



# PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 37th cycle

Research Area n. 1 - Advanced Materials and Smart Structures

**THEMATIC Research Field: DIGITAL TWIN AND ARTIFICIAL INTELLIGENCE  
APPLICATIONS FOR SPACE EXPLORATION PLATFORMS**

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1325.0**

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 research is focused on the development and use of a Digital-Twin of the space exploration systems, based on numerical and analytical models, which allows the implementation of effective and cost-effective Health and Usage Monitoring Systems (HUMS) approaches. The proposed technological solution will integrate the combined use of real / virtual sensors and a virtual model of the main subsystems and their possible interconnections, both in normal conditions and in the presence of damage, in such a way as to constantly have an assessment of the expected behavior of the intact system and be able to "compare" it in real time with what is instead observed by the sensors, in order to identify any possible anomaly. This approach was developed as part of previous research projects in the European Defense Agency framework (HECTOR, ASTYANAX and SAMAS) and adapted to multiple case studies for (i) load monitoring, (ii) diagnosis of structural damage and anomalies system, (iii) the filtering of signals in real time for the identification and updating of the model parameters and (iv) the consequent prognosis of evolution of the damage or of the damaged system. Within the proposed project, statistical methods of advanced signal analysis and machine learning will be used for the identification and classification of damage and, using



	<p>analytical or numerical damage evolution models, it will also be possible to predict the residual useful life of each subsystem, thus having the possibility to intervene promptly with the most suitable countermeasures.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>Methods are related to boost the capability of creating a multidisciplinary, multiphysics virtual environment aimed to define:</p> <ul style="list-style-type: none"> <li>• Numerical methods</li> <li>• Analytical and semi-analytical approaches</li> <li>• Experimental validation</li> </ul>
<p><b>Educational objectives</b></p>	<p>We provide doctoral candidates with high-level scientific training, fostering and refining research and problem-solving abilities. At the end of the PhD cycle the candidate will be able to plan and carry out original research by working in a team or leading a research group active in the field of structural design under extreme loading conditions. The candidate will strongly enhance both theoretical and experimental skills acquired during master studies.</p>
<p><b>Job opportunities</b></p>	<p>A recent survey showed that PhD candidates are <b>100% employed</b> after one year, in national and international companies and academic and non-academic research institutions, engaged in innovation, research and technical development. On average the survey showed that people earning our PhD title obtain <b>35% higher salary</b> than the corresponding employers with a Master of Science degree. Specifically, the skills and know-how developed during the PhD will allow to cover positions for design, maintenance and integrity assessment of advanced systems and components in aerospace, automotive and mechanical companies.</p>
<p><b>Composition of the research group</b></p>	<p>1 Full Professors 3 Associated Professors 0 Assistant Professors 9 PhD Students</p>
<p><b>Name of the research directors</b></p>	<p>Prof. Claudio Sbarufatti</p>



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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	566.36 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Funding for educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences); funding per PhD student per year: 2nd year: euros 1.534, 3rd year euros 1.534. Teaching assistantship: availability of funding in recognition of support to 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. <b>Computer availability:</b> 1st year: individual use 2nd year: individual use 3rd year: individual use <b>Desk availability:</b> 1st year: individual use 2nd year: individual use 3rd year: individual use.</p>