



# PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 40th cycle

Research Area n. 3 - Systems and Control

PNRR 630 Research Field: PHYSICS-INFORMED LEARNING TECHNIQUES FOR STATE ESTIMATION IN INTEGRATED MULTI-ENERGY SYSTEMS

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1500.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	<p>Multi-energy systems (MESs) consists in the synergetic operation of different energy vectors (e.g., interconnected electrical grids, heating systems and gas networks) and they are recognized as a key solution to enhance the energy transition, fostering the flexibility of the energy system and the diffusion of renewable sources. However, given their large-scale dimension and complexity, the optimal management and control of MESs requires to measure many different variables and the knowledge of large amounts of physical parameters, which is not feasible in practice. On the other hand, datasets of historical data are often available, but they are not sufficient to capture the entire systems dynamics. Because of this, this research activity aims to develop novel physics-informed machine learning techniques which, combining available data and physical knowledge, can be exploited to develop state estimators and reliable models for MESs, suitable for the design of optimization-based regulators.</p>
<b>Methods and techniques that will be developed and used to carry out the research</b>	<p>The research activity will concern the development of physics-informed machine learning techniques for designing state-estimators and reliable data-based models of multi-energy systems. These tools will be exploited to develop optimization-based predictive</p>



	<p>controllers, enabling the cost-effective management of real case studies. The research is carried out in collaboration with the research company Ricerca sul Sistema Energetico RSE SpA, exploiting their experimental benchmarks for assessing the performances of the developed solutions.</p>
<b>Educational objectives</b>	<p>The doctoral program offers advanced training in research topics which are currently explored by the scientific community in academy and industry. This doctoral research activity, focusing on machine learning methods applied to cutting-edge energy technologies, will enable the candidate to significantly enhance its competencies in timely topics. A research period in worldwide recognized research institutions and companies, will be also supported by the doctoral school and the supervisor.</p> <p><a href="http://dottoratoit.deib.polimi.it">http://dottoratoit.deib.polimi.it</a></p>
<b>Job opportunities</b>	<p>The PhD graduates have opportunities both in academy and industry. The intensive collaboration with industrial partners allowed several past PhD graduates to find a satisfactory job position in private companies. Job opportunities abroad are also frequently offered.</p>
<b>Composition of the research group</b>	<p>1 Full Professors 1 Associated Professors 2 Assistant Professors 4 PhD Students</p>
<b>Name of the research directors</b>	<p>Alessio La Bella</p>

<b>Contacts</b>	
<p>alessio.labella@polimi.it +02 2399 3436 <a href="https://www.deib.polimi.it/eng/people/details/744134">https://www.deib.polimi.it/eng/people/details/744134</a></p>	

<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>	--



Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Ricerca sul Sistema Energetico RSE SpA, Milano, Italia
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	École polytechnique fédérale de Lausanne (EPFL), Switzerland
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p><u>EDUCATIONAL ACTIVITIES</u> (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student.</p> <p><u>TEACHING ASSISTANTSHIP</u>: availability of funding in recognition of supporting teaching activities by the PhD student. 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.</p> <p><u>COMPUTER AVAILABILITY</u>: 1st year: Yes 2nd year: Yes 3rd year: Yes</p>