POLITECNICO DI MILANO

PhD in INGEGNERIA AEROSPAZIALE / AEROSPACE ENGINEERING - 40th cycle

THEMATIC Research Field: PROGETTO SPACE IT UP CONTRATTO DI FINANZIAMENTO ASI N. 2024-5-E.0 CUP MASTER I53D24000060005 CUP POLIMI D43C24000350006 - HYBRID DATA-DRIVEN NUMERICAL METHODS FOR STRUCTURAL DESIGN

Monthly net income of PhDscholarship (max 36 months)
€ 1600.0 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	Bando di finanziamento ASI decreto n. 687/2022 - Deliberazione n. 71/2022 – Tematica 15 Attività spaziali, di cui all’avviso MUR n. 341/2022 per Partenariati estesi. Progetto di ricerca "SPACE IT UP!" approvato con decreto ASI n. 53/2024. Contratto di finanziamento ASI n. 2024-5-E.0 (CUP Master I53D24000060005; CUP POLIMI D43C24000350006). ASI Funding Notice Decree No. 687/2022 - Resolution No. 71/2022 - Topic 15 Space Activities, referred to MUR Notice No. 341/2022 for Extended Partnerships. Research project "SPACE IT UP!" approved by ASI Decree No. 53/2024. ASI Funding Agreement No. 2024-5-E.0 (CUP Master I53D24000060005; CUP POLIMI D43C24000350006). Future space activities for the improvement of Earth Observation (EO) capabilities and the development of Extraterrestrial Habitats (EH) require new and advanced approaches for mission design up to subsystem level, including the structural design. Model-based procedures should be established at the various level of hierarchical decomposition of EO and EH systems. Incorporating digitalization throughout the entire stream of the program, utilizing artificial intelligence tools and procedures, will be fundamental in achieving mission goals and ensuring sustainability. This is true also for the analysis and design

	of future space structures. Indeed, robust design processes and comprehensive digitalization are required to optimize manufacturing, assembly integration, and testing; new computational strategies based on data-driven and multi-scale approaches can be exploited for improved process and structural modeling. The entire mission can benefit from the availability of these new numerical methods inasmuch they will help reducing the time for conventional testing, expand design possibilities, and integrate physical information from manufacturing phases into as-built models.
Methods and techniques that will be developed and used to carry out the research	The research activity will focus on developing methods and models for space structures realized using novel manufacturing techniques. An initial literature review will be conducted to investigate the current state-of-the-art and identify key features of the latest manufacturing techniques for space applications. Advanced finite element procedures will be developed with capabilities of accounting for manufacturing effects and process-induced uncertainties. Data-driven and multi-scale approaches will be used for this scope. The simulation framework will be capable of enriching the structural models with physical information available from high-fidelity numerical simulations and/or experimental results. These hybrid, data-driven models will be applied directly as tools for numerical analysis and prediction. The inverse use, as tools to identify the numerical parameters of the models, will also be investigated. The research carried out during the PhD program is consistent with the activities of the Space It Up! project - Spoke 2.
Educational objectives	The candidate will be exposed to both theoretical and numerical activities. Skills will be developed ranging from structural modeling to numerical competencies in finite element analysis and machine learning. The candidate will participate in the development of advanced

	methodologies for space technology, thus acquiring valuable skills for future cutting-edge research in the aerospace sector. The research activities envisaged in this project require the candidate to contribute autonomously and innovatively, aiming to foster critical thinking, intuition, and problem-solving abilities.
Job opportunities	The professional profile emerging from this program is well-suited for the space industry, thanks to the specific skills acquired in the proposed activities. The expertise developed, particularly in the field of numerical simulation and the development of new methods and models, is also valuable to organizations involved in technological development beyond the aerospace sector. The strong focus on fundamental research also makes the candidate an ideal profile for a career in research and development, both in academia and industry.
Composition of the research group	1 Full Professors 1 Associated Professors 0 Assistant Professors 0 PhD Students
Name of the research directors	Prof. Riccardo Vescovini

Contacts
Dipartimento di Scienze e Tecnologie Aerospaziali - Politecnico di Milano - via La Masa 34, 20156 Milano - Italy - tel. +390223998323 - fax +390223998334 - email: riccardo.vescovini@polimi.it - web site: www.aero.polimi.it

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	800.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
The PhD candidate will receive a desk, possibly through a hot-desking procedure, and a personal computer, if needed. Apart from the compulsory ones, the PhD candidate will have the opportunity to follow additional courses and receive economic support to attend summer schools and participate in conferences. There will be the possibility of paid teaching assistantship.