



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

**THEMATIC Research Field: NEW GENERATION METHODS FOR NUMERICAL SIMULATIONS**

Monthly net income of PhDscholarship (max 36 months)
<b>€ 1325.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
<b>Motivation and objectives of the research in this field</b>	<p>The objective of this project is to develop, analyze, and implement innovative numerical techniques that also support polytopal grids for the discretization of multi-physics problems modeled by systems of nonlinear partial differential equations (PDEs). This involves addressing key challenges, including incomplete differential operators in Hilbert complexes, the efficient solution of the discrete problems, also through the integration of Machine Learning techniques, and the efficient treatment of nonlinear and hybrid-dimensional multi-physics phenomena stemming from applications like computational geophysics, advanced manufacturing, or life sciences. This research is funded by the European Union, ERC Synergy Grant NEMESIS, project number 101115663 (<a href="https://erc-nemesis.eu">https://erc-nemesis.eu</a>).</p> <p>The proposed research promotes interdisciplinarity approaches, membership of international networks, and collaborations among the research group participating into the NEMESIS project (<a href="https://erc-nemesis.eu">https://erc-nemesis.eu</a>).</p>
<b>Methods and techniques that will be developed and used to carry out the research</b>	<p>The goal of the research project is to develop mathematically sound numerical methods for the numerical approximation of systems of nonlinear partial differential equations modeling multi-physics phenomena. Within the project we will develop innovative polytopal Finite Element methods to tame the inherited complexity and address challenges in the context of</p>



	physics-based modeling. The proposed computational methods will account for the complex geometries, the coupling effects, the multi-physics nature of the phenomena, and the relevant time scales. Scientific machine learning methods will be employed to improve computational efficiency and enable the translation capabilities of the computational models.
<b>Educational objectives</b>	This research focuses on innovative mathematical and computational methods that embrace the complementary perspectives of analysis of PDEs, numerical methods for PDEs, Machine Learning techniques and applications. Further information can be found at <a href="https://erc-nemesis.eu">https://erc-nemesis.eu</a>
<b>Job opportunities</b>	The research activity addresses innovative topics at the frontier of Computational Mathematics. The PhD candidate will develop mathematical and computational skills that will open to both industrial and academic research opportunities.
<b>Composition of the research group</b>	2 Full Professors 3 Associated Professors 1 Assistant Professors 1 PhD Students
<b>Name of the research directors</b>	Paola Francesca Antonietti

<b>Contacts</b>	
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<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<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



**Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information**

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:

1st year: max 1.800,50 euros

2nd year: max 1.800,50 euros

3rd year: max 1.800,50 euros

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.