POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 41st cycle

THEMATIC Research Field: PHYSICS-INFORMED GENERATIVE AI FOR ARCHITECTED MATERIALS

Monthly net income of PhDscholarship (max 36 months)
1500.0 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 scholarship is funded by the Italian Institute of Artificial Intelligence (AI4I). The research will be carried out jointly at AI4I and Politecnico di Milano. The project focuses on **architected materials**, also known as metamaterials. Architected materials are engineered systems whose exceptional properties originate from geometry rather than chemistry alone. By computationally designing their internal structure across scales, these materials can display unconventional mechanical, acoustic, or multifunctional behaviors. Recent advances in **artificial intelligence (AI) and generative modelling** have created new opportunities to accelerate their design and broaden the space of feasible, manufacturable architectures. Data-driven approaches now enable the integration of heterogeneous requirements — from geometric and manufacturing constraints to target mechanical responses and multifunctional performance. Within this context, the PhD project aims to develop **foundation models for the design of architected materials**. The main objective is to uncover new or unconventional physical behaviors and establish a unified framework for the design of high-performing, manufacturable metamaterials.
Methods and techniques that will be developed and used to carry out the research	The research will integrate **physics-based simulation**, **generative AI**, and **formal representations of material architectures** to develop a new class of models for the

	architectures to develop a new class of models for the design of architected materials. Potential applications include vibration attenuation, impact protection, and acoustic filtering. **Key methodologies** could include**:** •Generative deep learning models to support the creation of architected materials. •Unified graph and geometric encodings to incorporate design requirements. •Physics-informed pretraining on large-scale numerical datasets. •Multi-objective and multi-physics frameworks to enable inverse design of architected metamaterials. •Experimental validation through fabrication and testing of prototypes or samples.
Educational objectives	The PhD candidate will develop a **strong interdisciplinary background** spanning artificial intelligence, computational mechanics and modelling, engineering design, materials science, and manufacturing. In addition, the candidate will enhance soft skills such as scientific writing, communication, and problem-solving.The candidate will learn to develop and apply generative and physics-informed machine learning methods for the design of materials and structures. Expertise will be gained in multi-physics modelling and simulation of architected materials, as well as in dataset generation, curation, and model training. The candidate will further strengthen the ability to create, disseminate, and communicate scientific knowledge, and to work effectively within an international research environment.
Job opportunities	The scholarship offers immersion in a multidisciplinary and international research ecosystem, involving collaboration with leading AI scientists and potentially also industrial partners. The Research Director of this scholarship for the AI4I partner will be Dr. Marco Maurizi. Specifically, the AI4I research group composition is the following:

	Number of Principal Investigators: 1 Number of Postdoctoral Researchers: 3 Career opportunities could span across research, industry, and technology innovation, where AI and materials design converge. Successful candidates will develop competencies that could be exploited in academic and research positions in computational materials science, mechanics, and AI for engineering design. Potential industrial fields of interest concerning this topic can be aerospace, automotive, and digital manufacturing, among others. The combination of AI expertise, physical modeling, and collaborative experience will make the candidate potentially competitive for roles in the next generation of AI-driven materials discovery and design. Employment statistics of PhDs can be found https://cm.careerservice.polimi.it/en/employment-statistics/
Composition of the research group	0 Full Professors 1 Associated Professors 0 Assistant Professors 2 PhD Students
Name of the research directors	Prof. Serena Graziosi, Dr. Marco Maurizi (AI4I)

Contacts
Prof. Serena Graziosi https://www.mecc.polimi.it/en/staff/serena.graziosi Email: serena.graziosi@polimi.it Dr. Marco Maurizi, AI4I https://amed.rd-labs.ai4i.it/ Email: marco.maurizi@ai4i.it For questions about scholarship/support: phd-dmec@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	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 € 6.114,50. Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months (approx. 750 euro/month- net amount). Additionally, PhD candidates who spend at least 3 months abroad are eligible for an extra reimbursement of €3,000 to cover travel expenses. 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 theteaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.