BIOENGINEERING AND MEDICAL-SURGICAL SCIENCES

Ateneo - Technological solutions for real-world digital mobility assessment of diseased gait

Funded By	Politecnico di TORINO [P.iva/CF:00518460019]
Supervisor	CEREATTI ANDREA - andrea.cereatti@polito.it
Contact	CEREATTI ANDREA - andrea.cereatti@polito.it
Context of the research activity	This PhD project is aimed to develop, optimize, and validate multi-sensor-based system and algorithms for the assessment of diseased gait and other motor activities in real-world conditions.
Objectives	In order to target mobility loss effectively and be able to prevent it, we need valid technological tools that can detect and measure how well someone walks, including speed, symmetry/efficiency, pain, and endurance. Existing mobility endpoints based on clinical scales, patient self-reporting, and one-off assessment are resource intensive and lack sensitivity, which limits therapeutic development and clinical management. Novel approaches are needed that are low cost, smart, accurate and capable of use in the real world, including the home and the community. Wearable digital technology and artificial intelligence has the potential to measure and monitor real-world digital mobility outcomes at different temporal and spatial resolution levels. The research project aims to: • Definition and optimization of a modular and scalable multi-sensor wearable system for high resolution mobility assessment. The system will include in its full configuration multiple inertial measurement units (IMUs), a combination of infrared distance sensors, barometric sensors, pressure insoles, heart rate and pulse-oximetry sensors. • Implementation of innovative algorithms for the extraction of DMOs. To improve accuracy existing state of the art algorithms will be extended/improved using the following approaches: (1) multimodal sensing and data fusion; (2) pattern matching/enhancement methods; (3) combination of biomechanical models, machine learning, and direct integration methods. • Definition of the protocol and gold standard tools for technical validation. Validation will be carried out both in the clinical populations and a control group. The protocol will include: a) a lab-based protocol in combination with clinical tests; b) lab-based simulated daily activities, and c) unsupervised

	recording of free-living daily life activities in uncontrolled environments both indoor and outdoor.

Skills and competencies for the development of the activity	The candidate must have a background in biomedical instrumentation, biomedical signal processing, machine learning and signal interpretation. The candidate must have documented skills in the acquisition and analysis of magneto-inertial data, and in the use and integration of several acquisition devices simultaneously. Moreover, it is required experience in the design and conduction of experimental protocols. Experience in main programming languages (Matlab/Python/C++/Dart)