



# PhD in INGEGNERIA MECCANICA / MECHANICAL 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 -  
STRUCTURAL RELIABILITY OF MULTI-FUNCTIONAL SPACE COMPONENTS  
MANUFACTURED BY ADDITIVE MANUFACTURING**

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

**€ 1500.0**

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! Spoke 9: Habitat space and science 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! Spoke 9: Habitat space and science approved by ASI Decree No. 53/2024. ASI Funding Agreement No. 2024-5-E.0 (CUP Master I53D24000060005; CUP POLIMI D43C24000350006).

Additive manufacturing (AM) techniques enable production of complex geometries, that are challenging or impossible to realize through conventional manufacturing methodologies. This unprecedented geometrical freedom allows generating multi-functional parts that may result in a unique combination of different properties, such as excellent thermal behavior, high stiffness-to-weight ratio, as well as energy absorption. Therefore, AM techniques have been increasingly adopted in the space industry.



	<p>have been increasingly adopted in the space industry. However, the transfer from conventional to AM components in space applications introduces unique reliability and safety concerns that need rigorous investigation to meet the stringent aerospace standards. The aim of this research is to address the structural reliability of AM space applications consisting of hybrid lattice-and-solid components with multi-functional capabilities, with the intent to develop predictive tools to reduce experimental testing activities.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The methods and techniques for this objective will be:</p> <ul style="list-style-type: none"> <li>•Development of methodologies to estimate the quality and final mechanical performance of AM space components, combining classic mechanical testing approaches (static, fatigue, and thermal testing) with non-destructive methodologies (acoustic resonance testing, impulse excitation technique)</li> <li>•Assess the impact of AM intrinsic internal and surface defects on the component reliability investigating how the manufacturing process and materials may affect the final performance</li> <li>•Define guidelines and reliability-driven methodologies that address potential failure modes specifically for AM space components</li> <li>•Development of predictive numerical models that could function as component digital twin for the estimation of the in-service performance, including vibrations and thermal cycling, as well as the component response during the launching phase</li> <li>•Validating the predictive models and the reliability assessment methodologies through experimental testing of the component prototype</li> </ul>
<p><b>Educational objectives</b></p>	<p>This project is at the intersection of different disciplines ranging from mechanical/aerospace engineering, material science, and advanced manufacturing. The educational objective is to develop the area of interaction among these disciplines to provide the PhD student new skills to</p>



	these disciplines to provide the PhD student new skills to be applied to the solution of a complex problem.
<b>Job opportunities</b>	Job opportunities are very wide for this topic, and they could be: 1) R&D project engineer for space agencies/companies
<b>Composition of the research group</b>	2 Full Professors 2 Associated Professors 1 Assistant Professors 5 PhD Students
<b>Name of the research directors</b>	Proff. Stefano Foletti, Bianca Maria Colosimo

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<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>	750.0 €
<b>By number of months</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 6.114,50. Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months (approx. 750 euro/month- net amount). Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. 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.