



# PhD in MODELLI E METODI MATEMATICI PER L'INGEGNERIA / MATHEMATICAL MODELS AND METHODS IN ENGINEERING - 39th cycle

**PNRR 118 PA Research Field: ADVANCED DATA-ANALYSIS METHODS TO ENHANCE  
DIAGNOSIS AND TREATMENT OF NEURODEGENERATIVE AND NEURODEVELOPMENTAL  
DISORDERS**

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1325.0**

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**

Our National Health System is experiencing an ever increasing cost and organizational burden to diagnose, treat, and follow-up subjects affected by neurodegenerative and neurodevelopmental disorders, due to the increasing prevalence of such pathologies in the whole population. Early and accurate diagnosis of neurodegenerative diseases in clinical practice is vital for the development and optimization of therapeutic interventions and treatment strategies to prevent disease progression and improve patient outcome. Indeed, at present, diagnosis and identification of an efficient therapy is often carried out through a costly trial-and-error approach, resulting in a long and burdensome process, both for the hospitals and for the patients, and a poorer prognosis for the subject. Moreover, diagnostic biomarkers identifying disease pathology before the onset of overt and disabling symptoms are needed in order to recruit, monitor and treat, when necessary, individuals who are asymptomatic or with only mild symptoms. The objective of this PhD fellowship is the development of advanced data-analysis methods capable to provide valuable quantitative instruments to enhance currently used diagnostic and monitoring tools and biomarkers, and to support decision making concerning optimal treatment allocation and assessment of efficacy of innovative



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|  | <p>therapies. The methods will enable analysis of neuroimaging acquisitions, such as functional Magnetic Resonance Imaging (fMRI), possibly acquired longitudinally, or combined with other measures taken during clinical practice. Such instruments will support implementation of strongly user/patient oriented strategies, in a context of personalized medicine, and will help reducing the burden currently experienced by our National Health System for such pathologies. The proposed research activity fully meets some of the objectives of the National Recovery and Resilience Plan (PNRR) concerning the mission M6C2 (Innovazione, Ricerca e Digitalizzazione del Servizio Sanitario Nazionale).</p>   |
| <p><b>Methods and techniques that will be developed and used to carry out the research</b></p> | <p>The PhD candidate will define advanced data analysis methods for complex data and high-dimensional data arising from current neuroimaging modalities such as fMRI. These methods will belong to the class of physics-informed statistical models, and will permit the inclusion of the available problem-specific knowledge on the phenomena under study, including the complicated brain anatomy. The research will be carried out in collaboration with the Fondazione IRCCS Istituto Neurologico Carlo Besta, thanks to a consolidated collaboration with Eng. Ferruccio Panzica, Responsabile del Servizio di Ingegneria Clinica e membro della commissione Neuroimmagini della Lega Italiana contro l'Epilessia. Moreover, the research will also profit of an ongoing collaboration with Prof. Andre Marquand at Donders Centre for Cognitive Neuroimaging and Donders Institute for Brain, Cognition and Behaviour, Radboud University, The Netherlands.</p> |
| <p><b>Educational objectives</b></p>   | <p>The doctoral student will become a skillful data scientist, with expertise in advanced statistical learning and neuroimaging data. The research will be developed in a lively and stimulating research environment, within a team of statisticians, neuroscientists and clinical doctors.</p>   |
| <p><b>Job opportunities</b></p>  | <p>Data scientists are the most in-demand job today, among high-qualification jobs. In all industrial and business</p>   |



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|  | sectors, the demand for data scientists continues to outpace supply and dominates both the US and the European job market. |
| <b>Composition of the research group</b> | 3 Full Professors<br>4 Associated Professors<br>3 Assistant Professors<br>18 PhD Students                                  |
| <b>Name of the research directors</b>    | Prof. Laura M. Sangalli  |

| <b>Contacts</b>  |  |
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| Prof. Laura M. Sangalli: laura.sangalli@polimi.it, 02 2399 4554, <a href="https://sangalli.faculty.polimi.it">https://sangalli.faculty.polimi.it</a> |  |

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

| <b>Scholarship Increase for a period abroad</b> |         |
|---|---------|
| <b>Amount monthly</b>                           | 662.5 € |
| <b>By number of months</b>                      | 6       |

| <b>National Operational Program for Research and Innovation</b>   |   |
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| <b>Company where the candidate will attend the stage (name and brief description)</b>                       | Fondazione IRCCS Istituto Neurologico Carlo Besta |
| <b>By number of months at the company</b>   | 6   |
| <b>Institution or company where the candidate will spend the period abroad (name and brief description)</b> | to be defined                                     |
| <b>By number of months abroad</b>   | 6   |

| <b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>   |
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| <p>Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): financial aid per PhD student per year</p> <p>1st year: max 1.800,47 euros<br/>2nd year: max 1.800,47 euros<br/>3rd year: max 1.800,47 euros</p> <p>The PhD students are encouraged to take part in activities related to teaching, within the limits allowed by the regulations. 1 individual PC per student + several shared PC. Access to one cluster with 32 processors and 384 GB RAM, and to several multi-processor servers.</p> |