POLITECNICO DI MILANO

PhD in BIOINGEGNERIA / BIOENGINEERING - 40th cycle

INAIL Research Field: OBJECTIVE ASSESSMENT AND EVALUATION OF FUNCTIONAL LIMITATIONS AND BIOMECHANICAL DAMAGE USING WEARABLE SENSORS AND AI

Monthly net income of PhDscholarship (max 36 months)
€ 1600.0
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Currently, the evaluation of functional limitations resulting from occupational diseases or accidents is based on clinical data deriving from objective measurements and subjective observations on the subject affected by the outcomes of injuries resulting from accident or occupational disease. Subjective observations are therefore conditioned by the doctor's personal judgment and experience, which can vary significantly and can be influenced by the patient's compliance with the semiological maneuvers applied during the medical-legal examination. The main objectives of this project are: 1. Instrumentally verified functional evaluation of the subject with joint impairmentsThe main objective of this project is to develop and implement an objective evaluation methodology using wearable sensors. These sensors will provide precise measurements and quantifications of movement disorders, acquiring data that reflects the patient's actual physical limitations. Using artificial intelligence (AI), the data collected will be analyzed to ensure accurate and reliable assessments of functional limitations of the joint range. Artificial intelligence algorithms will help identify patterns and abnormalities in motor function, offering a comprehensive understanding of the patient's condition. 2. Evaluation of non-articular biological damage: the project aims to develop an application method to evaluate the biological damage to non-articular functional organ systems (e.g. cardio-circulatory system) resulting from

	occupational accidents/illnesses. This evaluation will be based on the objective parameters indicated in the Table of Impairments (DM 12.7.2000) and will include the inclusion of further functionality parameters derived from the most modern scientific literature (EBM), thus proceeding with a multiparametric analysis based on artificial intelligence. The objective is to establish a standardized and objective approach for the assessment of biological damage, moving away from the subjective and variable assessments currently in use. This application method will support medico-legal assessments by providing a clear, data-based basis for determining the extent of biological damage. By implementing these innovative methodologies, the project seeks to improve the accuracy and reliability of clinical-objective assessments of joint functional limitations from which to derive better reliability and assessments of biological damage, contributing to homogeneous and objective evaluation results of biological damage reported by workers with outcomes of occupational illnesses and injuries.
Methods and techniques that will be developed and used to carry out the research	The project will be developed in collaboration with INAIL at *Sovrintendenza sanitaria centrale* in Rome. The methods will include 1. Motor evaluation using wearable systems To evaluate motor function, a protocol for the use of wearable systems based on motor evaluation will be implemented. The accuracy of the wearable systems will be assessed by comparing their performance to gold standard systems, ensuring a reliable and valid assessment of motor function. 2. Implementation of the Remote Evaluation Protoco IA protocol will be developed to facilitate remote or remote motor assessment. This protocol will allow the evaluation of movements in the peripheral offices of INAIL, ensuring that the evaluations can also be conducted outside the centralized offices. Data collected from these peripheral sites will be analyzed centrally, ensuring consistency and comprehensive assessment of motor function across

	multiple locations. 3. AI-based methods to identify functional limitations. AI-based methods will be considered to identify movement characteristics that are indicative of real functional limitation. These AI methods will be trained to distinguish between real motor impairments and situations in which limitations are simulated. Leveraging machine learning algorithms, the project aims to accurately identify and characterize real functional limitations, improving the overall reliability of the motor assessment process. 4. Evaluation of non-articular impairments with multiparametric analysis supported by an artificial intelligence system. Cases of impairments of non-articular functional organ systems will be examined with evaluation of the biological damage according to the reference to the legal parameters combined with new functionality parameters derived from evidence-based medicine to structure a more complete evaluation method of damage to the person, also supported by a possible specially designed automated calculation application system. These methods will collectively ensure a robust and comprehensive approach to assessing motor and non-joint function, using advanced technologies and protocols to achieve accurate and reliable results
Educational objectives	The PhD student will have the opportunity 1) to learn processes and approaches in a field of great actuality (i.e. occupational medicine) 2) to access at the Motion analysis Labs of Politecnico di Milano for experimental activities 3) to improve knowledge about guidelines for the evaluation and for the redaction of workers risk.
Job opportunities	The PhD student will have the opportunity to create a background and skills useful for further job applications.
Composition of the research group	1 Full Professors 1 Associated Professors 2 Assistant Professors 3 PhD Students
Name of the research directors	Prof. Manuela Galli - Dott. Lucia Broccoli

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	800.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
The PhD student will have a desk at INAIL and at Politecnico di Milano. Some training courses and activities will be planned together with the participation in national and international conference and events. Opportunities in terms of teaching activities and support to students during thesis preparation will be considered.