



PhD in MODELLI E METODI MATEMATICI PER L'INGEGNERIA / MATHEMATICAL MODELS AND METHODS IN ENGINEERING - 41st cycle

**THEMATIC Research Field: NEXT-GENERATION COMPUTATIONAL METHODS FOR
SIMULATING COUPLED ELECTRO-METABOLIC DYNAMICS IN COMPLEX LIVING SYSTEMS**

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**

The PhD research will focus on developing next-generation numerical methods for simulating coupled electro-metabolic dynamics in complex living systems. Building on advanced multiphysics and multiscale PDE systems, the project aims to design and analyse innovative computational algorithms that integrate the dynamics of electro-metabolic processes across spatial and temporal scales. The work will combine rigorous PDEs modeling, advanced numerical methods on polytopal grids, and machine learning-based enhancement strategies to improve accuracy, stability, and efficiency. These proposed methodologies will enable large-scale, high-fidelity simulations of electro-metabolic interactions in complex biological systems. The PhD position includes full financial support provided through the following research grants:

Funded project references

- project title “Stability Analysis and Control Mechanisms of Seizures - SACMS” project number 77FF5F1A CUP D43C24002430001- funded under the NRRP Mission 4 - Component 2 - Investment 1.2 - Funding of projects submitted by young researchers, funded by the European Union – NextGenerationEU, under Notice D.D. No. 201 of 03.07.2024 and subsequent amendments, “Call for



	Young Researchers 2024”, and pursuant to Grant Decree D.D. No. 20 of 21.01.2025. ID SOE2024_0000089 •research project “New generation MEthods for numerical SimulationS – NEMESIS”, project number 101115663 (https://erc-nemesis.eu) funded by the European Union, ERC Synergy Grant. CUP D43C23003890006 Further information: https://erc-nemesis.eu/ https://cordis.europa.eu/project/id/101115663 https://mox.polimi.it/industrial-and-scientific-projects/project-detail/?id=204
Methods and techniques that will be developed and used to carry out the research	The PhD research will focus on next-generation numerical methods and algorithmic techniques along with machine learning–enhanced strategies for simulating coupled bio-electro-chemical interactions in complex systems in complex living systems.
Educational objectives	The research focuses on innovative mathematical and computational methods that embrace the complementary perspectives of analysis of PDEs, numerical methods and control for PDEs, Machine Learning techniques and applications.
Job opportunities	Graduates of this program are in high demand across various research institutions, industries, and tech-driven sectors. Their versatile modeling and numerical skills give access to excellent opportunities, including private research and innovation industrial consulting, scientific software development and risk assessment in management and insurance. In the academic sector, graduates of this program are prepared for postdoctoral positions, tenure-track faculty roles, and research fellowships in international institutions and universities.
Composition of the research group	1 Full Professors 1 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Proff. P.F. Antonietti, S. Pagani e Dr. N. Kumar



Contacts	
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Additional support - Financial aid per PhD student per year (gross amount)	
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Housing - Foreign Students	--
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Housing - Out-of-town residents	--
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Scholarship Increase for a period abroad	
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Amount monthly	700.0 €
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By number of months	6
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Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Each PhD student is provided with a personal workstation and access to shared computing facilities. PhD students have access to office space, university libraries, and a wide range of online scientific resources. Students will benefit from access to the dedicated NEMESIS server, a high-performance computing infrastructure made available through the ERC project. The NEMESIS server is specifically designed for large-scale simulations and support the development and validation of next-generation numerical methods. Financial support is available each year to cover expenses related to training activities and participation to courses, summer schools, workshops and conferences up to a maximum of €1,902.40 per year for three years. PhD students can benefit from the international dimension of the SACMS and NEMESIS ERC SyG projects, which involves close interaction with the research teams
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