POLITECNICO DI MILANO

PhD in DATA ANALYTICS AND DECISION SCIENCES - 40th cycle

THEMATIC Research Field: DEEP LEARNING STRATEGIES FOR EFFICIENT UNCERTAINTY QUANTIFICATION OF COMPLEX 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 goal of this project is the mathematical and computational setting of accurate and efficient strategies – involving, but not restricted to, reduced order models (ROMs) – for the effective solution of uncertainty quantification problems involving complex distributed systems. The project will deal with the setting, analysis, and implementation of adaptive and multi-level strategies for data assimilation and parameter estimation extending current Markov chain Monte Carlo methods and filtering techniques, exploiting variational deep learning architectures for simultaneous feature extraction and uncertainty quantification. Moreover, deep neural networks also be considered for operator approximation in the case of UQ problems involving parameterized partial differential equations. Instead, multi-fidelity strategies will be exploited when dealing with assimilation of data from multiple sources. Additional research topics will involve model discovery combined with filtering algorithms, latent dynamics modeling, feature extraction, as well as the use of uncertainty quantification in predictive digital twins.
Methods and techniques that will be developed and used to carry out the research	Computational strategies developed in the research project will leverage on both numerical approximation techniques and recent learning paradigms. The synergistic use of uncertainty quantification tools and deep/machine learning techniques will provide a flexible framework for the development of the envisaged

	framework for the development of the envisaged techniques. Applications to problems of interest in Engineering (ranging form, e.g., structural health monitoring to fluid dynamics) will also be considered.
Educational objectives	The candidate will have the opportunity to collaborate with a wide research group across several Departments of Politecnico di Milano (e.g., Civil and Environmental Engineering, Mechanical Engineering) as well as with worldwide recognized research groups.
Job opportunities	Besides Universities, Research Institutes, and DeepTech companies in Europe and all-over the world, job opportunities are related to fields where experts in computational methods, data science, Engineering, as well as machine and deep learning, are requested.
Composition of the research group	1 Full Professors 1 Associated Professors 3 Assistant Professors 4 PhD Students
Name of the research directors	Prof. Andrea Manzoni (DMAT)

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

List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:

1. Prof. Nathan Kutz and Prof. Steven Brunton, University of Washington, Seattle, US
2. Prof. Karen Willcox, ICES, University of Texas at Austin, USA
3. Dr. Mengwu Guo, University of Lund, Sweden

There are various forms of financial aid for activities of support to the teaching practice:

Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences):

Financial aid per PhD student per year:

1st year: max 1.902,38 euro per student

2nd year: max 1.902,38 euro per student

3rd year: max 1.902,38 euro per student

Teaching and lab assistantship: availability of funding in recognition of supporting teaching and lab activities by the PhD student.

Further support is available for students who engage in activities of teaching or additional lab duties coherent with their academic mission and doctoral training.

The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

*Computer availability***:**

1st year:*individual use*

2nd year: *individual use*

3rd year: *individual use*

*Desk availability***:**

1st year:*individual use*

2nd year: *individual use*

3rd year: *individual use*