PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 37th cycle

Research Area n. 1 - Advanced Materials and Smart Structures

THEMATIC Research Field: EXPERIMENTAL/NUMERICAL INVESTIGATION OF HIGH VELOCITY IMPACT BEHAVIOR OF 3D-PRINTED CELLULAR STRUCTURES AND GEOMETRY OPTIMIZATION FOR PROTECTIVE DEVICES

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	Thanks to the recent developments of 3D printing technologies, complex geometries made of high performant materials (such as metals and carbon fiber reinforced polymers) can be designed, produced and tested. Cellular structures are some of the most promising for many applications and are recently being studied in many fields of engineering. Among all, notable crashworthiness properties seem to emerge: their main advantage is the possibility to be geometrically optimized for a specific application, using simple parameters such as cell density or thickness. Most of the research found in literature at this day is focused on low energy and low velocity impacts, such as standard crash absorbers. In this context, the research proposed aims to extend the crashworthiness studies to high velocity impacts. The first objective of the research is to understand if and to what extent the aforementioned structures are able to withstand ballistic impacts, implementing reliable numerical models able to describe their behavior; the second objective is to exploit optimization algorithms to propose design solutions alternative to the state-of-the-art protective devices.
Methods and techniques that will be developed and used to carry out the	The research will be focused first on numerical activities

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research	at LaST, passive safety laboratory of the Aerospace Dpt. in Politecnico di Milano. Numerical models will be validated through simple dedicated tests, to be carried out internally. Parallelly, methods to parameterize and optimize the geometry will be implemented. The first specimens will be produced at the AddMe.Lab laboratory of the Mechanical Dpt. in Politecnico di Milano or externally; they will be tested and modelled: from static tests to low-velocity impacts to high energy/velocity tests. At last, geometries will be optimized for specific ballistic applications.
Educational objectives	The main educational objective is the implementation of reliable numerical models able to describe the behavior of 3D printed structures when subjected to high velocity impacts.
Job opportunities	Last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared Master of Science holders in the same field.
Composition of the research group	2 Full Professors 1 Associated Professors 0 Assistant Professors 0 PhD Students
Name of the research directors	Proff. Marco Boniardi, Marco Anghileri

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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

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Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
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: there are various forms of financial aid to support activities of teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations. **Computer availability:** 1st year: individual use 2nd year: individual use 3rd year: individual use **Desk availability:** 1st year: individual use 2nd year: individual use 3rd year: individual use.