



PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 38th cycle

**THEMATIC Research Field: DIGITAL TWINS FOR SPACE SYSTEMS TOWARDS ENHANCED
LIFECYCLE EFFECTIVENESS**

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 research focuses on the creation of tools for the digital transition of spacecraft production processes, with particular attention to the development of the so-called digital twins. This migration helps to optimize each development phase, from product definition to implementation and verification, to its operational management, reducing time-to-market. Effective systems engineering process management reduces the waste of resources, time, and materials, contributing to ecosystem conservation, and promoting technological growth with sustainable industrial processes. The systematic application of the digital twin tool to the industrial chain of production and management of space systems, nested in Model-Based System Engineering and Concurrent Engineering environments, is on the one hand a key element to cope with the massive production of spacecraft expected in the next future and the privatization of the market on the other, more articulated in its players made up of industrial realities of a highly diversified nature: in fact, it favors a common and shared, rapid, standardized work area for the entire supply chain involved, facilitating checks, interfaces, and analysis of non-conformities. The availability of a totally digital representation of the spacecraft not only in its components but also in its operational functions allows it to carry out analysis and design synthesis in a short time, conduct test and integration activities in a targeted and effective way, plan operational activities and prevent \detect causes of



	<p>possible malfunctions during the flight in a more robust way than is currently the case.</p> <p>The research activities will focus on the development of satellite digital twins, representative of the functional system aspects, from design to in-flight operational management.</p> <p>The proposed approach and its effectiveness will be addressed and tested in close collaboration with industry, a leading player in the design and management of space systems and missions, to work on real cases and data to understand the real benefit of the digitization of production processes for the improvement of sustainability.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research has a highly innovative character, as system engineering in the Space sector is currently faced with classic methodologies, scarcely digitized except for the component analysis and design phases.</p> <p>The creation of a development platform for spacecraft digital twins implies in-depth multidisciplinary and systemic expertise, having to model the functional interaction of complex elements that themselves require dedicated modeling at a lower level.</p> <p>In the context of research, the candidate will have the opportunity to develop in-depth skills in the different disciplinary areas involving on-board systems and mission operational management - avionics, telecommunications, electricity, vehicle dynamics measurement and control equipment, thermal, etc – and of the modeling approaches that can be adopted in each of them, to achieve an effective functional representation of the entire satellite machine in its specific operational scenario.</p> <p>Furthermore, he will acquire critical analysis and intervention skills in relation to the different problems that the phases of the satellite production cycle often ask to solve.</p> <p>Taking a cue from a complex mission scenario currently under construction, we will proceed with the choice of the most suitable software environment for the development of the virtual model, with the definition of the most interesting system sectors to be implemented and with the selection of the models that can be adopted for the single disciplines, with particular attention to the operational</p>



	aspects of the individual components. We will then proceed with the bottom-up development of the individual blocks, alternating it with the necessary verification and test campaigns, to conclude with the integration of at least three related disciplinary blocks in the operational phase of the vehicle, to conclude with the verification campaign, possibly in benchmark with results, if available, obtained from campaigns with HW in the loop.
Educational objectives	The goal is to train a professional capable of formalizing and managing the design and development of complex systems through their digitization. The skills acquired will make it possible to build a high-profile professional figure with engineering skills at the system administrator level, invaluable both in the development phase and in the satellite mission management phase, able to fit effectively into the industrial fabric with the necessary knowledge of the digital tools necessary in the current panorama of industrial development in this direction. The training will also include the acquisition of soft skills through periodic involvement in presentation and dissemination activities. The interaction, when possible, with the industrial and agency part of the space sector, will accompany the training.
Job opportunities	Insertion in the industrial sector, not only in space, as coordinator of complex projects for the construction of systems, such as satellites, flight or land vehicles; access to the role of system engineer, responsible for verification and testing activities and development of virtual modeling environments in favor of sustainable industrial development
Composition of the research group	1 Full Professors 0 Associated Professors 2 Assistant Professors 12 PhD Students
Name of the research directors	Prof. Michèle Lavagna

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	2100.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>The Ph.D. candidate will receive a desk and a personal computer. Apart from the compulsory ones, the Ph.D. candidate will have the opportunity to follow additional courses, receive economic support to attend summer schools, and participate in conferences. There will be the possibility of paid teaching assistantship.</p>