underwater archaeological evidence concerning their valorization, documentation, and accessibility. This challenge is mainly due to their position, depth, and vulnerability of the wooden hull, as well as other organic materials of the cargo. The scientific community's growing interest in surveying and monitoring submerged assets arises from the increasing demand for high-resolution products with metric and radiometric contents. Although many instrumental and methodological solutions for the documentation, monitoring, and study of the archaeological and cultural heritage, through geomatics techniques, are already available for the terrestrial environment, for the underwater context (representing more than 70% of our planet's surface), the challenge is still open. In fact, the high-resolution capability and precise positioning in these contexts are still a big challenge. It is currently possible to speed up and make more cost-effective archaeologists' work, guaranteeing at the same time safety conditions during underwater operations, thanks to the use of underwater photogrammetry and the integration of various types of cameras and sensors (such as sonar and multibeam) installed on remotely operated submarine or surface drones. This novel underwater surveying methodology also allows the documentation and mapping of higher depths and considerable extensions. The underwater heritage is currently the privilege of a few professionals: the technologies

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developed by the project will thus enable access, fruition, and sharing of archaeological findings and marine landscape through immersive tours and 3D models. Moreover, the project aims to develop innovative and easy-to-use solutions based on integrated instrumentation and deliver a detailed description of the operative procedures useful in underwater archaeology and scalable to other fields of application. The significant impact of the project is undeniable. It can be resumed in: 1. increased comprehensive knowledge and awareness of these archaeological assets, with subsequent "in situ" preservation and control of the underwater archaeological sites concerning shipwrecks, their cargos, and onboard equipment; 2. safety in work operations; 3. wider accessibility, i.e. bringing heritage to a large public thanks to virtual fruition tools, which can enhance and return the underwater heritage to the community.

Persone coinvolte

- **Filiberto Chiabrando** (Responsabile Scientifico)
- **Andrea Maria Lingua** (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design
- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEL SALENTO** - Coordinatore

Parole chiave

Settori ERC

PE2_17 - Metrology and measurement SH6_3 - General archaeology, archaeometry, landscape archaeology

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 5. Raggiungere l'uguaglianza di genere ed emancipare tutte le donne e le ragazze|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 10. Ridurre l'ineguaglianza all'interno di e fra le nazioni|Obiettivo 14. Conservare e utilizzare in modo durevole gli oceani, i mari e le risorse marine per uno sviluppo sostenibile

Budget

Costo totale progetto:	€ 242.695,00
Contributo totale progetto:	€ 187.151,00
Costo totale PoliTo:	€ 119.158,00
Contributo PoliTo:	€ 87.701,00

PRECISE - APtameR based thEragnostiC strategy to impair the crosstalk between glIoma Stem cElls and their niche

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Alessandro Chiado'

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Ruolo PoliTo:

Partner

Abstract

Glioblastoma (GBM) has remained a disease with one of the worst prognoses and one of the most devastating outcomes over the past decades. Despite advancements in surgical methods, radiation therapy and chemotherapy, GBM patients have a current life expectancy of 14 to 15 months after diagnosis. The presence of the blood-brain-barrier (BBB) makes GBM treatment and diagnosis extremely challenging. Survival of GBM patients is seriously hampered by glioma stem cells (GSCs) due to their devastating therapy-resistance and self-replicating capacity. The properties of GSCs rely on a dynamic process of communication between them and their niches, a protective microenvironment in GBM. Extracellular vesicles (EVs) produced by GSCs are central in the inter-cellular communication with their hypoxic, vascular, and immune niches and hence maintain high intra-tumoral heterogeneity. EVs are accessible in biofluids and may contain valuable biomarkers for GBM patient diagnosis and follow-up. Aptamers, short synthetic DNA or RNA oligonucleotides are promising candidates for targeted therapies and diagnosis in brain diseases for their high specificity and stability, the ability to cross the BBB, lack of toxicity and immunogenicity. The present project (PRECISE) aspires at the development of novel therapeutic aptamer conjugates able to impair molecular mechanisms underlying the communication between GSCs and their niches. We will also exploit the possibility of a novel aptamer-based approach for the detection of GSC-derived EVs by a Surface Enhanced Raman Scattering (SERS) biosensing strategy in a microfluidic chip for early detection of GBM patients. These aims will be pursued because of a recently identified aptamer, A40s, that selectively targets GSCs and GSCs derived EVs. The investigation will increase knowledge on the mechanisms that regulate GSCs and will foster the identification of novel therapeutic (molecular and immunological) and diagnostic strategies, specifically targeting the GSCs. Finally, we will implement dissemination of the obtained results to “expert” and “non-expert” audience to promote awareness of GBM disease in the social community. To achieve these goals,

skills and knowledge in different scientific fields are put in place. Three Research Units (RU) characterized by different but complementary scientific expertise will be involved. It is expected that the PRECISE outcomes will move from basic research to translation medicine providing significant scientific benefits for the development of possible application as GBM therapeutic and diagnostic approach.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

LS7_2 - Diagnostic tools (e.g. genetic, imaging) PE4_2 - Spectroscopic and spectrometric techniques

Budget

Costo totale progetto:	€ 317.333,00
Contributo totale progetto:	€ 250.000,00
Costo totale PoliTo:	€ 60.000,00
Contributo PoliTo:	€ 60.000,00

AID-STRU - AgeIng and Degradation in the performances of STRUctures: model- and data-driven tools embedded in digital-twins

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Bernardino Chiaia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022X9TETW

Ruolo PoliTo:

Partner

Abstract

Ageing plays a key role in the management of the infrastructural heritage, with a wide range of consequences spanning from the safety of users to the economic costs, from the reparation techniques to the inconveniences and delays due to works. Knowing the current state of a manufact turns out to be a key desiderata for Authorities. In this Research Project, the problem of ageing and degradation of infrastructures will be studied through a hierarchical methodology, i.e., considering the scale of the material, of the structural element and of different infrastructure (e.g., bridge, large roof, etc). The target of the project is modelling the influence of ageing and degradation on the mechanical performances of materials and, thus, of the whole manufact, regardless of the origin of damage (e.g. physical or chemical attack, corrosion, fatigue, pitting, fire,..). Currently, Guidelines and Codes do not include specific indication for the modelling rules of ageing and degradation on existing civil structures. The approach normally aims at reaching a certain "level of knowledge" of the real mechanical performances of an infrastructure by means of destructive or nondestructive tests on materials and elements. Predictive degradation laws are still at the research level, showing poor relations with experiments at the real scale and practically no outputs for reliable engineering calculations and robust structural assessment. Recent collapses of bridges testify the need for a more consistent approach to the assessment of existing infrastructures. The aim of this project is to develop physically-based reliable models for ageing and degradation of ordinary or prestressed reinforced concrete and steel manufacts, including bridges, viaducts and large roofs

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

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Politecnico di Torino

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI CHIETI-PESCARA "G. D'ANNUNZIO"**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"** - Coordinatore

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Budget

Costo totale progetto:	€ 304.535,00
Contributo totale progetto:	€ 196.667,00
Costo totale PoliTo:	€ 99.140,00
Contributo PoliTo:	€ 64.024,00

LowImpactFuels4Met - Low environmental impact fuels for metallurgical industries

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- David Chiaramonti

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022P3PJXN

Ruolo PoliTo:

Partner

Abstract

Fuels and various energy sources play a fundamental role in the metallurgical industries. Steel production tends to be highly dependent on coal and/or gas for energy, for carrying out chemical reactions, or both. There are possibilities for reducing CO2 emissions at several points. The production has been gradually decarbonized by reducing the use of coal, which would be partially replaced by natural gas, oil, plastic waste, hydrogen, electricity, integration with CO2 capture, utilization and storage technology and sustainable biomass technology. Hydrogen is the most promising candidate for a low-carbon replacement, as it could offer significant climate benefits.The hydrogen production from non-renewable sources continue to grow all around the world because of the continuous needing of such energetic vector in the modern industry. Given the early stage of methane pyrolysis and the range of technologies available, an economic and efficiency evaluation of the process remains lacking. Assuming the technology successfully scales and the carbon black is not sold onto the market, the decision to build a methane pyrolysis facility or a blue hydrogen facility will largely depend on the handling of the carbon-based byproducts and its impact on the economics of hydrogen production. Obviously, the decarbonization of human activities needs that hydrogen will be produced through sustainable routes. One of the most promising ways is the electrolysis of water with the energy sources provided by renewables. By hydrogen-based steelmaking route, CO2 emissions would be reduced by more than 80%. Hydrogen steelmaking will depend profoundly on the availability of green hydrogen. It can be generated from natural gas or from water by electrolysis. Hydrogen, either pure or as a synthesis gas through reforming methane or natural gas, can be used in conventional direct-reduction reactors or in more futuristic flash reactors. These hydrogen production technologies will provide a crucial support for the development of hydrogen metallurgy in steel industry. The project will be developed through different Tasks

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carried out by the different partners always connected and collaborating each other. The project Tasks will be: T1-Hydrogen production through electrolysis (University of Salento) Months 0-18 T2-Natural gas pyrolysis (Polytechnic of Turin; Polytechnic of Milan) Months 0-9 T3-Pyrolysis carbon production for metallurgical furnaces (Polytechnic of Milan) Months 0-9 T4-Direct reduced iron production through hydrogen (University of Salento) Months 10-21 T5-Microstructural characterization of pre-reduced iron (University of Salento) Months 13-22 T6-Cast iron production from pre-reduced iron and pyrolysis carbon (Polytechnic of Milan) Months 17-21 T7-Employment of pyrolysis carbon into fuel cells (Polytechnic of Milan) Months 10-14 T8- Management, coordination and dissemination (University of Salento; Polytechnic of Turin; Polytechnic of Milan) Months 0-24

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEL SALENTO** - Coordinatore

Parole chiave

Settori ERC

PE8_9 - Production technology, process engineering PE8_11 - Sustainable design (for recycling, for environment, eco-design)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 236.621,00
Contributo totale progetto:	€ 196.963,00
Costo totale PoliTo:	€ 53.500,00
Contributo PoliTo:	€ 47.000,00

PREDICT - Adverse cardiovascular events in coronary Plaques not undeRgoing pErcutaneous coronary intervention evaluateD with optIcal Coherence Tomography. The PREDICT machine-learning risk score

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Claudio Chiastra

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022497RZ4

Ruolo PoliTo:

Partner

Abstract

Acute coronary syndrome (ACS) most commonly arises from thrombosis of coronary artery lesions that angiographically appear mild, typically with non-flow limiting stenosis, but pathologically contain large plaque burden with an organized lipid-rich necrotic core that is separated from the lumen by a thin fibrous cap. These thin cap fibroatheromas place patients at risk for future unstable angina, acute myocardial infarction (MI) and cardiac death, and they have been termed vulnerable plaques (1-3). In this context, optical coherence tomography (OCT) has emerged as one of the most promising tools to assess patients with coronary lesions and to detect key features of plaques at high risk for rupture and consequently responsible of future cardiovascular events (4-6). However, whether prophylactic revascularization of non–flow-limiting vulnerable plaques might improve patient prognosis is unknown (7). To date, the diagnostic yield of invasive and noninvasive imaging techniques in predicting future major adverse cardiovascular events (MACE) among patients with vulnerable plaques remain low and the treatment of non-flow limiting stenosis with high-risk features is still controversial (8). Although the presence of high-risk coronary lesion features confer a higher and exponential risk of adverse events, there are no available imaging and clinical based risk scores that predict the risk of MACE at follow-up in patients with non-flow limiting coronary artery stenosis. The aim of our project is to predict with the aid of artificial intelligence (AI) and machine learning techniques the natural history of non-flow limiting coronary artery stenoses, and to develop and validate a machine learning risk score capable of estimate the risk of MACE during follow-up based on the OCT findings observed at the coronary

plaques not undergoing percutaneous coronary intervention (PCI) and the clinical characteristics of the patients (9,10). We will collect information on all the coronary lesions not undergoing PCI evaluated by performing OCT in non-culprit vessels of patients presenting with ACS at the index procedure. All the OCT runs will be digitalized and analyzed with the aid of AI. The OCT appearance of the coronary plaques will be analyzed with AI and related with the risk of MACE during follow-up (a composite of cardiac death, and myocardial infarction). A predictive risk AI model based on the OCT images of the coronary plaques and the clinical characteristics of the patients will be developed to estimate the risk of the incidence of MACE at follow-up. State-of-the-art machine learning algorithms, including convolutional neural networks, random forests, and support vector machines, will be exploited and we will calculate the area under the curve (AUC) of the receiver operating characteristic curve for the internal validation dataset to select a probability threshold, which we will apply to the testing dataset.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università Cattolica del Sacro Cuore**
- **Università degli Studi di Napoli Federico II**
- **Università degli Studi di Torino** - Coordinatore

Parole chiave

Settori ERC

LS4_7 - Cardiovascular diseases LS4_1 - Organ physiology and pathophysiology PE6_7 - Artificial intelligence, intelligent systems, multi agent systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 220.702,00
Contributo totale progetto:	€ 187.479,00
Costo totale PoliTo:	€ 49.800,00
Contributo PoliTo:	€ 41.529,00

DESIRE - Design and validation of an advanced delivery system for miRNAs and stem cell-derived extracellular vesicles for direct cardiac reprogramming through a mechanically-stimulated human cardiac scar model - DESIRE

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Valeria Chiono

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022YS87H7

Ruolo PoliTo:

Coordinatore

Abstract

Ischemic heart disease is the major cause of mortality worldwide, making the demand for safe and effective cardiac regeneration approaches an urgent need. In vitro pathological cardiac tissue models may support efficient design and preclinical validation of new advanced therapies in compliance with 3Rs principle (Reduction, Refinement, Replacement). Among investigated approaches, non-viral direct reprogramming (DR) of cardiac fibroblasts (CFs) into induced cardiomyocytes (iCMs) triggered by microRNA release has emerged as a promising strategy for in situ treatment and cardiac function recovery, although it is limited by low efficiency. DESIRE project aims at exploiting interdisciplinary and complementary expertise, including tissue engineering, biomaterial design, nanomedicine, human stem cell extracellular vesicle biology, microfluidics and in vitro modelling, to significantly enhance cardiac DR efficiency. DESIRE will design an advanced DR approach for post-infarct cardiac regeneration based on in situ delivery of four reprogramming microRNAs, called miRcombo. To improve treatment specificity, efficiency and safety, miRcombo-loaded lipoplexes will be surface decorated with hyaluronic acid (HA-LPs), to bind CD44 receptors overexpressed by CFs during post-infarct inflammation. To improve in situ retention of HA-LPs/miRNA, they will be administered by an injectable bioactive hydrogel, obtained by blending natural polymers, such alginate (ALG), its derivative di-aldehyde alginate (ADA) and gelatin modified with carbohydrazide (GEL-C), forming a double crosslinked network by calcium ions and Shiff's base reaction. Human amniotic fluid stem cell-derived extracellular vesicles (hAFS-EVs) providing paracrine cardio-protection, antifibrotic

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and anti-inflammatory signaling will be co-encapsulated in the hydrogel for gradual release to further enhance DR efficiency ("priming treatment"). The bioactive hydrogel will be provided with proper biochemical and biophysical cues to maximize DR efficiency and iCM maturation, and will be validated in a novel human cardiac scar on a chip simulating post-injection hydrogel-tissue interaction. The model will also impart in vivo-like mechanical stimulation, responsible for the establishment of a fibrotic microenvironment and will allow live-recording of electrophysiological parameters. In vitro preclinical validation of DESIRE advanced approach will involve a comparison of the structural and functional properties of iCMs with human adult CMs and induced pluripotent stem cell-derived CMs, healthy cardiac tissue model (positive control) and untreated cardiac scar model (negative control). In vitro preclinically-validated advanced approach from DESIRE will support new technological developments and collaborative projects at EU level for progressive translation into clinical settings. Perspective applications include cardiac regeneration from ischemic, acquired or inherited heart fibrotic disease.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI GENOVA**

Parole chiave

Settori ERC

LS7_6 - Gene therapy, cell therapy, regenerative medicine PE8_13 - Industrial bioengineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 228.720,00
Contributo totale progetto:	€ 197.500,00
Costo totale PoliTo:	€ 82.950,00
Contributo PoliTo:	€ 71.100,00

HERO - Smart injectable Hydrogels carrying multi-functional nano-systEms to tackle chRonic wound biOfilm through an antibiotic-free approach

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Gianluca Ciardelli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022C2B8T8

Ruolo PoliTo:

Coordinatore

Abstract

Chronic skin wounds (CSWs) affect more than 40M patients globally and represent a growing burden for the healthcare systems (costs > $18.5B in 2022). Among the different factors contributing to wound chronicity, bacterial infections and biofilms represent the most severe issues to face in wound management (over 60% of CSWs contain biofilm). In this scenario, the gold standard treatment encompasses biofilm eradication and bacterial burden reduction through debridement and antibiotic administration. However, antibiotic administration should not be used indiscriminately as their wide application increases the risk of selection of multidrug-resistant organisms, resulting in adverse events and treatment failure. To provide significant breakthroughs in the available therapeutic approaches for an CSW treatment, HERO will engineer a smart injectable multifunctional hydrogel able to dislodge biofilm, while preventing its relapse, reducing the overall microbial burden, and creating a favorable environment for the healing process. To gather all these features within a single injectable formulation HERO will combine a lactoferrin-loaded thermo-sensitive and alkaline pH-responsive bioartificial hydrogel based on a custom-made amphiphilic poly(ether urethane) bearing pendant -COOH and hyaluronic acid, with farnesol-loaded quaternary ammonium palmitoyl glycol chitosan (F-GCPQ) micelles. Micelle nano-size and chemical nature will favour biofilm infiltration and dislodging, further enhanced by the antibiofilm effect of the progressively released farnesol. The concurrent release of lactoferrin will provide additional antimicrobial, anti-inflammatory, and pro-healing properties. Furthermore, the inclusion on hyaluronic acid is expected to further stimulate the creation of a favorable environment to initiate the healing cascade, while providing an acidifying effect of the wound bed pH that is expected to contribute to microbial load decrease.

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Lastly, HERO alkaline pH-responsiveness will accelerate payload release in response to the absorption of CSW alkaline exudate, thus resulting in a prompt adaptation of system behavior to the wound status. HERO formulation will be easy to prepare, handle and inject, thus answering to the need of new antibiotic-free wound care products suitable for auto-medication too. It will be engineered to remain in loco for up to 72h thus avoiding the need for a daily dressing replacement and will be easy to remove by simple irrigation with water solutions, with significant advantages in terms of patient comfort and healthy tissue preservation. Lastly, the use of the scented farnesol will enhance patient psychological wellness, being smell a recurrent issue in CSWs. HERO has thus been conceived to significantly impact the biomedical field, providing a new approach for CSW treatment. Finally, its multi-component nature will allow a flexible design of the therapeutic approach that might be adapted to patient-specific strategies.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI FIRENZE**
- **UNIVERSITA' DEGLI STUDI DI MODENA E REGGIO EMILIA**

Parole chiave

Settori ERC

LS6_9 - Bacteriology PE8_13 - Industrial bioengineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 224.620,00
Contributo totale progetto:	€ 197.036,00
Costo totale PoliTo:	€ 82.820,00
Contributo PoliTo:	€ 71.627,00

RECYCLE-CO2 - A Combined Experimental and Theoretical Approach for Single-Atom Catalyst Engineering Towards Tuneable Activity and Selectivity in CO2 electroreduction

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Giancarlo Cicero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Ruolo PoliTo:

Partner

Abstract

RECYCLE-CO2 focuses on the electrochemical reduction of CO2 (CO2RR) into valuable chemicals and fuels using innovative and selective electrocatalysts. CO2RR, although being very promising, confronts many challenges due to the low energy content in CO2, high reaction energy barriers, slow kinetics for CO2 electroreduction, and low selectivity toward a specific product. Therefore, the design and development of highly active and selective catalysts is crucial for practical application of electrocatalytic CO2RR. In this project, high-efficiency electrochemical CO2 conversion will be achieved by synthesizing a new generation of single atom catalysts (SACs) with engineered dual-coordination dispersed in carbon nanotubes. The state of the art of CO2RR catalysts based on SACs mainly consists of transition metal atoms (M) with porphyrin-like M-N4 moieties embedded in the support. In RECYCLE-CO2, we aim at achieving direct control of SACs' activity and selectivity by modifying M first coordination shell. With this goal, we will substitute one or more N atoms in the M-N4 moiety with less electronegative elements, such as P and S. We expect that this will result in unique electronic properties (e.g. charge/spin states, electron density near Fermi level), distinct from those observed for the corresponding M-N4. Specifically, we aim at forming asymmetrical atomic interfaces with a tunable energy level of the metal d orbitals in order to facilitate the binding of CO2RR key intermediates on the active sites and lower their adsorption energy barriers. The control over the SAC structural and electronic properties will allow us guiding the reaction towards specific C1 products such as CO, HCOOH, CH4 and CH3OH. The goal of RECYCLE-CO2 is not only the preparation of SAC electrocatalysts, but is more ambitious: by combining theory and experimental approaches, we want to develop a reliable procedure to modify and control the electronic and structural properties of SACs, by engineering the SACs' local environment, in order to boost the

CO2RR reaction and tune the products selectivity. Materials innovation will be guaranteed by a collaborative network gathering theoretical and experimental know-how. Ab initio simulations will be combined with state-of-the art analysis of the catalyst during realistic operando conditions to identify the catalytically active sites and clarify reaction mechanism. This will provide a fundamental understanding of structure/composition-activity relationships and will allow tailoring SAC coordination shell to achieve improved selectivity. The research groups involved in RECYCLE-CO2 have complementary expertise which will guarantee successful achievements of the project objectives, in particular: (i) the group at UNIPD has unique know-how in the synthesis and operando characterization of innovative electrocatalysts; (ii) the group at Politecnico di Torino (POLITO) is expert in catalysts design by means of ab initio simulations.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PADOVA** - Coordinatore

Parole chiave

Settori ERC

PE4_4 - Surface science and nanostructures

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell'ecosistema terrestre

Budget

Costo totale progetto:	€ 262.362,00
Contributo totale progetto:	€ 199.712,00
Costo totale PoliTo:	€ 112.589,00
Contributo PoliTo:	€ 81.722,00

LIFEBLOOD - A lab-on-a-chip integrated with electrochemical transistors for cardiac biomarkers evaluation in human blood (LIFEBLOOD)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Matteo Cocuzza

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022KTJLHL

Ruolo PoliTo:

Partner

Abstract

A timely medical intervention is sometimes a matter of life and death, as in the case of acute myocardial infarction (AMI), thus making rapid diagnosis fundamental for saving patient lives. AMI is characterized by damage to the cardiac myocytes and represents one of the most severe consequences of cardiovascular diseases, a global health problem that demands a strong approach to prevention and early treatment. For many years, the traditional electrocardiogram (ECG) has been used in hospitals to diagnose the occurrence of a heart attack, but then it has been revealed to be an insufficient approach. To gain a rapid response of analysis and prevent mortality, today, there is a strong demand for the development of new diagnostic tools able to provide, in particular, the real-time detection and monitoring of biomarkers in biological fluids. Since its first identification as biomarker for AMI in the 80s, cardiac troponin (cTnI) has become the gold standard for AMI diagnosis due to its release in blood only upon direct myocardium damage. However, still to date, there is an urgent need of portable systems enabling to measure the levels of cTnI at the bedside combining sensitivity, speed and small sample volume. In this scenario, it remains crucial as well the differential diagnosis between AMI and other cardiac events, including myopericarditis. C-reactive protein (CRP), for example, is a highly specific indicator of inflammation and myocardial ischemia. The cardio/inflammation-specificity of cTnI and CRP along with their long persistence in the blood make them valuable biomarkers providing an extended diagnostic window for the detection of AMI. Therefore, CRP-cTnI ratio is an effective approach for differential diagnosis of AMI. LIFEBLOOD presents a groundbreaking approach for the real-time detection of cTnI and CRP starting from a sub-milliliter volume of human blood. This ambitious goal will be pursued through the development of an innovative lab-on-chip (LOC)

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platform, integrating microfluidic technology, to separate blood cells and plasma, and highly-sensitive biosensors, based on Organic Electrochemical Transistors (OECTs) gated by electrodes properly functionalized with antibodies and aptamers as recognition molecules, to detect and monitor in-line cTnI and CRP and estimate CRP-cTnI ratio for AMI diagnose. The main scientific and technological challenges will be addressed by combining a number of innovative approaches including the use of advanced micromachining techniques, the detailed analysis of various biofunctionalization patterns, the application of robust testing protocols mainly relying on differential electrical measurements, the contemporary availability of both healthy and pathological blood with known concentration of cTnI and CRP. The efforts to sustain the project objectives will be in charge of a young, dynamic and interdisciplinary research group with specific and synergistic competences in all the required fields.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore

Parole chiave

Settori ERC

PE4_11 - Physical chemistry of biological systems PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors PE8_5 - Fluid mechanics, hydraulic-, turbo-, and piston engines

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 265.867,00
Contributo totale progetto:	€ 199.961,00
Costo totale PoliTo:	€ 77.648,00
Contributo PoliTo:	€ 59.486,00

IEES - Institutions, Education and Entrepreneurship Studies: a Novel Perspective on University Impact (IEES)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alessandra Colombelli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022_AYY9RK

Ruolo PoliTo:

Partner

Abstract

IEES investigates the phenomenon of student entrepreneurship (SE, i.e. “entrepreneurial endeavors undertaken by university students”) and focuses on its diffusion and impact in Italy across its different manifestations and on how higher education institutions (HEIs) ecosystems influence such manifestations.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI BERGAMO** - Coordinatore

Parole chiave

Settori ERC

SH1_10 - Management; marketing; organisational behaviour; operations management SH1_9 - Industrial organisation; strategy; entrepreneurship

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 4. Fornire un’educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti|Obiettivo 5. Raggiungere l’uguaglianza di genere ed emancipare tutte le donne e le ragazze

Budget

Costo totale progetto:	€ 255.361,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell’Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Contributo totale progetto:	€ 204.103,00
Costo totale PoliTo:	€ 26.569,00
Contributo PoliTo:	€ 16.959,00

THEROCKLAB - THErmo- and hydro-mechanical monitoring and modeling of jointed ROCKs: a national Site LABoratory network

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Chiara Colombero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università della Ricerca)

Codice identificativo progetto:

2022BSFCHK

Ruolo PoliTo:

Coordinatore

Abstract

THEROCKLAB focuses on the study of thermo- and hydro-mechanical processes affecting fractured rock masses, through multisensor monitoring and modeling approaches. A national network of small-scale potentially unstable rock compartments, monitored with a common integrated methodology, is established within the project. The selected rock masses are exploited as site laboratories to assess the predisposition to failure linked to the natural meteorological and climatic forcing. The five field labs are located along the Alps and the Apennines to maximize the variety of geo-structural settings potentially prone to instability and the possible environmental and climatic conditions. The four research units involved in the project (POLITO, UNIBO, UNIROMA1, UNIMIB) carry different expertise and methodological approaches to the monitoring and modeling of unstable rock masses. Their experience is integrated in THEROCKLAB for the design, instrumentation, long-term continuous monitoring of a new site lab located in the periglacial environment and likely affected by permafrost degradation. The integrated methodology mainly involves continuous passive seismic and geomechanical monitoring, coupled with remote Ministero dell'Università e della Ricerca MUR - BANDO 2022 sensing techniques. Data collected at the different site labs are then integrated and interpreted as a function of the external meteorological and climatic conditions, with a special focus on air temperature and precipitation effects on site stability. The selection of a site lab located in an abandoned quarry makes experiments in forced thermal and vibrational conditions feasible within the project. These tests allow for exploring the evolution of mechanical properties until the final collapse in comparison with natural forcing conditions, for early warning perspectives. Similar tests, including freezing-thawing cycles, are carried out at the laboratory scale on intact and fractured rock blocks intrumented for the continuous

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Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

monitoring of deformations and seismic parameters during the experiments. The lab scale is used as a proxy to improve the understanding of the correlation between rock mass quality and susceptibility to damage due to the thermal and hydrogeological drivers recorded at the field scale. The experiments are also designed to explore the sensitivity of seismic and mechanical parameters close to failure, in comparison with natural conditions. Both lab and field scales make extensive use of numerical modeling for a deeper understanding and quantification of the recorded thermo- and hydro-mechanical processes and to forecast possible field instabilities. THEROCKLAB final aim is to define standard procedures for a multi-scale characterization, monitoring and modeling of hydro- and thermo-mechanical effects on fractured rock masses, to promote the spread of diffuse monitoring and prevention of natural hazards.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI MILANO BICOCCA**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

PE10_7 - Physics of earth’s interior, seismology, volcanology PE10_5 - Geology, tectonics, volcanology

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 268.704,00
Contributo totale progetto:	€ 189.541,00
Costo totale PoliTo:	€ 79.304,00
Contributo PoliTo:	€ 60.646,00

RRMA - Rockfall risk mitigation in the Alps

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Vincenzo Corrado

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20223MKEMB

Ruolo PoliTo:

Partner

Abstract

L'obiettivo principale del progetto è lo sviluppo di modelli accurati ed esportabili di trasmissione del calore della roccia, specifici per diversi litotipi, da utilizzare per la mitigazione del rischio in aree soggette a caduta massi ad alta quota. Il progetto avrà come oggetto l'area alpina già strumentata del bacino glaciale della Bessanese, che negli anni passati è stata banco di prova della ricerca sul monitoraggio della caduta massi con tecniche innovative e ha visto una stretta collaborazione con la metrologia e con il contributo dell'INRiM, nell'ambito dei progetti RIST e RIST2 guidati dal CNR-IRPI, nonché l'iniziativa GeoClimAlp. Questi progetti hanno proposto un approccio metrologico alle misurazioni della temperatura nei siti ad alta quota, al fine di caratterizzare le condizioni meteorologiche e geologiche che innescano le frane nelle Alpi. La presente proposta, dopo diversi anni di ricerca sulle cause della caduta massi nelle Alpi, permetterà di passare alla fase successiva. In particolare, affinerà l'approccio già applicato in passato con nuova strumentazione, più litotipi e diverse pareti rocciose con diverse esposizioni solari, al fine di ampliare la conoscenza dei meccanismi cruciali per lo sviluppo delle instabilità rocciose. L'unità di ricerca guidata dal CNR IRPI installerà, monitorerà e gestirà tutta la strumentazione nel bacino glaciale della Bessanese, eseguirà l'analisi e individuerà anche un secondo sito alpino adatto a nuova strumentazione, che entrerà in gioco nella seconda parte di questo progetto. Tutta la strumentazione sarà accuratamente calibrata e caratterizzata da INRiM, sia in laboratorio sia in campo, grazie a numerosi strumenti portatili, ideati e realizzati a tale scopo durante i progetti MeteoMet e MeteoMet2. Questa proposta prevede anche la caratterizzazione termica di laboratorio di diversi litotipi, al fine di comprenderne il comportamento quando sottoposti a particolari condizioni ambientali (sbalzi di temperatura, vento, pressione, radiazione solare, contenuto di umidità), grazie alle strutture uniche disponibili presso INRiM, come la galleria del vento/camera climatica EDDIE. Sulla base di questa caratterizzazione termica, il Politecnico di Torino costruirà un modello numerico che simulerà e spiegherà il

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

comportamento termico di questi diversi litotipi soggetti a queste condizioni. Tali modelli verranno poi testati sul campo, utilizzando il secondo sito alpino individuato dal CNR IRPI come validatore dei modelli, valutandone l'esportabilità e la possibilità di essere applicati anche ad altre aree dell'arco alpino.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **I.N.RI.M. - ISTITUTO NAZIONALE DI RICERCA METROLOGICA** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE10_18 - Cryosphere, dynamics of snow and ice cover, sea ice, permafrosts and ice sheets PE1_18 - Scientific computing and data processing

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell'ecosistema terrestre

Budget

Costo totale progetto:	€ 279.496,00
Contributo totale progetto:	€ 189.955,00
Costo totale PoliTo:	€ 73.720,00
Contributo PoliTo:	€ 52.060,00

INSSPIRED SOULS - INnovative and Sustainable Stabilization Processes Involving REcycleD SOils and Used materiaLS – INSSPIRED SOULS

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Renato Maria Cosentini

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022EFFE52

Ruolo PoliTo:

Partner

Abstract

Soil stabilization by binders (e.g. lime and cement) is a widely applied technique to improve hydro-mechanical properties of excavated soils that, otherwise, must be disposed in landfill, with significant economic and environmental costs (energy consumption and CO2 emission in transport, space-consuming in landfills). In this perspective, soil stabilization by binders certainly is a geotechnical engineering application that aims at the sustainable reuse of soils. However, traditional binders production causes significant CO2 emission and extraction of the raw material for their production is an unsolved environmental issue. Soil stabilization using innovative binders such as industrial by-products can increase the sustainability level achieved with stabilization, taking advantage of the circular economy framework. This PRIN proposal aims to further enhance the sustainable feature of the soil stabilization, focusing on both the binder types and theMinistero dell'Università e della Ricerca MUR - BANDO 2022 material to be reused. The main objectives of the research are: (1) Investigate the feasibility of soil stabilization using by-products from industry (e.g. fly ashes, blast furnace slag, marble slurry) allowing their reuse in geotechnical applications. (2) Study the stabilization process of soils whose management represents an environmental issues to be solved (in Italy and abroad) such as dredged sediments or very soft soils. (3) Analyze the stabilization capability of traditional or innovative binders for contaminated materials (e.g. dredged sediments) and for the application in impervious barriers for pollutants containment (e.g. hydraulic cutoff walls). (4) Evaluate the long-term behavior and durability of the stabilized soils after severe and prolonged environmental and chemical conditions. The research will be developed by experimental activities aiming at the chemo-hydro-mechanical characterization of different geomaterials (clayey soils, dredged sediments, very soft soils), before and after stabilization with different types of

binders. In particular, the study of different saturation conditions and effectiveness of chemical binder-soils processes will allow to optimize the mix design procedure also by identifying reliable and easy-to-determine parameters to monitor the reaction progress over time, also evaluating the induced modification from a microstructural point of view. The study will be conducted benefiting from the broad background experience and know-how of the three research units on stabilization of soils by traditional binders, behavior of unsaturated soil, laboratory geophysical characterization and microstructural analysis of geomaterials. Each research unit will contribute with its laboratory equipment and expertise. All results and knowledge gained during the project will be disseminated through drafting of technical guidelines and the promotion of a final workshop open to all the interested stakeholders.

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' POLITECNICA DELLE MARCHE** - Coordinatore

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_11 - Sustainable design (for recycling, for environment, eco-design) PE10_17 - Hydrology, water and soil pollution

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo|Obiettivo 17. Rafforzare i mezzi di attuazione e rinnovare il partenariato mondiale per lo sviluppo sostenibile

Budget

Costo totale progetto:	€ 237.078,00
Contributo totale progetto:	€ 197.482,00
Costo totale PoliTo:	€ 75.199,00
Contributo PoliTo:	€ 63.990,00

The new Italian geographies of logistics. Between post-pandemic transition and multi-level policy responses.

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Giancarlo Cotella

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022TRFAA5

Ruolo PoliTo:

Coordinatore

Abstract

Within the social sciences and public debates, the Covid-19 pandemic has catalysed attention on its geographical diffusion and impact on selected sectors. Less is known on how it affected the multilevel spatialities of logistics and how the latter intertwines with the transition that awaits cities and regions. Initial contributions on the matter were developed within the emerging literature on 'operational landscapes', for which logistics activities are necessary to the functioning of cities and regions, while generating selected negative impacts (on liveability, congestion, health etc.). To shed light on the matter, the research analyses the geography of the territories of logistics in Italy, how they have been impacted by the pandemic and how they are planning their post-pandemic future. More in detail, it addresses three main aspects: The uneven geographies of logistics. The pandemic had an uneven impact on Italian regions, spreading from and hitting more severely highly exploited territories such as manufacturing districts and logistics hubs. It caused asymmetric effects, which were path-dependent on peculiar specialisations, socioeconomic vulnerability and spatial marginality, in so doing exacerbating existing inequalities. The project maps these phenomena in the country and develops a typology of the Italian territories of logistics. The governance of the post-pandemic transition of logistics. Logistics is high on the agenda of regions and companies, even more so in relation to the role it can play in the post-pandemic transition. Also the Italian National Recovery and Resilience Plan (NRRP), launched within the EU Recovery and Resilience Facility and aimed at paving the way for long-term economic recovery, is characterised by a marked focus on logistics. However, the topic is approached in rather sectoral terms, disregarding socio-spatial and local governance implications. Through selected case studies, the project explores the local implication of the pandemic and the governance mechanisms through which local actors attempt to reconcile supralocal policies and

the peculiar nature of their territories. The development of place-based policies. The project develops guidance concerning the case study territories and their governance dynamics. The results will also be analysed in relation to their relevance to other territories of logistics in Italy and in Europe. Finally, the collected evidence will inform the development of supralocal policies that approach the issue of logistics through a place-based approach. Overall, while geographical focusing on the Italian context, due to the strong relevance of the issues at stake for most European countries, the result of the research will provide a timely contribution to the international scientific and policy debate on the post-pandemic transition of the territories of logistics and, more in general, to the emerging literature on the operation landscapes.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **Gran Sasso Science Institute - Scuola Universitaria Superiore**
- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

SH2_9 - Urban, regional and rural studies SH2_11 - Human, economic and social geography

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 261.627,00
Contributo totale progetto:	€ 202.357,00
Costo totale PoliTo:	€ 119.507,00
Contributo PoliTo:	€ 86.287,00

ENVIREG4FIRMS - Environmental regulation and the pressure towards a sustainable reallocation of international trade flows: new empirical evidence from Italy

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Anna D'Ambrosio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Ruolo PoliTo:

Partner

Abstract

The increasing attention to climate change brings sustainability high on the agenda of governments and international institutions. Public policies are increasingly regulating the use of polluting substances, the production of hazardous waste, emissions, deforestation, and the protection of animal stocks. The EU Green New Deal and the recent Piano Nazionale di Ripresa e Resilienza (PNRR) are good examples of how the EU and national governments try to force firms in the direction of increasing sustainability of the production process. However, these are only the most recent measures of a longer-term process of stimulation towards the so-called green transition. One of the key hindrances toward a green transformation is the alleged trade-off between growing versus greening the economy (Brandi et al 2020). Indeed, environmental provisions impose compliance costs on domestic firms, causing a restructuring of firms' sourcing strategies and technologies. If the costs of reorganizing production become too high, they may offset part of the benefits. Moreover, large asymmetries in the stringency of environmental policies across countries may drive firms to offshore their production toward countries or regions with less stringent regulation, defined as "pollution havens" (Levinson and Taylor, 2008), through import or by directly moving some production phases via outward foreign direct investment (FDI). On a more positive side, Porter and van der Linde (1995) argue that stricter environmental policies can stimulate efficiency improvements and innovations in greener technologies that turn out to increase domestic firms' competitiveness or induce a greening of the production outcomes. This project positions within the lively debate on whether environmental policies drive more costs or more benefits, i.e. ultimately between the prevalence of the "pollution haven" (PHH) vs. the "Porter" hypothesis (PH), focusing on the Italian context, with an empirical approach. We leverage detailed firm-level data on import, export, and FDI of Italian firms, and the quasi-experimental setting introduced by a

major policy change in environmental protection, i.e., the REACH regulation, one of the most relevant and impacting regulations for the physical production of goods in the EU. Specifically, we intend to exploit, with a diff-in-diff approach, the shock introduced by the REACH regulation to the imports of Italian firms to study how this affected their costs, production technology, offshoring decisions, and the sustainability of their international trade flows. An immediate outcome of the project is expected to be an impact evaluation of the environmental policy per se. More broadly, we expect to shed light on the potential threat and opportunities of environmental policies for Italian firms, as well as on internal and external factors their reaction to the regulatory context.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **Alessandro Manello - Università degli Studi di Torino** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

SH1_2 - International trade; international business; international management; spatial economics SH1_12 - Agricultural economics; energy economics; environmental economics SH1_6 - Econometrics; operations research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età|Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 257.304,00
Contributo totale progetto:	€ 199.604,00
Costo totale PoliTo:	€ 82.500,00
Contributo PoliTo:	€ 76.300,00

PAIN AND GAIN - Positioning And INtelligent Alarms supported by a New Dense GNSS Affordable Infrastructure

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Paolo Dabove

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022P8C7ZA

Ruolo PoliTo:

Coordinatore

Abstract

Accurate knowledge of real-time positioning of people, objects and goods is essential for many applications, both outdoor and also indoor or underwater contexts: positioning is an enabling technology in many cases, ranging from navigation, autonomous terrestrial and aerial vehicles, precision agriculture to landslide monitoring, just to cite few. The spread of wearable and low-cost (LC) devices, like smartphones and tablets, has increased the possibility to improve the positioning knowledge of non-professional users in outdoor areas. However, the use of these instruments for precise positioning is uncommon because the methodologies needed for such aim are not completely developed and ready to use. Besides, it is still challenging to use these devices in mountain areas, where infrastructures (e.g., GNSS permanent stations, Long Term Evolution connection, etc.) are not available. In this context, this research project wants to pursue the usability of LC and portable devices for precise positioning in challenging conditions, where the positioning reliability usually cannot be guaranteed, and to test the implemented solutions in pilot studies of wide interest, in particular for the public safety.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Parole chiave

Settori ERC

PE10_14 - Earth observations from space/remote sensing

Budget

Costo totale progetto:	€ 269.992,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Contributo totale progetto:	€ 195.608,00
Costo totale PoliTo:	€ 122.880,00
Contributo PoliTo:	€ 83.528,00

URGET VADEMECUM 2030-50 - URban de-pollution and de-carbonisation from emissions GEnerated by Transport systems: eVAluation of DEdicated Methodologies, technologies and EConomic thresholds for an unprecedented Mobility at 2030-50

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- **Bruno Dalla Chiara**

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022LWA9W7

Ruolo PoliTo:

Partner

Abstract

The general goal of the research project URGET VADEMECUM 2030-50 is to tackle both local pollution and global carbon neutrality issues in the urban context regarding mobility and related transport systems in the short, medium and long term. This goal is pursued by proposing new technological solutions, clustering real data, quantifying potential modal shift towards less pollutant solutions for satisfying mobility and – most of all- by developing an innovative assessment methodology aimed at defining tailor-made, place-based, as well as unprecedented solutions for decarbonized, sustainable urban mobility. This is in line with the objective of climate-neutral transport by 2050, pursued by the Sustainable and Smart Mobility Strategy (2020) adopted in the framework of the European Green Deal, the New European Urban Mobility Framework (2021), and the other policies and intermediate targets set by the EU for 2030 about sustainable cities and transport, taking into account Directive 50/2008. The proposed methodology, based on the combination of consolidated evaluation tools that are re-interpreted in an up-to-date way, will support decision-making and fund-raising by selecting and calibrating different measures to reduce/eliminate transport-related pollution and GHG emissions.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UKE - Università Kore di ENNA**
- **Università degli Studi di FIRENZE** - Coordinatore
- **Università degli Studi di Napoli Federico II**

Parole chiave

Settori ERC

SH2_8 - Energy, transportation and mobility SH2_7 - Environmental and climate change, societal impact and policy

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 256.705,00
Contributo totale progetto:	€ 202.465,00
Costo totale PoliTo:	€ 64.265,00
Contributo PoliTo:	€ 49.528,00

Luoghi e storie di prossimità. Una metodologia per la rigenerazione degli spazi collettivi dei quartieri moderni

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Filippo De Pieri

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. 2022XZZYA5

Ruolo PoliTo:

Partner

Abstract

Il progetto propone di sperimentare una metodologia di ricerca finalizzata alla rigenerazione degli spazi collettivi dei quartieri moderni come risorsa cruciale per affrontare le sfide poste all'abitare dalla crisi pandemica. La proposta intende infatti contribuire al progetto di una "città della prossimità", creando le condizioni per far incontrare la significativa offerta di spazi collettivi nei quartieri moderni con la nuova domanda di spazi e servizi di prossimità generata dalla diffusione di stili di vita e lavoro più intensamente legati agli ambienti abitativi, nonché con la domanda di socialità espressa dalle comunità attraverso forme di riappropriazione dei luoghi e di welfare informale. Nello specifico, il progetto di ricerca intende sperimentare una metodologia di intervento multidisciplinare e partecipata da mettere a disposizione di enti locali, proprietari, associazioni di cittadini e soggetti privati interessati alla rigenerazione di spazi e servizi collettivi nei quartieri moderni. La metodologia proposta declina in termini innovativi la tecnica dei cosiddetti Living Lab, applicandola ai processi di trasformazione dei contesti urbani. Tutti gli stakeholders che parteciperanno attivamente alle diverse fasi del progetto diventeranno i soggetti centrali delle strategie di rigenerazione messe in campo: dalla definizione di successivi "campi di prossimità" intesi come territori "abitabili" al di fuori dell'alloggio alla identificazione delle criticità e delle potenzialità degli spazi collettivi, dalla definizione di ipotesi di intervento per la loro rigenerazione alla costruzione di narrazioni sui luoghi che riconoscano le memorie e gli immaginari associati ai quartieri come parte essenziale di un patrimonio collettivo, fino alla condivisione dei materiali raccolti dalla ricerca in una specifica piattaforma WebGIS "Spazi e storie di prossimità". La metodologia proposta sarà sperimentata in tre casi studio con caratteristiche significativamente differenziate e allo stesso tempo tipiche, in modo da poterne verificare la validità e la possibilità di applicazione in diversi

contesti. I casi studio, scelti in tre città italiane (Torino, Roma e Napoli) e rappresentativi di tre stagioni del moderno (1930-45; 1945-65; 1965-1985), saranno caratterizzati da una dotazione particolarmente ricca e diversificata di spazi collettivi in condizioni di sottoutilizzazione, abbandono e/o degrado: spazi di distribuzione, altri spazi comuni degli edifici, spazi comuni aperti, locali originariamente destinati ai servizi utili alla comunità insediata. Questi spazi saranno oggetto di un percorso partecipativo e di co-progettazione che promuoverà i tavoli di incontro degli Urban Living Lab come luogo fondamentale per la ricostruzione della storia degli spazi collettivi e per l'elaborazione di ipotesi di rigenerazione improntate a una logica di trasformazione incrementale dei luoghi.

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi della Campania Luigi Vanvitelli**
- **UNIVERSITA' DEGLI STUDI ROMA TRE** - Coordinatore

Parole chiave

Settori ERC

SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 244.968,00
Contributo totale progetto:	€ 202.336,00
Costo totale PoliTo:	€ 50.327,00
Contributo PoliTo:	€ 46.110,00

Luoghi e storie di prossimità. Una metodologia per la rigenerazione degli spazi collettivi dei quartieri moderni

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Filippo De Pieri

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. 2022XZZYA5

Ruolo PoliTo:

Partner

Abstract

Il progetto propone di sperimentare una metodologia di ricerca finalizzata alla rigenerazione degli spazi collettivi dei quartieri moderni come risorsa cruciale per affrontare le sfide poste all'abitare dalla crisi pandemica. La proposta intende infatti contribuire al progetto di una "città della prossimità", creando le condizioni per far incontrare la significativa offerta di spazi collettivi nei quartieri moderni con la nuova domanda di spazi e servizi di prossimità generata dalla diffusione di stili di vita e lavoro più intensamente legati agli ambienti abitativi, nonché con la domanda di socialità espressa dalle comunità attraverso forme di riappropriazione dei luoghi e di welfare informale. Nello specifico, il progetto di ricerca intende sperimentare una metodologia di intervento multidisciplinare e partecipata da mettere a disposizione di enti locali, proprietari, associazioni di cittadini e soggetti privati interessati alla rigenerazione di spazi e servizi collettivi nei quartieri moderni. La metodologia proposta declina in termini innovativi la tecnica dei cosiddetti Living Lab, applicandola ai processi di trasformazione dei contesti urbani. Tutti gli stakeholders che parteciperanno attivamente alle diverse fasi del progetto diventeranno i soggetti centrali delle strategie di rigenerazione messe in campo: dalla definizione di successivi "campi di prossimità" intesi come territori "abitabili" al di fuori dell'alloggio alla identificazione delle criticità e delle potenzialità degli spazi collettivi, dalla definizione di ipotesi di intervento per la loro rigenerazione alla costruzione di narrazioni sui luoghi che riconoscano le memorie e gli immaginari associati ai quartieri come parte essenziale di un patrimonio collettivo, fino alla condivisione dei materiali raccolti dalla ricerca in una specifica piattaforma WebGIS "Spazi e storie di prossimità". La metodologia proposta sarà sperimentata in tre casi studio con caratteristiche significativamente differenziate e allo stesso tempo tipiche, in modo da poterne verificare la validità e la possibilità di applicazione in diversi

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

contesti. I casi studio, scelti in tre città italiane (Torino, Roma e Napoli) e rappresentativi di tre stagioni del moderno (1930-45; 1945-65; 1965-1985), saranno caratterizzati da una dotazione particolarmente ricca e diversificata di spazi collettivi in condizioni di sottoutilizzazione, abbandono e/o degrado: spazi di distribuzione, altri spazi comuni degli edifici, spazi comuni aperti, locali originariamente destinati ai servizi utili alla comunità insediata. Questi spazi saranno oggetto di un percorso partecipativo e di co-progettazione che promuoverà i tavoli di incontro degli Urban Living Lab come luogo fondamentale per la ricostruzione della storia degli spazi collettivi e per l'elaborazione di ipotesi di rigenerazione improntate a una logica di trasformazione incrementale dei luoghi.

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi della Campania Luigi Vanvitelli**
- **UNIVERSITA' DEGLI STUDI ROMA TRE** - Coordinatore

Parole chiave

Settori ERC

SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 244.968,00
Contributo totale progetto:	€ 202.336,00
Costo totale PoliTo:	€ 50.327,00
Contributo PoliTo:	€ 46.110,00

DIGI-Teens - Improving digital wellbeing with and for teens: a gamified and personalized intelligent system

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luigi De Russis

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20225WY8B5

Ruolo PoliTo:

Coordinatore

Abstract

Researchers have recently focused on unexpected problems resulting from excessive and frequent use of personal devices, such as smartphones, and online services and applications. These problems gave rise to a new kind of psychological "digital" wellbeing, investigated from different fields such as Human-Computer Interaction (HCI) and psychology. As a result, we now have technological solutions that help users self-regulate their technology use with interventions like timers and lockout mechanisms. However, previous works highlight that achieving digital wellbeing is a path of personal growth that requires education more than self-monitoring strategies. This project aims to design, implement, and evaluate a novel web-based gamification platform for "teaching" digital wellbeing at school or as a part of other educational programs. The generalizability of such a platform is crucial so that it can be used in different situations and for different purposes. Teachers and educators can use the platform to establish personalized learning paths for teenagers through End-User Development (EUD) techniques. In addition, the learning paths will adapt to different devices and, thanks to Artificial Intelligence (AI) methods, to the context where teachers and educators envision the educational path. In the context of a high school class, for example, a teacher could set up a gamified learning path that, through a mobile application, will empower students to collaboratively learn how to use their smartphones more consciously and give more space to interpersonal relationships. The theoretical investigation will be grounded in the challenging empirical goal to derive guidelines, requirements, and best practices for designing a common digital platform based on gamification for supporting teachers and educators in promoting digital wellbeing to teenagers. Throughout the project, we will employ co-design techniques to elicit both requirements and the actual needs, values, and practices of all the involved stakeholders, i.e., teachers, educators, and teenagers. To this end, we

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plan to involve Italian high schools and associations working with teenagers in the project. The work plan is based on parallel experimentations, partially independent of each other, to reduce dependability and maximize velocity while using shared measures and tools to reflect on the experience and feed the shared documents of requirements, guidelines, and best practices. We will adopt rapid prototyping and multiple rounds of design ideas evaluations. At the same time, long-term research will be aligned within the research communities relevant to the project. In this respect, the project will combine an experiment-driven approach with a community-based discussion by involving researchers in the fields of HCI, EUD, and AI in workshops and symposia. Similarly, the communities of practitioners will be involved to discuss the ideas and champion the results.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE6_9 - Human computer interaction and interface, visualisation and natural language processing PE6_7 - Artificial intelligence, intelligent systems, multi agent systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età|Obiettivo 4. Fornire un'educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti

Budget

Costo totale progetto:	€ 279.398,00
Contributo totale progetto:	€ 243.768,00
Costo totale PoliTo:	€ 133.723,00
Contributo PoliTo:	€ 107.000,00

AMELIE - Alternative Materials for Emissions controL in hybrId vEhicle devices

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Fabio Alessandro Deorsola

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Ruolo PoliTo:

Partner

Abstract

Alternative Materials for Emissions controL in hybrId vEhicle devices - AMELIE

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE8_2 - Chemical engineering, technical chemistry

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 272.562,00
Contributo totale progetto:	€ 197.142,00
Costo totale PoliTo:	€ 68.118,00
Contributo PoliTo:	€ 48.948,00

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Saisei - Multi-Scale Protocols Generation for Intelligent Biofabrication

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Stefano Di Carlo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

20222RT5LC

Ruolo PoliTo:

Coordinatore

Abstract

Biofabrication is an emerging field that identifies the set of processes required for the "automated generation of biologically functional products with a structural organization through bioprinting or bioassembly and subsequent tissue maturation processes". Biofabrication technologies have the potential to revolutionize the Regenerative Medicine and Organs-on-Chip (OoC) domains. This project innovates in the domain of computational tools to support 2D/3D biofabrication technologies. Its goal is the "development of a software framework, from now on called Saisei Protocol Generator (SPG), capable of generating optimal protocols to improve the biofabrication of complex in vitro models using static and dynamic 2D/3D co-culture techniques". The SPG framework combines two crucial elements designed during the project. First, a multi-scale modeling strategy allows modeling and simulating an entire co-culture system, including the automated culture environment and the target biosystem. Second, a multi-objective Design Space Exploration engine exploits simulations to generate optimized biofabrication protocols. The project has the potential to significantly improve the efficiency of the development of a new biofabrication protocol by exploiting massive low-cost in silico simulations rather than more expensive in vitro experiments. The project aims at validating its results in the domain of the biofabrication of 2D and 3D in vitro co-cultures of human mesenchymal and endothelial cells intended to mimic the natural bone regeneration process for both pharmacological tests and regenerative purposes. Co-cultures will be performed under static and dynamic conditions using insert-based two-chamber co-cultures (for paracrine only cross-talk) and spheroid co-cultures (for paracrine and physical cross-talk in the same matrix support). Both applications require correctly recapitulating the phenotypic features linked to the paracrine cross-talk between mesenchymal and endothelial cells in terms of cell differentiation, metabolism, proliferation, and morphogenesis, underlying neo-vascularization potential in bone

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regeneration. The latter event is particularly relevant since angiogenesis and vascular endothelial remodeling sustain the metabolic demand of bone growth. The proposed research plan and the multidisciplinary synergy among Computational Biology, Bioengineering, and Cell Biology available in this project move a step forward toward the concept of intelligent and digitized biofabrication.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **Università degli Studi "Magna Graecia" di CATANZARO**
- **Università degli Studi di Torinio**

Parole chiave

Settori ERC

PE6_13 - Bioinformatics, biocomputing, and DNA and molecular computation systems, cyber-physical systems PE6_12 - Scientific computing, simulation and modelling tools PE8_13 - Industrial bioengineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 319.975,00
Contributo totale progetto:	€ 249.610,00
Costo totale PoliTo:	€ 93.898,00
Contributo PoliTo:	€ 70.223,00

MORPHEUS - GeoMORPHomEtry throUgh Scales for a resilient landscape

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Vincenzo Di Pietra

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022JEFZRM

Ruolo PoliTo:

Partner

Abstract

The ongoing increasing frequency of extreme events is expected to impact more severely on the environment and the infrastructures. Understanding sediment dynamics, considering these forcings, is thus of extreme importance for putting into place effective risk mitigation measures for a more resilient landscape. To address such an issue, in recent years, sediment connectivity (SC) has emerged as a key intrinsic property of geomorphic systems representing the potential for sediment transfer through system compartments. In literature, SC has been explored either from a structural or a functional standpoint. Structural SC is derived by analyzing mainly topographic data and deriving connectivity indices that have been widely applied. Such an approach was found informative in defining preferential mass movements, sediment pathways and sink areas, setting hazard priorities to sediment source areas, characterizing landslide sediment provenance, and assessing the impact of natural and anthropic structures (roads, terraces, dams) on sediment fate and hazard exposure. Functional SC tries instead to include temporal scales and process effects into such a framework, for example by measuring morphological variations derived from multi-temporal topographic information through DEM of Difference (DoD) techniques. The MORPHEUS project aims at providing improved tools and related guidelines for applying multi-scale and multi-temporal SC analyses, based on geomorphometric techniques. The proposed approach represents, to a great extent, a novel paradigm in connectivity-related investigations, leading to a significant advance in knowledge for increasing landscape resilience and for a new sediment management perspective.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

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Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi di PADOVA**

Parole chiave

Settori ERC

PE10_13 - Physical geography

Budget

Costo totale progetto:	€ 236.310,00
Contributo totale progetto:	€ 189.999,00
Costo totale PoliTo:	€ 63.410,00
Contributo PoliTo:	€ 53.199,00

Vitruvius's De architectura in classical and early modern age: philology, archaeology, digital library, and 3D modellin

Durata:

17/10/2023 - 16/10/2025

Responsabile scientifico:

- Francesco Paolo Di Teodoro

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022PCRLJ9

Ruolo PoliTo:

Partner

Abstract

The project focusses on two aspects of Vitruvius De Architectura Libri Decem (first century B.C.): The first aspect, is not to consider it only as a primary source used by Early modern readers, but as a synthesis of what Vitruvius saw and interpreted in terms of Greek Hellenistic and Early Augustan architecture. This distinction allows to investigate on how the Latin architectural theoretician was able to understand and to describe ancient architecture and how he related with architecture of his time both in terms of active design as an architect and in terms of a proto-architectural criticism and theory. The second aspect of the project is about Vitruvius De Architectura as a source in early modern time, from the editio princeps edited by Sulpicio da Veroli (Rome c. 1486) up to Daniele Barbaro's (Venice 1556). Historiography tends to consider the De Architectura a monolithic source that, starting from the fifteenth century was read by architects, patrons and humanists to learn the hidden theory and the logic of the ruins. Early modern editions are seminal for archaeologists, historians of Latin and Italian literature, less so for architectural historians because they tent to neglect the plurality of the first generations of modern editions filled with mistakes, misinterpretations and corruptions of the text. This project aims to question the notion of "Vitruvian orthodoxy" claiming that this treatise is not the single link of the chain that connects classical architecture with the modern one, but a much more multifaceted and complex part of a process of transmission of the culture of classical architecture. In so doing De Architectura turns into a device that links at least three different period of times of the history of architecture: The Pre-Hellenistic and Hellenistic period, the Early Augustan period and the Renaissance. The research group is organized upon three units and a sub-unit: The first unit belongs to University of Bologna coordinated by the P.I., the second unit belongs to Politecnico of Turin. These two units, composed by architectural historians, will be in charge of

the philological and textual analysis of a selection of manuscripts and a dozen of printed Renaissance edition. The third unit from University of Urbino will cover the archaeological part of the project focusing on the Temple G at Selinus, Sicily, which features are compatible with Vitruvius's description of the Doric temple, and the basilica of Fano of which Vitruvius himself claimed to be the architect and the builder. The Sub-unit is the Museo Galileo in Florence that will provide all the support for the digitalization of the data. An innovative database will make possible to navigate all the Renaissance editions making them comparable in many different ways. This database is the first step for the creation of a digital "Vitruvioteque" displaying all the materials pertaining to Vitruvius, his treatise and his context.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Parole chiave

Settori ERC

SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 4. Fornire un'educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti

Budget

Costo totale progetto:	€ 257.145,00
Contributo totale progetto:	€ 200.719,00
Costo totale PoliTo:	€ 63.918,00
Contributo PoliTo:	€ 63.918,00

NEThEQS - Non-equilibrium coherent thermal effects in quantum systems

Durata:

27/10/2023 - 26/10/2025

Responsabile scientifico:

- Fabrizio Dolcini

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022B9P8LN

Ruolo PoliTo:

Coordinatore

Abstract

Quantum thermodynamics is a rapidly growing field that meets a critical challenge in quantum technologies: The development of efficient devices that maximize the heat conversion into electricity and minimize heat waste. NEThEQS is a theoretical project that aims to investigate the interplay between quantum coherent phenomena and non-equilibrium thermal effects. By suitably combining the complementary expertise of two Units, PoliTO and NANO-CNR, the project addresses some specific open problems, with a balance between fundamental questions of quantum thermal engines and some of their implementations. At a more fundamental level, we shall first consider a generic bipartite quantum system that converts a temperature gradient into work, acting as a heat engine. We shall investigate whether entanglement and other kinds of quantum correlations can improve the efficiency of a thermodynamic cycle. Then, we will extend the study to the multipartite case, by comparing the performance of machines in uncorrelated states and different kinds of multipartite quantum correlations. At a more applicative level, we shall study specific implementations of thermal engines. Focussing first on spin-orbit coupled nanowires, whose promising thermoelectric applications have been overshadowed by the search for Majorana states, we shall investigate whether their phase-coherent transport can be exploited to control their thermoelectric response through electron quantum interference. Then, the effects on thermal properties of an additional coherent phenomenon, namely the superconducting pairing, will be analyzed. Furthermore, we shall consider multi-terminal setups involving edge states of topological insulators or Hall systems coupled to superconductors, and we shall analyze the thermoelectric effects generated by a temperature difference between the terminals. Our goal is to clarify the relation between entanglement of Cooper pairs and thermoelectric effects, to compute the correlations of charge, heat and spin currents, and to analyze how these depend on interference effects and electronic interactions. Finally, we aim to explore the time-

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dependent coherent dynamics and the far from equilibrium regime. We shall investigate how the heat dynamics resulting from the quench of a thermally asymmetric initial state in an isolated quantum system is affected by the presence of topological states or a flux. Also, we shall consider the case of periodically driven systems, and study the efficiency and performances of coherent thermal machines based on topological materials and superconductors. By addressing these challenging problems, NEThEQS is expected to provide a valuable contribution to the technological applications of subKelvin quantum engines and high sensitivity quantum sensors. At the same time, it will contribute to the development of an Italian community in the field of quantum thermodynamics and quantum technologies.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE3_11 - Mesoscopic physics PE3_3 - Transport properties of condensed matter PE2_10 - Quantum optics and quantum information

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 115.846,00
Contributo totale progetto:	€ 94.551,00
Costo totale PoliTo:	€ 115.846,00
Contributo PoliTo:	€ 94.551,00

NoDES - Nonlinear dispersive equations in presence of singularities

Durata:

28/09/2023 - 28/09/2025

Responsabile scientifico:

- Simone Dovetta

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20225ATSTP

Ruolo PoliTo:

Coordinatore

Abstract

We propose a two–year three–unit research project concerning several mathematical problems arising in the rigorous treatment of nonlinear dispersive equations in presence of singularities. Among dispersive Hamiltonian PDEs, Schrödinger and Dirac equations have becoming cornerstones in the mathematical modelling since their introductions in the XIXth century. The evolution of the experimental techniques in various applied sciences, e.g. condensed and solid matter physics, neurosciences, nanotechnology and so forth, have been gathering through the decades a prominent interest on nonlinear dispersive models. In particular, the last years witnessed a lot of progress in the rigorous analysis of effective nonlinear equations in presence of strong spatial non-homogeneity, inherently calling for the introduction of singularities. Though naturally rising in the applications, such topics triggered a wide horizon of theoretical investigations as well and contributed to fuel flourishing lines of research in pure or applied mathematics. Deep non–homogeneities appear in various fields and in several forms, mainly meant to capture typical complex features of the environment in many natural phenomena. Two common examples are point defects in propagation media and vertices of branching structures and networks. More specifically, the present project focuses on the following two different ways to implement singularities: 1. nonlinear singular equations, where singular potentials, e.g. delta–type potentials, are coupled with nonlinear effective equations; 2. nonlinear equations on singular structures, where standard nonlinear equations are considered on domains as metric graphs or quantum hybrids. Our aim will be twofold. On the one hand, this is a theoretical project primary dedicated to develop the mathematical formalization of such singular models and to push forward the exploration of their phenomenology, which has already proved to be extremely varied. On the other hand, specific attention will be devoted to exploit a rigorous approach to extract relevant insights about features of interest for real world applications.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' CATTOLICA DEL SACRO CUORE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**

Parole chiave

Settori ERC

PE1_11 - Theoretical aspects of partial differential equations PE1_8 - Analysis PE1_12 - Mathematical physics

Budget

Costo totale progetto:	€ 214.128,00
Contributo totale progetto:	€ 187.405,00
Costo totale PoliTo:	€ 120.746,00
Contributo PoliTo:	€ 115.746,00

GENESIS - Green Electrolyte and Biomass-derived Electrodes for Sustainable Electrochemical Storage Devices (GENESIS)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Giuseppe Antonio Elia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022ZZHS7L

Ruolo PoliTo:

Coordinatore

Abstract

The substantial growth of renewable energy production expected in the coming years requires efficient massive storage to improve large-scale grid integration of intermittent electricity sources (e.g. solar, tides, wind). Nowadays, a more in-depth penetration of renewable electricity production is limited by our ability to store energy efficiently. Currently, lithium-ion (Li-ion) batteries represent state-of-the-art in the field. However, the expected demand for Li-ion batteries driven by the automotive sector may raise issues regarding materials supply for lithium (viz. Li2CO3) and electrode raw materials (e.g. cobalt-based, Ni-based, natural graphite). Low-cost Na-ion batteries development based on abundant and sustainable compounds can relieve the market constraints, guaranteeing a substantial growth of the renewable energy sector supplying more flexibility/balancing to the grid. Therefore, developing new Na-ion-based technologies requires: i) the discovery/investigation of new materials/components being widely distributed in large amounts and without strategic contingencies; ii) utilization of green and sustainable materials in all their life phases (production, use, end-of-life). The target of GENESIS is to develop new materials for next-generation, high performance and sustainable secondary Na-ion batteries. In this context, GENESIS will investigate green, cost-effective and sustainable electrolytes to be coupled with biomass-derived electrodes, aiming at a more in-depth understanding of those systems, thus enabling the development of advancedlow cost and sustainable Na-ion storage systems. GENESIS will investigate in particular: i) computationally-assisted investigation of new materials for both the electrode and the electrolyte compartments; ii) application of advanced ex-situ and in-situ characterisation tools; iii) "green" fabrication of electrode/electrolyte materials; iv) their assembly and electrochemical testing in lab-scale half-cells. The project is intended to start at TRL-1/2 and reach TRL-4 in 24 months, and its targets are in

sound consonance with the EU calls HORIZON 2020/HORIZON EUROPE. Recyclable, naturally abundant materials will be processed to become energy storage components with minimum or even zero environmental impact. The materials investigated within GENESIS will be characterised by: i) low environmental impact in terms of supplying, processing/manufacturing and post-cycling disposal/reuse; ii) elemental abundance; iii) low toxicity; iv) safety, and v) low cost. The project will focus on understanding transport-(micro)structure relationships of the electrode/electrolyte materials proposed and the physicochemical and functional behaviour. Emphasis will be devoted to the chemical/electrochemical stability of materials and interfaces and green, low-impact preparation methods by exploiting waste/biomasses and solvent-free/water-based routes.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA DEGLI STUDI DI CAMERINO - DIP. PROGETTAZIONE COSTRUZIONE DELL'AMBIENTE (PROCAM) - COLLE DELL'ANNUNZIATA**
- **Università di Torino**

Parole chiave

Settori ERC

PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors PE4_17 - Characterisation methods of materials

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 225.008,00
Contributo totale progetto:	€ 209.812,00
Costo totale PoliTo:	€ 82.612,00
Contributo PoliTo:	€ 82.612,00

DiAGreen - Digital twin of Agricultural Greenhouses: a multi-domain tool for energy efficiency, decarbonization, enhanced production and cost reduction of intensive greenhouse cropping systems

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Enrico Fabrizio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022FPHNXZ

Ruolo PoliTo:

Coordinatore

Abstract

Crop production in greenhouses supplies most agricultural products in industrialized countries while being one of the most energy-intensive operations in the agricultural sector. In the Mediterranean basin, it is estimated that the energy consumption for heating can achieve 440 kWh m-2a-1. Most of the energy used for climate control and carbonic fertilization of these structures comes from fossil fuels. With the recent sharp increase in the cost of fossil energy sources due to the geopolitical threads, the impact on the price of the final product is increasingly important. In the light of the decarbonization and to contrast the cost increase in greenhouse crop products, there is the need to disruptively innovate how greenhouses consume energy sources. Although strategies for reducing energy use were well studied in the past (e.g., thermal insulation, shading and HVAC control, renewables), there is still the need to integrate them into a framework able to dynamically respond to drivers such as outdoor (changing) climate, production needs, (variable) costs. At the same time, interpretation of data acquired from new and cost-effective digital devices for monitoring and controlling the greenhouse environment is essential to feedback on the operation, cultivation, and environmental impact of the greenhouse itself. The DiAGreen project aims at creating and testing digital twins, a new generation of virtual representations of agricultural greenhouses that serves as the real-time digital counterpart of physical greenhouses. The proposed digital twins exploit the capabilities of multi-scale and multi-domain greenhouse models, historical measurements from sensors, optimization approaches, and future predictions for decreasing the energy use and thus the carbon impact of greenhouses, adapting the best strategies to current and future time steps. This project, through the development

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of greenhouse digital twins, makes one step forward towards the Greenhouse 4.0 Industry. Digital twins can remarkably improve the design and operation of greenhouses, optimized in terms of energy efficiency, productivity, sustainability, and quality of the productions facing the future challenges of fossil fuels availability and costs, climate change, and future food demand.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**
- **UNIVERSITA' DI PISA**

Parole chiave

Settori ERC

LS9_4 - Plant sciences (including crop production, plant breeding, agroecology, soil biology) PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_6 - Energy processes engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 2. Porre fine alla fame, raggiungere la sicurezza alimentare, migliorare la nutrizione e promuovere un'agricoltura sostenibile|Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 240.160,00
Contributo totale progetto:	€ 197.500,00
Costo totale PoliTo:	€ 63.660,00
Contributo PoliTo:	€ 52.600,00

WADERE - Development of thermally-driven sorption process for WAtER DEsAlinAtion using low-grade REnEWAblE EnERgy

Durata:

28/09/2023 - 26/09/2025

Responsabile scientifico:

- Matteo Fasano

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022PSPA8R

Ruolo PoliTo:

Partner

Abstract

The demand of fresh water is constantly growing worldwide. So far, this need is satisfied through high exergy-inputs, driven by electricity or high-temperature source. The development of innovative low-exergy solutions is then urgent. By a holistic approach, the WADERE project intends to develop and pre-validate at lab-scale (TRL3) a thermally-driven sorption process to provide desalinated water using low-grade heat sources (

Strutture coinvolte

- CWC - CWC - CleanWaterCenter@PoliTo
- DENERG - Dipartimento Energia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' DEGLI STUDI DI TRIESTE**

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering

Obiettivi di Sviluppo Sostenibile

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(Sustainable Development Goals)

Obiettivo 6. Garantire a tutti la disponibilità e la gestione sostenibile dell'acqua e delle strutture igienico-sanitarie|Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 228.497,00
Contributo totale progetto:	€ 197.496,00
Costo totale PoliTo:	€ 58.081,00
Contributo PoliTo:	€ 52.030,00

MIRABLE - Measurement Infrastructure for Research on heAlthy and zero energy Buildings in novel Living lab Ecosystems

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Fabio Favoino

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

022ZNJHHY

Ruolo PoliTo:

Coordinatore

Abstract

The building sector plays a pivotal role to achieve the EU targets in terms of ecological transition, while being fundamental in determining people health, wellbeing and comfort. A huge effort has been done in the last decades to increase the energy efficiency and indoor environmental quality (IEQ) of buildings, however a performance gap between actual operational performance and expected results is present, due to several factors pertaining the building design, construction and operational stages. The lack of widespread multi-domain studies, investigating mutual interrelations between different aspects of IEQ and between the occupants' responses and interaction with the surrounding environment, and the lack of involvement of the occupants in R&D&I activities, reducing acceptability and integration of innovative technologies. The MIRABLE project aims to develop a methodology to reduce this gap by designing, implementing and validating a measurement infrastructure for monitoring multi-domain indoor environmental conditions and occupants' interaction in full scale Living Laboratories (LL). This will be designed for a laboratory under construction (H-IEQ LL), to realize a new working model of LL, to support human-centric research on IEQ and human-centric R&D&I activities supporting building sector technological development, in the perspective of achieving healthy and smart buildings, to reduce energy use and promote resilience. The new H-IEQ LL will be characterized by a very well controlled environment, and therefore the MIRABLE project is aimed to ensure the development of methodologies (i) to include the occupant as a sensor, actuator and driver of innovation in the research ecosystem, and (ii) for defining a ground-truth for wearable and low-grade sensors for IEQ measurements, concerning occupant immediate physical proximity (by means of wearable sensors), their feedbacks and interaction with the building systems. Such infrastructure should present: (i) minimum alteration of the perception of IEQ and

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disruption to the occupant; (ii) acceptable level of accuracy depending on the aim of R&D activity; (iii) ability to generate multi-domain data of the physical environment and of the occupant response; (iv) high level of discretization of the information (temporarily and spatially). MIRABLE project will develop through the following activities: (i) understand the best practices to monitor occupant comfort and interaction with buildings; (ii) identify, implement and metrologically characterize the sensors network for multi-domain monitoring of the physical environment and the wearable sensors to monitor occupant related quantities; (iii) design, implement and commission the measurement and data acquisition infrastructure; (iv) integrate, analyze and post-process the aggregated data oriented towards LL use cases demonstration; (v) disseminate results at EU and national level, and define possible exploitation strategies.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **I.N.RI.M. - ISTITUTO NAZIONALE DI RICERCA METROLOGICA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

LS1_5 - Protein synthesis, modification and turnover PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età|Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 251.021,00
Contributo totale progetto:	€ 197.351,00
Costo totale PoliTo:	€ 142.024,00
Contributo PoliTo:	€ 118.359,00

NextGenSProDesT - Next Generation Space Propulsion Design Techniques

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Andrea Ferrero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022B2X937

Ruolo PoliTo:

Partner

Abstract

The device of interest is a LOX-CH4 Liquid Rocket Engine (LRE) equipped with a pintle injector, regarded as a natural choice when the mission profile requires a large throttling range. The project aims at leveraging advanced mathematical techniques to generate a reliable multi-fidelity model, built upon both experimental and numerical high-fidelity data and capable of embedding the key physical features of the latter. The novelty of the project lies in a mathematically sound workflow to exploit all the available experimental data and systematically compensating for the lack of experiments by means of high-fidelity numerical modeling. The resulting augmented-fidelity model will embed the uncertainty on the parameters and, once validated, will be exploited to generate a low-fidelity Response Surface Model (RSM) to be employed in Computer-Aided Engineering (CAE) Robust Design Optimization (DO). The results of the project have a strong translational impact on the entire aerospace propulsion and power generation industry.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi della Campania Luigi Vanvitelli**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"** - Coordinatore

Parole chiave

Settori ERC

PE8_1 - Aerospace engineering PE8_4 - Computational engineering

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Politecnico di Torino

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 219.936,00
Contributo totale progetto:	€ 196.236,00
Costo totale PoliTo:	€ 72.048,00
Contributo PoliTo:	€ 60.198,00

MULTITOOL - CoMbined CO2 captUre and reduction to methane in compact dual functionaL reacTors with cellular structured Internals for inTensified heat and mass transpOrt: from labOratory to bench scaLe

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Domenico Ferrero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022YCEAH4

Ruolo PoliTo:

Partner

Abstract

In the Paris Agreement (2015), UN member states have committed to limit global warming below 2°C versus pre-industrial levels. This implies reducing greenhouse gas (GHG) emissions by 80 to 95 % of the 1990 level by 2050. Such an ambitious target requires to develop sustainable strategies to mitigate CO2 emissions from power conversion and energy intensive industrial processes. To pursue this goal, Carbon Capture and Storage (CCS) and Carbon Capture and Utilization (CCU) processes have been widely investigated. Among capture technologies, CO2 adsorption is receiving a lot of attention in view of its relatively low energy consumption and, with reference to CCU, the ability to produce CO2 streams with concentration and purity characteristics matching the requirements of several conversion processes such as catalytic hydrogenation to methane, methanol or dimethyl ether and liquid hydrocarbons. In recent years, the on-site combination of CO2 capture and catalytic conversion (iCCC: integrating CO2 Capture and Conversion) has been proposed as a promising approach to cope with the hurdles associated with the intermittent production and the difficult storage and transport of renewable hydrogen. Within this scenario, the MULTITOOL project will focus on the development of a novel technology of combined CO2 capture and catalytic conversion to methane. The technology will be based on the following innovative tools: -structured conductive internals, specifically conceived to improve the heat transfer performances enabling the design of adsorbers and catalytic reactors able to deal with the severe heat management issues associated both with temperature swing cycles and with temperature control in the presence of strongly exothermic processes; - integrated reactors, which combine materials with CO2 adsorption capacity with

hydrogenation catalytic washcoat to be synergically operated under cycling conditions. Different process configurations will be investigated, starting from a state of the art arrangement, where CO2 adsorption and its catalytic conversion to methane are performed in separated process units, operated at independently optimized conditions and using benchmark or advanced catalytic materials, up to a fully integrated approach based on the use of a single reactor process unit able to cycle from adsorption to catalytic conversion of CO2. Such configurations will be investigated by means of mathematical model analysis, material testing and characterization, bench scale testing. The results will provide the basis for a techno-economic analysis which addresses the complete system chain, from feedstocks (Renewable Energy Sources-RES, CO2 sources, H2-delivery processes) to final Synthetic Natural Gas, by including all the steps of the processes in order to fully assess the potential of the investigated technologies in the framework of real industrial boundaries.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE8_2 - Chemical engineering, technical chemistry PE8_6 - Energy processes engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 248.724,00
Contributo totale progetto:	€ 195.729,00
Costo totale PoliTo:	€ 65.964,00
Contributo PoliTo:	€ 51.019,00

ReproNet - Reprocessable thermosets via dynamic polymer networks

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alberto Fina

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022TCJRCA

Ruolo PoliTo:

Coordinatore

Abstract

ReproNet addresses the design, preparation and development of novel, sustainable and recyclable dynamic polymer networks. The aim is to obtain a new class of high performance and melt-processable materials for the replacement of conventional epoxy resins, which are non-recyclable by thermomechanical methods. Dynamically crosslinked materials has recently been proposed as an alternative to thermosets, thanks to the possibility to be reprocessed, exploiting the dynamic exchange of covalent bonds. However, the state of the art dynamic networks suffer strong limitations in both synthesis, carried out in organic solvents, and processability, typically limited to compression moulding only, precluding transfer to industrial applications. In this scenario, ReproNet is aimed to bridge between the chemistry of dynamic networks and technology of polymer processing, by the design and validation of a novel class of sustainable dynamic networks. The proposed strategy is based on the exploitation of different linear polymers, with chemical structure similar to conventional bisphenol A-based epoxy resins, which are dynamically crosslinked by the exploitation of bonds exchange in covalent adaptable networks or bond cleavage in thermoreversible networks. With this approach, ReproNet addresses fundamental research aspects related to the efficient and sustainable synthesis of linear polymers, to the tailoring of dynamics in bond exchange processes and design of processing conditions to control reactions in the molten polymers. Attention to sustainability of materials and processes is applied throughout the whole project, including 1) the selection of bio-sourced polymers as an alternative to conventional phenoxy resins, 2) the reactive melt processing (solventless) for the functionalization of linear polymers and the synthesis of dynamic networks and 3) the recyclability of materials from the envisaged applications. ReproNet is therefore aiming at providing materials solutions enabling a circular economy system, to substitute the “take-make-dispose” model with the circular “take-make-remake” one. ReproNet research will

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bring potentially groundbreaking innovation in several industrial fields, in bulk applications such as interleafs for toughening of epoxy composites and electric&electronics boards, as well in hot-melt adhesives, including on-demand debonding applications. ReproNet partnership is designed to fully cover the wide range of expertise needed for successfully tackling its challenging objectives. The principal investigator of the project, Prof. Alberto Fina, brings expertise in the field of polymer reactive processing, thermomechanical properties and recycling. The team is completed by Prof. Enrico Dalcanale, leading scientist in the field of polymer chemistry applied to dynamically crosslinked systems, and by Prof. Veronica Ambrogi, recognized expert in the production and exploitation of bio-based epoxy precursors as well as in polymer rheology.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.) PE5_15 - Polymer chemistry

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 264.834,00
Contributo totale progetto:	€ 198.563,00
Costo totale PoliTo:	€ 102.403,00
Contributo PoliTo:	€ 71.227,00

ReproNet - Reprocessable thermosets via dynamic polymer networks

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alberto Fina

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022TCJRCA

Ruolo PoliTo:

Coordinatore

Abstract

ReproNet addresses the design, preparation and development of novel, sustainable and recyclable dynamic polymer networks. The aim is to obtain a new class of high performance and melt-processable materials for the replacement of conventional epoxy resins, which are non-recyclable by thermomechanical methods. Dynamically crosslinked materials has recently been proposed as an alternative to thermosets, thanks to the possibility to be reprocessed, exploiting the dynamic exchange of covalent bonds. However, the state of the art dynamic networks suffer strong limitations in both synthesis, carried out in organic solvents, and processability, typically limited to compression moulding only, precluding transfer to industrial applications. In this scenario, ReproNet is aimed to bridge between the chemistry of dynamic networks and technology of polymer processing, by the design and validation of a novel class of sustainable dynamic networks. The proposed strategy is based on the exploitation of different linear polymers, with chemical structure similar to conventional bisphenol A-based epoxy resins, which are dynamically crosslinked by the exploitation of bonds exchange in covalent adaptable networks or bond cleavage in thermoreversible networks. With this approach, ReproNet addresses fundamental research aspects related to the efficient and sustainable synthesis of linear polymers, to the tailoring of dynamics in bond exchange processes and design of processing conditions to control reactions in the molten polymers. Attention to sustainability of materials and processes is applied throughout the whole project, including 1) the selection of bio-sourced polymers as an alternative to conventional phenoxy resins, 2) the reactive melt processing (solventless) for the functionalization of linear polymers and the synthesis of dynamic networks and 3) the recyclability of materials from the envisaged applications. ReproNet is therefore aiming at providing materials solutions enabling a circular economy system, to substitute the “take-make-dispose” model with the circular “take-make-remake” one. ReproNet research will

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bring potentially groundbreaking innovation in several industrial fields, in bulk applications such as interleafs for toughening of epoxy composites and electric&electronics boards, as well in hot-melt adhesives, including on-demand debonding applications. ReproNet partnership is designed to fully cover the wide range of expertise needed for successfully tackling its challenging objectives. The principal investigator of the project, Prof. Alberto Fina, brings expertise in the field of polymer reactive processing, thermomechanical properties and recycling. The team is completed by Prof. Enrico Dalcanale, leading scientist in the field of polymer chemistry applied to dynamically crosslinked systems, and by Prof. Veronica Ambrogi, recognized expert in the production and exploitation of bio-based epoxy precursors as well as in polymer rheology.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.) PE5_15 - Polymer chemistry

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 264.834,00
Contributo totale progetto:	€ 198.563,00
Costo totale PoliTo:	€ 102.403,00
Contributo PoliTo:	€ 71.227,0

EXPRESS - EXploring fish waste Potential for the integrated generation of RESourceS

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Debora Fino

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

20222XR2FR

Ruolo PoliTo:

Coordinatore

Abstract

EXPRESS will develop an integrated biorefinery to recover high-value compounds and hydrogen from fishery wastes and bioproducts, which are a potential source of hydrolysed proteins, fatty acids, enzymes. FAO estimates about 180 M tonnes of live weight from catch and aquaculture, with 25% to 70% of by-products such as viscera, heads, scales, bones and shells. A Biorefinery shifts the paradigm from fossil to renewable biological sources; the EXPRESS project adds the further challenge of using low temperature and fully electrified processes, combining biological processes such as fermentation, photofermentation, anaerobic digestion, and bioelectrochemical processes in an integrated approach. EXPRESS project aims to obtain energy from secondary raw materials, within the frame of a circular economy model, transforming wastes and by-products into added-value products. In the biorefinery scheme of EXPRESS, soft parts, such as fish viscera and filleting residues, as well as the organic fraction of mollusc wastes will be processed by (photo)fermentation approaches and enzymatic hydrolysis to obtain protein hydrolysates, bioactive peptides, omega-3 rich oils and medium chain fatty acids. The effluent will be sent to a separation section or to other processes to l produce hydrogen and poly ß-hydroxybutyrate. The separation section of EXPRESS will exploit low-temperature processes to purify streams from the upstream processes. Dialysis and electrodialysis will be also considered. The lean streams of the biorefinery will be processed in the energy carrier generation section, where fermentation will be combined with microbial electrolysis to obtain hydrogen. A final process of anaerobic digestion will exploit the remaining energy content of the biorefinery residues. Finally, an alternative biological photofermentation approach will be developed for biogas upgrading by H2S removal and CO2 exploitation by autotrophic metabolism. There are research initiatives for the recovery of chemicals from fish by-products, but no commercial facilities are in operation, and the research mainly targets single products with single processes. Conversely EXPRESS proposes

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a novel approach of integrated marine biorefinery with low-temperature processes, fully powered with electricity. Therefore, EXPRESS fulfils the requirements of the main EU and national strategies, such as Hydrogen, Bioeconomy and blue growth strategies, and the Circular Economy Action Plan.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_2 - Chemical engineering, technical chemistry

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 14. Conservare e utilizzare in modo durevole gli oceani, i mari e le risorse marine per uno sviluppo sostenibile

Budget

Costo totale progetto:	€ 242.010,00
Contributo totale progetto:	€ 197.497,00
Costo totale PoliTo:	€ 58.559,00
Contributo PoliTo:	€ 47.788,00

DIGACE - DIGital innovative Aicraft CErtification

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marco Fioriti

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20229H8N9P

Ruolo PoliTo:

Partner

Abstract

DIGACE project aims to provide a digital approach towards the certification of innovative hybrid-electric aircraft configurations belonging to the part CS23 for normal category airplane. With the rapid advent of novel configurations and technologies, regulation authorities took quickly remedial publishing several amendment and special condition, to fill the gap and overcome certification shortcomings, replacing rigid design requirements with performance-based airworthiness standards. The CS23 modifications led to, over the accepted Means of Compliance (MoC) from prescriptive advisory circulars, several consensus standards accepted from aviation community. Besides the fact to handle many scattered documents each other cross-linked, these requirements are often not well interpreted or absolutely neglected in the design stage of innovative configurations, resulting in misleading and uncertifiable architectures. Making a bridge between design methodologies of innovative hybrid-electric aircraft and regulation requirements, DIGACE project will contribute to the skeleton of certification process driving the design towards the product. The state-of-the-art Model-Based-System-Engineering (MBSE) approach will be employed to digitalize and model the document-based approach of the regulations, reducing integration issues. From a document-centric paper-based, DIGACE project will collect the dataset produced in the certification process into a digital model regulation and MoC form, allowing the automatic checklist and data reporting for any specific requirements. Focusing on some of regulation subparts, requirements and MoC will be digitally traced using a Systems Modeling Language (SysML), highlighting the needed test cases suitable as means of compliance. At design stage, simulation tools will be used as test cases to analyze the aircraft configuration according to the regulation requirements. Available methods, such as Overall Aircraft Design, Performance & Mission simulation, Hybrid-Electric Powerplant sizing, and On-Board-System will be reviewed according to regulation requirements, to be digitally used as MoC. The designed configurations will be

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regulation compliant, and automatic certification reporting will be enabled for the CS23 subparts under investigation (Subpart B Flight, Subpart C Structure, Subpart E Powerplant installation and Subpart F Systems and equipment). The proposed research will reduce the development time and cost of future aeronautical products avoiding the development of uncertifiable design and the time needed to provide the necessary documentation to the certification authorities. Abovementioned methodologies will be applied to two application cases, a six-engine high-lift-propeller distributed propulsion aircraft, with a hybrid-electric powertrain or with full-electric powertrain, demonstrating the process flexibility. Assuming different regulation requirements or MoC, the resilience of proposed approach will be proved.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore

Parole chiave

Settori ERC

PE8_1 - Aerospace engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un’occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell’ecosistema terrestre

Budget

Costo totale progetto:	€ 276.311,00
Contributo totale progetto:	€ 197.499,00
Costo totale PoliTo:	€ 77.684,00
Contributo PoliTo:	€ 59.250,00

Origami - Mimicking in vivo-like tumor microenvironment to model non-small cell lung cancer patient-derived organoids dynamics

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Francesca Frascella

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Ruolo PoliTo:

Partner

Abstract

Compared to conventional pre-clinical systems, such as the use of classical cell lines and animal models, organoid technology is a new extraordinary tool which can provide new keys about mechanisms underlying cellular dynamics, able to extend basic biological research into a more physiologically and also pathologically relevant human setting. Lung organoids have sprung up in more researching fields, because of their ability to recapitulate the 3D structure and functions of the in vivo counterpart organs. Unfortunately, in a cancer research setting, the culture system for lung cancer organoids is still immature, resulting in limited success rate and low tumor purity. The idea is that none of the established protocols was able to adequately simulate the tumor microenvironment, characterized by strong biophysical signaling mediated by cell contacts with the extracellular and biochemical stimulation mediated by stromal cells. The lack of these fundamental features relapse in defects of cell dynamics and, therefore, long-term propagation failure. In this scenario, our proposal (named ORiGAMi: Organoids in Gelatin-Methacrylate) aims to generate a platform of patient-derived organoids (PDO), established from both healthy and tumor tissues of patients affected by non-small cell lung cancer (NSCLC), mimicking NSCLC tumor microenvironment. The goal will be reached by developing a flexible and tunable ECM-like culture system based on Gelatin Methacrylate-based hydrogel (GelMA), in which organoids growth will be supported through soluble factors secreted by patient-derived stromal cells. GelMA is a promising alternative candidate to standard basement-membrane extract which has the main potential to be modulated in composition, geometry, stiffness and which can be functionalized with ad-hoc biomolecules, overcoming the main limitations in robustness and versatility common to the classical ECM-like matrices. Moreover, GelMA is a biocompatible, biodegradable, non-cytotoxic, and non-immunogenic gelatin-based hydrogel, already used for bioprinting applications. The ORiGAMi platform, including organoids generated by healthy and NSCLC cells of each patient, will allow investigations of in

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

vivo-like fundamental biochemical signalling involved in cell growth and proliferation, biological and biophysical mechanisms regulating cell-cell and cell-matrix communication, as well as metabolic rewiring. The characterization of these healthy and NSCLC cell dynamics boost the employment of patient-derived organoids in personalized medicine, studying patient-specific pharmacological responses to adjuvant standard therapies and novel therapeutic approaches. A tumor type for which organoid-guided clinical decision making could be of particular value is NSCLC. This is in line with the main interest of our research consortium that will be committed to achieving a suitable tool for prospective therapeutic studies or to manage drug resistance.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore

Parole chiave

Settori ERC

LS3_12 - Stem cell biology

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 213.040,00
Contributo totale progetto:	€ 187.500,00
Costo totale PoliTo:	€ 91.650,00
Contributo PoliTo:	€ 91.650,00

INTACT - Innovative additively manufactured parts INspection via non-destructive methods based on ThermograAphy and Computed Tomography (INTACT)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Manuela Galati

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022WA5TJ4

Ruolo PoliTo:

Coordinatore

Abstract

Additively manufactured components are currently gaining a relevant place in many industrial sectors. However, the potential of additive manufacturing (AM) processes is still lacking significant research to achieve reliable broad industrial adoption in which repeatability and stability are restricting factors. Physical phenomena participating in the AM processes may generate defects between different layers, within the individual layers, and in the overall part such as internal defects. Thus, one of the main challenges in AM chain becomes the setup of methods to guarantee structural integrity and appropriateness of the component for the operating scenario. In this context, Non-Destructive Testing (NDT) represents a key technology for describing AM complexity, detecting and evaluating defects in the part without destroying its serviceability. Today, the most diffused solution is X-Ray computed tomography (CT), whose costs are only affordable for high-end components. A further difficulty is that CT represents a bottleneck in the lead-time, as it can take almost as long as the production itself. INTACT aims to increase the NDT investigation effectiveness towards a more rapid and economical solution, enhanced by combining other destructive and ND methods. INTACT integrates the rapidity and cost-effectiveness of thermography with the precision of detection of CT-scan for a full and fast description of AM complexity. Compared to conventional analyses, INTACT will define ad-hoc reference artefacts to characterise and compare the different NDT methods. The artefact will contain specific defects and features representative of AM. Owing to their totally non-destructive and non-invasive nature, the same components will be inspected by different NDTs. The aim is to highlight various demonstrations of parts characterisation through different data. Techniques with the ability to carry out high-throughput calculations based on artificial intelligence or inferential statistical analyses will be harnessed to develop proper data post-processing methods

for thermogram analysis. The post-processed data from each system will be then compared to each other and with the predesigned nominal artefacts. These data will allow defining the operability of each system and, at the same time, verify its reliability. The data integration will allow to compensate for the limitations associated with each technology, enhance the defect detectability and component description of each other NDT techniques and define a reliable novel architecture to calibrate the thermography with the aim to be used as a stand-alone, fast and low-cost NDT method to characterise the AM part complexity fully. The use of this novel architecture will be tested using industrial components. Additionally, the novel approach will make available an unprecedented amount of well-structured data, which will serve as training set for a more robust ND diagnostic testing of metallic additively manufactured parts.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI MODENA E REGGIO EMILIA**

Parole chiave

Settori ERC

PE8_9 - Production technology, process engineering PE8_7 - Mechanical and manufacturing engineering (shaping, mounting, joining, separation) PE8_10 - Industrial design (product design, ergonomics, man-machine interfaces, etc.)

Budget

Costo totale progetto:	€ 247.981,00
Contributo totale progetto:	€ 197.472,00
Costo totale PoliTo:	€ 146.873,00
Contributo PoliTo:	€ 117.540,00

ASSOCIATE - Artificial intelligence-powered Support System fOr asCendIng AorTa anEurysms

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Diego Gallo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022L7KK7L

Ruolo PoliTo:

Coordinatore

Abstract

The ASSOCIATE project will integrate demographic information, clinical and imaging parameters, biomarkers data, biomechanical modeling and morphologic aTAA shape features to build robust predictive models. Leveraging artificial intelligence methods, we aim at (i) predicting the risk of adverse events like rupture and dissection and (ii) estimating the aTAA growth trajectory. ASSOCIATE is conducted in partnership between Politecnico di Torino, University of Palermo and University of Torino. The participants ensure the collection of heterogeneous medical data from several aTAA cases giving rise to an unprecedented repository (approximately 600+ aTAA cases). This project will generate new knowledge on the mechanistic understanding of aTAAs, at the same time laying the foundations for a “digital patient” technology by which physicians will reap the benefits of a novel paradigm of predictive and personalized medicine based on multidisciplinary data and artificial intelligence. The outcome of this project will unlock unprecedented levels of accuracy in identifying high-risk or high-cost patients, facilitating a more effective and efficient care.

Persone coinvolte

- Diego Gallo (Responsabile Scientifico)
- Gabriella Balestra (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni
- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

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Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PALERMO**
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 234.768,00
Contributo totale progetto:	€ 196.927,00
Costo totale PoliTo:	€ 111.901,00
Contributo PoliTo:	€ 88.356,00

ECCO-2050 - Smart Energy in Cities and Communities for 2050

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marta Gandiglio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022ZM87LR

Ruolo PoliTo:

Partner

Abstract

Smart Cities and Energy communities are receiving a special attention from the EU, as confirmed by the several projects under development in Italy such as STARDUST in Trento, RUGGEDISED in Parma, SmartEnCity in Lecce and Sharing Cities in Milan [1]. A Smart City is an urban area that uses different types of methods and sensors to collect data from citizens, buildings, systems (e.g., gas and electricity grid, generators) and services (e.g., public transportation, lighting, hospitals) with the goal of optimizing the management/planning of resources, systems and services to citizens. Thanks to the synergies between the different systems, such a systematic approach allows improving the quality of life [2] and reducing the consumption of fossil fuels and emissions of CO2 and emissions [3]. Similar benefits occur in an energy community which aggregates different prosumers sharing the renewable energy resources and energy storage systems. Through a local smart energy network, the different prosumers can exchange energy with the final goal of minimizing the energy cost/consumption of the community. A variety of terms is used in the current literature for the energy system serving smart cities/districts: multi-energy systems [4], energy hubs/districts [5] [6], microgrids [7] and aggregators [8]. While they might feature some differences depending on the application (e.g., providing or not balancing services to the electric grid), their common feature is the presence of multiple energy conversion technologies and energy storages which are aggregated and managed in a synergic manner by an integrated Energy Management Strategy (EMS) algorithm. For this reason, a more general definition is Aggregated Energy System (AES). The EMS uses optimization methods to determine the most efficient operational strategy of the power generation units, energy distribution networks and loads subject to demand-side management programs [9]. The development of EMS is a very active research area with several hundreds of publications per year. EMS can be classified depending on the number of decision makers: centralized EMS and

distributed EMS. Centralized EMS are suitable for applications where a single decision maker plans the operation of the AES and state of the art approaches rely on Mixed Integer Linear Programming (MILP) formulations [10] which can provide optimality guarantees of the solution. Distributed EMS algorithms enable prosumers to locally optimize the operation of their own generation/consumption units while cooperating to determine the optimal solution for the community. Coordination mechanisms can be price-based [11] (price signals are communicated to prosumers/owners [12]), incentive-based or based on decomposition algorithms [13].While most researchers focus.....

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PARMA**
- **UNIVERSITA' DI FERRARA**

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering PE7_3 - Simulation engineering and modelling

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 238.413,00
Contributo totale progetto:	€ 196.627,00
Costo totale PoliTo:	€ 55.151,00
Contributo PoliTo:	€ 45.287,00

FRISBEE - Flood pRediction In Small ungauged Basins of Italy through Enhanced runoff coefficient assEssment

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Daniele Ganora

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

@A@@C7D"2E

Ruolo PoliTo:

Partner

Abstract

The Italian territory is characterized by high variability in the climate and is affected by the occurrence of extreme rainfall events highly localised in space and time. The vulnerability to such events is exacerbated by the complex morphological setting. The most significant recent catastrophic flood events have been reported in small basins (area

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **Consiglio Nazionale delle Ricerche** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE10_17 - Hydrology, water and soil pollution PE10_14 - Earth observations from space/remote sensing

Budget

Costo totale progetto:	€ 249.736,00
Contributo totale progetto:	€ 189.696,00
Costo totale PoliTo:	€ 116.437,00
Contributo PoliTo:	€ 88.444,00

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Politecnico
di Torino

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e della Ricerca

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WAA - Women Atlas Archive. Mapping the legacy of women in architecture, planning, civil engineering and design

Durata:

12/12/2023 - 11/12/2025

Responsabile scientifico:

- Emilia Maria Garda

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

202274ZEHR

Ruolo PoliTo:

Coordinatore

Abstract

In Italy, women's legacy finds it difficult to be recognized specifically in architecture, planning, civil engineering and design. In the contemporary history and theory of these disciplines, the contribution of women is still, mostly, omitted or forgotten. One reason for this void is the historical subordinated position of women in design professions; another reason is the difficulty of scholars in identifying the primary sources. To fill this void WAA will create a critical mapping of archives and archival collections produced by Italian women who worked in Italy in the twentieth century. As at present just a few archives are known, the research will consist of finding, disclosing and arousing archival documents. This research will give a new impetus to women's history studies as well as to the contemporary history of architecture, history of construction and design history. The disclosing of new data through a digital online Atlas will facilitate the process of intertwining sources to highlight women's cultural legacy and to increase the social and historical value of their contribution to the creation of tangible and intangible heritage. Complementary case studies on different fields of design and in different historical and social conditions of women's professional emancipation will examine memory and legacy to define a range of specific criteria for the recognition of a heritage featured by gender issues. As it is known, gender has become an increasingly important area for heritage, the highest aim of the project is to rethink the concept of heritage itself for leaving an image of a more egalitarian and gender-balanced society. The professional archives can reveal the historical and cultural values of sites, buildings, and artefacts created by women. The research of the formation and circulation of archives will achieve a comprehensive vision of memory and identity that have fallen into oblivion or marginalized by the disciplinary historiographies. It will provide the formation of a Data Collection of different types of documents across geographic and socio-cultural

borders. The research will be also implemented throughout an International Conference Workshop. Both the results will be used to create the Atlas of Women's Archives, through which women's archives ofdesigners, architects, engineers, etc. will be mapped and digitised across the country. The purpose of the Atlas will be to show which archives deal with women, but also to make it easier to find the material for each professional. It addresses students, academics, professionals and actors in the domain of Cultural Heritage. The WAA system will have the potential to be further developed by collecting in a systematic critical way also new digital documentation by embracing a participative approach where users will also be donors of documents. In addition to the Atlas, the main products will be the creation of a Journal, and a Book.

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Parole chiave

Settori ERC

LS1_1 - Molecular interactions LS1_10 - Structural biology (NMR) LS1_6 - Lipid synthesis, modification and turnover LS1_7 - Carbohydrate synthesis, modification and turnover LS1_8 - Biophysics (e.g. transport mechanisms, bioenergetics, fluorescence) LS1_9 - Structural biology (crystallography and EM) LS2_1 - Genomics, comparative genomics, functional genomics LS2_10 - Bioinformatics LS2_11 - Computational biology LS2_12 - Biostatistics LS2_13 - Systems biology LS2_12 - Biostatistics LS1_5 - Protein synthesis, modification and turnover LS2_13 - Systems biology LS2_2 - Transcriptomics LS2_3 - Proteomics LS2_4 - Metabolomics LS2_14 - Biological systems analysis, modelling and simulation LS2_6 - Molecular genetics, reverse genetics and RNAi LS2_7 - Quantitative genetics LS2_8 - Epigenetics and gene regulation LS2_9 - Genetic epidemiology LS3_1 - Morphology and functional imaging of cells LS3_10 - Development, developmental genetics, pattern formation and embryology in plants LS3_11 - Cell genetics LS3_12 - Stem cell biology LS3_2 - Cell biology and molecular transport mechanisms LS3_3 - Cell cycle and division LS2_5 - Glycomics LS1_4 - RNA synthesis, processing, modification and degradation LS3_4 - Apoptosis LS3_5 - Cell differentiation, physiology and dynamics LS1_3 - DNA synthesis, modification, repair, recombination and degradation LS1_2 - General biochemistry and metabolism LS1_11 - Biochemistry and molecular mechanisms of signal transduction LS3_6 - Organelle biology LS4_1 - Organ physiology and pathophysiology LS4_4 - Ageing LS3_7 - Cell signalling and cellular interactions LS3_8 - Signal transduction LS4_3 - Endocrinology LS3_9 - Development, developmental genetics, pattern formation and embryology in animals LS4_2 - Comparative physiology and pathophysiology SH6_12 - Gender history; Cultural History; History of Collective Identities and Memories SH5_8 - Cultural studies, cultural identities and memories, cultural heritage SH5_6 - History of art and architecture, arts-based research SH6_13 - History of Ideas, Intellectual History, history of economic thought

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 5. Raggiungere l'uguaglianza di genere ed emancipare tutte le donne e le ragazze

Budget

Costo totale progetto:	€ 65.251,00
Contributo totale progetto:	€ 47.726,00

Costo totale PoliTo:	€ 40.000,00
Contributo PoliTo:	€ 29.475,00

B4A - Blockchain for All

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Valentina Gatteschi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20225MN5K3

Ruolo PoliTo:

Coordinatore

Abstract

The Blockchain for All project (B4A) aims at researching useful techniques that could bring the blockchain "universe" closer to the wider public, or could simplify its interaction from skilled users. In particular, the project foresees the implementation of a tool that will support companies/developers/end-users in the following tasks: - evaluating the alternatives: the tool will support companies in identifying a) whether a blockchain is really needed for a use case and b) which blockchain framework is more suitable for the specific use case; - implementing no-coding/low-coding: the tool will support non-skilled users in the development of blockchain-based applications, enabling them to write smart contracts and web3 code without having programming skills; - analyzing the blockchain: the tool will provide programmers with an interface for visual analytics of smart contracts, that could allow them to quickly grasp the main characteristic of a smart contract, compare several of them, or retrieve them based on a set of keywords/features. This tool will have a dual purpose. On the one hand, since after the development phase, a testing phase is planned, it will help the researchers involved in the project testing different approaches with users coming from both the commercial and the research world, with different skills and professional roles, in order to identify the most suitable approaches. On the other, the tool, once released, will improve the adoption of the blockchain technology. The achieved results could be relevant for users with different technical skills levels, in particular for: a) companies' top managers, who, by following a well-defined methodology to describe a use case relevant for their company could find if the company should make technological investments in blockchain (and even which blockchain framework is more suitable); b) people without technical skills, that could be able to understand the behavior of (or even code) a smart contract thanks to visualization and semantic technologies, among others; c) developers, that could find/reuse decentralized applications (dApps) already developed, or quickly grasp the main characteristics of a smart contract thanks to visual dashboards. d) citizens,

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associations, small retailers, institutions that want to benefit from the affordances offered by the blockchain without any technical knowledge and don’t want or don’t have the resources to resort to predefined applications or to develop them.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **FONDAZIONE LINKS - LEADING INNOVATION & KNOWLEDGE FOR SOCIETY**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

PE6_9 - Human computer interaction and interface, visualisation and natural language processing PE6_7 - Artificial intelligence, intelligent systems, multi agent systems PE6_3 - Software engineering, operating systems, computer languages

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 4. Fornire un’educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti|Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un’occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 285.000,00
Contributo totale progetto:	€ 250.000,00
Costo totale PoliTo:	€ 144.000,00
Contributo PoliTo:	€ 128.000,00

SURENET: Surveillance of the URban Environment exploiting deployed optical NETworks

Durata:

29/09/2023 - 28/09/2025

Responsabile scientifico:

- Roberto Gaudino

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero Università e Ricerca)

Codice identificativo progetto:

2022HRKKCN

Ruolo PoliTo:

Coordinatore

Abstract

SURENET project aims at the advancement of the operation of already deployed telecommunication (TLC) optical networks (ONs) to support urban infrastructures surveillance and monitoring through the exploitation of breakthrough fibre optic sensors (FOSs). ONs represent the enabling technology for backbone and metro-access networks, interconnecting final users and data centers to the global Internet across cities, regions, countries, continents to deliver ultra-broad band digital services. In the last decade and in particularly in these last two years (due to the increase of tele-teaching and tele-working), massive traffic growth rates pushed the ONs directly to the final user, with massive investments from private and public operators to deploy Fiber to the Home (FTTH). In the EU27 region, the official statistics [FTTH21] for 2021 showed that 20.5% of households are today reached by fiber (compound annual growth rate CAGR=16.6%). The presence of fibers is today ubiquitous, constituting a pervasive web covering the planet and in particular urban areas. There is a growing interest to use ONs not only for TLCs, but also for urban infrastructures remote monitoring through Fiber Optic Sensors (FOS): ONs can be exploited for monitoring purposes, providing an unprecedented fruitful synergy between TLC and sensing applications. The introduction of FOSs could be used to monitor physical parameters (such as strain, vibrations, anomalous events and temperature) along the fiber and enable their continuous space-time analysis over large areas. SURENET will focus on these topics, exploiting recently demonstrated unconventional, TLC-compatible sensing strategies to provide a real-time, monitoring of mechanical vibrations and thermal perturbations. SURENET will experimentally demonstrate the possibility of anomalies detection, such as dynamic stresses and anomalous vibrations in buildings passed by FTTH and Metro ONs, also monitoring seismic events or human-induced problem in civil infrastructures, focusing on increasing urban resilience and hazards early detection. Also innovative fibers such as

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multi-core fibers (MCFs) will be considered in order to add the spatial dimension to the portfolio of optical multiplexing technologies. FOSs adoption and their integration in standard TLC networks will represent a breakthrough innovation providing new tools for the real-time, dynamic study of anthropogenic, seismic and geophysical events. Optical monitoring will anyway not only useful for civil protection, but it is also greatly interesting for TLC operators, to improve the early-warning of anomalous events on the TLC infrastructure itself, through the continuous surveillance of the embedded network and real-time safety diagnostic. SURENET outcomes could support institutional decision makers in fields of civil to the environment protection, offering tools for the prompt detection of structural faults, seismic and natural hazards in populated areas.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni
- PhotoNxt - PhotoNext - Centro Interdipartimentale PoliTO sulla Fotonica applicata

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE7_6 - Communication technology, high-frequency technology PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 253.943,00
Contributo totale progetto:	€ 200.000,00
Costo totale PoliTo:	€ 132.826,00
Contributo PoliTo:	€ 100.000,00

EnabLi - Enabling high-energy, room temperature all solid-state lithium metal batteries with advanced polymer-based electrolytes and high-voltage cathodes through enhanced interface control

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Claudio Gerbaldi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022KSK84A

Ruolo PoliTo:

Coordinatore

Abstract

The greatest challenges towards worldwide success of electric vehicles revolve around safety, energy density and cost of battery technologies. Innovation in the materials chain is fundamental to address these challenges by replacing flammable and unstable liquid electrolytes and enabling dendrite-free cycling of high-energy Li-metal cells manufactured by sustainable, cost-effective procedures. The EnabLi project aims at demonstrating key-enabling advances in the development of all-solid-state battery technology by employing crosslinked hybrid polymer electrolytes laminated onto the Li metal anode and high-voltage cathodes coated with a polymer electrolyte with high oxidation potential. Special attention will be devoted to the optimization of interfaces: unique combination of their development guided by advanced modelling/characterization will enable all-solid-state cells that feature improved energy density (ED of 700 Wh/kg at the materials level), durability and greatly enhanced safety at competitive cost in line with generation 4b targeted by EU roadmap to 2030. Our strategies to reach the targets at laboratory-scale level chiefly include: i) development of hybrid polymer-based electrolytes with high thermal/electrochemical stability; ii) development and application of newly designed high-ED 4V class cathodes at low Co-content for high energy/power cells; iii) understanding of interface chemical/structural features, electrical response, and charge transfer phenomena by advanced atomistic modelling. To validate the innovative materials and approaches, prototype cells will be designed with focus on automotive application and tested in different conditions of temperature, current regimes, and long-term cycling, to understand and detect ageing/safety-related issues. Green, sustainable chemical approaches will be used, including solvent-free electrolyte

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processing and water-based cathode formulation. EnabLi engages 3 internationally renowned Italian academic groups with unique combination of complementary skills, all involved in the Battery2030+ initiative. It is organized in 5 intertwined workpackages exploring the entire value chain from computationally assisted screening of electrode/electrolyte materials and their sustainable production/processing, to the application of advanced electrochemical characterization and, finally, their assembly in full cell prototypes in pouch configuration (TRL-4). The research and innovation actions carried under EnabLi will pave the technological route for the implementation of a national rechargeable battery industry, also enabling higher uptake by the electromobility sector and end-consumers, in view of climate neutrality and green energy transition by 2030 and beyond. The total human effort to reach project goals will be guaranteed by involvement of researchers with competence and time per activities, and purposely employed and trained Young Researchers, with most attention paid to ensure gender balance.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **Università degli Studi di Milano Bicocca**
- **Università degli Studi di Napoli Federico II**

Parole chiave

Settori ERC

PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors PE4_17 - Characterisation methods of materials PE5_6 - New materials: oxides, alloys, composite, organic-inorganic hybrid, nanoparticles

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 255.320,00
Contributo totale progetto:	€ 199.945,00
Costo totale PoliTo:	€ 101.173,00
Contributo PoliTo:	€ 75.290,00

SmartShires - Smart Shires: Sustainable Smart Services for the Countryside

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Paolo Giaccone

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero)

Codice identificativo progetto:

2022N2NH42

Ruolo PoliTo:

Partner

Abstract

In recent years, advances in the ICT domain were focused mainly on "smart cities", offering a set of strategies aiming at improving and optimizing services offered to citizens. All these services have been mainly devoted to dense metropolitan areas. In the long-term, these efforts will have two relevant social effects: on one hand, they improve the life of the citizen. On the other hand, they will strengthen the differences among different areas of the same country or region. The problem is not just a matter of "digital divide", and it is not possible to trivially replicate smart cities services, or ask to deploy the same technological infrastructures, in a decentralized area. Indeed, the different economic circumstances make smart cities related solutions not feasible in the considered contexts. The need to rethink the way we design smart services is confirmed by the EU strategic research agenda for 2021-2024, which considers a balanced development of vibrant rural, coastal, peri-urban and urban areas as the main objective of a European Green Deal (35% of Horizon Europe budget). The aim of this project is to devise a software architecture promoting the development of sustainable, secure and opportunistic solutions for the deployment of smart services in decentralized areas. These solutions must be cheap and not strictly dependent on the presence of classic ICT infrastructures. Digital resource scarcity must be overcome through sharing and adequate organization of data, computation and communication facilities. This must be accomplished by integrating legacy access network infrastructures with alternative cooperative approaches, based on opportunistic and community-based mesh networks. Similarly, based on the specific service to host, computation might be performed over cloud, edge computing or completely decentralized architectures, by guaranteeing the desired level of privacy. Even decentralized storage is a potential solution that allows storing data without having to rely on centralized data silos. The overall sharing of network, computing and storage resources must be securely traced and rewarded. To this extent, scalable blockchain

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based techniques will provide accountability and incentives management, since they offer proof of cooperation, which can be automatically awarded via smart contracts and the distribution of crypto-tokens to be employed in the smart services ecosystem. The SmartShires project will combine all these technologies, and through the design of novel algorithms and methodologies, it will enable the development of novel services devoted to the creation of sustainable smart shires. We will focus on a use-case related to eHealth monitoring and on the development of a Proof of Concept for securely handling transmission of sensitive data, in absence of Internet connectivity, through trusted data mules.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI URBINO "CARLO BO"** - Coordinatore
- **UNIVERSITA' DELLA CALABRIA**

Parole chiave

Settori ERC

PE6_1 - Computer architecture, pervasive computing, ubiquitous computing PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 329.994,00
Contributo totale progetto:	€ 227.911,00
Costo totale PoliTo:	€ 77.364,00
Contributo PoliTo:	€ 56.427,00

ICELESS

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Mauro Giorcelli

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Ruolo PoliTo:

Partner

Abstract

The general objective of the project ICELESS (Ice Control Enabled via a Low-Energy Smart System) is to define a novel approach for the ice control, integrating different cutting-edge technologies (nanotechnology, smart materials, electronics, ultrasound, data processing) within a platform fitted out with its own automatism, in order to reduce the energy demand and to overcome the lack of application flexibility and adaptivity of current solutions against icing phenomena. The innovative idea of the project is that ice control can be broken down into a few main actions (prevention, identification, removal) and they can be fulfilled by means of a distributed transducer network with a flexible architecture (i.e. tunable with the specific application) and a proper operation control unit built around this network. Namely, this process enables to capture event flows (warnings), elaborate and locate them, send/(re)distribute the appropriate actions all over the transducer networks with the highest efficiency and the lowest possible power, enabling a collective distributed coordination. This idea is fulfilled by combining the use of liquid-super repellent and heating surfaces along with ultrasound, handled by distributed transducers acting as sensors or actuators or both. When these technologies meet together, the major advantage is that ice protection is achieved with the lowest energy demand possible. In detail, it is expected that nanostructured organic/inorganic hybrid coatings with static and dynamic superhydrophobicity, applied on the target surface, inhibit the ice accretion or weaken the ice adhesion strength without any power supply. The electric heating coating based on biological charcoal enables an efficient control of surface temperature with energy saving. Meanwhile, ultrasound, benefiting from these actions, contributes both to hinder frost formations and to detect or remove ice buildup inducing shear stresses at the ice-structure interface sufficient to enable the detachment. In this context, sensing devices generate “contextualized streams” of data representing events about something that is happening somewhere on the structure. Otherwise, actuating devices receive “contextualized commands streams” related to what they should do over time. This process demands for proper management to operate autonomously and in real-time. It is indeed challenging to ensure low

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operating-energy and proper feedback in a variety of conditions and applications. To achieve this ambitious aim, ICELESS consortium brought together specialists from universities and research institutes with different, but complementary backgrounds to address all the project facets. This is how the technologies conceived to address icing challenges and the hardware/software solutions demanded for their coordination are investigated thoroughly within ICELESS in a strong interdisciplinary and multidisciplinary collaboration among partners.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore

Parole chiave

Settori ERC

PE3_4 - Electronic properties of materials, surfaces, interfaces, nanostructures, etc. PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 210.419,00
Contributo totale progetto:	€ 194.279,00
Costo totale PoliTo:	€ 58.914,00
Contributo PoliTo:	€ 53.581,00

ACRE: AI-Based Causality and Reasoning for Deceptive Assets

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Danilo Giordano

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022EP2L7H

Ruolo PoliTo:

Partner

Abstract

ACRE (AI-Based Causality and Reasoning for Deceptive Assets) will reinforce the resilience of cybersecurity defence mechanisms against advanced persistent threats. The goal is to provide cyber threat analysts with actionable intelligence to understand and investigate malicious activities targeting complex environments such as complex network infrastructures and distributed systems that support services essential to our society. The current threat landscape, adversarial ecosystem, and expansion of the attack surface link to an environment of staggering complexity where cyber threats affect the entire fabric of our interconnected world. Optimising for the known threats only is not enough: we need to build resilient systems that adapt to new types of complex attacks quickly. Machine Learning and Artificial Intelligence (AI) algorithms enable new methodologies to extract knowledge and actionable intelligence from large streams of services and networking devices logs (TECHINT). ACRE will advance the state-of-the-art in cyber threat intelligence analysis—from data collection to causal hypotheses generation—to provide active defence against novel—yet unknown—threats, in order to reinforce the resilience of cybersecurity active defence mechanisms in Italy and Europe. Our aims are: 1. to understand how to gather contextual evidence for supporting security analysts in their cyber threat situational understanding; 2. to advance robust and trustworthy capabilities for cyber threat situational understanding; 3. to assist security analysts in uncovering novel threats quickly. The concrete objectives of ACRE are: 1. to mature the representation of heterogeneous data collected by security sensors distributed across the network for identifying groups of attacks with similar patterns in order to understand how to gather contextual evidence for supporting security analysts in their cyber threat situational understanding; 2. to investigate efficient uncertainty-aware causal learning and reasoning over large bandwidth data streams in order to advance robust and trustworthy capabilities for cyber threat situational understanding; 3. to enable state-

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of-the-art security monitoring infrastructures to evolve autonomously for maximising data collections of unknown attack patterns in order to assist security analysts in uncovering novel threats quickly. ACRE will advance the state-of-the-art in representation learning and reasoning over complex streams of TECHINT. Moreover, it will also improve current active defence solutions by proposing the concept of autonomous defence that employs both smart honeypots and reinforcement learning.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica
- SmartDat - SmartData@PoliTO - Big Data and Data Science Laboratory

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI BRESCIA** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

PE6_5 - Cryptology, security, privacy, quantum crypto

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 249.667,00
Contributo totale progetto:	€ 249.667,00
Costo totale PoliTo:	€ 69.747,00
Contributo PoliTo:	€ 69.747,00

SEMPER - Synthetically Engineered EMissive PNA for Medical Diagnostics based on Optical and Surface-Enhanced Raman Techniques

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Fabrizio Giorgis

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

m_pi.AOODGRIC.REGISTRO_PRIN2022.0005707.31-03-2022

Ruolo PoliTo:

Partner

Abstract

Peptide nucleic acids (PNAs) are one of the best-performing tools in chemical biology for DNA and RNA recognition. PNA properties can be modulated by chemical modification to improve target affinity/selectivity and to introduce reporter or functional groups to create smart probes to develop ultra-sensitive detection techniques. To achieve these goals, fundamental research will be carried out, starting from the basic properties of PNAs and their interactions with microRNAs (miR), one of the most studied classes of cancer biomarkers. SEMPER aims to merge the state of the art from organic chemistry, chemical biology, and nanophysics to develop innovative dual probes, for fluorescence and Surface-Enhanced Raman Scattering (SERS) based assays to quantify miRs down to fM concentration. PNAs can form heteroduplexes with complementary DNA/RNA characterized by higher stability in comparison to the canonical duplexes, which can be translated into higher sensitivity towards short sequences of nucleic acids like miRs. PNAs' higher robustness and straightforward preparation compared to DNA/RNA can better tolerate both the functionalization along the sequence and the presence of small functional molecules working as fluorescent and Raman reporter for SERS investigation. Two synthetic orthogonal yet complementary strategies will produce suitable PNAs able to provide emission and Raman signal without lowering their high affinity and selectivity towards the target miRs. The former aims to obtain the first complete emissive isomorphic genetic alphabet for PNAs, based on thieno[3,4-d]pyrimidine core, allowing the preparation of intrinsically fluorescent PNAs. The latter will focus on the functionalization of novel environmentally sensitive and intercalating naphthalenediimides (NDI) as PNA tags, able to work at the same time as fluorescence and Raman reporter. The intrinsically emissive PNAs and the NDI-tagged PNA will be employed to detect short miRs by user-friendly cost-effective

fluorescence assay and by the ultra-sensitive SERS-based techniques. SERS microfluidic sensing platforms integrating plasmonic nanostructures will be developed, with a customization devoted to multiplexed analysis. The detection strategy will be also implemented with opticaltweezing, enabling the chemical-free creation and control of SERS-active sites in-liquid. Biochemical functionalization protocols for SERS substrates will be adapted to our PNA probes suitably designed to bound specific miR sequences. SERS-based platforms will provide high sensitivity while avoiding time-consuming chemical amplification steps, typical of polymerase chain reaction (PCR) assays. Large dynamic range (up to 4 decades) can be achieved, overcoming the performances of standard colorimetric analysis such ELISA. Finally, portability and moderate cost of the managed equipment will make these amplified spectroscopic analyses competitive with more complex tools such as real-time PCR and microarray technology.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore

Parole chiave

Settori ERC

PE3_10 - Nanophysics: nanoelectronics, nanophotonics, nanomagnetism, nanoelectromechanics, etc.

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 244.619,00
Contributo totale progetto:	€ 189.777,00
Costo totale PoliTo:	€ 78.328,00
Contributo PoliTo:	€ 62.377,00

NaMaSCale - From the Nano to the Macro SCale: a deep investigation of grain boundaries in high-Tc superconducting Wires (NaMaSCale)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Laura Gozzelino

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022TZ8R7C

Ruolo PoliTo:

Partner

Abstract

Materiali superconduttori quali ad esempio il BSCCO-2212 (Bi2Sr2CaCu2Ox) possono essere prodotti sotto forma di "round cables" con proprietà isotrope mediante il processo "powder in tube". Questo ne fa degli ottimi candidati per realizzare magneti superconduttori che a loro volta trovano impiego in ambiti di ricerca (Large Hadron Collider al CERN) o di supporto alla transizione energetica (magneti in reattori a fusione, sistemi per la generazione di energia da fonti rinnovabili e per il suo immagazzinamento) o ancora in ambito medico (diagnostica mediante risonanza magnetica nucleare). Tuttavia l'ottimizzazione di tali cavi non è ancora stata raggiunta: la massima corrente che possono trasportare (corrente critica) è infatti ancora limitata dal disallineamento dell'orientazione cristallina al passaggio tra un grano e l'altro. Un altro materiale molto promettente per la realizzazione di "round cables" è il superconduttore di recente scoperta Ba-122 (Ba0.5K0.5As2Fe2): pur essendo meno sviluppato del Bi-2212 dal punto di vista tecnologico, ha già dimostrato ottime prestazioni in campo magnetico. Anche nel suo caso, però, il disallineamento dell'orientazione cristallina al bordo di grano può limitare il valore di corrente critica. Al fine di ottimizzare l'accoppiamento tra i grani e quindi la corrente critica del cavo, il progetto NaMaSCale si prefigge come principale obiettivo lo studio di come il disallineamento ai bordi di grano influenzi la corrente critica in funzione della temperatura di lavoro e del campo magnetico in campioni policristallini di BSCCO-2212 e Ba-122 appositamente cresciuti e, per quanto riguarda il BSCCO-2212, anche in cavi multifilamentari. Lo studio verrà effettuato con varie tecniche di misura che permetteranno una analisi su varie scale spaziali, dalla misura della corrente critica globale del campione fino all'analisi al microscopio a trasmissione elettronica del singolo bordo di grano. Nell'ambito del progetto, l'unità di ricerca del Politecnico di Torino effettuerà misure di campo magnetico locale e densità di corrente locale su

scala sub-millimetrica e microscopica mediante, rispettivamente, magnetometria a scansione con sonde ad effetto Hall e caratterizzazione magneto-ottica e analisi dell'orientazione cristallografica dei grani e delle proprietà dei bordi grano mediante tecniche diffrattometriche.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI GENOVA**

Parole chiave

Settori ERC

PE3_6 - Macroscopic quantum phenomena: superconductivity, superfluidity, etc.

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 260.089,00
Contributo totale progetto:	€ 189.996,00
Costo totale PoliTo:	€ 76.446,00
Contributo PoliTo:	€ 58.308,00

CRAWL - Carbon Release in A Warming cLimate: a proxy data model comparison for the analysis of past episodes and future scenarios

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Jost-diedrich Graf Von Hardenberg

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022T4XEBP

Ruolo PoliTo:

Partner

Abstract

This research is designed as an interdisciplinary effort involving stratigraphers, micropaleontologists, geophysicists, geochemists and climate modelers on the study of the environmental changes leading to the onset of major carbon cycle aberrations that occurred between 56–52 millions of years ago. This time interval, which corresponds to the late Paleocene–early Eocene, records a long-term warming culminating at the Early Eocene Climatic Optimum when the highest temperature of the last 66 millions of years occurred. Superimposed on this trend, a series of transient episodes of global warming and ocean acidification, known as hyperthermals, captures the geologically rapid (10^3-4 yr) release of massive amounts (10^3 Gton) of carbon into the coupled atmosphere-ocean system. Hyperthermals are thought to be caused by natural carbon stocks (e.g. permafrost and/or gas hydrates) crossing a threshold for carbon release, under the combined action of long-term warming and orbital forcing. Studying the behavior of the climate system across hyperthermals provides an opportunity for testing the long-term response of climate following large greenhouse gas (GHGs) emission events. Accordingly, much effort has been devoted to the analysis of hyperthermal events as paleo-analogues of the ongoing warming related to the anthropogenic excess of carbon into the atmosphere. On the other hand, the analysis of the time intervals preceding hyperthermal events offers the opportunity to characterize the environmental changes leading to the release of carbon under enhanced greenhouse conditions. In fact, baseline CO2 concentrations of the early Eocene are similar to worst-case scenarios included in the Shared Socioeconomic Pathways for 2100. On this basis, the overall goal of the proposed research is to provide a quantification of the magnitude of the forcing processes and feedbacks in play for the release of carbon from natural stocks across individual hyperthermal events. To this end, we will obtain geochemical and biotic proxy records from a suite

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of different sites representative of a wide spectrum of depositional environments and geography as a basis for the integration with an Earth Model of Intermediate Complexity designed to explore the conditions leading to carbon release. Cyclostratigraphic analysis will provide the basis for a robust chronology of the obtained proxy records and for the model-oriented recognition of orbital forcing and its phasing across hyperthermals. Increasing CO2 concentrations throughout the early Eocene provide an opportunity to carry out this exercise for different baseline conditions. We believe that the results of this research will contribute to evaluating the stability of present-day natural carbon reservoirs under increasing global temperature conditions.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **Istituto Nazionale Geofisica e Vulcanologia** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE10_6 - Palaeoclimatology, palaeoecology PE10_9 - Biogeochemistry, biogeochemical cycles, environmental chemistry

Budget

Costo totale progetto:	€ 321.205,00
Contributo totale progetto:	€ 224.883,00
Costo totale PoliTo:	€ 89.923,00
Contributo PoliTo:	€ 72.452,00

ReveDH: REVolutionary changE of vision for District Heating: holistic approach to realistically reach 100% renewable networks

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Elisa Guelpa

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022J294C3

Ruolo PoliTo:

Coordinatore

Abstract

The world energy framework has been significantly changing in the last years, as a consequence of the challenging goals in terms of decarbonization, the increasing energy demand of developing countries and, politically, the requirements of energy independency. In this framework, renewable energy sources are expected to increase their share towards very high percentages. To properly proceed towards such energy scenarios, if on one side there is an indubitable need of appropriate technologies for generation/distribution/storage, on the other side there is a new and crucial role that is expected to be played by energy utilities and end-users. The full problem cannot be faced only from a technical viewpoint, but with the integration of the engineering aspects with legal, sociologic and economic considerations. ReveDH project proposes a breakthrough approach able to formulate the latest energy engineering problems in a multidisciplinary way which includes the definition of a common language, an analysis of the energy scenarios from the different perspectives, the formulation of a comprehensive optimization problem and the discussion of the results. A specific problem, which is of primary relevance both in terms of global impact on urban areas and from the research approach viewpoint, is the transition of District Heating (DH) from the current energy system towards its future role in a society no more based on fossil fuels. DH represents a unique chance to realistically drive the energy transition because it allows the integration of renewable energy sources/waste heat output (RESWH) in urban areas but also provide a huge source of flexibility to the electricity grid. Transition requires the use of DH in a different way than what is currently performed, which pillars are described in B.1. ReveDH starting from an engineering approach, will propose innovative engineering solutions to boost the penetration of local renewable energy resources into DH infrastructure. The holistic and multilevel approach (B.2.1) created in ReveDH, will provide quantitative answers on the best

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strategy to make the existing infrastructure technically compatible with the requirements of future 100% RESWH systems, optimizing together, along the technical aspects, the potentials/benefits on the end-user involvement defining strategies to overcome communication barriers, gender differences, anxieties/desires (sociological), the legal issues to enhance the juridic framework, paying attention to protection of end-user and their data, and the definition of a new appropriate DH market framework to enable distributed generation considering price differentiation and interaction with the electricity grid (economic). ReveDH has the ambition to become a) a beacon to guide the transition towards RESWH supplied DH b) an inspirational project that will show the primary importance of combining different competences to inclusively reach the goal of a green and cohesive society.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' STUDI TRENTO**

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 209.034,00
Contributo totale progetto:	€ 194.960,00
Costo totale PoliTo:	€ 136.074,00
Contributo PoliTo:	€ 122.000,00

interface - AtomIc scale eNgineering of metal halide perovskiTEs suRFace towards exceptionally stAble and highly seleCtive photoElectrodes for CO2 conversion into fuels

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Simelys Pris Hernandez Ribullen

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Codice identificativo progetto:

2022HWWW3S

Ruolo PoliTo:

Partner

Abstract

CO2 conversion to valuable products is essential for climate-change mitigation and renewable energy production. The photoelectrocatalytic (PEC) CO2 reduction approach driven by solar energy and electricity is a competitive solution. The surface chemistry of the photocatalyst drives the CO2 chemical conversion. Hence, poor control of actives sites on the surface is the typical reason for the low selectivity, inefficiency, and rapid system degradation. Besides, the photoreduction in aqueous solution is highly desirable in order for the project to be environmentally friendly. Therefore, the development of water stable photocatalysts with a high catalytic activity and selectivity for the transformation of CO2 is the key strategy to accomplish this goal. Metal halide perovskite (MHP) materials have the potential to revolutionize the field, by virtue of their ease of synthesis, excellent light harvesting, efficient photon-to-carrier conversion and transport within nm-to-micron lengths. Several perovskite materials have already been synthesized and developed with excellent optoelectronic properties fulfilling the technology requirements. However they suffer from poor resistance to moisture, a still open issue that also hinders the commercial development of MHPs for photovoltaics. The Achilles heel that mostly triggers the material decomposition is believed to lay on the exposed interfaces/material surface. INTERFACE project proposes a unique combination of vapor phase treatments to simultaneously address two key challenges for the burgeoning of the MHP technology: i) producing water-stable systems and ii) acquiring atomic scale control over the MHP exposed surface. In terms of immediate and impactful outputs, INTERFACE aims to address these challenges by engineering MHP surface in thin-film form by adding specific chemical functionalities through plasma assisted-modification and atomic layer deposition (ALD) of conformal ultra-

thin layers of protective/active partner materials. These modifications will be specifically tailored to enhance their stability in water adding hydrophobic barriers and to increase their PEC activity and selectivity towards CO2 reduction towards superior hydrocarbons by adding specific catalytic active sites to the MHP surface or coupling atomically engineered co-catalysts. The simultaneous chemical and spectroscopic investigation will enable the understanding and manipulation of complex interfaces for the rational development of a stable, highly efficient PEC system at reduced environmental impact. To achieve the ambitious goals, we will combine the expert and complementary know-how of a team of recognized Italian scientists which is essential for a timely breakthrough. This forms an incredible asset for the success of the project, and also a tremendous push for pioneering new knowledge and innovative approaches across different fields, with repercussions ways beyond photocatalysis.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI**

Parole chiave

Settori ERC

PE8_11 - Sustainable design (for recycling, for environment, eco-design) PE5_3 - Surface modification PE4_4 - Surface science and nanostructures

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 356.800,00
Contributo totale progetto:	€ 249.800,00
Costo totale PoliTo:	€ 65.886,00
Contributo PoliTo:	€ 46.136,00

CARE - CO2 Advanced, environmental-friendly nano-technology based electrochemical REduction (CARE)

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Andrea Lamberti

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero Università e Ricerca)

Ruolo PoliTo:

Coordinatore

Abstract

CO2 Advanced, environmental-friendly nano-technology based electrochemical REduction (CARE)

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI ROMA - TOR VERGATA**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

PE5_15 - Polymer chemistry

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 276.298,00
Contributo totale progetto:	€ 189.873,00
Costo totale PoliTo:	€ 63.132,00
Contributo PoliTo:	€ 55.743,00

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Ministero dell'Università e della Ricerca
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SPACE - Simplifying Predictable and energy-efficient Acceleration from Cloud to Edge

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luciano Lavagno

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Universita' e Ricerca)

Codice identificativo progetto:

202254AM7H

Ruolo PoliTo:

Coordinatore

Abstract

Digital technologies such as embedded AI, IoT and edge/cloud computing are at the heart of the transition to a greener economy, both at the European and Italian level. For this transition to happen, compute platforms capable of delivering high performance within tight power envelopes are fundamental. FPGA-based systems-on-chip are among the most promising solutions, but their adoption is hindered by integration, programming, and management complexity of many heterogeneous components. The computational complexity, sustained data flow and tight system requirements of algorithm acceleration via FPGAs exacerbate these problems, forcing lengthy design iterations to select and configure HW and SW components. Starting from the technical challenges in Unmanned Aerial Vehicles and Radio Access Networks, PEACE will define an integrated design methodology and framework to efficiently deploy accelerators on multiple FPGA-based SoCs while meeting performance, predictability and energy constraints.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI MODENA E REGGIO EMILIA**

Parole chiave

Settori ERC

PE6_1 - Computer architecture, pervasive computing, ubiquitous computing PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Politecnico di Torino

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 308.420,00
Contributo totale progetto:	€ 214.119,00
Costo totale PoliTo:	€ 154.211,00
Contributo PoliTo:	€ 107.060,00

Crafted in Stone and Recorded on Paper: The Architectural and Archival Heritage of the Smaller Italian Municipalities (12th-20th Centuries). Historical Research and Digital Enhancement.

Durata:

30/11/2023 - 29/11/2025

Responsabile scientifico:

- Andrea Longhi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

P2022YT2YJ

Ruolo PoliTo:

Partner

Abstract

Italian municipalities are keepers of a vast building heritage, the result of centuries of history. Since the end of the 12th century, communal governments have built, transformed, and preserved a rich landscape of public architecture. Through perseverance and adaptability, communal institutions projected themselves in building programs conducted in different timescales. Communal governments created complex structures to finance and control the construction of these buildings: thus, the processes related to the physical dimension of architecture have intersected with the development of bureaucratic procedures for managing public heritage. Both have resulted in the production of a vast heritage of documents aimed at guaranteeing the legitimacy of technical and creative processes: for centuries, administrations and citizens alike identified themselves with the construction of the civic palace and the establishment of the communal archives. This research project tackles these two aspects (a history that is both ‘crafted in stone’ and ‘recorded on paper’) with the aim to understand and promote buildings and documentary deposits that can describe and make sharable histories linked to the culture of 'good government' of Italian cities. Carried out by five Units, the research will focus on the analysis of the so-called ‘centri minori’ by considering paradigmatic geographies in the history of north-central Italy. The starting point is the historiographical definition of ‘quasi-città’ (Chittolini 1990), from here the research project will turn towards the so-called ‘aree interne’ or areas that have been marginalized in the wake of more recent settlement phenomena. The five Units will identify documents that help interpret, decode, and describe the heritage of built and common areas (squares, streets, etc.) of several case studies. The project involves the building of a geo-referenced database, which will be the main

working tool, as well as one of the most significant research outputs: the data on both 'stone' and 'paper' construction sites will become a common heritage, contributing to a greater awareness of complex historical processes and a stronger cohesion in civil society. The project will enable the digitization of a selection of neglected or endangered documents. To such an end, the framework of the ‘PND del patrimonio culturale’ will be considered fundamental. The project also envisages the organization of public discussions aimed at opening a debate in the scientific community while strengthening the interdisciplinary character of the research, involving local authorities, archives and Soprintendenze. The final objective of the project, in addition to the publication of a volume and monographic essays in Open Access, is to pour its results into a website that will become a reference point for a wide and varied public, providing knowledge that can open new perspectives on the study and management of Italy's cultural heritage.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 295.476,00
Contributo totale progetto:	€ 230.641,00
Costo totale PoliTo:	€ 30.746,00
Contributo PoliTo:	€ 24.000,00

SMART-IC - Smart Monitoring and Production Optimization for Zero-waste Semiconductor Manufacturing: SMART-IC

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Enrico Macii

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022T7YSHJ

Ruolo PoliTo:

Coordinatore

Abstract

In recent years, data became the main driver of innovation in manufacturing, particularly with the advent of Machine Learning-based technologies for process optimization. This revolution, called Industry 4.0 (I4.0), introduced decentralized, self-organizing and self-learning systems for production control, with new machine learning algorithms getting increasingly powerful to solve real world problems, like predictive maintenance and anomaly detection. On the other hand, many data-driven applications are still far from being optimized to cover many aspects and the complexity of modern industries. Data-driven dynamic scheduling and allocation in complex manufacturing scenarios have been only partially developed by the literature. Moreover, correlations between smart monitoring, production scheduling and anomaly detection/predictive maintenance have been only partially exploited, while they could be beneficial to improve effectiveness and reduce production machinery wear. The integration of all such aspects into a coherent analysis and optimization production flow is a challenging task. The SMART-IC main objective is to develop new data-driven approaches for smart monitoring and production optimization. The focus of the project is semiconductor manufacturing, one of the most technologically advanced and data-intensive industrial sectors, where process quality, control and simulation tools are critical for decreasing costs and increasing yield. Additionally, the increased semiconductor demand and the simultaneous global chip shortage make waste reduction and effectiveness improvement extremely critical. In SMART-IC we aim at reducing defect generation at the electronic component level and, therefore, its propagation to the system level and then to the system-of-system (SoS) level. SMART-IC main ambition is to inspect, detect and reduce all relevant wafer level defects, and among those, to identify and contain the ‘latent’ defects on mask and wafers during components manufacturing. With advanced inspections, consisting of

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massive inspection systems, interconnected sensors and component functional safety real time monitoring module, vast amount of generated data will allow to model, monitor and feedback earlier Ministero dell'Università e della Ricerca MUR - BANDO 2022 phases of the IC manufacturing, to minimize the number of defects at each process steps and by that to reduce waste products at all levels, which will require to be recalled from the field, recycled or re-used. It is important to note that this goal falls in the indications of the Chips Act and of the Industrial Strategy, promulgated in February 2022 by the European Commission: both documents underline the need for “devices [...] designed for energy efficiency and durability, repairability, upgradability, maintenance, reuse and recycling”.

Strutture coinvolte

- DIST - Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio

Parole chiave

Settori ERC

PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems PE6_11 - Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video) PE6_7 - Artificial intelligence, intelligent systems, multi agent systems

Budget

Costo totale progetto:	€ 285.899,00
Contributo totale progetto:	€ 277.999,00
Costo totale PoliTo:	€ 99.649,00
Contributo PoliTo:	€ 79.964,00

TLALVMD - Tailor-made Light Alloys for Light Vehicles Modular Design

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Diego Giovanni Manfredi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022RC3P9S

Ruolo PoliTo:

Partner

Abstract

The aim of the research project is the development and properties assessment of an innovative high-strength lightweight alloy for light electric vehicles manufacturing. According to the European Union, the transport sector produces the 28% of the total carbon dioxide (CO2) and the use of Electric Vehicles (EVs) or assisted vehicles should be viable solutions to reduce emmissions. Hybrid mobility should also increase the health quality of citizens by promoting active mobility, thus decreasing sedentariness diseases. In this view, the development of agile modular vehicles could catalyse the mobility transition to more distributed and clean solutions, simpler and more compact, affordable with reduced maintenance costs and readily available. The lightweighting trends in mobility driven by sustainability, cost savings, and performance increased the demand for materials and design concepts able to overcome the basic weight reduction and structural efficiency limits. Particular attention is paid to light metals, recyclable and flexible in terms of performances which can be further enhanced by innovative design solutions enabled by additive manufacturing (AM) technologies, mainly laser powder bed fusion (LPBF). Extremely fine microstructures characterized by outstanding mechanical properties as well as improved components stiffness due to the almost infinitive design solutions. In addition, the powder feedstock used for the manufacturing can be tailor-made inside gas atomizers, which enable the development of brand-new alloys designed to overcome traditional alloys compositions, performances as well as durability. Among them, alloys based on Al-Si-Mg system with addition of elements like Cu or Ni, or with addition of ceramic micrometric reinforcements, such as TiC or TiB2, are very promising and some preliminary studies seem to offer outstanding outlooks that can fit well with the requirements of electric mobility transition. In the last years, several studies pointed out that LPBF alloys has unique properties which led to different behaviours compared to the same alloys processed through conventional processes in

terms of corrosion, fatigue and corrosion-fatigue resistance. Corrosion performances must be investigated as they affect the material durability, which is strictly connected to sustainability and safety. Since several years the collaboration between Politecnico di Torino - leader in the development of new alloys by AM - and the Università degli Studi di Bergamo - recognized at international level for the specific expertise in the study of corrosion behaviour of alloys produced by means of LPBF - is well established. In the present project, the two teams will be involved in the design and production by gas atomization of a new alloy to be manufactured by LPBF for modular EVs and then in the microstructural and mechanical characterization as well as in the corrosion, stress corrosion cracking and corrosion-fatigue characterizations.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi di Bergamo** - Coordinatore

Parole chiave

Settori ERC

PE2_11 - Lasers, ultra-short lasers and laser physics

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 140.600,00
Contributo totale progetto:	€ 124.600,00
Costo totale PoliTo:	€ 62.000,00
Contributo PoliTo:	€ 62.000,00

PRIMA - PRivacy Infringements Machine-Advice

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alessandro Mantelero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Ruolo PoliTo:

Partner

Abstract

PRIMA (PRivacy Infringements Machine-Advice) studies the law and practice of privacy policies, develops methods and techniques for their automated analysis, and implements a prototype to assess their lawfulness. It deploys analytics—a mix of data science, artificial intelligence, machine learning, natural language processing, and statistics—to detect and assess privacy policies' infringments. PRIMA has three main objectives: 1) Normative (doctrinal) objective: The project will provide deeper understanding of the legal requirements concerning privacy policy. It will define normative standards concerning two case studies (i.e., online platforms and e-health products). It will identify criteria for their quality relative to: i) comprehensiveness of information; ii) substantive compliance; and iii) clarity of expression. It will identify and classify clauses that are unlawful or potentially unlawful. 2) Empirical (socio-legal) objective: The project will expand the existing knowledge of the structure, logic, and dynamic of practices concerning privacy policies in order to (i) detect trends in the content and usage of the policies, (ii) discuss impacts on the formulation and accessibility on parties' behaviour; (iii) identify and classify legal shortcomings as well as good practices. 3) Legal-informatics objective: The project will provide a new approach for the analysis, assessment and improvement of legal documents. It will show how methods and techniques for natural language processing and machine learning can be deployed and further developed in the domain of data protection policies and related contracts. It will build a prototype to (i) detect and assess privacy policies' infringements, by detecting (potentially) unlawful and unclear clauses and pointing to missing information, (ii) compute a data-protection score, providing an overall evaluation of the privacy policy (iii) provide advice to improveme privacy policies, (iv) facilitate appropriate legal or social counteractions. The project team combines all the different scientific, theoretical and methodological approaches into a new interdisciplinary synthesis (law, computing, legal informatics, AI, ML, legal theory, computer ethics). PRIMA has the potential to have a strong impact on science and technology as well as on society and economics, placing Italian legal research and practice at the forefront in the use of AI in the legal domain. The study and the

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

practice of the law will also profit from a new powerful method for legal cognition, practice and law enforcement. PRIMA will contribute to what we may call citizens-empowering AI, i.e., to the development of AI technologies supporting individuals and civil society. In particular, it will develop methods and technologies to engage more proactively and effectively in monitoring compliance and in enforcing the law by relying on AI tools.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

SH2_4 - Legal studies, constitutions, human rights, comparative law

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 16. Promuovere società pacifiche e inclusive per uno sviluppo sostenibile

Budget

Costo totale progetto:	€ 224.957,00
Contributo totale progetto:	€ 224.957,00
Costo totale PoliTo:	€ 45.018,00
Contributo PoliTo:	€ 45.018,00

AI-SUST - Artificial Intelligence for SUainable seismic risk reduction of STructures (AI-SUST)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Giuseppe Carlo Marano

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero)

Codice identificativo progetto:

2022LEFKHS

Ruolo PoliTo:

Coordinatore

Abstract

The dramatic seismic events occurred in Italy in past 15 years, have clearly highlighted that reconstruction and restoration costs of large territories are unsustainable by the governments. Also, cities downtime for reconstruction has a dramatic societal impact, such as depopulation and disaggregation of social tissue. To mitigate the effects of these catastrophic events, the only way known is the prevention by reduction of seismic risk. This is intended as a diffuse incentive to reinforcement and retrofitting of buildings and infrastructure, to bring seismic risk below acceptable thresholds. However, a diffuse seismic risk reduction still would involve significant costs and downtime and also a massive employment of raw material with consequent increase of CO2 emissions. This research project gathers all these aspects, proposing a breakdown way of facing the issue through the aid of artificial intelligence (AI) soft computing techniques. The idea developed in this research proposal is to bring artificial intelligence techniques to become a real aid to the current strategic decision processes (what to do and where). The project aims at implementing an artificial intelligence architecture supporting users (engineers or public administrators) in designing sustainable and strategic seismic retrofitting interventions to protect structures and infrastructures against the consequences of earthquakes. AI algorithms are here proposed as a chance to: Solve large and difficult optimization problems such as retrofitting cost minimization or reinforcing material volume minimization in seismic upgrading design. Provide estimations of seismic risk reduction costs of single structures as a function of simplified inputs. The first goal will be achieved by implementing metaheuristic bio-inspired algorithms, based on the Darwinian concept of natural selection. In a few words a metaheuristic optimization framework will consider a target solution (e.g. the one with the lowest cost) as the strongest individual. The second goals will be achieved by implementing an Artificial Neural Networks (ANNs). ANNs are computational data-driven methods based on the idea to

mimic the learning and memory capability of the human brain. The ANN will be trained by data and will allow doing simple estimations of seismic risk reduction costs as a function of a limited number of data (e.g. seismic hazards, number of floors, surface, structural typology etc). Both the goals have relevant fallouts in engineering design practice and strategic decision processes. The challenge to face is making AI-based retrofitting design a stable reality in civil engineering, so that interventions will cost less, will be more effective and will be less invasive, and more and more buildings and infrastructures could be retrofitted with less capitals, less time, less material waste.

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.) PE8_11 - Sustainable design (for recycling, for environment, eco-design)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 274.288,00
Contributo totale progetto:	€ 196.868,00
Costo totale PoliTo:	€ 110.688,00
Contributo PoliTo:	€ 95.468,00

NESSF - Non-equilibrium self-assembly of structured fluids: a multi-scale engineering problem

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Daniele Marchisio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Codice identificativo progetto:

2022JJRH8H

Ruolo PoliTo:

Coordinatore

Abstract

This project aims at investigating structured fluids with a multiscale approach combining experiments, theory and simulations. A particular test case, representative of other structured fluids, is selected and studied: binary mixtures of water and Pluronic. Pluronics are tri-block amphiphilic copolymers, aka as poloxamers, with important applications in the pharmaceutical and cosmetic industries. In the context of this project, Pluronics will serve as a model system, due to the wide range of molecular weights and amphiphilic features covered. In fact, depending on the type of molecule, temperature, concentration and external applied flow, they can indeed behave as unimers, create supramolecular aggregates or give rise to phase transitions. Three time- and length-scales are here studied: (1) molecules, (2) microstructures & (3) chemical-reactors/industrial-mixing-devices. Pluronic molecules self-assemble (or aggregate) in water above critical concentrations and temperatures, forming molecular arrangements or microstructures, which in turn result in non-Newtonian behaviour. This latter is eventually crucial in determining the performance of mixing operations involved in the preparation or processing of structured fluids. (1) Molecules are investigated by using full-atom molecular dynamics (MD). The aim is to characterize the behaviour of single Pluronic molecules in water and to quantify the corresponding transport properties, by performing simulations at different concentrations and temperatures. (2) Microstructures (e.g., spherical micelles, rod-like micelles, hexagonal phases, lamellar phases, etc.) are investigated by using both experimental rheology in the linear and non-linear regimes and computational models to explain and/or support experiments. The objective is to understand the microstructure-property relationship, to study the effect of deformation and to investigate quiescent and dynamic phase equilibria, explored also with the use of a coarse-grained MD model, based on dissipative particle dynamics (DPD). (3) The analysis of reactors

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focuses on particle image velocimetry (PIV), planar laser induced fluorescence (PLIF) and power consumption measurements on stirred tanks. These experimental investigations complement the rheological characterization previously described and provide experimental data for the validation of computational fluid dynamics (CFD) models. The description of the non-Newtonian behaviour of the investigated structured fluid in CFD models will be initially based on analytical constitutive equations, which will then be replaced by a rheological description actively learned from DPD simulations via artificial intelligence (AI). AI allows a very efficient coupling of DPD and CFD simulations. Being based on opensource codes, they will result into a seamless uptake in academic and industrial environments.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**

Parole chiave

Settori ERC

PE8_2 - Chemical engineering, technical chemistry

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 5. Raggiungere l'uguaglianza di genere ed emancipare tutte le donne e le ragazze|Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 359.096,00
Contributo totale progetto:	€ 247.353,00
Costo totale PoliTo:	€ 85.160,00
Contributo PoliTo:	€ 46.657,00

BREAKing BONDS - BRoadEning our Actual Knowledge on the BOtulinum Neurotoxin DiffuSion

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Taian Martins

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20229CH2K2

Ruolo PoliTo:

Coordinatore

Abstract

Botulinum toxin (BT) is a potent agent used for the focal treatment of patients with spastic paresis, a neurological condition affecting most children and adults with highly common disorders such as stroke, cerebral palsy, brain trauma, spinal cord injury or multiple sclerosis. After intramuscular injection, BT acts mainly on the presynaptic endings of peripheral cholinergic nerves, cleaving synaptosomal proteins that mediate exocytosis of acetylcholine. Limiting BT diffusion within volumes confining the end-plates minimises the risk of adverse effects resulting from BT migration to sites remote from the injection site, contributing therefore to the success of BT-based therapy. To contend with open issues related to anatomical differences between individuals, formulations of marketed BTs, dose-response curves, and volume and dilution, successful administration of BT requires predicting the diffusion of the toxin effect rather than of the solution containing the toxin in the targeted medium. BREAKing BONDS represents a ground-breaking step beyond the state of the art in this regard, aiming to solve two cardinal issues regarding the optimal delivery of BT to spastic muscles. Building upon recent advances in the detection, processing and modelling of high-density electromyograms, BREAKing BONDS will: i) provide a benchmark for the in vivo assessment of the BT uptake volume in humans; ii) develop a patient-specific model of BT diffusion, ensuring safer and more effective use of BT. Reaching these goals complies with the well-accepted view that BT administration tailored to individuals is likely to promote better short- and long-term effects with a low risk-benefit ratio. In addition to furthering our understanding on the mechanistic basis underpinning BT diffusion and internalisation, the knowledge to be gained from BREAKing BONDS will help decreasing the economic and social burden of spastic paresis, optimising BT delivery and stimulating the emergence of more effective formulations.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

LS2_14 - Biological systems analysis, modelling and simulation

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 222.170,00
Contributo totale progetto:	€ 222.170,00
Costo totale PoliTo:	€ 126.731,00
Contributo PoliTo:	€ 126.731,00

E.HU.MAN - Empathically enhanced robot for the collaboration with HUmans in MANufacturing (E.HU.MAN)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luca Mastrogiacomo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022Z9JBJC

Ruolo PoliTo:

Coordinatore

Abstract

The concept of Industry 5.0, recently launched by European Commission, is based on three fundamental pillars: sustainability, resilience and human-centricity. Human-centered manufacturing emphasizes the need to bring humans back to the center of production processes and to use technology to support rather than exclude them. Human-Robot Collaboration (HRC) is a paradigm that embraces this vision and has the potential to enhance human capital. HRC is a direct form of interaction between humans and robots aimed at combining their skills to achieve a common goal. The main enabling technology of HRC is collaborative robotics. Collaborative robots (or cobots), unlike classic industrial robots, are designed to share the workspace with humans, promoting greater flexibility of production processes. Cobots' features potentially enable their application in complex industrial tasks, such as assembly, quality control and service provision. However, the concept of collaboration for cobots still primarily refers to the safe sharing of the workspace with humans. A true and deeper HRC would require robots to have intrinsic intelligence, to perform their task by sensing their environment and adapting their behavior. More so, the full exploitation of HRC in the industrial context still requires the integration of technologies to recognize human activity: cobots with capabilities in understanding human activities and psychophysiological state (e.g., affect, fatigue, stress) can better support the operator during a task. In this perspective, intelligent cobots can represent effective mediators between humans' well-being and manufacturers' productivity performance. By bringing together academic partners whose skills range from manufacturing technologies, neuroscience and artificial intelligence, the aim of the project is to study and improve HRC in industrial field, focusing on humans' well-being. In detail, the main research objectives are: The assessment of the effect of HRC on the operator. A set of standardized tests must be defined, with the goal of assessing

the effect of HRC through the analysis of the psychophysiological state of the operator during collaborative tasks. The modeling of human psychophysiological state. Ministero dell'Università e della Ricerca MUR - BANDO 2022 The results of standardized testing may allow for the development of real-time prediction models of the human's psychophysiological state, relying on the integration of multiple information sources (e.g., physiological signals, task status, workspace conditions). The optimization of cobot behavior. The ultimate goal is the design of behavior adaptation models for cobots aimed at dynamically improving ergonomics and human well-being in industrial contexts. Expected results of the project target the design of proactive and intelligent collaborative robotic systems (i.e., systems composed of robots, end-effectors, devices and sensors), which potentially leads to several benefits from technological, social and economic perspectives.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' CATTOLICA DEL SACRO CUORE**

Parole chiave

Settori ERC

PE8_7 - Mechanical and manufacturing engineering (shaping, mounting, joining, separation) PE6_11 - Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video) SH4_5 - Attention, perception, action, consciousness

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 256.335,00
Contributo totale progetto:	€ 190.201,00
Costo totale PoliTo:	€ 154.715,00
Contributo PoliTo:	€ 114.799,00

Resilient - Resilience Evaluation by Experimental and Theoretical Approaches in Electrical Distribution Systems with Underground Cables

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Andrea Mazza

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022ZCHTHH

Ruolo PoliTo:

Coordinatore

Abstract

The number of extreme weather events (EWE) has increased in recent years. In particular, the occurrence and intensity of heat waves (HW) are becoming non-negligible at a European level. The distribution system, due to its extension on the territory and being mostly composed of underground cables (in cities and urban centers) is the most heavily stressed infrastructure during the HW occurrence. This proposal focuses on the study of the effect of HW on portions of cables and joints, following three main directions: field measurements, laboratory experience and simulation activities. Field measurements will be carried out to provide a benchmark regarding soil moisture, irradiance and heat transfer under defined electrical load and temperature of cables and joints. The values collected in the field will be used to calibrate and set up a test bench installed in the laboratory with the aim of replicating the measured irradiance (and therefore heat exchange) conditions. Once calibrated, the test bench will be used to replicate the typical irradiance and load conditions that occur during HW. Both cables and joints will be studied to highlight their contribution to failures during HW. The entire test bench, as well as the measurement system in the field, will be designed paying attention to apply metrological accuracy: only in this way, in fact, it is possible to correctly replicate the experiment at a later time and provide useful information to third parties (e.g., international standardization organizations, distribution system operators, cable manufacturers) regarding the behavior of cables and joints during heat waves.

Strutture coinvolte

- DENERG - Dipartimento Energia

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Partner

- **I.N.RI.M. - ISTITUTO NAZIONALE DI RICERCA METROLOGICA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

PE7_2 - Electrical engineering: power components and/or systems PE7_12 - Electrical energy production, distribution, application

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 243.672,00
Contributo totale progetto:	€ 199.998,00
Costo totale PoliTo:	€ 77.548,00
Contributo PoliTo:	€ 67.998,00

AI-VASCUES - quAntitative Imaging of VAScular dysregulation as a funCtional basis for aUtoimmune disordErs and tumorS

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Kristen Mariko Meiburger

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022CJB9EH

Ruolo PoliTo:

Coordinatore

Abstract

A well-known biomarker of both oncological and autoimmune diseases is their vascular “fingerprint”. The regulation of vascular function in response to changing metabolic needs is essential for the maintenance of normal tissue and organ functions. In fact, one hallmark of cancer is the deregulation of angiogenic signaling, resulting in a process called neoangiogenesis, where the newly developed blood vessels are often organized chaotically and densely-packed around the tumor. Similarly, vascular dysregulation is also involved when considering autoimmune diseases and, in particular, inflammation, that is an important pathophysiological event that involves changes in cell composition and molecular characteristics, by promoting the infiltration of inflammatory immune cells and local oxidative stress and by triggering vascular pathological signals. Photoacoustics (PA) is a rapidly growing imaging modality that allows a non-invasive quantitative and metabolic analysis of vasculature. Studies have shown great potentials for this imaging modality, which is however still limited to ad-hoc specialized geometrical detectors or artefact-ridden images when using traditional linear probes for detection. The main goal of this project concerns with quantitative imaging of vasculature, and in particular vascular dysregulation, as a functional basis for autoimmune diseases and tumors using photoacoustic imaging and artificial intelligence. Innovative methods for PA volume imaging using a linear ultrasound probe will be developed and innovative multi-angle illumination of the imaged area will be explored for high-resolution and artefact-reduced volumetric and functional PA imaging. The project begins at in-silico and in-vitro levels, including simulations and phantom studies. Then, the activity will advance towards in-vivo chicken embryo studies. The project climaxes at the in-vivo clinical study of cancerous dermatological lesions and inflammation of the Achilles

tendon. Importantly, artificial intelligence-based methods, specifically generative adversarial networks (GANs), will be employed to optimize and enhance the acquired photoacoustic images. Artificial intelligence methods will be employed to automatically segment and classify the acquired photoacoustic volumes and also the dermoscopic and histopathological biopsy images acquired in routine clinical practice. As a result of this project, an innovative 3D photoacoustic imaging system using a common ultrasound linear probe for detection will be developed, making the entire system potentially miniaturizable in the future for point-of-care solutions. The partnership of AI-VASCUES is a multidisciplinary team of experts in biomedical engineering, signal and image processing, together with clinicians in two fields. This composition will provide an ideal synergy of background knowledge, tech know-how, case scenarios and outreach potential for the best potential scientific and socioeconomic impact.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partner

- **POLITECNICO DI BARI**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI BARI ALDO MORO**
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering PE6_11 - Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 275.794,00
Contributo totale progetto:	€ 197.496,00
Costo totale PoliTo:	€ 111.048,00
Contributo PoliTo:	€ 78.047,00

XInternet (eXplainable Internet)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marco Mellia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

20225CETN9

Ruolo PoliTo:

Partner

Abstract

“The Internet is the first thing that humanity has built that humanity doesn't understand, the largest experiment in anarchy that we have ever had.” This quote from Eric Schmidt, former CEO of Google, is still very timely. The importance of the Internet has been clearly highlighted during the COVID-19 pandemic and in recent events in Russia-Ukraine conflict, anticipated by and contemporary to Internet-mediated information warfare and cyberwar. Yet, understanding and explaining how the Internet works and how humans use it remain open questions. Cybersecurity is dominating the priorities as we adapt to a post-COVID-19 era, with adversaries attacking devices connected in homes, hospitals, cars, etc. Visibility becomes as critical as the Internet itself, and extracting human-understandable actionable and valuable information (i.e. “explain”) from raw traffic data is crucial. In a nutshell, we need fundamental instruments to explain the Internet. XInternet aims at studying how to leverage Artificial Intelligence (AI) and Machine Learning (ML) to continuously and automatically extract valuable and actionable information from raw network data collected on the network. For this, we build upon datasets the partners already have and other means to collect new data by instrumenting state-of-art honeypots, passive monitors, and platforms to collect data from mobile devices. Armed with this, we will investigate the fundamental problem of understanding how to represent network data in a suitable manner for AI/ML applications. But network data changes over time and space. This calls for novel and specific representation architectures able to capture the correlation over time and space seen in internet traffic, and to clearly communicate such information in a standardized format to human operators. Moreover, the adoption of AI-based solutions is hindered by their inherent black-box nature, that constitutes an ethical and legal roadblock for real-world application, and a limit for its improvement. Therefore, we will employ Explainable AI techniques to make AI models interpretable, manageable, and trustworthy. We will demonstrate XInternet in two novel and timely use cases considering: (i) Mobile-app traffic classification and

prediction where legitimate traffic is collected, represented, annotated, and analyzed, to design and implement novel strategies for traffic characterization, classification, and prediction at several granularities: a specific focus will be on traffic generated by the “most popular” apps during COVID-19 pandemic (e.g., Teams, Zoom, Skype, Meet, etc.); (ii) Cybersecurity, where malicious/anomalous traffic is collected, represented, annotated, and analyzed, to design and implement novel strategies for anomaly detection and analysis of cyber-attacks: a specific focus will be on malware traffic collected during the cyber-war of Russian-Ukraine conflict.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica
- SmartDat - SmartData@PoliTO - Big Data and Data Science Laboratory

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore

Parole chiave

Settori ERC

PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.) PE6_7 - Artificial intelligence, intelligent systems, multi agent systems PE6_5 - Cryptology, security, privacy, quantum crypto

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 250.000,00
Contributo totale progetto:	€ 232.184,00
Costo totale PoliTo:	€ 99.999,00
Contributo PoliTo:	€ 92.873,00

6GTWINS - Deploying Artificial Intelligence in 6G Network Management using Digital Twins

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Michela Meo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022MWBFEE

Ruolo PoliTo:

Partner

Abstract

5G/6G systems are well known to go beyond the classical “one-fits-all” paradigm of previous radio mobile network generations. They provide not only the possibility to dynamically create, update and delete custom “private networks” in the form of network slices for supporting special applications with challenging heterogeneous needs, but even to split and to distribute the overall system across various stakeholders and domains. These stakeholders can span from infrastructure or connectivity providers to vertical user/application providers. To support this new paradigm, 5G/6G systems are composed of an ever increasing number of control and management components acting on the different domains, which are able to expose and consume 5G and edge computing resources “as-a-Service.” The inner complexity of this multi-tenant and multi-domain environment is envisaged to be handled by the use of “Intent-Based” APIs, able to abstract and to separate diverse Artificial Intelligence (AI) engines providing automated operations and the reinforcement/optimization of policies for each Stakeholder domain. In this complex and radically new environment, the cascade effect of a change in the optimization policy (or even of a single reconfiguration of resources) by a Stakeholder can be hardly mapped onto the effect produced on the overall ecosystem. In detail, this can arise especially in those cases where AI engines of Stakeholders have partially conflicting policies and objectives, and might trigger potential network instability or performance decay. The 6GTWINS project aims to address this issue by exploiting the concept of Digital Twins and applying it to network automation and orchestration. In particular, the project will design solutions for exploiting Digital Twins for What-If analysis and for speeding up AI/ML training. Obviously, the project is not so ambitious to completely fill the research gap in this complex and multi-facet problem, but to move some first steps towards novel approaches and promising technologies. In fact, the project decided to restrict the application scenario of the studied technologies

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to a representative use-case, namely a Digital Twin-based network orchestration framework for 5G/6G slicing.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CATANIA**
- **UNIVERSITA' DEGLI STUDI DI GENOVA**
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**
-

Parole chiave

Settori ERC

PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.) PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 233.533,00
Contributo totale progetto:	€ 199.387,00
Costo totale PoliTo:	€ 47.893,00
Contributo PoliTo:	€ 39.660,00

MUSTANG - Materials sustainability for polymer additive manufacturing

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- **Massimo Messori**

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO

Codice identificativo progetto:

202247PK9X

Ruolo PoliTo:

Coordinatore

Abstract

PRIN 2022 - MUSTANG

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 279.151,00
Contributo totale progetto:	€ 249.869,00
Costo totale PoliTo:	€ 81.110,00
Contributo PoliTo:	€ 60.050,00

Finanziato dall'Unione europea NextGenerationEU
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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

AGROMET - An integrated environmental sustainable approach for the valorization of wet agroindustrial wastes to biomethane

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alessandro Hugo Antonio Monteverde

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022EX89KF

Ruolo PoliTo:

Partner

Abstract

Agricultural production and agro-food industry generate large volume of liquid wastes and solid residues which cause severe pollution problems if not properly managed or treated. On the other hand, the large amount of organic matter produced can represent a new resource if adequately managed and upgraded to fuels and high value products, according to a bio-refinery approach. On this account, AGROMET focuses on the valorisation of wet agroindustrial wastes (WAW) to obtain methane-rich stream production. Particularly, since Sicily is the second largest region in Italy where waste management is a critical issue, wastes from citrus industries are selected as raw materials. Accordingly, AGROMET implies the integration of hydrothermal liquefaction, HTL process (endothermic) and catalytic gasification in supercritical water conditions, SCWG (exothermic), as a successful strategy to obtain CH4 from wet biomass. HTL process would allow the pre-processing of the wet biomass into aqueous and biocrude fractions, both feeding the SCWG reactor operated in presence of selective non noble-metal based catalysts. This approach will overcome the main restrictions linked to the need of expensive drying pre-treatments required by classical gasification and the presence of inorganic compounds in the mixture which limit the catalyst lifetime during the SCWG. In addition, based on chemical composition of feedstock, suitable technologies for the extraction of added value chemicals from raw WAW and oily/solid fractions produced will be evaluated while a crucial step would consist in the detoxification of the process water by the catalytic wet air oxidation (CWAO) for water recovery and/or reuse. The SCWG reactor will be loaded with structured catalysts prepared by a 3D robocasting machine, based on ink-paste micro-extrusion as a powerful tool to properly control the multifunctional features of the solid system. Catalyst development will be supported by i) in-depth chemico-physical

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

characterization of fresh and used systems, ii) testing results in lab-scale reactors and iii) computational-modelling. Structure-activity relationships and key-factors affecting the catalytic performance will be defined to optimize materials development. The sustainability of the whole process ideally based on a zero-waste approach will be evaluated by LCA tools. Maximum CH4 productivity will be predicted by multi-scale simulation, from DFT to process simulation. Scientific challenges concerning process intensification, catalyst and reactor design, quanto mechanical modelling and sustainability analysis will be addressed by a highly competent team with complementary skills following a multidisciplinary cooperative approach. By valorising waste-to-fuels, AGROMET will positively impact on the social context exporting a new agricultural development model, in which a diversified energy supply is able to influence not only local economies, but also environmental policies on a large scale

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_9 - Production technology, process engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 229.414,00
Contributo totale progetto:	€ 197.498,00
Costo totale PoliTo:	€ 59.131,00
Contributo PoliTo:	€ 52.559,00

Co.Co. War - Dissonant Heritage and War. Conservation and Communication of a difficult legacy - Co.Co. War

Durata:

17/10/2023 - 16/10/2025

Responsabile scientifico:

- Emanuele Morezzi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

Prot. 2022YHNX9M

Ruolo PoliTo:

Partner

Abstract

The topic of the proposal concerns the preservation, communication and safeguarding of Dissonant Heritage caused by conflicts, both real (war) and regarding interpretation. The project is based on the analysis of a significant sample of case studies related to this specific heritage, one characterised by a controversial legacy that has marked its history and in which it has taken on different roles. The analysis highlights a possible path of re-signification underway, where the communication of values, beyond the stigma attached to it, is part of a new way of understanding this complex heritage on the part of the community. These case studies are analysed with the specific aim of identifying appropriate tactics which can be used to address the preservation of a Dissonant Heritage which is such not so much by virtue of a “tainted legacy”, a memory that is difficult to manage, but because it acquires (or is acquiring) dissonance through a communication that manipulates and alters their stratified memory with the aim of making an asset become a divisive element of the communities. It opens up an understanding of Dissonant Heritage, linked to the one theorised by Tunbridge and Ashworth, to include objects at the centre of communities that attribute discordant meanings to a heritage which are superimposed on a dissonance originating from history itself, following changes that cause an inversion of values and messages. This manipulation is not linked to "trauma removal", but is instead purposely distorted to foment feelings linked to nationalism, and to open up a vulnus in the community, particularly where tensions between "social groups" have only partially subsided. In the production of this 'New' Dissonant Heritage, virtual platforms (social media) play a fundamental role, as access to them is not only simplified and less filtered compared to official communication channels (radio, press), but above because of their visibility, speed of diffusion and lack of a

“validation”. The message thus launched reaches a wide audience, particularly among those groups that are less accustomed to the use of digital tools or less culturally prepared, and more likely to uncritically absorb unverified content (e.g. fake news). In this interpretative conflict, the question of "why preserve" becomes the product of a consensus rather than the outcome of the deeper reasons that should be the basis of choices concerning Cultural Heritage. The aim of the project is therefore to identify, through the analysis of significant experiences, which innovative tools can identify and control this new form of risk for heritage, mapping situations where there are tensions conveyed through manipulated communication, and identifying tactics based on the analysis of virtuous cases of re-signification of Dissonant Heritage, in order to positively influence its safeguard and to outline management strategy for the conservation and communication of this architectural legacy.

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' POLITECNICA DELLE MARCHE**

Parole chiave

Settori ERC

SH5_7 - Museums, exhibitions, conservation and restoration

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 252.431,00
Contributo totale progetto:	€ 200.489,00
Costo totale PoliTo:	€ 87.344,00
Contributo PoliTo:	€ 65.165,00

ReCoMa - Real and Complex Manifolds : Geometry and Holomorphic Dynamics

Durata:

28/09/2023 - 28/09/2025

Responsabile scientifico:

- Emilio Musso

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022AP8HZ9

Ruolo PoliTo:

Partner

Abstract

This project aims to combine mathematicians whose research interests are in various aspects of geometry on real and complex manifolds and spaces. We aim to achieve results and give significant contributions in these areas of mathematics, by gathering together expertises from different researchers and promoting the interaction of various methodologies to complement and reinforce each other. The emphasis is on the systematic study of geometric properties of real and complex spaces and functions there defined, with a particular regard to holomorphic dynamics and differential geometric aspects. Geometry of manifolds concerns their analytic, algebraic and metric properties and, on the other side, the study of the topological, differential and holomorphic objects - such as maps, fiber bundles and operators - which can be defined on them. New objects appear in a natural way: self-maps, differential operators, divisors, Jacobian varieties, moduli spaces, etc. The dynamical and analytic properties of those objects reflect then on the geometrical properties of the manifolds. Starting from these considerations, the following general themes identify the scope of this project. 1. Structure of manifolds: Riemannian, Kähler, symplectic, Hermitian, CR manifolds, real and complex analytic spaces, quaternionic analogues, geometry of domains in the different settings, special geometries and holonomy, Einstein metrics, geometric quantization. 2. Maps on manifolds: geometric function theory, discrete and continuous holomorphic dynamics of maps and automorphisms, holomorphic evolution equations, boundary regularity of biholomorphic mappings, immersions and submanifolds, pluripotential theory on Hermitian manifolds, Special Riemannian metrics, Lie groups and homogeneous spaces, representation theory.

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi dell'Aquila**
- **UNIVERSITA' DEGLI STUDI DI FIRENZE**
- **UNIVERSITA' DEGLI STUDI DI PARMA**
- **UNIVERSITA' DEGLI STUDI DI TORINO**
-

Parole chiave

Settori ERC

LS1_1 - Molecular interactions LS1_10 - Structural biology (NMR) PE1_5 - Geometry PE1_4 - Algebraic and complex geometry PE1_7 - Lie groups, Lie algebras

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 4. Fornire un'educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti

Budget

Costo totale progetto:	€ 301.000,00
Contributo totale progetto:	€ 187.500,00
Costo totale PoliTo:	€ 52.500,00
Contributo PoliTo:	€ 23.440,00

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dell'Università
e della Ricerca

Italiadomani
PIANO NAZIONALE
DI RIPRESA E RESILIENZA

APICRAM - Advanced Printed Implants for Cranial Reconstruction by Additive Manufacturing

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Elisa Padovano

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Ruolo PoliTo:

Partner

Abstract

Traumatic brain injuries (TBIs) are regarded as a life-threatening impairment of global importance, leading to death and disability in very young people, usually aged 1 to 44, due mainly to motor vehicle crashes, falls, sports and assaults. Cranioplastic surgery plays a pivotal role in this scenario, with the ultimate aim of providing to the patient the most complete clinical/functional rehabilitation together with a satisfactory aesthetic outcome. However, up to date, no consensus about the optimal materials and procedures for the cranioplasty has been reached, and many criticisms have been evidenced, particularly in terms of the commonly used materials and the associated inflammatory reactions and infection risks. Thus, there is an urgent demand for new systems for cranial reconstruction, simultaneously guaranteeing the inhibition of infections/inflammations occurring and providing a favourable regenerative microenvironment. In this framework, APICRAM proposes a fully integrated therapeutic approach, aimed at overcoming the limits of the actually used polymeric cranial implants, such as low mechanical properties, lack of osseointegration, post-surgery inflammation. Different and innovative approaches will be investigated to improve the tissue/scaffold interface and provide osteointegration, enhanced mechanical properties and biological responsiveness, simultaneously supplying anti-inflammatory and regenerative properties. The APICRAM integrated approach has not been proposed so far. This final ambitious purpose will be achieved through intermediate aims: (i) the formulation of new composite filaments and powders, based on hydroxyapatite and biopolymers, for the production of cranial scaffolds/implants by fused deposition modeling and selective laser sintering, respectively; (ii) the design and realization of functionally graded cranial implants, with a hierarchical interconnected porosity, to resemble the skull hierarchical structure; (iii) the development of an appropriate hydroxyapatite coating selectively around the scaffold perimeter facing the surrounding bone tissue, to promote osseointegration; (iv) the functionalisation of the printed implants/scaffolds by loading them with selected antibiotics/anti-inflammatory agents, bioactive molecules and growth factors, in order

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

to avoid/limit the occurring of possible post surgery inflammation and to create a favourable regenerative microenvironment. The developed technologies and approaches will represent new tools and resources for an innovative and efficient treatment of traumatic cranial defects, through a multidisciplinary and integrated approach. APICRAM results will pave the way for the treatment of TBI but also for other cranial repair indications, e.g., tumor resection, decompressive hemicraniectomy, and, congenital anomalies/growing skull fractures for pediatric patients, significantly improving the patients' health and life quality.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi Niccolò Cusano - Telematica Roma** - Coordinatore

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Budget

Costo totale progetto:	€ 206.054,00
Contributo totale progetto:	€ 197.451,00
Costo totale PoliTo:	€ 79.274,00
Contributo PoliTo:	€ 79.274,00

EXMOPRODE - Explainable Models for Protein Design

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Andrea Pagnani

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero Università e Ricerca (MUR))

Codice identificativo progetto:

2022TE5B7X

Ruolo PoliTo:

Coordinatore

Abstract

The question of how to design novel protein sequences with desired biochemical characteristics using machine learning methods has increasingly become a focal point for academic research and industry. Especially recent advances in artificial intelligence have led to massive investments in this field, which promises to revolutionize tasks like drug discovery, antibody design, and enzyme engineering. However, developing models that capture important biological constraints while being versatile and robust enough for design tasks is still an open problem. One promising approach, apart from neural network-based architectures, is the use of Potts models, which originate from statistical physics and are trained on homologous protein sequences. These constituted a major breakthrough in protein sequence modeling and are now used widely for protein structure prediction, the assessment of mutational effects, and also the creation of novel protein sequences. The aim of the project is to improve Potts models for protein sequences and to adapt them for high-potential applications. Potts models are often preferable to black-box neural network architectures due to their simplicity combined with state-of-the-art performance in several tasks. Neural networks, on the other hand, are in principle able to model more complex patterns in the data and are easily scalable to very large datasets, albeit with a loss of interpretability in terms of the underlying biology. In this project, we will close the gap between the two approaches by i) combining Potts models with neural networks to develop models that are both expressive and interpretable and ii) applying the tools of sensitivity analysis and explainable AI to neural networks trained for protein design and other tasks for understanding what biological information these models capture from the data. This connects to the topic of physics-informed machine learning, which integrates physical models and machine learning methods, and which we will leverage in the project for developing novel methods for predictive modeling in the context of panning experiments for protein design, where better computational methods promise a large reduction in experimental costs and novel insights into the

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

explored fitness landscapes. An additional important aspect underlying the models and methods in this project is the sequence alignment step during preprocessing, which influences the results heavily by shaping the data used for training the models and is often a source of biases and distortion. We will, therefore, in combination with the design of the models, develop methods for training directly on unaligned data, with the goal of improving performance in domains of application where alignment is difficult and prone to error.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' COMMERCIALE LUIGI BOCCONI**

Parole chiave

Settori ERC

PE3_15 - Statistical physics: phase transitions, noise and fluctuations, models of complex systems, etc. PE6_13 - Bioinformatics, biocomputing, and DNA and molecular computation systems, cyber-physical systems

Budget

Costo totale progetto:	€ 195.678,00
Contributo totale progetto:	€ 189.531,00
Costo totale PoliTo:	€ 104.478,00
Contributo PoliTo:	€ 98.331,00

DESIRE - Design and stereolithography of cell-instructive gradient scaffolds for osteochondral tissue regeneration

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Paola Palmero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

20228JPCTY

Ruolo PoliTo:

Coordinatore

Abstract

Goal of DESIRE is to engineer and build innovative osteochondral (OC) scaffolds to boost the regeneration of either bone and cartilage tissues beyond the levels reached by state-of-art products. Scaffolds, designed to maximize the formation of new bone and cartilage, will be fabricated by Stereolithography (SL), allowing to achieve unprecedented control over scaffold inner architecture. New biopolymers for SL will be developed, to match 3D printing technical specifications with biological and mechanical requirements of the constructs. Scaffolds will be seeded with human Mesenchymal Stem Cells (MSCs) under perfusion culturing conditions, as the most advanced technique to prompt cells differentiation. Ministero dell'Università e della Ricerca MUR - BANDO 2022 Scaffolds will be designed as a single structure, but with a gradual/adjustable variation of the inner features from bone to cartilage-side, also taking care of their transition zone. Design will be supported by Finite Element Method analysis, where on the ground of mechanical properties and permeability of constituent tissues, different sets of porosity features (amount, size and shape) will be predicted, to deepen their role on cells differentiation. A selected number of modelled structures (from 3 to 5) will be designed based on the minimal surface structures approach, able to satisfy the modelled inner features and their adjustable gradation along the scaffold. New photocurable polymer inks for SL will be developed, by considering both natural polymers (prompting cell adhesion and differentiation, but low mechanical strength) and synthetic polymers (higher mechanical response but high viscosity and lower biocompatibility). Bioinks will be conceived as a blend of natural and synthetic polymers, also including the discrete addition of calcium phosphate particles for yielding the bone-like part of the scaffold, providing a unique printable extra cellular matrix-like formulation. The challenge in the SL process will

be to fabricate scaffolds with the tuned inner features and to build structural-compositional graded structures while satisfying accuracy and reproducibility requirements. 3D construct will be finally cultured under perfusion bioreactor, to boost cells differentiation into both bone and cartilage-like cells, deepening the role of the inner features in prompting cells differentiation. The ambition of DESIRE is to quantitatively asses, by histological and morphometric analyses, the higher OC regeneration potential of the developed scaffolds compared to current available products. In DESIRE, the synergic combination of the most advanced strategies in OC scaffolds are addressed, namely new printable bioinks, tailored design of scaffold architecture, SL technology and perfusion bioreactor, thus boosting knowledge, technologies and clinical practices.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Parole chiave

Settori ERC

PE8_9 - Production technology, process engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 303.400,00
Contributo totale progetto:	€ 238.400,00
Costo totale PoliTo:	€ 123.905,00
Contributo PoliTo:	€ 94.905,00

SCALE-UP! - How to scale up startups: using the scientific method to make organizational design decisions

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Emilio Paolucci

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022YEL4S2

Ruolo PoliTo:

Partner

Abstract

Favoring the scale up of startups is a key policy concern in Europe. Despite policymakers emphasize the importance of financial resources for the scale up, scholars recognize that also qualified human capital is crucial. Startups face severe challenges in recruiting talents and organizing their activities. The limited research on organizational design in startups is of little help to address such challenges. To assist startups, our project studies the effects of the adoption of a scientific approach (i.e. mirroring the approach used by researchers in science) in making decisions about recruitment and organization of talents for the scale up (hereafter, organizational design decisions). We will first develop a theoretical framework based on the assumption that a scientific approach provides rigorous bases to predict the outcomes of entrepreneurs' decisions. Entrepreneurs may overestimate (false positives) or underestimate (false negatives) the potential outcomes of their decisions. We posit that, like in science, entrepreneurs using a scientific approach reduce false positives and false negatives. We build on the intuition that, as the decisions made by most entrepreneurs are not effective, entrepreneurs are more likely to face false positives than false negatives. Thus, a scientific approach which corrects these errors is more likely to reveal that a seemingly good strategy is not effective than a seemingly bad strategy is effective. Entrepreneurs adopting a scientific approach are thus more likely to change their organizational design strategies and succeed in scale up than entrepreneurs who do not adopt this approach. We will test this framework in a randomized control trial (RCT). We will offer entrepreneurs from 150 startups in the pre-scale up phase free-of-charge training on how to recruit talents and organize employees' activities. We will split the entrepreneurs into a treatment and a control group. While we will offer the control group standard training, we will teach the

treatment group to develop and test hypotheses about decisions' outcomes and discuss the results in a scientific manner. Then, we will monitor and analyze the actions and performance of all startups in the 10 months after training. The combination of a theoretical framework, that focuses on a novel approach and develops testable implications, and rigorous empirical evidence based on a RCT, will advance the literature on organizational design in startups. Moreover, our results will have relevant practical implications; they can both inform the design of policy initiatives facilitating talent attraction in startups and help universities, incubators and technology transfer offices design effective entrepreneurial training programs. We think we are the right team to implement this proposal because we can leverage the experience in conducting RCTs and the contacts in the Italian startup ecosystem we developed in a PRIN 2017 project based on RCTs targeting startups.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

SH1_11 - Technological change, innovation, research & development

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 218.768,00
Contributo totale progetto:	€ 179.498,00
Costo totale PoliTo:	€ 91.037,00
Contributo PoliTo:	€ 68.459,00

ENTWINED - Enhanced Neural real-time digital TWIN for Electrical Drives

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Eros Gian Alessandro Pasero

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022WNX4H2

Ruolo PoliTo:

Partner

Abstract

The Enhanced Neural real-time digital TWIN for Electrical Drives (ENTWINED) research project aims at developing an innovative control methodology of electrical drives and power converters based on the Digital Twin (DT) able to provides several advanced control functions, such as health monitoring, estimation of uncertainty parameters, predictive maintenance, fault detection and management. The principle of operation of ENTWINED is shown in Figure A10.1. The real-time digital model receives data from the physical system, like operating environments, functionalities, working conditions, sensor data, and so on, through communication interfaces or protocols. The real-time digital model processes these data, using also Machine learning and/or Artificial intelligence (ML/AI), to update itself in real-time and send some control commands to provide optimization and decision support for physical systems. By continuously monitoring the components in real-time, it is possible to act with a different strategy (e.g. preventive maintenance) in the event of sudden stress for the component that would lead to sudden breakage. In addition, in the perspective of pervasive use of wide bandgap power devices (Sic and Gan), the proposed approach allows operating at much higher voltages, frequencies, and temperatures than conventional. Indeed, machine learning is a very powerful tool to recognize patterns in data (e.g. anomalies) and to detect (diagnosis) and prevent (prognosis) machine faults. In this sense, periodic component checks can be avoided or reduced in frequency, which is a great advantage especially in offshore wind farms where the distance is one of the major costs. The ENTWINED methodology will be implemented and applied to a real case such as the wind offshore applications, providing the great advantage of reducing the periodic maintenance of the power conversion system. Thanks to this, periodic power converter component checks can be avoided or reduced in frequency, which is a great advantage especially in wind offshore applications where distances represent one of the major costs. The

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ENTWINED method can be easily applied to other sectors, such as automotive, aerospace, railway, naval, marine sectors, where the gradual evolution from hydro-pneumatic to electrical disposition of power has placed stringent requirements on the reliability of power electronic components power conversion system. The proposed project received many expressions of interests from main producers of the power modules, such as Semikron, and main companies of real-time simulator like the Hardware-In-the-Loop (HIL) producers, such as OPAL RT, Typhon and National Instruments.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI ROMA TRE** - Coordinatore

Parole chiave

Settori ERC

PE7_2 - Electrical engineering: power components and/or systems PE7_3 - Simulation engineering and modelling

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 246.395,00
Contributo totale progetto:	€ 199.900,00
Costo totale PoliTo:	€ 86.495,00
Contributo PoliTo:	€ 60.000,00

ARISTOTELES - ARtificial Intelligence and STOchasTic simulation for the rEsiLience of critical infrastructurES

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Nicola Pedroni

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022TAFXZ5

Ruolo PoliTo:

Partner

Abstract

Modern society depends on critical lifelines, like electric power and natural gas, telephone and other communication systems, water, wastewaterand transportation systems (roads and highways, rail systems, ports, and airports). Many of these infrastructures are aging and are exposed to different natural hazards (e.g., earthquakes, tusnamis, hurricanes and floods), whose intensity and severity has been increasing in the past years,possibly due to climate change. Resilience has become a relevant attribute to consider in the design for the management of any infrastructure, forensuring the capability of withstanding disruptive events and recovering performance Scenario simulation plays a key role for analysing resilience and informing the investments on prevention, mitigation and recovery. However, itbecomes computationally demanding when exploring the response of the complex Critical Infrastructures (CI) under uncertain disruptive events.Artificial Intelligence (AI) and stochastic simulation can be combined for simulating efficiently the response of an infrastructure exposed to anuncertain disruptive event, under uncertain operational and environmental conditions. The framework of integration of AI and stochastic simulation must perform the: - characterization of the (natural) hazards under climate changing scenarios; - evaluation of the impact and frequency of the hazardous events; - exploration of recovery strategies; - optimization of recovery strategies; - assessment and management of the uncertainties involved. The aim of the project is to develop such framework and the corresponding computational platform (ARISTOTELES), to support designing andmanaging infrastructures. In the project, we focus in particular on the Energy Critical Infrastructures (ECI) for their pivotal role in supporting otherinfrastructures and society as a whole, in a scenario of energy transition.

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA**
- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE7_3 - Simulation engineering and modelling PE8_4 - Computational engineering PE8_6 - Energy processes engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 204.048,00
Contributo totale progetto:	€ 179.999,00
Costo totale PoliTo:	€ 75.214,00
Contributo PoliTo:	€ 67.221,00

DAMA - Design of Acoustic Metamaterials for Aeronautical applications

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marco Petrolo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della ricerca)

Codice identificativo progetto:

20229PLCAC

Ruolo PoliTo:

Partner

Abstract

To compete in the global market, the design of modern aircraft is driven by the continuous improvement of the safety and cabin comfort. It is well known that the human factor represents one of the leading causes of accidents across all transportation modes. Among all human factor aspects, fatigue is one of the most critical in commercial aviation. In this context, Noise and Vibration (N&V) can deeply affect flight attendants and pilots in cabin and cockpit. On the other hand, airliners have also paid great attention, over the past twenty years, to the influence of N&V on the comfort of passengers due to longer trips and to passenger expectations, viewing the comfort as one of the main aircraft quality indicators. Thus, in the framework of a human-centered design philosophy, the main target of the project is to achieve an improved design of cockpit and cabin environment by considering the effects of vibration and noise on pilot performance and passenger comfort. To this aim, the project is articulated into three different sub-targets: 1. simulate the main N&V conditions that can occur in the aircraft by defining a high-fidelity vibro-acoutic model; 2. develop innovative passive treatments for lining panels of cockpit and cabin mainly based on the use of acoustic metamaterials; 3. optimize the design of acoustic metamaterials according to the technical constrains deriving from the aeronautical application. Since low frequencies are especially difficult to absorb with conventional materials, due to the order of magnitude of the wavelength, metamaterials are here proposed for the broadband soundproofing of fuselage. Metamaterials derive their properties from their newly designed microstructures with repeating patterns - not from the properties of the materials they are composed of – hence, the need of efficient numerical tools for their dynamic characterization (coupon level) and vibro-acoustic simulation at large scale (panel level). According to the wavelength, two basic approaches will be employed for the numerical analyses: deterministic in the low-frequency range by the use of finite element method; statistical in the mid to high

frequency range where energy-based methods are more appropriate, as the Statistical Energy Analysis (SEA). Summarizing, the concurrent targets in terms of 'N&V simulation' and 'metamaterials design' will be processed for the lining panels development and weighted to define a high-fidelity virtual environment through a 'multidisciplinary optimization process' built on aeronautical requirements (weight, thinness, mechanical strenght, fire resistance etc.). An important strength of the project will be represented by the high accuracy of the vibro-acoustic model that will be validated through experimental tests at both coupon scale (impedance tube) and large-component scale (reverberant room).

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI BARI** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**

Parole chiave

Settori ERC

PE8_1 - Aerospace engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 215.659,00
Contributo totale progetto:	€ 196.795,00
Costo totale PoliTo:	€ 66.443,00
Contributo PoliTo:	€ 60.792,00

IN MOOSHEAC - INnovative damage MOnitoring Of Self-HEAling Composites by acoustic emissions in civil and aerospace applications

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Gianfranco Piana

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022JFMPSC

Ruolo PoliTo:

Partner

Abstract

The service life of a composite material can be improved by proper maintenance and repairing. However, repairing and maintenance incur a considerable amount of downtime. Self-Healing (SH) composites, which are inspired by natural healing systems like human skins, have the capability to autonomously regain their structural integrity and improve their service life. Research on SH composites are thriving in the past few years. SH composites use healing agents, which are encapsulated in thin-walled capsules or vascular networks and are strategically dispersed in the structurally weak matrices or at the interfaces between the matrix and load carrying fibres. The propagating damage bursts the capsules or the vascular networks and releases the healing agent. This will arrest the propagating damage and retain the structural integrity of the composites. The development of new healing agents, designing new healing systems, or the improvement of number of healing cycles achieved by the SH composites are the areas targeted by researchers over the years. The retention of mechanical properties and other structural properties by the SH composites post healing in real structural applications is seldom addressed widely. It is essential to develop a monitoring system for investigating the healing processes and assuring the retention capability of the SH composites. Damages occurring in the inaccessible areas of polymer matrix composites or concrete structures can potentially be healed by the SH composites. However, an in-situ monitoring of the damage progression in these materials and the subsequent healing processes is imperative. The use of advanced Non-Destructive Evaluation (NDE) techniques can identify and localize the damage and healing occurrences. Non-invasive techniques such as Acoustic Emission (AE) technique, optical techniques such as Digital Image Correlation or Electromagnetic techniques such as THz time domain spectroscopy are quite powerful

for in-situ process monitoring of large structures. This research proposal aimed at utilizing NDE techniques for monitoring the healing process of the SH composites and to investigate their structural properties post healing. The most advanced AE testing, Optical and Electromagnetic techniques are proposed to be used contemporarily to investigate the healing characteristics of the SH composites thoroughly. Advanced data processing tools and Machine Learning tools are proposed to be used to support the implementation of NDE techniques. Besides, this project also aims at investigating the mechanical and structural behaviour of the SH composites at the damage evolution stages, healing stages and the post healing stages using the advanced NDE techniques. Apart from these, the healing efficiency will also be addressed using these techniques. In a nutshell, the overall aim of this project can be stated as the comprehensive investigation of SH composites in the structural applications using advanced NDE techniques.

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Partner

- **POLITECNICO DI BARI** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE8_7 - Mechanical and manufacturing engineering (shaping, mounting, joining, separation) PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_1 - Aerospace engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 217.124,00
Contributo totale progetto:	€ 189.017,00
Costo totale PoliTo:	€ 99.057,00
Contributo PoliTo:	€ 86.522,00

FaReX - Full and Reduced order modelling of coupled systems: focus on non-matching methods and automatic learning

Durata:

28/09/2023 - 28/09/2025

Responsabile scientifico:

- Sandra Pieraccini

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20227K44ME

Ruolo PoliTo:

Partner

Abstract

The simulation of real-life problems characterised by multiphysics phenomena presents numerous challenges. Some examples can be found in fluid-structure interaction, multiphase and coupled fluid heat transfer problems. In these cases, classical numerical approaches require -- at the very least -- large computational power, excellent meshing tools, and the satisfaction of hypotheses which are often too stringent for real life application. Consider, for example, fluid structure interaction and phase transition phenomena. Their simulation requires the solution of coupled problems on moving domains, where the solid, the fluid, and the interface itself obey different physical laws, each presenting its unique set of complex endeavours. The most used simulation strategy in this case is the Arbitrary Lagrangian Eulerian technique, where domains are continuously deformed and interfaces are matched exactly: the biggest limit of this approach is that it cannot handle topological changes and large deformations without remeshing. Embedded/Immersed/Non-matching methods have been proposed to overcome some of the limitations of body fitted techniques. This research project focuses on the development and analysis of several types of non-matching and immersed computational methods. Further, it aims at the integration of these methodologies with cutting edge reduced order and complexity reduction methods. Together, these approaches will allow for the treatment of extremely challenging multiscale and multiphysics problems out of reach with classical approaches, unlocking computational complexity reduction and reducing design-cycle times. The research units in Trieste, Torino and Brescia share a consolidated expertise on advanced discretisation schemes based on variational approaches, such as finite elements, including spectral and hp type finite elements, immersed methods, finite volumes and reduced order methods. The project is

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organised in three work packages (WP): WP1: Numerical Analysis of immersed, embedded, and non-matching methods for coupled problems WP2: Model order reduction and machine learning enhancement of scientific computing problems WP3: Open source software development

Persone coinvolte

- Sandra Pieraccini (Responsabile Scientifico)
- Claudio Canuto (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **SISSA - SCUOLA INTERNAZIONALE SUPERIORE DI STUDI AVANZATI** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI BRESCIA**

Parole chiave

Settori ERC

PE1_17 - Numerical analysis PE1_18 - Scientific computing and data processing PE6_12 - Scientific computing, simulation and modelling tools

Budget

Costo totale progetto:	€ 255.200,00
Contributo totale progetto:	€ 219.200,00
Costo totale PoliTo:	€ 76.750,00
Contributo PoliTo:	€ 64.000,00

PARIDE - Prototyping of a high resolution, radiation hard, and portable SiC-CsI particle identification system for heavy-ion nuclear reactions

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Carlo De Benedictis

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20227Z4HB8

Ruolo PoliTo:

Partner

Abstract

The project presented in this proposal is aimed to the construction of a prototype of a new kind of portable and versatile particle identification system, suitable to detect swift heavy ions in nuclear physics reactions. The system is based on SiC-CsI(Tl) telescope detector cells, arranged in 3 towers, each hosting 20 telescopes. It is intended to be modular, compact, and versatile, in order to be used in different nuclear physics experiments with minimal adaptations on existing setups. Moreover, both the materials possess high radiation hardness and stability over time, guaranteeing a low maintenance and reliable system, and the possibility to measure at high ion rates, e.g., at very forward angles. The orientation of the towers will be adjustable, to better accommodate different setups and needs. The acquisition system for the 60 SiC and 60 CsI detectors will be composed of 64 channels electronic modules (new generation preamplifiers and digitizers), reducing the encumbrance of the electronics to the minimum. A single telescope is composed by a first stage, made of 100 microns thick SiC detector (the delta E stage), intended to be crossed by incoming ions, and a second stage, made of a 5 mm thick CsI(Tl) scintillator (the residual energy stage, intended to stop the particle), coupled to a photodiode. The detectors present a large area (1.5 x 1.5 cm^2), offering a wide solid angle when assembled into towers. A deep characterization of the SiC detectors will be also done, to study their degree of crystallinity, doping, and impurity level and explore their edge structure. Such analyses will be performed before and after irradiation with heavy-ion beams. The project will be carried out at INFN-Laboratori Nazionali del Sud and POLITO, combining the expertise and synergy of the two institutions in nuclear and material physics. The final goal of the project is to deliver a turnkey particle identification

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system, equipped with the electronics, mechanical supports, flanges, cables, and data acquisition, which can be used immediately for many nuclear experimental studies.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **ISTITUTO NAZIONALE DI FISICA NUCLEARE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE2_3 - Nuclear physics

Budget

Costo totale progetto:	€ 214.621,00
Contributo totale progetto:	€ 206.258,00
Costo totale PoliTo:	€ 56.000,00
Contributo PoliTo:	€ 56.000,00

ReFuel - Strategies for the advanced hydrothermal liquefaction of recalcitrant bioresources to renewable fuel (ReFuel)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Raffaele Pirone

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022KBPRNK

Ruolo PoliTo:

Partner

Abstract

Europe must reach a 14% renewable share in transport fuels and a 27% penetration across energy sectors by 2030 (SET-Plan Declaration). Effective conversion of non-food/low ILUC biomass into advanced biofuels targets this result entailing lower use of fossil fuels. Hydro Thermal Liquefaction (HTL) is a promising thermochemical process effective in converting recalcitrant bioresources into a valuable “bio-crude” (BC). Despite HTL has been studied over decades, both at the fundamental and technological development levels, there are still poorly explored aspects to study. The only sustainable feedstock for industrial HTL are zero, or even negative cost residual and recalcitrant bioresources as sewage sludge (SS), food industry waste and the organic fraction of municipal solid waste (OFMSW). These are very complex matrixes made by inorganics, biogenic and not biogenic organics such as plastics. Moreover their random collective origin makes their composition highly different with time thus changing the performances of pilot HTL plants. Attempts have been made to overcome the hurdles of such variability also using pretreatment protocols. However, these approaches are empirically developed with an evident lack of knowledge on the mechanisms and the different reaction pathways activated in the process as well as on the mutual interactions between the different biomass constituents, especially for those of non-biogenic origin. Then the very effect of the different pretreatments proposed to dump seasonal variability of the biofeedstock are not yet sufficiently studied. The ReFuel project aims to get a deeper understanding of the effect of acid and alkaline pretreatments of OFMSW on their recalcitrance, mitigation of annual variability, improvement of yield and reduction of heteroatom content of achievable BC. This goal will be pursued by comparing the outcomes of pretreatment and HTL of a real feedstock, OFMSW obtained from Sicilian

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municipalities, and of selected model compounds representative of main OFMSW components (carbohydrates, lignin, protein, lipid, polyolefins) mixed to simulate real composition. HCOOH and KOH will be selected as pretreatment agents as they have improved yield and quality of BC from HTL of untreated SS (Prestigiacomo et al. 2021; Nazari et al. 2015). The real applicative interest of the project is demonstrated by the fact that at the Gela biorefinery is yet operative a continuous HTL pilot plant assigned to Eni Rewind that can that can produce about 100 kg of BC from HTL of OFMSW (WtF report). Refuel will enlarge the base of knowledge for an efficient exploitation of recalcitrant bioresources of interest for the production of Ministero dell'Università e della Ricerca MUR - BANDO 2022 renewable fuels in HTL and will be a sound basis for further researches in context more apt to collaboration with industry (Horizon Europe, PON).

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PALERMO** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PALERMO**

Parole chiave

Settori ERC

PE4_12 - Chemical reactions: mechanisms, dynamics, kinetics and catalytic reactions PE4_18 - Environment chemistry PE8_11 - Sustainable design (for recycling, for environment, eco-design) PE8_2 - Chemical engineering, technical chemistry PE8_6 - Energy processes engineering PE8_9 - Production technology, process engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile|Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*|Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell'ecosistema terrestre

Budget

Costo totale progetto:	€ 255.848,00
Contributo totale progetto:	€ 197.480,00
Costo totale PoliTo:	€ 127.718,00
Contributo PoliTo:	€ 91.480,00

FLOOD@ROAD - Flash-FLOOD risk at crossings between ROAD and river networks

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Federico Vagnon

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

202257JJSJ

Ruolo PoliTo:

Partner

Abstract

The management of flood risk scenarios is a major open issue with strong societal and economic impacts, especially in the context of climate change adaptation. Roads are frequently affected by floods, while they are essential for emergency operations. More specifically: (i) floods (flash-floods in particular) are hard to accurately and timely predict; (ii) most loss of lives because of floods occur on roads, particularly near river crossings; (iii) the era of big data lacks an effective integrated flood-road emergency management system for scenarios that, by definition, are rare. To overcome these difficulties, the general objective of the research is the development of a new multidisciplinary framework that will combine scientific advancements in the capability of (i) predicting flood and flash-flood events, (ii) identifying critical river-road intersections, (iii) assessing the impact of road closures on the network traffic with the goal of assessing drivers' risks in adverse meteo conditions. The application objectives are the design and preliminary validation of an innovative risk analysis tool for road managers and users, based on predetermined ranking-based hydrological assessment of river crossings in the road network and communication track of meteorological scenarios fed by the ready (real-time) identification of the rarity of the rainfall patterns. The starting point is the use of Quantitative Precipitation Forecast from high-resolution operational meteorological models for the estimation of the exceedance probability of predetermined rainfall thresholds, defined through off-line scenario simulations of possible dangerous conditions in road-river crossings with new integrated hydrologic-hydraulic modeling. A meso-scale (province area) transport model will be implemented to understand the disruption effects of the flood on the road network, and identify safe itineraries. This will result in the capability of issuing informative flood alerts targeted at specific portions of the road network. A first hindcast approach will assess how the system would behave in the case of replication of past extreme rainfall events; the preliminary demonstration in true real-

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Ministero dell'Università e della Ricerca
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time will follow. The development of a dedicated geospatial data collector/sharing platform will ensure integration of scenarios and modelling components to efficiently feed the real-time application. The application of the new methodologies on two different study areas (one for the setup and one for replication) will demonstrate the capability of delivering also tangible operational products,

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Parole chiave

Settori ERC

PE10_17 - Hydrology, water and soil pollution PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Budget

Costo totale progetto:	€ 203.101,00
Contributo totale progetto:	€ 189.878,00
Costo totale PoliTo:	€ 53.095,00
Contributo PoliTo:	€ 46.920,00

4IPLAY - Improving Intelligent Infrastructure Inspection by Pushing UAS Level of AutonomY in challenging environments

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Stefano Primatesta

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20228KBR5R

Ruolo PoliTo:

Partner

Abstract

Sustainable management of infrastructures such as bridges requires regular and accurate inspections and monitoring, which are crucial to avoid tragic stories such as the Morandi Bridge one. Traditional methods for bridge inspection have relied on operators who exploit snooper trucks or lifts to access the infrastructure and present challenges related to safety, high costs also due to the possible necessity of temporary closures, human factors linked to the experience and subjectivity of the personnel. Mobile inspection robots have been proposed as a tool to aid bridge inspections. Their key advantages include the ability to access areas of a bridge that are otherwise difficult to inspect and to automate the process of collecting and processing data thus increasing repeatability and reliability of inspections. However, costs and coverage per unit time still present challenges. Recently, drones and related sensing technologies such as visual/thermal cameras/Lidars have become a fundamental asset to complement other measurement sources (in situ and spaceborne observations) thus enabling cost-effective maintenance of many structures. Nevertheless, technological gaps remain which hinder the full exploitation of drone potential for intelligent infrastructure inspection: automated visual inspections and reliable flight operations in complex environments under various visibility and weather constraints present challenges such as poor GNSS satellite coverage, magnetic interference due to metal elements, and challenging micro-weather conditions in the proximity of infrastructures. That is why we propose "4IPLAY - Improving Intelligent Infrastructure Inspection by Pushing UAS Level of AutonomY in challenging environments", a project that will demonstrate in relevant environments the concept of repeatable automated visual inspection based on autonomous drones. 4IPLAY builds on the know-how experience of a multi-disciplinary research team and will

focus on three main pillars: - Automated acquisition and processing of multi-spectral data using artificial intelligence approaches. - Advanced flight control logics which are tailored for the conditions encountered in the proximity of large infrastructures. - Distributed multi-drone architectures to support real time cooperative navigation and off-line trajectory reconstruction. 1-to-N planning and control will be implemented, also considering tight integration of cooperative navigation and distributed sensing. These concepts will be demonstrated in high fidelity simulation environments, also exploiting advanced tools for generation of synthetic scenarios which represent a digital twin of the considered infrastructure. They will then be tested in flight exploiting experimental facilities already available at the research units. The project will pave the way for repeatable autonomous multi-drone-based inspection and monitoring, with significant industrial impact and societal benefits

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**
- **UNIVERSITA' POLITECNICA DELLE MARCHE** - Coordinatore

Parole chiave

Settori ERC

PE6_8 - Computer graphics, computer vision, multi media, computer games PE6_7 - Artificial intelligence, intelligent systems, multi agent systems PE8_1 - Aerospace engineering

Budget

Costo totale progetto:	€ 261.806,00
Contributo totale progetto:	€ 227.991,00
Costo totale PoliTo:	€ 85.454,00
Contributo PoliTo:	€ 72.713,00

Higher-order interactions in social dynamics with application to monetary networks

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Anton Proskurnikov

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022K8EZBW

Ruolo PoliTo:

Coordinatore

Abstract

The project contributes to a novel chapter of mathematical control theory that studies models of opinion formation and decision making in social groups. The term "opinion", in its broadest sense, stands for some numerical characteristic of a social agent (a person or an organization) that is altered by social influence, for instance, a cognitive orientation towards some object or event, an appraisal of another agent, a set of cultural or personal traits, the reputation. Dynamic models of opinion formation give simplified yet instructive description of many social processes and phenomena. We consider bounded confidence models on hypergraphs to model e-monetary networks where agents, characterized by homophily and biased assimilation, engage in many-body transactions. The paradigm of behavioral finance implies that opinion formation mechanisms, coming from social psychology, play a fundamental role in determining decisions of financial agents and interactions among them. However, applications of dynamic models in economics and finance are rather limited and primarily concerned with dynamics of markets and policies of targeted advertisement. A wide gap exists between dynamic models and complex behaviors of real financial agents. We aim to fill it by devising new models that are based on opinion formation and disclose key drivers of decision making in networks of financial agents. As a case study, we use a business-to-business (B2B) electronic currency network whose provider, Sardex S.p.A., has expressed its interest in the project and agreed to supply non-confidential data about the networks of transactions to be used for the model validation. The Sardex Ministero dell'Università e della Ricerca MUR - BANDO 2022 community includes thousands of members and provides its partners with a credit line used to purchase goods and services within the network. Recent works have revealed non-trivial topological features of the Sardex transaction network; however, the mechanism underlying the network evolution, which is driven by opinion formation, remains undisclosed. Opinions in this context characterize

reputations of financial agents and influence the frequencies of transactions between them; conversely, the volume of transactions completed by an agent affects its reputation in a complex feedback loop between the opinions and the agent's actions. A key feature of monetary networks is the presence of interactions in groups of three or more agents that cannot be reduced to sum of pairwise interactions. Sardex allows transactions with more than two agents, in which one agent can compensate for the purchase of an asset by closing a cycle of transactions with third parties. Therefore, we will make use of the paradigm of networks with higher-order interactions to capture the opinion formation mechanisms that reflect into the simple graph of transactions we observe. We expect that the analysis of our application will lead to a breakthrough in the theory of higher-order dynamical networks that is in its infancy.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II**
- **UNIVERSITA' DEL SANNIO**

Parole chiave

Settori ERC

PE1_19 - Control theory and optimisation PE7_1 - Control engineering PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.)

Budget

Costo totale progetto:	€ 207.770,00
Contributo totale progetto:	€ 187.500,00
Costo totale PoliTo:	€ 74.800,00
Contributo PoliTo:	€ 67.500,00

STRATEGY - Nanostructured Synthetic polymers TReated in Alkaline solutions To design hiErarchical porous laser-induced Graphene catalyst layers for energY

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marzia Quaglio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR _ Ministero dell'Univertità e della Ricerca)

Codice identificativo progetto:

20222H42ZP

Ruolo PoliTo:

Coordinatore

Abstract

STRATEGY aims at demonstrating a radically new approach to design catalyst layers (CL) for energy devices as fuel cells, based on Laser-Induced Graphene with Hierarchical pore structure (H-LIG) and controlled composition obtained under ambient conditions from electrospun-1D nanofibers (NFs) of synthetic polymers after alkaline treatment. During laser processing, the conversion of NFs into graphene will induce the crystallization of metal-oxide (MO) nano-catalysts (NCs). This project will prove the possibility to control NCs nucleation at the surface of H-LIG NFs by laser writing. The exploitation of surface-sensitive characterization techniques applied at nano- and mesoscale based on electron microscopy and x-ray scattering measurements coupled with the non-destructive tomography for 3D reconstruction of the porous structure and with in-operando experiments during the catalytic process will guarantee the control of all the process parameters. Studies will show that NFs made of N-rich polymers mixed with MO precursors enable the creation of H-LIG with enhanced durability, stability and catalytic activity toward the oxygen reduction reaction (ORR). The new method is based on the rational combination of laser writing, activation, and electrospinning to obtain a 3D LIG characterized by a hierarchical structure overpassing the properties of materials obtained by the separate use of each process. H-LIG combines all the merits of graphene-based materials to the hierarchical porosity due to the micropores of LIG, the mesopores of the alkali-induced activation and the macropores of the 1D-NFs by electrospinning. In this radically new process, electrospun-NFs hold great promise as the ideal nanoscale building blocks to control and tune the degree of interconnection in the H-LIG and thus enable control and modulation of hierarchical porosity and composition.

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Solutions of synthetic polymers with high carbonization yield will be optimized and investigated in the presence of metal-organic precursors, such as manganese oxide, to obtain CLs with optimal electrocatalytic behavior toward the ORR. As-electrospun NFs will be treated in alkaline solutions, thus enabling conversion in LIG of ALL polymers by CO2 laser in ambient conditions (patent pending), allowing the conjunct activation of graphene during its formation. With this radically new approach, STRATEGY allows LIG in ambient conditions from polymers such as polyacrylonitrile and polyvinylidene fluoride traditionally carbonized in a controlled atmosphere only. Opening laser processing to nanostructured polymers of this kind offers new opportunities to combine tunable porosity to spontaneous doping in LIG, adding catalytic properties that can be of extreme interest for energy applications. STRATEGY project will investigate the new process deeply to identify the parameters governing porosity features and relate them to the chemical, physical and catalytic properties to develop innovative H-LIG CLs.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE4_4 - Surface science and nanostructures PE4_8 - Electrochemistry, electrodialysis, microfluidics, sensors PE3_4 - Electronic properties of materials, surfaces, interfaces, nanostructures, etc.

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 239.749,00
Contributo totale progetto:	€ 199.262,00
Costo totale PoliTo:	€ 119.880,00
Contributo PoliTo:	€ 99.088,00

CryMiNaL-QC - Cryogenic Microwave Nano-Electronics for Quantum Computing

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Chiara Ramella

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022PB4SX4

Ruolo PoliTo:

Partner

Abstract

Quantum Computing (QC) is universally considered a key enabling technology that will allow solving problems unthinkable with classic computing, by exploiting the quantum properties of quantum bits (qubits). Practical quantum computers should integrate millions of qubits together with the electronic circuits used to control and readout their values. The key issue is that they need millikelvin-range operating temperatures and microwave excitations to continuously refresh, control and correctly readout their values. Solid-state qubits fabricated in ultra-scaled CMOS enable large-scale integration of millions of qubits onto a single a chip. Moreover, they can operate at higher temperatures (few K), a crucial feature to relax the refrigerator power constraints (i.e.,

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PAVIA**
- **UNIVERSITA' DI MILANO BICOCCA** - Coordinatore

Parole chiave

Settori ERC

PE7_5 - (Micro and nano) electronic, optoelectronic and photonic components PE7_3 - Simulation engineering and modelling PE7_11 - Components and systems for applications (in e.g. medicine, biology, environment)

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Politecnico di Torino

Budget

Costo totale progetto:	€ 230.274,00
Contributo totale progetto:	€ 199.853,00
Costo totale PoliTo:	€ 48.961,00
Contributo PoliTo:	€ 18.540,00

HONEY: Hybrid ONline tEchnologY for particle therapy

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Maurizio Rebaudengo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022KYTKB5

Ruolo PoliTo:

Partner

Abstract

The HONEY project aims at developing innovative hybrid technology able to significantly improve both beam monitoring and online treatment verification in Charged Particle Therapy (CPT). CPT is considered the most advanced radiotherapy method in oncology. Thanks to the favourable depth dose deposition for charged particles and the enhanced radiobiological effectiveness for heavier ions, CPT is highly effective in reducing toxicity, lowering secondary malignancy risk and increasing tumor local control. To fully exploit its potential, the beam parameters and the particle range inside the patient must be thoroughly monitored. So, there is an urgent need for technological improvements to overcome current limitations and implement better treatment optimization and new emerging modalities. The HONEY final goal is to develop and build a new hybrid prototype, integrating beam monitoring and treatment verification devices by means of high performance data acquisition and online analysis. Beam monitoring detectors based on Ultra Fast Silicon Detectors (UFSD) will provide an excellent time resolution at therapeutic rates, necessary to improve in-vivo verification techniques by exploiting the particle time measurements. Moreover, beam shape and position will be precisely assessed. Scintillating crystals coupled to Silicon PhotoMultiplier (SiPM) will exploit the secondary particles produced by the interaction between the primary beam and human tissues to develop a hybrid in-vivo treatment verification system. Both annihilation photons from positron emitters (in-beam Positron Emission Tomography (PET) modality) and nuclear de-excitation photons (multi-detector Prompt Gamma Timing (PGT) modality) will be collected within the same detector and integrated with the information of the primary particle transit time, measured by UFSD. A highly performing Data AcQuisition (DAQ) system based on Field Programmable Gate Arrays (FPGA) will be developed to assure data synchronization between the detectors, particle identification (PET or PGT signals), triggering and optimized data

buffering, so as to guarantee the straightforward application of HONEY findings in a clinical environment. Innovative image reconstruction algorithms and data analysis methods will be developed to provide the necessary feedback to physicians. Their effectiveness will be tested in clinical situations, gathering the information required to design new paradigms for in-vivo treatment verification.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **ISTITUTO NAZIONALE DI FISICA NUCLEARE** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

LS7_2 - Diagnostic tools (e.g. genetic, imaging) PE2_3 - Nuclear physics

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età|Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 346.050,00
Contributo totale progetto:	€ 249.956,00
Costo totale PoliTo:	€ 99.045,00
Contributo PoliTo:	€ 77.267,00

TOMORROW - TOpology & Material Optimization using additive manufactuRing to maximize stRuctural and thermal perfOrmances of building Walls

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luciana Restuccia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022TZ3S4M

Ruolo PoliTo:

Partner

Abstract

The implementation of Industry 4.0 technologies in the construction industry arises from the desire to identify innovative fabrication techniques which are more efficient, flexible and sustainable than traditional ones. Additive manufacturing (AM) of cementitious materials, also known as 3D Concrete Printing - 3DCP, is rapidly gaining popularity worldwide for the automated fabrication of architectural components and structural elements. Frequently reported potential benefits are: reduced material use, decreased labor/improved safety, increased construction speed, customized geometries. Thus, the increasingly stringent requests in terms of energy performance of new/existing buildings, the need for high structural efficiency over the in-service-life, and the optimization of life cycle resources may represent key drivers for the development of advanced automation solutions to fabricate innovative and more sustainable construction systems. This research project aims to exploit the synergy between material and topology optimization through the use of additive manufacturing – more specifically, 3DCP technique – for the fabrication of innovative engineered building wall elements characterized by reduced raw materials' consumption while maximizing structural and thermal performance. The key innovation consists in the advanced use of free-form characteristics and fresh material control -at the macro and micro scale, respectively- enabled by 3DCP technique which makes Topology & Material Optimization (T&MO) algorithms applicable to the design-to-fabrication of engineered building walls. Thus, advanced performance-based customization can be achieved by tailoring the design of both material and shape according to input needs and pre-defined objective functions, such as aesthetics, thermal performance, applied loads, embodied CO2-eq, raw material consumption and total costs. To this scope, a comprehensive T&MO framework will be developed

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in TOMORROW project by considering as the design variable the micro-macro material distribution within the wall, ensuring, at the same time, compatibility with the material feeding and trajectory capabilities of the printing machinery. Two interconnected levels of action are foreseen: i) Micro: design and control material density during printing (up to lightweight foamed concrete), yielding functionally graded materials (FGMs); ii) Macro: inner/outer topology of the walls in a thermo-mechanical constrained environment to take into account properties commonly antithetical to each other: thermal insulation, mechanical stiffness/strength, lightness, durability. The implementation of the project, demonstrated by the realization and testing of engineered wall prototypes, will contribute to reduced material consumption, increased energy efficiency and digital transformation of the sector, promoting multidisciplinary collaborations useful both for new sustainable constructions and for the retrofit of existing buildings.

Persone coinvolte

- **Luciana Restuccia** (Responsabile Scientifico)
- **Stefano Invernizzi** (Componente gruppo di Ricerca)

Strutture coinvolte

- DISEG - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment PE8_10 - Industrial design (product design, ergonomics, man-machine interfaces, etc.) PE8_11 - Sustainable design (for recycling, for environment, eco-design)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 300.348,00
Contributo totale progetto:	€ 197.358,00
Costo totale PoliTo:	€ 103.571,00
Contributo PoliTo:	€ 66.078,00

CLEVER - CLimate-changE-resilient cities Via Extensive and Rational use of nature-based solutions

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Fulvio Boano

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022SZWBCP

Ruolo PoliTo:

Partner

Abstract

Urban areas are facing several challenges that are reshaping the city structure: population is growing fast, with a consequently urbanization increment, and climate changes are leading to an intensification of extreme rainfall events and a temperature increase. In this context, the European Commission is funding new Green Deal programs to support the achievement of the Sustainable Development Goals of the 2030 Agenda and, coherently, Italy is diverting consistent resources of the recovery fund to increase the resilience and sustainability of urban areas, with particular attention to green infrastructures. Given these premises, which constitute the motivations of CLEVER, our aim is to explore the impacts of implementation of some Nature-Based Solutions (NBSs), with particular attention to the mitigation of urban pluvial flood in nowadays and future scenarios. More specifically, the project focuses on the analysis of potential benefits arising from the development of a network of nature inspired measures that can be easily installed in buildings or in their close proximity, such as Green Roofs (GRs), Multilayers GRs (MGRs) and Green Courts (GCs), towards the creation of more sustainable and resilient cities. Such tools offer indeed multiple benefits for the sustainable urban development: thanks to their high rainwater retention capacity, they help mitigating pluvial floods; they play a significant role in the energy flux exchanges between building and atmosphere, facilitating the thermal roof insulation; and they contribute to restore the vegetation in the urban environment, increasing the biodiversity and adding aesthetic value to the buildings and, more in general, to the city. The project activities are organized following the line from the single building to the full city. Working packages have been designed to investigate different types of NBSs capitalizing partners' experiences and expertise. We will integrate knowledge from different fields:

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hydrology, ecohydrology, meteorology and disseminate results among policy makers, schools and via social media. Project analyses will be focused on and supported by the building scale assessment of rainwater retention performances at different pilot cases already available, underlining the ecohydrological processes acting within each NBS. Modelling activities will be aimed at investigating the impact of NBSs implementation at city-scale. The Research Units (RUs) involved in the project have recognized expertise on the mentioned topics. The feasibility of the proposal is guaranteed by the fact that the RUs are already equipped with three experimental GRs of different typology (including two advanced MGRs) and the installation of a GC is already ongoing. It is also worth mentioning that a Dutch SME, specialized in green roofs and other NBS design and realization, has expressed willing to cooperate and high interest in the project's outcomes.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PALERMO**

Parole chiave

Settori ERC

PE10_17 - Hydrology, water and soil pollution

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 240.404,00
Contributo totale progetto:	€ 197.026,00
Costo totale PoliTo:	€ 82.502,00
Contributo PoliTo:	€ 64.688,00

NEURONE: extremely efficient NEUromorphic Reservoir cOmputing in Nanowire network hardwarE

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Carlo Ricciardi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

20229JRTZA

Ruolo PoliTo:

Partner

Abstract

The current progress in Artificial Intelligence and Deep Learning technologies has an unsustainable environmental, social and economic cost. We identify the primary sources of this cost in a poor scaling of the computational cost of the training algorithms, on the one hand, and in a non-optimized structure of the hardware to execute these algorithms, on the other. In this project we propose a radically new framework for Deep Learning applications in physical substrates, that is based on the principles of hardware-software co-design and Green AI, making efficiency a key factor of both algorithms and their hardware implementations. On the hardware side, we embrace the Neuromorphic Computing paradigm, designing low-cost and versatile substrates based on Nanowire Networks for physical implementation of unconventional computing paradigms. On the software side, we focus on a physics-informed design of Reservoir Computing neural networks, using complex dynamical systems characterizations to enable the development of extremely efficient Deep Learning algorithms. The project will ultimately develop a Neural Nanowire Network (NNWN), a neuromorphic computing system capable of learning efficiently from temporal data. We will develop its mathematical description, software implementation, and physical fabrication. The NNWN system will be demonstrated, both in silico and on chip, in real-world edge-computing applications, validating its accuracy-efficiency tradeoff advantage in comparison to state-of-the-art solutions.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

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Politecnico di Torino

Parole chiave

Settori ERC

PE6_11 - Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video) PE3_10 - Nanophysics: nanoelectronics, nanophotonics, nanomagnetism, nanoelectromechanics, etc.

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 315.000,00
Contributo totale progetto:	€ 250.000,00
Costo totale PoliTo:	€ 60.965,00
Contributo PoliTo:	€ 60.965,00

SEDMORNET - Multi-Scale sEDiment transport and MORphodynamic conNEcTivity in rivers

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luca Ridolfi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università della Ricerca)

Codice identificativo progetto:

20224ZFJ8C

Ruolo PoliTo:

Partner

Abstract

SEDMORNET focuses on river morphodynamics, the science of physical processes that studies changes in river forms, which represent a fundamental control of the integrity of many freshwater ecosystems and related biodiversity, and are at the base of river management for flood protection and risk prevention. Achievements of nearly 40 years in river morphodynamic studies mainly refer to unit processes occurring at specific scales under equilibrium assumption between flow and sediment transport, while non-equilibrium, unsteadiness and connectivity across multiple scales are essential drivers of the actual evolutionary trajectories of the river morphology. To address this fundamental gap, the core novelty of the SEDMORNET project will investigate the relation between sediment connectivity across and within scales and morphodynamic processes. Considering that variability in streamflow and sediment supply are the external drivers of morphodynamics, which reflect climatic or anthropogenic changes acting at larger scales, the project will take a multi-scale approach aiming to: 1) quantify the connectivity properties of wet and active riverbed areas in multi-thread rivers at different flow stages; 2) formulate a conceptual and quantitative model that links the statistical properties of streamflow and sediment supply with the consequent space-time variability of connectivity; 3) develop quantitative, process-based nested morphodynamic models to predict reach-scale evolutionary trajectories of river morphology in response to anthropic and climate changes in the river basin. The project will integrate the complementary expertises of the two Research Units: physics-based analytical morphodynamic modelling, integrated with field/remote sensing observations (University of Trento - UniTN), and stochastic, analytical modelling of river processes (Politecnico di Torino - PoliTO). The strong modelling focus will be complemented with laboratory experiments on a large mobile-bed flume and the analysis of already collected large morphodynamic datasets by the Research Units. Novel methods for river morphodynamics will be also

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capitalised from other fields of science (complex network models, scale-nested modelling). Two postdoctoral young researchers will be recruited by UniTN and PoliTO to work full time on the project, supervised by 2 permanent staff in each unit and supported by 4 already enrolled PhD students, ensuring a fair balance between the research activities, the specific skills needed and the effort required. Results of SEDMORNET can support effective planning and implementation of investments on river restoration foreseen in the Next Generation EU and PNRR programmes, contributing to social and economic well being and to more resilient river ecosystems. Achieving the project's potential impact on the scientific community, students, stakeholders and the general public is supported by a dedicated dissemination strategy.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' STUDI TRENTO** - Coordinatore

Parole chiave

Settori ERC

PE10_17 - Hydrology, water and soil pollution PE10_13 - Physical geography

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 6. Garantire a tutti la disponibilità e la gestione sostenibile dell'acqua e delle strutture igienico-sanitarie|Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell'ecosistema terrestre

Budget

Costo totale progetto:	€ 293.104,00
Contributo totale progetto:	€ 231.541,00
Costo totale PoliTo:	€ 141.454,00
Contributo PoliTo:	€ 97.576,00

2D-EMMA - Technologically Scalable 2D Materials and Extended Operando Measurement Methodologies for Advanced Device Fabrication (2D-EMMA)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Francesca Risplendi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

202289PMBP

Ruolo PoliTo:

Partner

Abstract

Galileo Galilei famously stated, “All truths are easy to understand once they are discovered; the point is to discover them.” This statement is surely true for today’s nanotechnology. For instance, emergent nanomaterials such as two-dimensional (2D) transition metal dichalcogenide (TMD) compounds offer exciting, wide opportunities from novel (opto-)electronic devices to catalytic energy conversion and biomedical/healthcare applications. The most widely studied TMD compound is MoS2, which can be grown as ultra-thin layered films and monolayers on flexible substrates in a versatile and mechanically stable manner, while maintaining high mobility in field-effect transistors and sub-parts-per-billion sensitivity for gas detection. Utilizing the unique properties of layered 2D materials, many surprising physical phenomena can be further obtained by stacking them together to form heterostructures. One major challenge, however, is given by the lack of cost-efficient and scalable processes for large-area production of 2D materials, which has limited up to now the progress towards a mature integration of these materials in various technologies. In addition, the fundamental properties of 2D materials are governed by nanoscopic phenomena that are highly susceptible to external perturbations, including environmental conditions during device operation. The role of scientists is thus to bridge the boundaries between laboratory research and industrially relevant "real-world" conditions. For instance, identifying key defects, how they are influenced under device operation and how they affect device performance, as well as a quick robust method of detecting such defects, will help to foster successful translation of 2D materials to innovative technologies. The 2D-EMMA consortium consists of young ambitious researchers from five different Italian regions It aims at developing integrated manufacturing technology for 2D materials based on a novel and

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technologically relevant growth technique, namely ionized jet deposition. It will also allow overcoming critical experimental problems, such as controlled interfacing, and exploring new integrated electronic and sensing device concepts. This would allow 2D materials to enter the semiconductor roadmap, the key to unlocking their commercial potential. We will bundle our different know-hows and complementary strengths to expand multi-modal operando characterization of nanomaterials like TMDs in technologically relevant device architectures under operative conditions. Our focus for advanced operando characterization will be on scanning probe techniques and electron spectroscopy, which are among the most wide-spread and versatile characterization techniques in modern science, used across all disciplines in academia and industry. The project will allow us to discover the fundamental mechanisms under true operative constraints to have a leveraged impact on the nanomaterials' effective design and functionality.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE** - Coordinatore
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI**

Parole chiave

Settori ERC

PE3_4 - Electronic properties of materials, surfaces, interfaces, nanostructures, etc. PE3_5 - Semiconductors and insulators: material growth, physical properties PE3_10 - Nanophysics: nanoelectronics, nanophotonics, nanomagnetism, nanoelectromechanics, etc. PE5_4 - Thin films

Budget

Costo totale progetto:	€ 225.129,00
Contributo totale progetto:	€ 189.989,00
Costo totale PoliTo:	€ 43.655,00
Contributo PoliTo:	€ 43.655,00

Politecnico di Torino

NEWTON - NEtWork programmabiliTy tOols at haNds

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Fulvio Giovanni Ottavio Risso

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e Ricerca)

Codice identificativo progetto:

2022ZA8T22

Ruolo PoliTo:

Partner

Abstract

With 5G and beyond, network architectures are facing unprecedented changes. Cloud resources are being pushed at the edge of the network to meet latency requirements of critical applications and to keep sensitive data in trusted locations. Moreover, network technology is radically changing while embracing a programmability approach that enables very efficient traffic manipulation and computing tasks directly in HW pipelines (e.g., P4) once used only for switching, while SW approaches (e.g., eBPF/XDP, DPDK, smartNICs) become increasingly important because of their close vicinity with end-user (cloud-native) services. However, current network programmability primitives target mainly network experts, with a limited capability to accommodate the necessities from other domains (e.g., cloud services). NEWTON will address the above problems by designing and developing a novel framework that will expose network programmability primitives to a larger community, such as cloud-native developers and cloud orchestrators. For instance, “cloud native” services ask for new requirements (e.g., seamless scalability, unprecedented agility, geographical replicas, controlled latency between elementary microservices, continuous integration and delivery, and more) that demand massive cooperation from the underlying network platform. Furthermore, given that agility has no value without efficiency, NEWTON pursues an aggressive decomposition of network functions into “micro” (and distributed) elementary components, possibly deployed on multiple target platforms (e.g., SW, HW, smartNICs), running separately and dynamically orchestrated (by the NEWTON platform) to seamlessly provide the expected behavior. As part of the emerging network programmability paradigms, NEWTON includes also novel technologies such as Segment Routing, which provides the ability to code directly into each packet header where the traffic should be sent and how the traffic should be treated, thus representing an ideal complement for its programmable network functions. In NEWTON, users will be able to ask for complex services using either imperative and declarative abstractions (i.e., intents), as well as design their

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own service by composing the available elementary building blocks. The richness of the underlying infrastructure will also be exposed to developers, with different abstractions available to different categories of developers. The NEWTON versatility in the exposure of abstractions, APIs, tools and platforms is of fundamental importance to foster the adoption of the foreseen platform and stimulate faster technology progress. Finally, NEWTON will also target network developers and experimenters by providing a prototyping and testing platform, enabling the above actors to practice with advanced network programmability concepts and emulate their behavior ahead of any field trial.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI BERGAMO**
- **UNIVERSITA' DI PISA**
- **UNIVERSITA' DI ROMA - TOR VERGATA**

Parole chiave

Settori ERC

PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 310.590,00
Contributo totale progetto:	€ 310.590,00
Costo totale PoliTo:	€ 49.695,00
Contributo PoliTo:	€ 39.996,00

Musical Metaverse: an inclusive Extended Reality platform for networked musical interactions

Durata:

17/10/2023 - 16/10/2025

Responsabile scientifico:

- Cristina Emma Margherita Rottondi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Ruolo PoliTo:

Partner

Abstract

This project sets out with the goal of creating an inclusive Extended Reality (XR) platform for networked musical interactions in the Metaverse, to achieve novel forms of musical expression and foster music composition, performance, and education. The Metaverse relates to a vision of a virtual, digital world which is parallel to the real, physical world, where each user owns and interacts through his/her own avatar. The "Musical Metaverse" (MM), the Metaverse part dedicated to musical activities, is currently in its infancy. As of today an investigation about the technical, artistic and inclusivity-related opportunities and challenges posed by the MM has not been conducted yet. Moreover, current XR platforms are unable to effectively support real-time networked musical interactions between geographically displaced musicians due to unsolved technical issues, such as the guarantee of communication latencies of less than 30 ms. Furthermore, only a few studies have investigated collaborative music making in XR, and little is known about the influence of diversity factors in MM interactions, such as gender or disability. Investigations on all these topics are crucial for enabling MM ecosystems that musical stakeholders can utilize in efficient, creative and responsible ways. Given the timeliness and expected importance of the MM, such investigations are useful to provide developers with guidelines for creating better musical XR environments and interactions between stakeholders. The project aims to achieve three interdependent objectives: 1) To gain a rich understanding of musicians' needs for different musical activities in the MM, and design with them methods to satisfy their needs; 2) To develop new fundamental methods for the synchronous interconnection of musicians within collaborative XR environments; 3) To explore and empirically study new services for musicians exploiting the developed methods. The project adopts a methodology consisting of an iterative paradigm based on 3 partially overlapping phases, Design-Develop-Evaluate. The phases are iterated twice, aiming to progressively increase the technology readiness level and achieve a tangible proof-of-concept of the envisioned technology. The focus will be on classical, pop, rock, and experimental music, which are genres selected for covering a

wide and heterogeneous scope in terms of music creation and consumption. Moreover, three musical activities will be investigated, namely composition, performance and education. The project brings together 2 technical universities and 2 musical institutions with complementary skills in different fields: music, human-computer interaction, XR, networking, machine learning, sociology, ethics, and innovation. Such interdisciplinary approach is necessary to address the project vision and respond holistically and critically to its significant challenges. The project is a high-impact endeavour from which basic science, art, industry and society can benefit.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **CONSERVATORIO DI MUSICA ALFREDO CASELLA - L'AQUILA**
- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **SAE Italia International Technology College**
- **Università degli studi di Trento** - Coordinatore

Parole chiave

Settori ERC

PE6_9 - Human computer interaction and interface, visualisation and natural language processing PE7_8 - Networks (communication networks, sensor networks, networks of robots, etc.) SH5_5 - Music and musicology; history of music

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 4. Fornire un'educazione di qualità, equa ed inclusiva, e opportunità di apprendimento per tutti

Budget

Costo totale progetto:	€ 253.442,00
Contributo totale progetto:	€ 202.260,00
Costo totale PoliTo:	€ 94.306,00
Contributo PoliTo:	€ 80.550,00

DIGITRANS-PAR - Drivers and impact of digital transformation of the Italian PA at the regional level

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Stefano Sacchi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022RCSPF3

Ruolo PoliTo:

Coordinatore

Abstract

In the field of public policy and administration there has been an increasing debate over digital transformation DT, which “entails the pervasive adoption of digital technologies in production and consumption activities that rely on a significant dimension of data development and data analysis”. In parallel, DT has been at the top of the EU reform agenda, particularly after the pandemic. Next Generation EU and the Italian NRRP represent a unique opportunity for improving on the DT of the public administration (PA) in Italy. Yet these extraordinary investments are not per se a sufficient condition for reforms. As highlighted by the contemporary literature, IOs, governments and stakeholders largely support DT and outline the potential gains for the improvement of PA; yet this emphasis is not paralleled by reform advancements. DIGITRANS-PAR addresses this paradox by casting light on the policy challenges posed by DT and its policy impact in the Italian case. In terms of the empirical strategy, two policy sectors are investigated, the governance of which is shared between the State and the regions: health policy and (active) labor market policy. DIGITRANS-PAR focuses on the factors that favor or hinder the DT of PA at national and especially subnational levels of government. Moreover, it investigates the impact of the same process on the implementation of policies and administrative performance. Assessment of new reforms and programs launched by the Italian NRRP is crucial to shed light on the likely trajectory of DT in Italy and provide effective policy recommendations. DIGITRANS-PAR aims to innovate the current state of the literature by: a) adding to administrative and organizational preconditions the systematic analysis of political factors; b) providing a fine-grained analysis of the impact of DT on PA, going beyond the effects of the process on the quality of administrative routines to focus on efficiency, effectiveness and quality performance

indicators. To do so the project adopts a context-based and mixed-method design, combining quantitative analysis of politico-institutional factors with qualitative analysis of individual and organizational factors to account for the adoption of DT, as well as of impact of DT on specific policies closely related to citizens' wellbeing and life chances at the regional level. DIGITRANS-PAR has three overarching aims: a) to explain the delay of Italy (and the variation across regions) in the DT of the PA. Albeit focused on one country case, our research strategy makes use of potentially large variation at the regional level to probe into the importance of factors and drivers identified by the literature; b) to assess the potential outcomes of DT of the Italian PA; c) to provide policy recommendations to policymakers and practitioners at both national and regional levels.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO S.ANNA**

Parole chiave

Settori ERC

SH2_1 - Political systems, governance SH3_7 - Social policies, welfare

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 230.474,00
Contributo totale progetto:	€ 206.266,00
Costo totale PoliTo:	€ 120.204,00
Contributo PoliTo:	€ 105.418,00

EnaTech-RDE - Enabling Technologies for Turbine Design in CO2-Free Rotating Detonation Engines

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Simone Salvadori

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022BW9SHS

Ruolo PoliTo:

Partner

Abstract

Notwithstanding the impact caused worldwide by COVID-19 pandemic on the industrial sector, the global energy demand already shows a growing trend. Contextually, the current crisis in Ukraine obliges EU to move towards self-sustained energy scenarios. Also, the objective of a carbon-neutral economy by 2050 pushes to an increasing use of renewable energy sources, which requires the adoption of storage technologies to balance the associated non-programmable power generation. The use of energy vectors such as hydrogen carriers seems to be the most effective strategy to store energy as it is possible to adopt these green fuels in Gas Turbines (GT), which are key technologies to balance energy supply and demand. Despite the last 3 decades have seen significant improvements in GT-related technologies with relevant step forwards in terms of emissions reduction, breakthrough innovations are still limited to the use of Joule-Brayton cycle. The objective of the EnaTech-RDE project is to contribute to the development of the Rotating Detonation Engine (RDE) as an innovative concept for the next generation GT, which is able to efficiently employ hydrogen as fuel. The adoption of a combustion process that occurs through a rotating detonation wave inside of a circular chamber allows for realizing a Pressure Gain Combustion (PGC) cycle, thus providing an increase of the overall thermodynamic efficiency up to 15% for a small/medium GT size. RDE is the most promising PGC solution thanks to the high frequency of the unsteady flow at combustor outlet that facilitates a proper turbine feeding. In fact, an efficient coupling between the Rotating Detonation Combustor (RDC) and the turbine is of paramount importance since theoretical efficiency improvement associated to the modified cycle may be overcome by the dramatic reduction of the turbine efficiency. In the EnaTech-RDE project, research units from POLIMI and POLITO face the critical aspect of RDC/turbine coupling by designing enabling technologies for RDEs, while considering the impact of the developed solutions on the overall system performance. POLIMI oversees the

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analysis of the thermodynamic cycle, the design of optimal sub/supersonic stages, the design of a fluctuating system for its state-of-the-art wind tunnel facility where the newly designed high-pressure vanes are tested, and the verification of the stage design in cooled configuration. POLITO oversees the design of transition ducts, which are able to provide the proper flow condition to the turbine and to weaken flow fluctuations coming from an RDC, the design of the cooling system for vanes, and the coupled simulations of ducts and vanes. Eventually, the fluctuating conditions from the ducts, the designed geometries and the experimental data will be made available in an open access form. The obtained results provide a tangible increase in the knowledge of RDE-related technologies, thus contributing to future practical adoption of the concept.

Persone coinvolte

- **Simone Salvadori** (Responsabile Scientifico)
- **Daniela Anna Misul** (Componente gruppo di Ricerca)

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE8_5 - Fluid mechanics, hydraulic-, turbo-, and piston engines PE8_6 - Energy processes engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 240.918,00
Contributo totale progetto:	€ 196.698,00
Costo totale PoliTo:	€ 79.790,00
Contributo PoliTo:	€ 79.790,00

MAGASTORAGE - MicrowavE-assisted manufacturinG of cerAmic composites for improved thermal energy STORAGE systems

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Milena Salvo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MIUR)

Ruolo PoliTo:

Partner

Abstract

Natural fluctuations in renewable energy sources demand for effective large-scale energy storage solutions to manage the possible time mismatch between energy production and consumption. Among the most popular high-temperature thermal energy storage (TES) systems, molten salts filled tanks proved as one of the most attractive and environmentally friendly solutions due to their high boiling points, low viscosity, low vapor pressure and high volumetric heat capacities, along with their low cost and market readiness. Concentrated Solar Power (CSP) plants are among the main applications benefiting of the molten salts as heat transfer fluids (HTF) to store thermal energy providing a potentially constant on-demand supply of solar power without the need for fossil fuel backup systems. However, the low thermal conductivity of conventional solar salts limits the resulting energy storage density and leads to large stored volumes, translating in a relatively high cost. Differently, metallic Phase-Change Materials (mPCM) can provide higher thermal conductivities and energy storage densities due to the much higher operating temperature range (up to 1400°C), which enable to achieve performances comparable with other benchmark storage technologies. Nevertheless, the demanding operating conditions of these materials require the use of compatible refractory materials for the production of their containers. Chemical Vapor Infiltrated (CVI) SiC/SiC composites, where the silicon carbide (SiC) based matrix is deposited from gaseous reactants on to a heated substrate of SiC fiber preforms, excel for their high temperature and corrosion properties along with a high fracture toughness and low density, making them ideal candidates for the replacement of metals and ceramics for applications in aggressive environments. However, the long manufacturing times (of the order of several weeks) and the run-to-run reproducibility severely limit the broad usage of this technology. In this framework, Microwave-assisted CVI (MW-CVI) shows several advantages in the infiltration of SiC/SiC composites, mainly thanks to its ability to induce an inside-out densification pattern, thus reducing the processing times of about one order of

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magnitude. The relevance of SiC/SiC composites can be still more strengthened developing easier and more rapid techniques for the joining among CMCs, which would open the use of these materials to several strategic applications. The MicrowavE-assisted manufacturinG of cerAmic composites for improved thermal energy STORAGE systems (MEGASTORAGE) project will address these challenges by proposing innovative MW-assisted heating technologies to abate production costs and develop joining technologies to enable the utilization of SiC/SiC components within CSP applications and beyond. MEGASTORAGE RTD activities involve some of the principal Italian experts and research institutes in the field and results strategic from the industrial and economic point of view as a part of the challenges addressed within the M2C2 section of the PNRR.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI PISA** - Coordinatore

Parole chiave

Settori ERC

PE8_8 - Materials engineering (metals, ceramics, polymers, composites, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 459.050,00
Contributo totale progetto:	€ 249.963,00
Costo totale PoliTo:	€ 92.942,00
Contributo PoliTo:	€ 61.504,00

COLTRANE-V - COntinous Learning capabilities for funcTional safety Run-time threAts maNagEment in Automotive RISC-V based ECU

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alessandro Savino

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022HWM3T9

Ruolo PoliTo:

Coordinatore

Abstract

Cyber-Physical Systems penetrate different domains, from IoT to Automotive. Because CPSs are coupled with new and complex failure mechanisms due to nanometer-scale fabrication technology, a version consisting of many hardware and software components with mixed degrees of criticality, hardcoded redundancies in the design, and fixed runtime recovery policies are no longer sufficient. Moreover, they are subject to malicious attacks, requiring that the next-generation intelligent systems support new groundbreaking paradigms for a holistic approach towards learning-based resilience. This is particularly true in Automotive: when the system is not working correctly, it likely leads to potential hazards, compromising the safety of all the users. The primary purpose of this project is the pursuit of system dependability in the Automotive domain, complementing the well-known methodologies to design safe systems through a set of holistic data-driven learning-based approaches during the operation lifecycle of computing systems. The idea is to support a continuous learning approach, such that systems can continue to provide expected functionality despite malfunctioning components or cybersecurity attacks breakdown. This project aims at achieving the objective by exploring new architectures for continuous monitoring and learning. We aim at building a prototype based on a RISC-V microprocessor coupled with an Artificial Intelligence (AI) based hardware accelerator. The accelerator will include classification capabilities and reinforcement learning strategies to detect failures and cybersecurity threats, and apply proper countermeasures on the fly. Such architecture allows for building an intelligent system that exploits continuous monitoring for threat detection and To support the feasibility, we foresee a use case implementing an autonomous driving task deployed following all functional safety specifications by ISO 26262. The approach targets sensitive parts of the RISC-V

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microprocessor that might suffer from hardware faults, i.e., registers affected by stuck-at. The system will include an online real-time monitoring task, which will continuously observe RISC-V monitoring features, i.e., performance monitor counters (PMCs), to feed an Artificial Neural Network (ANN) model, which is trained for anomaly detection and running on a hardware accelerator for the sake of efficiency. The ANN enables the detection of safety-critical deviations of the system behavior either caused by HW faults or by cybersecurity attacks. Also, anomaly detection enables the activation of hardware or software, i.e., Operating system level, remedial actions. The latter are selected using a Deep Reinforcement Learning (DRL) based agent that determines the most appropriate sequence of actions to mitigate the fault and restore a typical behavior of the system without failing the functional safety of the system.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI CATANIA**
- **UNIVERSITA' DEGLI STUDI DI GENOVA**

Parole chiave

Settori ERC

PE6_1 - Computer architecture, pervasive computing, ubiquitous computing PE6_7 - Artificial intelligence, intelligent systems, multi agent systems PE6_5 - Cryptology, security, privacy, quantum crypto

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 397.718,00
Contributo totale progetto:	€ 249.854,00
Costo totale PoliTo:	€ 109.436,00
Contributo PoliTo:	€ 74.692,00

SCEPTELH - SuperConducting Energy Pipelines for the simultaneous Transfer of Electricity and Liquid Hydrogen: design and assessment of their potential role in boosting the decarbonization of the Italian industry

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Laura Savoldi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MIUR)

Codice identificativo progetto:

2022R9PWP5

Ruolo PoliTo:

Coordinatore

Abstract

The activity proposed here aims first at developing the conceptual design of a superconducting (SC) cable cooled by a flow of liquid hydrogen (LH2), for the combined transport of electricity and LH2 from the production sites to end-users. In fact, SC materials are capable of substituting resistive conductors in the power distribution, reducing electrodynamic losses and environmental impact. Their need for cooling at cryogenic temperature is typically met by liquid nitrogen or gaseous helium. However, the use of LH2 as the cryogen for such cables, when MgB2 is used as SC material, adds the distribution of LH2 to the benefits related to the use of SC cables. The conceptual design of a Superconducting Energy Pipeline (SCEP), combining SC cable with the LH2 cryogenic cooling, is carried out first developing a simulation tool capable to address the best SCEP layout based on the identification of proper operating parameters (voltage level, power, LH2 flow rate, length, etc). The robustness of the design is checked by detailed electric and thermal-hydraulic analysis, realized with state-of-the-art numerical tools developed by the proponents in the past twenty years. Figures of merit for the SCEP and its techno-economic characterization are the main outcome of the design activity. The proposal goes well beyond the mere SCEP conceptual design, addressing also the issue of the possible penetration of SCEPs, as resulting from the design phase, in the Italian energy system by means of a bottom-up technology-rich optimization model, under the assumption of partial equilibrium of competitive markets for the energy commodities. Two different categories of final end-users are considered for the SCEP. First, electric power and LH2 together can feed existing or new technologies in energy-intensive

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industrial sectors needing both electric energy (EE) and natural gas (NG), or directly hydrogen, assuming blending of NG and LH2. Second, the two commodities (EE and LH2) can split at the outlet of the SCEP to cover separate end-use demands. The possible contribution of SCEPs to the decarbonization of the Italian industrial sector and to the decrease of the dependence on NG is investigated through the definition and simulation of suitable scenarios constraining the CO2 emissions and NG availability to progressively lower levels. The analysis is based on the open-source TEMOA-Italy tool, recently developed and positively benchmarked against the TIMES-Italy model, used in turn by ENEA to support the Quarterly Analysis of the Italian Energy System. Eventually, based on the identification of the industrial processes that could benefit more from the availability of SCEP, the most suitable locations in Italy for the SCEP are identified, based on the planned availability of Renewable Energy Parks and on the presence nearby of industrial installations that, according to the TEMOA analysis, would become suitable end-users for the SCEP.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

PE7_12 - Electrical energy production, distribution, application

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 267.440,00
Contributo totale progetto:	€ 191.440,00
Costo totale PoliTo:	€ 150.299,00
Contributo PoliTo:	€ 111.099,00

CEDEAFIB - Cerebral fluid dynamics: investigating the association between atrial fibrillation and dementia through an integrated in silico-in vivo framework

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Stefania Scarsoglio

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022EAN2BB

Ruolo PoliTo:

Coordinatore

Abstract

Atrial fibrillation (AF), characterized by an irregular heart rhythm, is the most common cardiac arrhythmia, counting nearly 60 million prevalent cases worldwide in 2019 and with epidemiological projections foreseeing a further rise during the next decades. Dementia is a progressive neurological degeneration leading to decline in memory, reasoning, communication, and capacity to carry out daily activities, which currently affects more than 50 million people worldwide and with 150 million cases estimated in 2050. Both diseases share several common risk factors, many of which are modifiable, except for age and genetic factors. Through a constellation of potential underlying hemodynamic mechanisms - such as silent microembolic cerebral infarctions, altered cerebral blood flow, hypoperfusion and microbleeds - there is growing evidence that AF is independently associated with an increased risk of dementia and cognitive impairment, even in the absence of clinical strokes. However, causality mechanisms have not been established yet, and the impact of AF treatments on dementia development is far from being clear. Among the possible contributors, the hypothesis of an altered cerebral blood flow due to the AF irregular beating is the most intriguing and the least investigated. The complex interplay between wave propagation in a network of tapered viscoelastic vessels with different size and the irregular pulsatile flow makes AF effects on the brain microcirculation presently unknown. In fact, currently adopted clinical techniques to assess cerebral hemodynamics in vivo, such as transcranial Doppler and magnetic resonance imaging (MRI), lack the resolving power to provide insights on the deep cerebral regions. The present interdisciplinary Project involves two Units (Polito and Unito) and proposes an integrated and personalized in vivo-in silico framework, which combines an

innovative cerebral hemodynamic beat-to-beat monitoring at the microcirculation level, with a cutting-edge multiscale computational model of the whole cardiovascular system. This approach will be carried out on a population of about 60-80 AF patients undergoing electrical cardioversion (ECV), in order to evaluate the impact of sinus rhythm (SR) restoration on AF-induced altered cerebral microvascular hemodynamics. The main goal is to understand and quantify mechanistic AF-induced effects on the cerebral circulation underlying the association between AF and cognitive decline. Thus, our research proposal aims to contribute at filling the gaps in the pathophysiological knowledge of the cerebral hemodynamics during AF and providing scientific evidence to improve clinical AF management in order to reduce the impact on cerebral circulation. In this respect, a delay of the onset of dementia by just few years would have huge socio-economic implications, in terms of the patient's quality of life and burden of health care costs.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

PE8_5 - Fluid mechanics, hydraulic-, turbo-, and piston engines

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 240.398,00
Contributo totale progetto:	€ 174.284,00
Costo totale PoliTo:	€ 135.887,00
Contributo PoliTo:	€ 97.765,00

FREYA - Fault REactivation: a hYbrid numerical Approach

Durata:

28/09/2023 - 28/02/2026

Responsabile scientifico:

- Stefano Scialo'

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022MBY5JM

Ruolo PoliTo:

Partner

Abstract

For several years the scientific community has analyzed the genesis of earthquakes induced by the injection of fluids into the subsoil. However, the recent increase in seismicity caused by exploitation of the subsurface, sometimes followed by major destructive events [29,30], demands for a deeper understanding of the processes and the development of innovative techniques to mitigate the associated seismic risk. Moreover, a safe exploitation of the subsurface is key for the development of green energy sources such as geothermal energy, and to reduce greenhouse gas emissions via long term carbon dioxide storage. The goal of this project is to study the onset of seismicity as the result of fault slip, taking into account multiphysics couplings in complex geometries and applying advanced numerical methods. The solution of quasi-static poroelasticity is used to provide the initial conditions for slip onset and wave propagation simulations. The bricks composing the proposed framework, in Fig. 1, are the expected outcomes of the following work-packages: WP1-- Space discretization of complex geometries with hybrid grids and coupled numerical schemes: • generation of hybrid grids of simplicial and polytopal elements; • coupling of domains of different dimensions resulting from the application of model reduction techniques to multi-scale problems; • discretization with the use of FEM based and polytopal based (VEM) methods on hybrid grids. WP2 – Coupled models for poroelasticity and wave propagation: • mathematical model for poroelasticity in a faulted and fractured domain; • formulation of the frictional contact problem on faults; • mathematical model of elastic waves propagation as a consequence of fault slip. WP3 – Coupled numerical schemes for poroelasticity and wave propagation: • numerical discretization of poroelasticity in faulted domains; • investigation of monolithic/iterative solvers for poroelasticity in the mixed-mixed formulation; • numerical discretization of the elastic waves propagation problem. WP4 – Applications and investigation of realistic scenarios: • definition, implementation and

analysis of test cases; • investigation of additional nonlinear constitutive laws. A strong connection is expected among WP1, WP2 and WP3 for the definition of models, interface conditions, numerical and geometrical coupling. Inputs and objectives are defined in an interplay with WP4. The main outcome of the project is a fully coupled model and numerical scheme for the simulation of fault slip due to changes of the underground pressure and the consequent generation and propagation of a seismic wave, to enhance our understanding of the physical processes behind induced seismicity. This encompasses the advancement of the state of art of numerical approximation methods for PDEs and the development of software tools in an integrated framework.

Strutture coinvolte

- DISMA - Dipartimento di Scienze Matematiche "G. L. Lagrange"

Partner

- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI BARI ALDO MORO**
- **UNIVERSITA' DI MILANO BICOCCA**

Parole chiave

Settori ERC

PE1_17 - Numerical analysis PE1_18 - Scientific computing and data processing PE1_20 - Application of mathematics in sciences

Budget

Costo totale progetto:	€ 220.350,00
Contributo totale progetto:	€ 184.350,00
Costo totale PoliTo:	€ 66.800,00
Contributo PoliTo:	€ 48.800,00

CHOISIS (CHaracterisation Of Innovative and Sustainable Insulating Solutions)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Valentina Serra

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022372TM9

Ruolo PoliTo:

Partner

Abstract

The reduction of greenhouse gases in the building sector, according to EU targets, can be reached only through a properly informed process, providing a set of procedures, methodologies, data that support professionals and manufacturers in adopting novel and more energy efficient and sustainable materials and solutions. The project is thus finalised to support the green transition in the building sector making available methodologies, validated procedures, metrics, tools and data for energy, environmental and cost effective characterization of the most novel materials for building envelope insulation, recently entering the market. The project consists of five main lines: 1) Procedures and metrics for the thermal characterisation, under steady state and transient state, of novel solutions at material/components scale This step will focus on the development and implementation of characterisation procedures, at the material and small-scale component level, of the different advanced and sustainable materials under investigation. Measurements will also make available data to validate procedures (both experimental and numerical) aimed at supporting manufacturers in the optimisation process 2) From lab to in situ experimental characterization The measurement of the actual performance under real operating conditions is not a trivial task when materials are characterised by specific hygrothermal behaviours or by a dynamic behaviour. Data are needed in order to validate models and reduce the gap between expected and actual outcomes. New solutions at material/components scale on actual case studies will thus be tested by means of in situ investigations, using suitable experimental set-up. 3) Dynamic behaviour assessment of highly inhomogeneous components The dynamic tests of inhomogeneous materials are not fully covered by any standard, thus, an experimental approach, and a Computational Fluid Dynamic (CFD) investigation will be analysed to fill this gap. 4) Environmental and economic issues The assessment of the real advantages of the innovative materials and components has to include an analysis of their energy and

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environmental life-cycle performances (eco-profiles), as well as their life-cycle costs. Life Cycle Assessment (LCA) methodologies will be applied to this purpose, starting from the outcomes of the previous research phases and thanks to Environmental Product Declarations (EPD) and market data. 5) Dissemination The Dissemination will ensure the proper communication of results and a better market penetration of the proposed advanced solutions, through scientific papers and other channels (workshops and social media). The project will be developed according to the block diagram reported in fig.1 and the Gantt chart reported in fig.2. The project consists of 6 Work Packages (WPs), divided in Tasks, including one WP on Project management and coordination and one WP on Dissemination.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI ROMA TRE** - Coordinatore

Parole chiave

Settori ERC

PE8_6 - Energy processes engineering PE8_11 - Sustainable design (for recycling, for environment, eco-design) PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 281.898,00
Contributo totale progetto:	€ 197.269,00
Costo totale PoliTo:	€ 134.128,00
Contributo PoliTo:	€ 95.789,00

EACTIVE - SteeRing GroundwatEr Electro-bioremediAtion with ConducTIVe ParticlEs

Durata:

12/10/2023 - 11/10/2025

Responsabile scientifico:

- Rajandrea Sethi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022X399CM

Ruolo PoliTo:

Partner

Abstract

Anthropogenic pollution of groundwater by organic and inorganic contaminants (e.g., petroleum hydrocarbons, pharmaceuticals, nitrate, etc..) is an issue of ever-increasing relevance, particularly in consideration of the fact that more than half of the global freshwater supply for drinking, industrial uses, and irrigation comes from groundwater. Due to their unprecedented flexibility and environmental sustainability, microbial electrochemical technologies (MET) are increasingly being considered for the treatment of groundwater contaminated by a variety of organic and inorganic pollutants. Despite the promising results obtained at the lab-scale, several hurdles still limit the transition of MET-based bioremediation from the laboratory to the field. The most striking one being probably the lack of technically and economically viable system configurations. To address this critical limitation, REACTIVE aims to test, develop and validate a game-changing approach based on the novel concept of “diffuse electrically conductive zones”. These are created through the injection in the aquifer of environmentally safe (iron- or carbon-based) conductive (nano)particles, which upon transport and subsequent deposition over soil particles create an electrically conductive zone which could be exploited to control and fine-tune the delivery of electron donors or acceptors over a large distance, and accordingly drive the electro-bioremediation process in a more efficient manner. REACTIVE will tackle different types of groundwater contaminants, namely aromatic hydrocarbons and a model pharmaceutical compound, as well as nitrate and a model brominated flame retardant. REACTIVE activities and processes will be first tested and optimized at the lab-scale under highly controlled conditions and then validated at a pilot-scale under highly representative environmental conditions (e.g., using real soil and groundwater from a contaminated site). Developed technologies will then be benchmarked against conventional (bio)remediation processes by taking into account a number of key performance indicators, including the rate and efficiency of contaminant(s)

degradation, formation of side products, energy consumption, chemicals requirements and ecotoxicological effects. Overall, REACTIVE will not only generate new fundamental and applied knowledge with respect to the possibility to enhance and manipulate in situ biodegradation processes based on extracellular-electron transfer using electrically conductive (nano)particles but has the ambition to bring technologies which have had so far only academic interest into the field application and make them available for end-users.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Partner

- **Consiglio Nazionale delle Ricerche** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **Università degli Studi di BOLOGNA**

Parole chiave

Settori ERC

LS9_7 - Environmental biotechnology (including bioremediation, biodegradation) PE8_11 - Sustainable design (for recycling, for environment, eco-design)

Budget

Costo totale progetto:	€ 266.752,00
Contributo totale progetto:	€ 206.941,00
Costo totale PoliTo:	€ 92.064,00
Contributo PoliTo:	€ 68.569,00

GREENER - Reduction environmental impact of metal forming processes by understanding and developing electro-assisted plasticity

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luca Settineri

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università de della Ricerca)

Codice identificativo progetto:

2022WF78T3

Ruolo PoliTo:

Partner

Abstract

Manufacturing is a cornerstone of the economy of all the developed countries, it also impels and stimulates all the other sectors of economy, also provides a wide variety of jobs, both blue- and white- collar jobs, which bring higher standards of living to many sectors in society and builds a strong middle class. On the other hand manufacturing has a deep impact on the environment we live in, in the last years all the data on energy consumption, global temperatures, CO2 levels in the atmosphere, other impacts of industrialization, and population growth head up, meaning things are moving toward more challenging, and less sustainable, conditions. The demand for goods is continuously increasing in developed countries and the people of developing countries are pushing to reach the same life standards of people in developed countries: this means that the production of goods will increase more and more in the next years. This means that a big effort must be spent to make more sustainable manufacturing processes; the aim of this project, lying in this context, is to develop new knowledge to be used to design new manufacturing routes to reduce the environmental impact of metal forming operations. It has been calculated that the 80% of metal parts undergo, during their manufacturing path, to an high temperature forming stage. In the last years a lot of effort has been put to reduce the impact of these processes by optimizing process parameters, tooling, and routes. Despite this the basic principle exploited is still the same: heating up the components to be formed to soften the material then apply a load until the desired deformation is achieved. The idea of this project is to improve the formability of metals, and reduce the forces and temperatures to be applied, by applying an electric current in the workpiece during the forming. Some authors noticed an effect of electricity on the plastic deformation behavior and defined the electro-plasticity as the softening of the material, due to the

electric current, beyond the effect of the Joule heating. This phenomenon is far to be understood, and even its occurrence is under debate. The aim of this project is to investigate the effect of electric current on the forming of aluminum, steels and titanium and to try to use the acquired knowledge to develop more sustainable forming routes where lower temperatures and lower forces must be applied, leading to a reduction of the environmental impact of these processes. The objectives of the project, if reached, will both fill an open question in the understanding of plastic behavior and metals and will enable the development of more sustainable manufacturing processes to produce metal parts. The project will also include a detailed sustainability assessment to investigate the environmental impact of manufacturing processes based on the developed knowledge.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI GENOVA**
- **UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II** - Coordinatore

Parole chiave

Settori ERC

PE8_10 - Industrial design (product design, ergonomics, man-machine interfaces, etc.) PE8_7 - Mechanical and manufacturing engineering (shaping, mounting, joining, separation) PE8_9 - Production technology, process engineering

Budget

Costo totale progetto:	€ 295.918,00
Contributo totale progetto:	€ 197.326,00
Costo totale PoliTo:	€ 91.738,00
Contributo PoliTo:	€ 61.172,00

GEOCHARME - GEOphysical CHARacterization and Monitoring of Earthen dams and levees

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Laura Socco

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

20225NSHXT

Ruolo PoliTo:

Coordinatore

Abstract

The characterization and monitoring of levees and earthen dams require cost-effective and reliable methods able to identify the state of life of the embankment and foundation soil. The project is aimed at developing: • integrated geophysical methods, with special focus on surface/guided wave and resistivity data, for the characterization of levees; • novel processing tools for monitoring the levee conditions based on ambient noise measurements; • novel monitoring strategies based on the identification of failure precursors through seismic noise and electrical self-potentials generated by piping. The project is carried out by two research units that comprehend all the required competences and relies on the facilities and the technical staff of four labs (Polito-DIATI Applied Geophysics Lab, Polito Photonext Center, Polito-DIATI CC-Moving Lab, Unito- Earth Science Dept Geophysical and Geological-Technical Characterization Lab). The equipment, including proprietary developed prototypes, the computational facilities and the existing proprietary routines provide a solid basis for the project development. The project will generate open source codes for seismic data processing and inversion and seismic and resistivity data joint inversion customized for levee characterization. Moreover, specific correlations between geophysical data and relevant geotechnical parameters (e.g. hydraulic conductivity) will be developed and calibrated for levee characterization. Numerical modeling will be used to test the methods. Field data will be acquired along the Po river levees as validation of the implemented methods and tools. Numerical and field data, as scientific publications and codes will be made openly available to the research community. Dissemination of the results will be carefully planned also using social media to ensure adequate visibility to the project. Endorsement from scientific international partners, national and international companies and stake holders is witnessed by letters of interest. 11.

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 6. Garantire a tutti la disponibilità e la gestione sostenibile dell'acqua e delle strutture igienico-sanitarie

Budget

Costo totale progetto:	€ 277.577,00
Contributo totale progetto:	€ 196.821,00
Costo totale PoliTo:	€ 176.260,00
Contributo PoliTo:	€ 125.141,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

INFORTREAT. Reconstructing the Early Modern bastioned front. INformation models for the fruition of constructive knowledge in FORtified architecture TREATises (16th-18th Century): a new integrated analysis tool for the interpretation, restoration and maintenance of Early Modern fortified heritage.

Durata:

17/10/2023 - 16/10/2025

Responsabile scientifico:

- Roberta Spallone

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022JCYBXM

Ruolo PoliTo:

Partner

Abstract

INFORTREAT is aimed at the production of digital information systems to collect, transfer and translate the knowledge about construction of bastioned fortifications in Early Modern treatises on military architecture, in order to create an original knowledge tool in the field of conservation of the fortified heritage, as the latter is today exposed to ever-increasing environmental risks. For this purpose, a selection of relevant Italian and international fortification treatises from the 16th to the 18th century is at first deeply analyzed: textual and visual information is extracted from the treatises, and then made accessible and comparable through the use of 3D representations and Heritage-Building Information Modeling (H-BIM) environments. Building Information Models of the bastioned fronts are generated, assembling and visualizing the knowledge shared among Early Modern construction professionals, both in terms of materials, geometric characteristics, and of construction techniques. The apparatus of data, rules and references is therefore made accessible to a current public of scholars, heritage professionals and administrators through a new digital environment, with a both graphical and lexical readability key. A BIM library of parametric objects is then developed, translating into a graphic and digital language the components of historical fortifications, according to the historical sources. The transfer of rules and techniques enables the generation of specific digital models such as bastions, curtains, and outworks of fortified works. These elements can be virtually accessed and compared, but also extracted, modified, modeled and re-adapted,

leveraging the use of Visual Programming Languages within an open source environment. The information models are then compared to a sample of case studies of existing fortifications, in order to evaluate the interactions of theoretical and conceptual models with the real consistencies, and to suggest a new modus operandi for the approach and the analysis of bastioned constructions. As such, reality based models of present-day artifacts are later compared with ideal constructions, so as to evaluate the presence of recurring construction schemes and structures. The results of the study and BIM models are finally brought together in a web-based digital platform, fully accessible for research and conservation purposes (restoration, maintenance etc.), as well as for higher education and other activities in the field of Cultural Heritage

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **Università degli Studi di Pisa** - Coordinatore
- **UNIVERSITA' DI ROMA "LA SAPIENZA"**

Parole chiave

Settori ERC

SH5_13 - Computational Modelling and Digitisation in the Cultural Sphere SH5_8 - Cultural studies, cultural identities and memories, cultural heritage SH5_6 - History of art and architecture, arts-based research

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 306.179,00
Contributo totale progetto:	€ 198.630,00
Costo totale PoliTo:	€ 83.503,00
Contributo PoliTo:	€ 51.891,00

RECAP - Reducing car dependency through tailored policies to improve accessibility by proximity in highly car dependent territories

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Luca Staricco

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Ruolo PoliTo:

Partner

Budget

Costo totale PoliTo:	€ 92.905,00€
Contributo PoliTo:	€ 58.848,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

PASSO - 3D Printed Active Sensing inSOle

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Stefano Stassi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20222TKNRJ

Ruolo PoliTo:

Coordinatore

Abstract

Wearable devices are considered the next-generation tools due to the important role that they can hold in monitoring different physiological conditions coupled with their intriguing characteristics such as flexibility and stretchability. A wide variety of these of devices have been proposed and, among them, one important example in the medical field is represented by sensing insoles able to monitor the physiological conditions that can lead to the formation of foot ulcers in diabetic patients. It has been proven that controlling foot condition in diabetic patients, in terms of applied pressure and local temperature, helps to prevent the formation or worsening of ulcer which can even cause the limb amputation. Nevertheless, the simple monitoring cannot solve the problem, the correction of the foot posture with the relieve of the pressure is needed. Despite this awareness, a device able to monitor and actively correct the patient foot pressure is still lacking. For this reason, a complete system which can guarantee a fully conformable sensing and correction of non physiological foot weight distribution will represent a breakthrough in the care of diabetic patients. In this frame, the objective of PASSO is the development of a smart active insole able, through a sensing layer, to detect the physical parameters in terms of local pressure and temperature, which underline a non physiological weight distribution and then to directly correct the posture by an active layer composed of multiple air cavities which can be inflated or deflated, changing the local conformation and thus the local pressure. The key advantage of our proposal is that the device will be developed exploiting the great flexibility of design given by 3D printing (3DP) techniques, allowing the patient-tailored production of the conformable insole. Indeed, 3DP is known to provide a facile customization of the products and can be envisaged paired with imaging techniques enabling a reverse engineering process: models specifically designed on the patient's body can be reproduced on-demand by 3DP, allowing the production of unique devices with increased sensitivity. In detail, vat 3DP will be used, representing a valuable instrument in the development of tailor-made objects for

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

its high precision and great flexibility in the design of functional materials. Gathering the possibility to create unique and customized designs and the ability to develop functional materials able to offer sensitivity and flexibility, 3DP results the enabling technology for the development of highly performing smart and active insoles. At last, aiming to overcome the power supply problem, 3D printed triboelectric nanogenerators to harvest mechanical energy during walking and convert it in electrical energy will also be studied and integrated in the system. PASSO is an ambitious project that, exploiting cutting-edge technologies as 3D printing and sensor fabrication and integration, will offer forefront results that will have a strong impact from the academic and medical level to the commercial one.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI CAGLIARI**

Parole chiave

Settori ERC

PE8_9 - Production technology, process engineering

Budget

Costo totale progetto:	€ 197.500,00
Contributo totale progetto:	€ 197.500,00
Costo totale PoliTo:	€ 100.000,00
Contributo PoliTo:	€ 100.000,00

REASE: REsilient computing Architecture in the Space quantum communication Era

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Luca Sterpone

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022YEEB9Y

Ruolo PoliTo:

Coordinatore

Abstract

The REASE project aims at developing innovative clustering technology able to significantly improve the performances and robustness of reconfigurable computation in space and in Quantum Key Distribution (QKD) systems. Quantum Key Distribution (QKD) is a leading technology of Quantum Communication (QC) since it allows to realize a secrecy protocol, safe and resilient to any external attack. Recently, QKD transmitters have been successfully tested on CubeSat, enabling QCs for satellite. However, given the requested computation level, the hardware architecture capable to sustain a continuous data generation and transfer requires a multi-core system based on Field Programmable Gate Arrays (FPGAs) capable to implement a provably secure and reconfigurable QKD and fully exploit its potential. The final goal of the project is to develop and build an innovative architectural prototype, suitable for space satellite, integrating resilient reconfiguration capabilities, and validated with radiation beam campaigns.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **ISTITUTO NAZIONALE DI FISICA NUCLEARE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PADOVA**

Parole chiave

Settori ERC

PE6_2 - Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-

physical systems PE6_5 - Cryptology, security, privacy, quantum crypto PE8_1 - Aerospace engineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un'occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 369.712,00
Contributo totale progetto:	€ 248.032,00
Costo totale PoliTo:	€ 133.976,00
Contributo PoliTo:	€ 91.908,00

Nanomaterials for Fusion: experimental and modeling of nanostructured materials and plasma-material interactions for inertial & magnetic confinement fusion

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Fabio Subba

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022N5JBHT

Ruolo PoliTo:

Partner

Abstract

Thanks to its many appealing features (e.g. unlimited fuel, very high power density, no greenhouse emission, limited production of radioactive waste) nuclear fusion power has the potential to solve the energy problem for mankind. The quest toward fusion energy has started more than 60 years ago, following two main approaches for the confinement of thermonuclear plasma: inertial confinement fusion (ICF) and magnetic confinement fusion (MCF). Despite recent groundbreaking progresses in both ICF and MCF, significant challenges are still to be faced before the achievement of practical fusion power. One of the most critical aspects toward this goal is related to the development of advanced materials and the study of their interaction with fusion-relevant plasmas. In this framework, the specific interest for micro- and nanostructured materials (MNSM) has grown in recent years for both ICF and MCF researches. MNSMs can enhance the absorption of laser energy in ICF capsules and smooth inhomogeneities, serve as smart coatings for plasma-facing components in MCF devices or mimic the great variety of re/co-deposited materials that are observed in present-day tokamaks and are expected in ITER and DEMO. Given the intrinsic non-linearity and complexity of this topic, a multi-disciplinary approach is highly desirable. All the proponent Research Units (RUs) have provided substantial theoretical and experimental contributions in the fields of material science and technology and plasma-material interaction in configurations relevant for both ICF and MCF. This project aims at providing a multi-disciplinary research platform for the experimental and theoretical investigation of MNSM for fusion applications and their interaction with fusion-relevant plasmas, along the lines pioneered by the applicant RUs and exploiting the synergy offered by their complementary areas of

expertise.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI MILANO** - Coordinatore
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**

Parole chiave

Settori ERC

PE2_8 - Ultra-cold atoms and molecules PE3_9 - Condensed matter – beam interactions (photons, electrons, etc.)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 250.077,00
Contributo totale progetto:	€ 199.879,00
Costo totale PoliTo:	€ 71.470,00
Contributo PoliTo:	€ 63.351,00

Multi-phase fault tolerant MW range generation systems for hybrid-electric aircrafts

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alberto Tenconi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

Prot. 2022H9LJKC

Ruolo PoliTo:

Coordinatore

Abstract

Transportation Electrification is EU goal and in aviation the propulsion technologies evolve towards hybrid-electric systems to cope with lower emissions and improved reliability and maintenance costs. Hybrid-electric architectures are based on a gas-turbine driven electric generator that provides power supply to electric drives coupled with the aircraft propellers and this allows distributed propulsion to maximize the thrust efficiency and minimize the aerodynamic resistance. In hybrid-electric aircrafts the electrical design must deal with fault tolerant requirements and high currents due to the relatively low value of the on-board voltage. Multi-phase generating systems represent a unitary solution for the needs of safety-critical and high current applications. The intrinsic redundancy makes multi-phase arrangements compliant with the reliability standards and operational needs; spreading the overall power among multiple phases allows using faster semiconductor devices to achieve improved power quality and efficiency. Modules based on independent single-phase or three-phase units feature higher fault tolerance as, in case of fault, the disconnection of a converter module allows maintaining operation at reduced performance. However, if a fault occurs in the machine, the possibility to keep safe operation is still an open challenge. Further, the control algorithm must detect converter or machine faults and adopt a strategy to minimize reduction of the drive performance. The project aims to develop scientific knowledge and viable solutions for fault tolerant generating systems in hybrid-electric aircrafts. Focus will be on multi-phase generator system with working capability in presence of one or more faults. This objective will be pursued by means of design methods and simulation models devoted to the following: Università de L'Aquila will be in charge for designing a multi-phase generator with IPM rotor whereas Politecnico di Torino will investigate a lower TRL generator arrangement based on superconductive windings excitation to avoid permanent magnets and improve the power density; Università

Roma Tre will be in charge for setting up a multi-level AC-DC converter with high tolerance of faults in power semiconductors and Università di Bologna will develop a control algorithm for detection and management of fault conditions within the generating system. The Units will share a common approach in terms of multi-phase architecture, fault-detection and fault-management methods. The project includes experimental activities devoted to validation of the design and simulation methods. The Units include electric, electronic, mechanical and aerospace engineers, and experimental physicist to deal with all the project aspects. National/international companies expressed their interest on the impact of the expected results.

Persone coinvolte

- **Alberto Tenconi** (Responsabile Scientifico)
- **Andrea De Martin** (Responsabile Scientifico di Struttura)

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale
- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **Università degli Studi dell'Aquila**
- **UNIVERSITA' DEGLI STUDI DI BOLOGNA**
- **UNIVERSITA' DEGLI STUDI ROMA TRE**

Parole chiave

Settori ERC

PE7_2 - Electrical engineering: power components and/or systems PE7_12 - Electrical energy production, distribution, application

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 302.560,00
Contributo totale progetto:	€ 199.360,00
Costo totale PoliTo:	€ 69.280,00
Contributo PoliTo:	€ 51.680,00

BIOTICS - Prebiotics and probiotics from agro-food wastes to enhance soil and crop health.

Durata:

12/10/2023 - 11/10/2025

Responsabile scientifico:

- Tonia Tommasi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

. 2022K84JA5

Ruolo PoliTo:

Partner

Abstract

Several million tons of bio-wastes are produced every year globally, contributing to soil and water pollution, greenhouse gases emissions and loss of important nutrients, like N and P, in the environment. On the other side, soils are facing a strong reduction in terms of organic matter content, and agricultural and food systems mainly rely on external inputs, such as mineral fertilizers and chemical pesticides. The proposal BIOTICS aims to upcycle agro-industrial waste of fruit and vegetable products, including crop residues (AIWFV), into high value added bio-based products (pre and probiotics) for improving soil and crop health in sustainable farming. WP1 is dedicated to the treatment of biowaste for extraction of bio-active compounds and for isolation of microbial strains suitable for stimulating plants development and protecting them from diseases. In WP2 anaerobic digestion and pyrolysis are sequentially performed on the extraction residue of AIWFV to produce bio-fertilisers and energy to support the whole or part of the proposed biorefinery system. After the anaerobic digestion, the digestate will be dewatered and the liquid fraction will be used for agriculture, whereas the solid fraction, made up of the un-exploited carbonaceous-organic matter will be processed to produce biochar. The produced biochar will be applied as adsorbent material in WP1 and for the formulation of biobased products in WP3, and in part added to anaerobic digestion to enhance the process both in terms of digestate quality and methane content in the biogas production. Furthermore, the bio-oil of pyrolysis will be employed for the formulation of bio-fungicides in WP3 and tested in WP4. WP3. A study on the best mix ratio between digestates, biochar (from WP2) and bio-active compounds (from WP1) will be carried out in WP3 to develop well-balanced fertilizers and pesticides. WP4. Preliminary trials will be followed by extensive tests in greenhouse and soil, simulating the cultivation of different vegetable crops in microcosm, in greenhouse and soil. Assessment of qualitative and quantitative effects of biobased products on

crop development and yield will be carried out, with particular reference to their use as biofertilizers, biostimulants and biopesticides, comparing them with conventional products. WP5. Environmental and economic assessments will be carried out during all the laboratory and pilot tests, with the aim to detect, test by test, the environmental and economic bottlenecks of the test and provide a solution. Environmental and economic assessments will be performed with LCA and LCC-based methodologies. Both LCA and LCC will be employed as tools to achieve the sustainability of the proposed technology combinations (extraction, anaerobic digestion, pyrolysis and agricultural applications) from the pillars of their realisation.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI TORINO** - Coordinatore

Parole chiave

Settori ERC

LS9_4 - Plant sciences (including crop production, plant breeding, agroecology, soil biology)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*|Obiettivo 15. Proteggere, ripristinare e favorire un uso sostenibile dell'ecosistema terrestre

Budget

Costo totale progetto:	€ 228.055,00
Contributo totale progetto:	€ 206.263,00
Costo totale PoliTo:	€ 118.095,00
Contributo PoliTo:	€ 105.690,00

3D-BIOSAME - A 3D BIOprinted SpinAl cord Model to reach functional meaningful and clinically translatable rEgeneration (3D-BIOSAME)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Chiara Tonda Turo

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022YY9AR2

Ruolo PoliTo:

Coordinatore

Abstract

3D-BIOSAME project will develop physiological in vitro platforms expected to improve our current capabilities to boost the biological machinery that triggers regeneration in the injured spinal cord (SC) of mammals, in a therapeutic perspective. Studies in vivo provide important step-forwards, as an important approach for translational research, although showing several limitations. The in vitro platforms represent an alternative strategy. Not only do they reduce ethical and cost concerns, they also have the potential for patient-specific customization. Thus, in vitro platforms offer the unique potential to combine the features of the experimental system-model with the biological properties of tissues and organs, achieving the final goal of recapitulating the complex human physiology in vitro. At present, a full exploitation of this technology in neural regeneration is far from being achieved, and methods to produce a physiologically-relevant SC model are missing. The complexity of the mammalian SC structure and its heterogeneous composition hamper research efforts towards the development of in vitro SC recapitulating the key features of the in vivo mammalian context. 3D-BIOSAME aims to realize for the first time a 3D bioprinted SC model combining sensory, cortical and motor neurons with the glia counterpart in an in vivo-like framework. Three-D bioprinting is a cell-friendly method to fabricate cellularized scaffolds with defined geometry and multiple cell phenotypes. The use of ad hoc designed bioinks steers the cell towards high viability maximizing cell-cell, cell-extracellular environment interactions resulting in a more closely-matching of the in vivo scenario. We will utilize murine cells to establish the design and processing protocols of the model, whose reliability will be tested by comparing its response to injury with that of murine models. At present, generation of in vivo models of spinal cord injury (SCI) is a highly invasive, time-consuming

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process requiring a large number of animals to obtain relevant data of statistical significance. Experiments in vitro can strongly reduce these drawbacks. In this regard, we will propose in vitro SCI models by applying 2 different types of damage to central axons (classical mechanical injury and innovative toxin-based approach) and then monitor the ensuing axonal degeneration and glial activation. Next, known pro-regenerative agents, as well as a novel compound recently identified by UNIPD, will be used to boost regeneration. Indeed, we believe that the 3D model holds the potential to become a screening platform for the validation of novel pro-regenerative molecules, in a therapeutic perspective. 3D-BIOSAME will benefit from the scientific interaction among researchers having a multidisciplinary background with key expertise in biomedical engineering (POLITO), in vitro and in vivo mice models (UNITO), mammalian nerve regeneration (UNIPD), and materials characterization (CNR).

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale
- BIOMed - PolitoBIOMed Lab - Biomedical Engineering Lab

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

PE8_13 - Industrial bioengineering

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 3. Assicurare la salute e il benessere per tutti e per tutte le età

Budget

Costo totale progetto:	€ 265.512,00
Contributo totale progetto:	€ 197.231,00
Costo totale PoliTo:	€ 87.840,00
Contributo PoliTo:	€ 65.440,00

EndGame - Improving End-to-end testing of Web and Mobile Apps through Gamification

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marco Torchiano

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022PCCMLF

Ruolo PoliTo:

Coordinatore

Abstract

The ubiquitous diffusion of web and mobile technologies pushes modern society toward the Digital Transformation, which is a key priority in the Horizon EU Framework, the Italian Research Program (PNR), and the national recovery and resilience plan (PNRR). Our everyday experience, as well as news in the media show many cases where the presumably good intentions are not met by the actual behavior of web and mobile (W&M) applications, which on the contrary are riddled with evident malfunctions. Software is not just a commodity, but it is the foundation on which our current world is built. It is therefore crucial to ensure software is of good quality and future-proof to support our society and its citizens. Many complementary approaches exist to improve the quality of software. Software testing is the most used in practice and it is proven to catch faults and guarantees a good level of reliability and resilience. EndGame focuses on End-to-End (E2E) testing of the W&M apps; E2E testing refers to validation of a complex system in its context. It is based on the concept of a scenario from the end-users perspective, which describes the sequence of steps for accomplishing a valuable procedure. E2E test practice is still often manual and thus it is considered tedious, error-prone, and yielding poor cost/effectiveness. EndGame aims to support the generation of relevant E2E test scenarios leveraging a powerful approach: gamification, i.e. the application of game-like mechanics to activities of different nature. It usually involves elements such as leaderboards, achievements, missions, and competitions between players. A gamified approach for E2E testing will enable testers to challenge each other in the hunt for hidden faults and vulnerabilities. Effective test scenarios will produce higher scores and, eventually, awards for the tester. EndGame approach will develop an advanced platform supporting the introduction of several gamification mechanics and empirically evaluate their effectiveness and efficiency. To validate W&M apps in their operational context, EndGame aims to support the execution of E2E test

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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA

scenarios both in test and production environments, and concurrently by multiple users. This capability, along with strategies for recognizing unknown context states, can identify new tests covering unexplored scenarios and eventually improving software quality. EndGame will also address the quality of the test harness, in particular the test suites, by providing novel gamified approaches to reveal and remove issues - e.g., fragility, dependencies and flakiness - commonly found in test code so as to ensure the resilience of the tests themselves. Effectiveness of the solutions and practical relevance will be assessed in two real-world case studies. The improvements delivered by EndGame have the potential to foster the adoption of automated E2E tests in practice and thus significantly improve the overall quality of software systems.

Strutture coinvolte

- DAUIN - Dipartimento di Automatica e Informatica

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI GENOVA**

Parole chiave

Settori ERC

PE6_3 - Software engineering, operating systems, computer languages

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 9. Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile

Budget

Costo totale progetto:	€ 332.021,00
Contributo totale progetto:	€ 249.214,00
Costo totale PoliTo:	€ 146.368,00
Contributo PoliTo:	€ 110.847,00

NOW - Understanding Natural History: Nature, Evolution and Human Beings. A New Philosophical Framework

Durata:

17/10/2023 - 16/10/2025

Responsabile scientifico:

- Vera Tripodi

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022H3X748

Ruolo PoliTo:

Partner

Abstract

What is natural history? Recent years have seen a powerful new wave of studies labelled “natural histories”: from The Natural History of Morality or The Natural History of Economics to the very controversial Natural History of Rape and Natural History of Earth and its Future. These studies attempt to discuss numerous human traits and phenomena. But what does it mean to call something a natural history? What is the conceptual anatomy of such study? What are the general philosophical stakes of a paradigm that unifies “history” and “nature”—two apparently opposed notions—within the same conceptual domain? This project puts the concept of “natural history” under a critical lens to closely assess its structure, import, and theoretical consistency. Despite the variety of their explananda, all recent natural histories share an explanatory framework premised in evolution and rely on an array of cross-disciplinary knowledge (paleontology, climate developments, comparative psychology, etc.) to construct broad evolutionary scenarios for the emergence of certain phenomena. This has made them very attractive: their naturalistic take on a variety of complex issues has made them influential in domains extending beyond biology to philosophical debates in ethics, social ontology, and ecology. However, despite the unprecedented surge of interest in mobilizing “natural history” to address problems related to the constitution of the human, no detailed, comprehensive investigation of the anatomy of this narratives has been conducted. Yet natural histories are fraught not only with potentiality but also with conceptual issues that call for serious philosophical clarification. This applies to both (i) the specific conceptual, epistemic, and methodological issues involved in these accounts, and (ii) their broader impact on our notions of “nature” and “sociality”. For instance, (i) how do such studies conceptually define their objects? To what extent can one provide a

satisfactory naturalistic definition of an explanandum that is often normatively constituted? How do the disciplines upon which these accounts rely gain insight into our evolutionary past? (Reference to comparative psychology, for instance, has been accused of “chimpocentrism"). Moreover, what kind of explanatory import should we expect from these narratives? Such problems need to be explored if we are to better understand the potential and limits of natural-historical accounts. Further questions emerge related to (ii) what kinds of conceptions of “nature”, “naturalness,” and “historicity” these histories convey: how do they conceive normative phenomena? What are the broad consequences of adopting a historical perspective on nature or a natural perspective on history? Motivated by such questions, our project will critically investigate the notion of “natural history” to develop a comprehensive conceptual framework for (i) and (ii) and test its theoretical reach by applying it to a specific case study.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DEGLI STUDI DI PADOVA** - Coordinatore
- **UNIVERSITA' IUAV DI VENEZIA**

Parole chiave

Settori ERC

SH4_13 - Philosophy of science, epistemology, logic SH5_11 - Ethics; social and political philosophy SH5_9 - Social anthropology, religious studies, symbolic representation

Budget

Costo totale progetto:	€ 229.566,00
Contributo totale progetto:	€ 200.725,00
Costo totale PoliTo:	€ 53.151,00
Contributo PoliTo:	€ 53.151,00

SPHERE - Seasonal Prediction of water-availability: enHancing watER sEcurity from high mountains to plains

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Marta Tuninetti

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO UNIVERSITA' E RICERCA)

Codice identificativo progetto:

0224XSR7F

Ruolo PoliTo:

Partner

Abstract

The Mediterranean region is warming faster than the global average, heat waves are projected to intensify and summer rainfall will likely be reduced with increasing water shortages. Also relatively water-rich mountain regions such as the Alps registered an increased frequency of droughts and this tendency is expected to further strengthen in the future, triggering conflicts among different sectors of water use including agriculture, energy production, tourism, industry, household, and biodiversity conservation. The SPHERE project addresses the challenge of enhancing water security in Alpine catchments and surrounding plains, as in the framework of UN SDG Target 6.4 (Water use and scarcity), Horizon Europe and Italian PNRR M2C4. Among adaptation strategies to reduce water-related risks, seasonal predictions have been considered with growing interest for their potential to provide early warning of extreme seasons, so that decision makers can take necessary actions to minimize adverse impacts. However, hydrological seasonal predictions are still in their infancy. Recent studies show skill in seasonal prediction of mountain snow water equivalent but it is unclear if this is reflected in skillful prediction of streamflow and water availability locally and downstream. The first objective of this project is to employ the most advanced dynamical seasonal forecasting systems, hydrological models, downscaling and analysis tools to develop a semi-operational forecast chain that delivers high-resolution spatially distributed seasonal forecasts of hydrological indicators, i.e. snow water equivalent, meltwater runoff and streamflow, to estimate the amount of water that will be available for the ecosystems and socio-economic activities in the season ahead, providing early information if extreme dry/wet conditions are expected in the forthcoming 6 months. The second main objective of the project is to employ seasonal forecasts of meteorological variables and a coupled

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soil water balance - crop growth model to predict irrigation requirements in agricultural areas in the downstream plains and possible issues of water supply with few months lead time.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Parole chiave

Settori ERC

PE10_17 - Hydrology, water and soil pollution PE10_18 - Cryosphere, dynamics of snow and ice cover, sea ice, permafrosts and ice sheets PE10_3 - Climatology and climate change

Budget

Costo totale progetto:	€ 217.280,00
Contributo totale progetto:	€ 199.946,00
Costo totale PoliTo:	€ 64.233,00
Contributo PoliTo:	€ 64.233,00

EGEI - The European green energy industry: equity financing instruments and policies in the climate action agenda

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Elisa Ughetto

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022BMZKNH

Ruolo PoliTo:

Coordinatore

Abstract

The threats of environmental issues linked to the global climate change have been recognized to be one of the most serious problems challenging the world (Bailey and Tatikonda, 2018; Lee et al., 2015; Lerner, 2010; Zhang et al., 2019). Energy-intensive industries are listed as one of the main industries that should be strongly committed to sustainability transition. The transition to climate neutrality and alignment with EU Green Deal-inspired policies offers an opportunity for green energy firms to engage in transformative climate and innovation actions that meet the urgency of the climate crisis in this decade. The extant academic literature has so far mainly investigated the role of established firms as valuable actors in the broader cleantech field, without focusing on green energy early-stage ventures and Small and Medium Enterprises (SMEs). Such firms are deemed to play a significant role in pursuing innovation in this field (Cohen and Winn, 2007; Dean and McMullen, 2007; Garud and Karnøe, 2003; Hart and Milstein, 1999; McDaniels and Robins, 2017; Owen et al., 2018; Wu¨stenhagen et al., 2008), but they often face financial constraints to develop and scale their business (Ghosh and Nanda, 2010; Giudici et al., 2018; Hornuf and Schwienbacher, 2018; Josefy et al., 2017) because of high levels of uncertainty characterizing their inventions and their capital-intensive nature. The project will involve four broad research activities: 1) “The mapping of green energy in Europe”: is aimed at building a complete dataset of green energy companies with associated financial accounting information, patent data, and sources of financing. We will map the geographical distribution, the evolution over time, the current size, the patenting activities, and the sources of financing of the green energy sector. 2) “The Collection of EU-level and country-level targeted policies and regulations” that are central to the European Green Deal (and that can be declined at both European and national level).

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3) “The enabling factors for the development of green energy firms”: is aimed at exploring the effects of the implementation of specific and targeted policies and regulations (at both EU-level and country-level) that are central to the European Green Deal and the effects of different sources of financing on the financial and innovative performance of green energy firms. 4) We will explore the extent to which the implementation of policies and regulations affect the offer of equity by VCs in the green energy sub-field. The results stemming from such research activities will lead to the definition of a set of policy recommendations.

Strutture coinvolte

- DIGEP - Dipartimento di Ingegneria Gestionale e della Produzione

Partner

- **ALMA MATER STUDIORUM UNIVERSITA' DI BOLOGNA**
- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore

Parole chiave

Settori ERC

SH1_4 - Financial economics; banking; corporate finance; international finance; accounting; auditing; insurance SH1_9 - Industrial organisation; strategy; entrepreneurship SH1_12 - Agricultural economics; energy economics; environmental economics

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l’accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 342.885,00
Contributo totale progetto:	€ 220.000,00
Costo totale PoliTo:	€ 136.435,00
Contributo PoliTo:	€ 88.000,00

LICAM - AI-powered LiDAR fusion for next-generation smartphone cameras

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Diego Valsesia

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della ricerca)

Codice identificativo progetto:

2022N25TSZ

Ruolo PoliTo:

Coordinatore

Abstract

Smartphone photography is nowadays the dominant means of shooting pictures in our everyday life. Due to the multiple limitations affecting smartphone cameras, computational approaches to image generation, processing and coding that overcome them are enjoying great success and are an active field of research. Today, we are on the verge of a new paradigm in mobile photography, with the integration of active sensing instruments, namely LiDAR, onboard smartphones. LiDAR allows capturing 3D information of a scene for 3D reconstruction and understanding tasks. However, in this project our aim is to study how LiDAR can assist the traditional RGB camera in improving its operations. While fusion of LiDAR and RGB has been around for a long time, it has always been addressed from the opposite point of view, i.e., using RGB images to improve LiDAR data. This has been historically motivated by the fact that depth sensing occurred on dedicated devices rather than on devices that are used to snap everydays pictures. In particular, the LICAM project will focus on developing novel AI-powered methods that use LiDAR depth maps acquired by smartphones to enhance restoration and coding of images acquired by the same smartphone, thus constructing a “virtual camera” that can benefit from the strengths of both sensors. The first key objective of the project is enhancing the performance of smartphone RGB cameras under low-light conditions, a notoriously challenging scenario, by using the LiDAR depth map as a guidance to denoise and remove motion blur from the low-light photo. Since LiDAR is an active sensing instrument, it does not suffer from low-light conditions and can provide valuable information to regularize the restoration process. The second key objective is the development of an image compression algorithm that can exploit depth information to define regions of interest and optimize their coding in a rate-distortion sense. We will further explore the novel idea of machine-driven compression, where compression of a low-light image is optimized, not for the goal of consumption of the raw image, but with the objective of

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maximizing the effectiveness of the downstream restoration process. Deep learning will be instrumental in building the sophisticated image models needed for effective information fusion. Indeed, since the problems addressed by this project are largely unexplored by current literature due to the recency of simultaneous RGB and LiDAR acquisition on smartphones, novel deep learning methodologies will need to be developed. The work performed in this project will be publicly released, including any new dataset created, in order to jump start research into this new and currently unexplored field. This will boost its scientific impact and allow for public reproducible research on the topic. It will also stimulate European advances in AI-driven computational photography, as Europe currently lags behind American and Asian corporations.

Strutture coinvolte

- DET - Dipartimento di Elettronica e Telecomunicazioni

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI BRESCIA**

Parole chiave

Settori ERC

PE7_7 - Signal processing

Budget

Costo totale progetto:	€ 229.394,00
Contributo totale progetto:	€ 199.709,00
Costo totale PoliTo:	€ 117.509,00
Contributo PoliTo:	€ 103.888,00

SYNERGY - Superconducting electric machines and crYogenic power electronics for high-efficiency, reliable and power-dense eNERGY conversion (SYNERGY)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Silvio Vaschetto

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E DELLA RICERCA)

Codice identificativo progetto:

2022H78JBT

Ruolo PoliTo:

Coordinatore

Abstract

To tackle the ever-increasing impact of harmful emissions on climate change, the 'green transition' pillar of the EU Recovery and Resilience Facility (RRF) and the 'green revolution and ecological transition' mission of the Italian Recovery and Resilience Plan (PNRR) endorse the development of key technologies for energy generation exploiting renewables, highly efficient energy conversions through the electrification of end uses, and a sustainable mobility. Besides efficiency, also the power-to-weight ratio is a key performance index to minimize the environmental footprint of energy conversion devices. The research project SYNERGY will investigate the practicability of high-performance electric machines equipped with superconductors, integrated with power electronics converters, and monitored by advanced diagnostic techniques while operated at cryogenic temperatures. Electric machines equipped with high temperature superconductors (HTS) feature high specific torque and efficiency due to low Joule losses and higher loading capacity. Power electronics components show promising advantages in cryogenic environment, such as higher power density, efficiency, and switching speed compared to room temperature conditions. Dedicated power conversion structures will be investigated to limit the use of passive components, such as inductors and electrolytic capacitors. Advanced diagnostic techniques will be developed to prevent quenching phenomena of the superconducting machine and failure of the cryogenic power converter. These technologies at cryogenic temperatures allow to push the specific power of electric drives up to values that can well exceed 10 kW/kg, as required by challenging applications such as offshore wind generators or electric aircraft propulsion systems. The project will include experimental activities on a reduced-scale test setup,

consisting of a small size induction machine with superconductors on the rotor side and supplied at the stator by a power electronics converter. The tests will be conducted submerging both the electric machine and the power converter in liquid nitrogen to keep their operating temperature at cryogenic conditions. Dissemination activities will be SYNERGY milestones to share new findings and learned lessons, as well as to favour the industrial technology transfer. The three research units involved in the project will synergically collaborate, addressing both specific research targets and joint testing activities. Politecnico di Torino will be responsible for the superconducting electric machine, Università di Parma for the cryogenic power electronics, and Università di Pavia for the control and diagnostic techniques. Companies of primary importance in the design and production of electric machines and drives for high-performance energy conversions expressed their industrial interest in this research project and the expected results.

Strutture coinvolte

- DENERG - Dipartimento Energia

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI PARMA**
- **UNIVERSITA' DEGLI STUDI DI PAVIA**

Parole chiave

Settori ERC

PE7_2 - Electrical engineering: power components and/or systems

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 285.120,00
Contributo totale progetto:	€ 199.520,00
Costo totale PoliTo:	€ 101.600,00
Contributo PoliTo:	€ 69.600,00

NGSL - NEXT GENERATION SOLAR LANDSCAPES. METHODS AND TOOLS FOR NEXT GENERATION SOLAR LANDSCAPES DESIGN: THE RENEWAL OF PHOTOVOLTAIC FIELDS AT THE END OF LIFE.

Durata:

18/10/2023 - 17/10/2025

Responsabile scientifico:

- Elena Vigliocco

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

20228PSZC8

Ruolo PoliTo:

Coordinatore

Abstract

Photovoltaic energy is an important asset for our future because it will contribute to allow us to be energy self-sufficient. This strategic asset, undergoing significant development, is mainly recognized as an energy resource and not as an opportunity to rethink the culture of the landscape. If many investigations are active in the field of the integration of photovoltaic in buildings, in agriculture (agrivoltaic) or in the use of floating systems, the studies on the decommissioning or revamping of photovoltaic fields are at the beginning and scientific literature is not sufficiently advanced. The research is innovative because it fills a lack of knowledge. About 83 millions of modules - 16 GW of production power - will reach the end of life in the period 2029-2032. Because at the moment in Italy 22 GW of production power are installed and that Sustainable Agenda 2030 asks for new 40 GW, the reuse and redesign of existent photovoltaic fields becomes urgent. In addition, the recent emergency in the procurement of raw materials (e.g. wheat and corn) has highlighted the need to rethink the Italian agricultural layout to make it more self-sufficient. The research project intends to promote new knowledge about reuse and redesign - decommissioning and revamping - of photovoltaic fields at the end of life. Reusing and redesign these photovoltaic fields can play an important role in both the construction of a new energy policy and the renovation of the landscape culture. It can be an important driver of growth jobs and economic development of sub-urban and rural areas in which solar fields are located - in particular southern Italian regions. The research intends to identify innovative interpretative methods that through the optimization of the land use can decrease the degraded and unused areas. The research investigates the opportunities offered by reuse and redesign of photovoltaic fields in

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order to develop new settlement models, which can mend impoverished and fragmented landscapes and offer the partial recovery of agricultural productions. The research increases the awareness that only a new systemic alliance between energy production needs and food production needs can active preserve and enhance the Italian landscape. The research methodology is set to be applied to different contexts since these infrastructures are widespread all over Country. Since photovoltaic fields and reuse and redesign opportunities that they offer are a phenomenon with similar characters in different Regions, the research project fosters the identification of a shared knowledge and the development of an Italian landscape strategy. Due to a creative partnership, the research will contribute in the process of definition and adoption of the best policies and practices (Good Practice Toolkit, D3) addressed to policy makers and practitioners to increase the environmental, social, cultural and economic impact of reuse and redesign of photovoltaic fields.

Strutture coinvolte

- DAD - Dipartimento di Architettura e Design

Partner

- **POLITECNICO DI MILANO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI TORINO**

Parole chiave

Settori ERC

PE8_3 - Civil engineering, architecture, maritime/hydraulic engineering, geotechnics, waste treatment

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili

Budget

Costo totale progetto:	€ 279.460,00
Contributo totale progetto:	€ 201.901,00
Costo totale PoliTo:	€ 125.985,00
Contributo PoliTo:	€ 92.584,00

Clim2FlEx - Mapping of climate to flood extremes

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Alberto Viglione

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MUR)

Codice identificativo progetto:

2022AX3882

Ruolo PoliTo:

Coordinatore

Abstract

As our climate system climbs through its current warming path, temperature and precipitation are greatly affected also in their extremes. Owing to their increasing societal impact, climate extremes have recently attracted large international programmes (IPCC, WCRP grand challenges) with an effort to standardize their detection (e.g. through climate extremes indices) and to allow attribution to climate change. There is a general concern that climate change may affect also the magnitude and frequency of river floods and, as a consequence, that existing and planned hydraulic structures and flood defences may become inadequate to provide the required protection level in the future. While a wide body of literature on the detection of flood changes is available, the identification of their underlying causes (i.e. flood change attribution) is still debated. In particular, in alpine areas, changes in heavy precipitation is only one of the drivers of flood change, being snow-rain partitioning and snowmelt other key processes in the formation of river floods of different type. The European Alps are therefore an ideal laboratory for analysing complex effects of climate on floods, also because they divide the Mediterranean and Continental Europe, with opposite projected changes in precipitation and different responses to climate oscillations. In the Clim2FlEx project we plan to better understand how floods of different kind and their impacts on the landscape are related to climate extremes (of precipitation and temperature) and how these extremes are related to large scale predictors (e.g. climate oscillations, teleconnections). Through a novel integrated modeling chain, we aim at identifying the climate extreme indices that better relate to river floods, the large-scale climate phenomena controlling their dynamics, their expected modifications due to climate change and the associated uncertainties. Three research questions will be at the core of Clim2FlEx: • What are the large scale predictors of climate extremes that are relevant to river floods and their change? • What is the role of spatio-temporal scales when mapping climate to flood extremes? • How are climate extremes and river floods of different types related to

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each other? Mapping climate to flood extremes is of interest from both theoretical and practical perspectives. From a theoretical point of view, a better understanding of the connection between climate extremes and floods will allow to better attribute flood changes to their underlying causes. From a practical point of view, the identification of climate indices relevant to flood extremes may allow to better incorporate climate projections in the assessment of flood hazard and risk, leading to a more informed selection of adaptation measures compared to what is now possible.

Strutture coinvolte

- DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

Parole chiave

Settori ERC

PE10_3 - Climatology and climate change PE10_17 - Hydrology, water and soil pollution

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 11. Rendere le città e gli insediamenti umani inclusivi, sicuri, duraturi e sostenibili|Obiettivo 13. Promuovere azioni, a tutti i livelli, per combattere il cambiamento climatico*

Budget

Costo totale progetto:	€ 289.422,00
Contributo totale progetto:	€ 212.500,00
Costo totale PoliTo:	€ 107.086,00
Contributo PoliTo:	€ 78.150,00

eXoft, innovative soft-rigid exoskeleton for smart factory

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Carmen Visconte

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (Ministero dell'Università e della Ricerca)

Codice identificativo progetto:

2022HYLWSJ

Ruolo PoliTo:

Partner

Abstract

Work related musculo-skeletal disorders represent a relevant percentage of occupational diseases in developed countries. Aside the laborers discomfort, they also reflect on companies with relevant economic effects. Nonetheless, the spread of exoskeletons for industrial applications is still limited. The reasons are to be sought on how they are perceived by workers: for many of them, their reduced mobility and not perfect adaptability to the kinematics of the human body make them more of a nuisance than a real help. Because of that, the use of exoskeletons in industry has been till now limited to non-ergonomic tasks that involve maintaining uncomfortable postures for extended periods. It is the case of over-head jobs in automotive assembly lines. In such cases, where just supporting the arms weight imposes prolonged stress on muscles, passive shoulder and arms exoskeletons have been demonstrated being beneficial for stress release. In many other applications in which workers could take advantage of external supports (e.g., repetitive lifting of loads from the ground in logistics), the use of exoskeleton is limited since the devices are perceived as an impediment to comfortable walking. The spread of wearable devices in industrial scenarios could bring advantages not only to jobs ergonomics and injuries assessment, but also to safety and risk management. The exoskeletons worn by labourers can be conceived as tools able to share quantitative data about the user posture and position within the working environment. Such pieces of information can then be used for active safety strategies, such as collision prevention and machines command. In few words, the object of the eXoft project is an active exoskeleton with innovative mechanical and actuation designs, conceived for integration in collaborative robotics environment. The purpose is to improve the comfort and safety of labourer tasked with heavy or repetitive jobs, while providing a tool for a safer integration of human-in-the-loop workflows. The technological and scientific advancements required by the project will be pursued by four macro-activities: design and prototyping of a hybrid

(soft-rigid) mechanism, design of a human-robot interaction control, design of an innovative actuation paradigm, and integration of the device features in collaborative robotics work scenario. Each activity will be carried out by a different unit and will step through the definition of design methods and requirements which will converge in an innovative device. The key idea is that of getting rid of the limitations given by traditional exoskeletons by introducing soft elements in the kinematic structure aimed at enhancing the motility perceived by the user. Also, the design of a novel device will allow to integrate it with the necessary extero- and proprio-ception ability useful for integration in a wider collaborative work environment.

Strutture coinvolte

- DIMEAS - Dipartimento di Ingegneria Meccanica e Aerospaziale

Partner

- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO S.ANNA**
- **UNIVERSITA' DEGLI STUDI DI PADOVA**
- **UNIVERSITA' POLITECNICA DELLE MARCHE** - Coordinatore

Parole chiave

Settori ERC

PE8_7 - Mechanical and manufacturing engineering (shaping, mounting, joining, separation)

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 8. Incentivare una crescita economica duratura, inclusiva e sostenibile, un’occupazione piena e produttiva ed un lavoro dignitoso per tutti

Budget

Costo totale progetto:	€ 225.753,00
Contributo totale progetto:	€ 192.612,00
Costo totale PoliTo:	€ 53.630,00
Contributo PoliTo:	€ 42.652,00

StarLight - DEVELOPMENT OF STARCH-BASED REVERSIBLY PHOTO-CROSSLINKED NANOCOMPOSITES FOR INNOVATIVE AND SUSTAINABLE PACKAGING (StarLight)

Durata:

16/10/2023 - 15/10/2025

Responsabile scientifico:

- Alessandra Vitale

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

20222K8A48

Ruolo PoliTo:

Partner

Abstract

Plastic packaging has an increasingly negative impact on the environment. In fact, only less than half of the plastic packaging waste generated is recycled in the EU (ca. 40% in 2019). In addition, plastic packaging production strongly relies on fossil sources, while sustainable alternatives may arise from the use of abundant, low cost, renewable, and biodegradable sources. StarLight aims to tackle both the issues by developing an innovative packaging material derived from a renewable agri-food waste such as starch. We expect that this new material can combine the properties of being recycled and/or composted on demand with good performances, competitive with those of plastic polymers currently used. Starch, a natural polymer obtainable from biomass and food waste, is water-sensitive, undergoes physico-chemical degradation at relatively low temperature, and lacks mechanical resistance. While these features are desirable for biodegradation, they hinder applications. Strategies to solve this issue are the addition of inorganic nanofillers and the use of reversible crosslinking processes. Within the project starch and nanofillers, such as 2D natural silicates or titanium dioxide, will be modified with reversibly photocrosslinkable groups. The resulting hybrid nanocomposite is expected to have mechanical performance and barrier to gases suitable for packaging. Key innovative points of StarLight are: i) reversibility of the curing reaction: reversible crosslinking groups introduced both on the starch chains and nanofiller surfaces ensure crosslinking upon irradiation at a given wavelength, and the dismantling of the composite (de-crosslinking) by irradiation at a different wavelength and/or by heating, allowing to re-obtain the prepolymers and the fillers, which can be then either composted or reprocessed/reused; ii) sustainability of the nanocomposite: the design of the material complies with the principles of green chemistry, i.e. the selected crosslinking

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reactions are eco-friendly, occur at room temperature, without organic solvents and harmful crosslinkers; iii) smart features of the nanocomposites combining mechanical stability, gas barrier, enhancement of the shelf life of the packaged product. The scientific outcomes of the project can open the way to the technological development of a new packaging satisfying the present requests of industry. On a long-term basis, the project may also have an impact on society in terms of packaging waste management. For these reasons, StarLight complies with mission 2 of the “PNRR” by tackling key issues such as circular economy and plastics recycling. Further objective of StarLight is the development of citizen’s awareness on sustainability, and training of young researchers recruited within the project, offering them professional skills useful for future employment in industry. Thus, StarLight also pursues the goals of mission 5 of the “PNRR” by reducing the gaps between research, society and industry.

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **Politecnico di TORINO**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE**
- **UNIVERSITA' DI MILANO BICOCCA**
- **UNIVERSITA' STUDI TRENTO** - Coordinatore

Parole chiave

Settori ERC

PE5_6 - New materials: oxides, alloys, composite, organic-inorganic hybrid, nanoparticles PE5_15 - Polymer chemistry PE5_7 - Biomaterials, biomaterials synthesis

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 12. Garantire modelli sostenibili di produzione e di consumo

Budget

Costo totale progetto:	€ 285.793,00
Contributo totale progetto:	€ 203.751,00
Costo totale PoliTo:	€ 92.678,00
Contributo PoliTo:	€ 64.925,00

ERACLITO - EaRth Abundant and non-toxiC doped metaL oxide-based electro-optIc photonic structures for smarT windows and radiative cOoling (ERACLITO)

Durata:

28/09/2023 - 27/09/2025

Responsabile scientifico:

- Francesco Scotognella

Tipo di progetto:

Ricerca Nazionale - PRIN

Ente finanziatore:

MINISTERO (MINISTERO DELL'UNIVERSITA' E RICERCA)

Codice identificativo progetto:

2022ZMA4X3

Ruolo PoliTo:

Coordinatore

Abstract

EaRth Abundant and non-toxiC doped metaL oxide-based electro-optIc photonic structures for smarT windows and radiative cOoling (ERACLITO)

Strutture coinvolte

- DISAT - Dipartimento Scienza Applicata e Tecnologia

Partner

- **C.N.R. - CONSIGLIO NAZIONALE DELLE RICERCHE**
- **POLITECNICO DI TORINO - AMMINISTRAZIONE CENTRALE** - Coordinatore
- **UNIVERSITA' DEGLI STUDI DI GENOVA**

Parole chiave

Settori ERC

PE3_10 - Nanophysics: nanoelectronics, nanophotonics, nanomagnetism, nanoelectromechanics, etc.

Obiettivi di Sviluppo Sostenibile (Sustainable Development Goals)

Obiettivo 7. Assicurare a tutti l'accesso a sistemi di energia economici, affidabili, sostenibili e moderni

Budget

Costo totale progetto:	€ 300.678,00
Contributo totale progetto:	€ 214.054,00

Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
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Costo totale PoliTo:	€ 80.915,00
Contributo PoliTo:	€ 68.415,00