



PhD in DATA ANALYTICS AND DECISION SCIENCES - 38th cycle

**THEMATIC Research Field: DEEP LEARNING FOR MULTI-SCALE AND MULTI-PHYSICS
PROBLEMS ARISING FROM MICRO-ELECTRO-MECHANICAL 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

Microsystems or Micro Electro Mechanical Systems (MEMS) are highly sophisticated devices, where electronics is coupled with mechanical parts to create micro sensors, micro actuators, as well as micro-fluidic devices. MEMS are today commonly used in automotive, aerospace, biomedical, and structural Engineering (for monitoring and self-actuation). Multi-disciplinary research is strongly needed to improve the performances and reliability of MEMS and to create new devices which will enable the Internet of Things and Industry 4.0 revolutions. The research focus is on the development and analysis of new computational strategies for the fast and reliable simulation of MEMS, involving multi-physics components. The proposed research project is related to the Joint Research Center between Politecnico di Milano and STMicroelectronics "Research Center on Sensor systems with Advanced Materials - STEAM".

Methods and techniques that will be developed and used to carry out the research

MEMS-oriented research needs a highly multi-disciplinary approach and a deep knowledge of the fundamentals of physics, mechanics and electronics. This activity involves the analysis, development and application of rapid and reliable techniques for numerical simulation leveraging on reduced order modeling and deep learning algorithms, for the real-time calculation of variables and outputs of interest, therefore featuring a strong synergy between Computational and Data Sciences. These techniques will be analyzed from an abstract point of view, extended to



	be analyzed from an abstract point of view, extended to the case of multi-scale and multi-physics problems, including multi-fidelity strategies, model discovery in the case of large-scale, highly nonlinear dynamical systems, manifold learning techniques, parameter estimation methods, uncertainty quantification, and digital twinning of complex systems.
Educational objectives	The candidate will have the opportunity to collaborate with a wide research group across several Departments of Politecnico di Milano. A close collaboration with research teams from STMicroelectronics will also characterize the PhD experience of the candidate.
Job opportunities	Besides direct employment in MEMS-research centers and industries in Europe and all-over the world, job opportunities are related to fields where experts in numerical methods, data science, computational mechanics, as well as advanced structural monitoring, are requested.
Composition of the research group	3 Full Professors 3 Associated Professors 3 Assistant Professors 7 PhD Students
Name of the research directors	Andrea Manzoni and Attilio Frangi

Contacts	
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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

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