ENERGETICS

MUR DM 117/AddFor - Innovative solutions for the smart control of electrified Connected and Autonomous Vehicles (CAVs)

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] ADDFOR SPA [P.iva/CF:09903210012] Politecnico di TORINO [P.iva/CF:00518460019]
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Context of the research activity	The even more stringent emission regulations together with the increasing concern into environmental issues have thrust the automotive industry to largely invest on R&D to define innovative solutions for the attainment of green vehicles characterized by low CO2 and pollutant emissions. Powertrain electrification is bound to play a significant role in achieving such a purpose and possible options would be represented by electrified vehicles (xEVs) as opposed to conventional powertrains. Still, the exploitation of the full potential of xEVs requires a dedicated design to cope with the constraints deriving from the different driving missions and the requirements from the customer together with sound and flexible control solutions that are to be tailored on the considered power-units and to efficiently handle the onboard energy storage system(s). Progetto finanziato nell'ambito del PNRR - DM 117/2023 - CUP E14D23001950004
	The present project aims at developing innovative and smart solutions for the control of electric or hybrid powertrains and for optimal onboard energy management, along with their integration into the existing infrastructure (V2X). Connected vehicles and advanced driver-assistance systems (ADAS) were initially conceived to achieve improved driving comfort and to prevent human errors, thus reducing road casualties. Still, the potential of such technologies for energy saving are currently at the forefront of scientific research and are gaining increasing interest. More specifically, the exploitation of the full potential of electrified vehicles requires tailored control to cope with the constraints deriving from the considered driving missions as well as from the specific driving behavior. The latter issues would benefit from

Objectives	the prediction of future road conditions that could be provided by Connected and Autonomous Vehicles (CAVs). Specific control algorithms would allow for an efficient exploitation of the on-board stored energy and for reducing traffic congestion. Connected electrified vehicles are hence an essential component of the transition to a more sustainable transportation system. Specific attention should also be paid to cloud-based algorithms and digital twins to overcome the constraints set by the state-of-the-art of ECUs and to further boost the potential of real-time solutions for xEVs control. Still, the latencies and issues caused by remote communication impose some limitations on their applicability and are worth investigating into. Within this framework, the main objective of the proposed PhD program is the development of solutions for the control and the energy management of electric and hybrid powertrains to be implemented either/both on the local vehicle ECU or/and on the Cloud. Specific attention will be paid to the effectiveness of such control solutions in reducing environmental impact and pollutant emissions. The project also aims at integrating these latter in the infrastructure to attain a sustainable mobility model. Model-based solutions, data-driven models, and artificial intelligence networks will be exploited, and the computational burden will be evaluated from a real-time working perspective. The upsides and downsides of the ECU onboard implementation will be investigated and compared to the advantages offered by the remote cloud implementation. The limitations carried by the available communication technologies, both for cloud implementation and for V2X integration will be thoroughly assessed in terms of energy saving and drivability. The research activity is fully coherent with the PNRR guidelines and will merge the competences of the research group to those of AddFor s.p.a., thus promoting the joint academic and industrial research and thrusting the education of professional figures trained to face the decarbonization challenge.

Skills and competencies for the development of the activity	Technical competences about: electrified vehicles architecture and modelling; optimization techniques; AI solutions. Good knowledge of programming and simulation tools (Matlab, Simulink, Python). Capability to work in a multidisciplinary research team. Good knowledge of the English language.