



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

PNRR 118 INTERDISC Research Field: AN INNOVATIVE NEUROCOMPUTATIONAL DATA- DRIVEN FRAMEWORK FOR MOTOR CONTROL

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

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

One of the main objectives of the Italian plan for recovery and resilience (PNRR) is the address of the health of the society (PNRR-Mission 6).

Overall, the National Health Service (SSN) has adequate health outcomes, a high life expectancy at birth, even though health expenditure on GDP is lower than the EU average. However, the need for effective and efficient neurorehabilitation is becoming a societal problem given the growing number of people in need, and the lack of accessible therapists and facilities for local services. In the computational model based on the concept of active inference, brain function can be framed as an (active) inference process, in which the nervous system makes predictions on its sensory data that it expects as input from the interaction with the environment. This project aims to develop a neurocomputational framework that is able to:

- i) infer model parameter values for patients affected by different pathologies/functional disabilities based on a standardized assessment protocol that can be performed routinely in a clinical setting;
- ii) model the effect on the motor control and the interaction between the current ("sick") motor control model and the rehabilitation intervention (for example, what is happening by manipulating the expected sensations through external devices).

Methods and techniques that will be

The achievement of the proposed objectives is based on



<p>developed and used to carry out the research</p>	<p>The achievement of the proposed objectives is based on the integration of three methodologies:</p> <ul style="list-style-type: none"> - M1) Informed parameters estimation. Development of the computational model in the active inference framework and of a methodology for estimating the parameters of the motor control model informed by biomechanical parameters derived from standardized protocols. - M2) Model perturbations. Study and modeling of the perturbation of the model following the intervention of external factors that act on the sensory data input to the model (e.g., robotic movement of a joint). - M3) High-dimensional functional data analysis. Statistical-learning methods for exploration, prediction and classification of functional signals, from imaging and from biomechanical measurements.
<p>Educational objectives</p>	<p>The PhD student will gain an interdisciplinary knowledge of technologies and processes related to new paradigms in human assistance and empowerment. The proposal is part of the university's multidisciplinary initiatives and contributes in particular to SDG3 (Good Health). The project intends to integrate the skills for the development of a neurocomputational model able to describe the physiological or pathological motor behavior and how it is perturbed by external stimuli by building a model to support the decision-making process to deal with a rehabilitation emergency towards a more effective and sustainable one.</p>
<p>Job opportunities</p>	<p>Skills and competences in the field are extremely interesting for all the companies, rehabilitation centres, hospitals and regulatory institutions involved in rehabilitation and assistance of acute and chronic frail people.</p> <p>Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary compared to Master of Science holders in the same field.</p>



Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Eng. Marta Gandolla, Prof. Laura Sangalli

Contacts
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For questions about scholarship/support, please contact phd-dmec@polimi.it.

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	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	ETH Zürich
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 5.707,13.
Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.