



# PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 37th cycle

**THEMATIC Research Field: DEVELOPMENT OF REDUCED ORDER MODELLING FOR DATA ASSIMILATION WITH APPLICATION TO NUCLEAR IMAGING**

**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**

In the design and optimization of engineering systems  $\zeta$  as the ones for nuclear imaging  $\zeta$ , computational cost can prevent the use of modern modelling tools especially for large systems. In addition, modelling hypothesis and parameter uncertainty can degrade the accuracy of the a-priori prediction of the system. In this light, hybrid data assimilation methods can be developed, in which a theoretical prediction, approximated with a reduced order model, is corrected or updated by real evaluations of some fields (e.g. the measure of the detector in the imaging machine). The research activity is aimed at the development of advanced reduced order modelling techniques to be applied in the design and optimization phase of real engineering systems (e.g., nuclear imaging). Two specific topics are going to be tackled, namely i) the correct positioning of sensors/detectors since their available position is limited; ii) state estimation from indirect measurements for the quantities that cannot be directly measured.

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

Reduced order modelling techniques will be applied to improve the imaging process. As starting point, the main non-intrusive techniques employed will be the Generalized Empirical Interpolation Method (GEIM) and the Parametrized-Background Data-Weak (PBDW) formulation. Measurement locations will be selected and



	optimized accordingly to the outcome of the offline techniques whereas and noise reduction techniques will be also used to take into account possible source that can deteriorate the quality of the analysis. State estimation from indirect measurements will be also analysed.
<b>Educational objectives</b>	This activity will allow the student to gain knowledge and understanding in the development of advanced numerical techniques to support nuclear imaging applications. The research activities will provide the student with the opportunity to become an expert both from a modelling and experimental point of view.
<b>Job opportunities</b>	The job opportunities for a PhD graduate in this research area can be found in universities, industry, research centers and support organizations.
<b>Composition of the research group</b>	1 Full Professors 2 Associated Professors 1 Assistant Professors 9 PhD Students
<b>Name of the research directors</b>	Antonio Cammi, Andrea Pola

<b>Contacts</b>	
antonio.cammi@polimi.it andrea.pola@polimi.it  <a href="http://www.nuclearenergy.polimi.it">http://www.nuclearenergy.polimi.it</a>	

<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>	564.01 €
<b>By number of months</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<b>Educational activities:</b> Financial aid per PhD student is available for purchase of study books and material, funding for



participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. The amount is about Euro 3.000,00.

***Teaching assistantship:***

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.

*Computer availability:* individual use.

*Desk availability:* individual use.

***Awards:*** Awards will be recognized to the PhD candidate up to Euro 1.500,00 (gross amount, after completion of the 3rd year). More details about this program will be provided by PhD Program Steering Committee.