Postdoctoral research project opportunity at CNES

Design and optimization of architectured materials for space applications

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Description of the project

Architectured Materials [1] are an emerging class of advanced materials that bring new possibilities in terms of functional properties, filling gaps in *Ashby*'s material performance maps. The term *architectured materials* describes any heterogeneous material that exhibits improved specific properties due to a thoughtful and predetermined morphology and/or topology design. This usually induces characteristic length-scales comparable to the size of the final component being produced, i.e. the millimetre scale. Additive and/or localised laser processing methods appear as natural candidates for developing such materials [2]. While such materials have been considered for spatial applications in the past [3], the specifications for mechanical damping were never considered until now.
In the context of a project aiming at developing architectured materials for space applications, we intend to investigate lightweight metallic materials with structural damping capabilities. Different ways for architecturing materials will be considered, as shown on Fig.1.
The goal of the present project is to optimize the effective (homogenized) behaviour of a deterministic architectured material obtained from powder-based additive manufacturing, as well as validating experimentally the damping behaviour (in collaboration with CNES and CNAM). To do so, a new computational homogenization framework will be developed in order to account for effective damping behaviour.

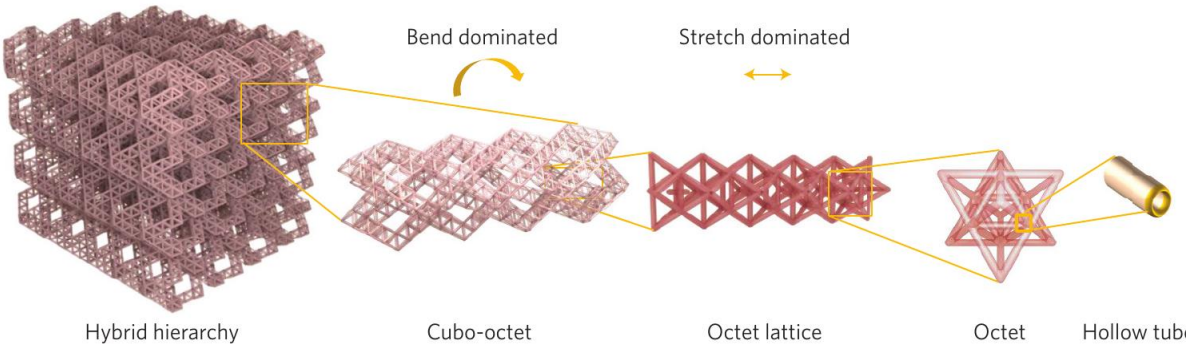

Fig.1 Example of a hierarchical lattice architecturation strategy combining bending and stretching [4]

The successful candidate must be citizen of one of the 23 ESA-affiliated countries. He/she should contact the principal investigator as soon as possible (before May 2017). He/she should hold a PhD at the starting date of the contract. The candidate should have a relevant experience in additive manufacturing and/or topology optimization and/or computational mechanics of materials and structures. The funding is for a 24-month fixed-term contract, starting before the end of 2017. The job is based in Paris, France at the PIMM laboratory (Arts et Métiers-ParisTech/CNAM/CNRS), with interaction with CNES (Paris and Toulouse), as well as possible trips to Australia. Although knowledge of the French language is not mandatory, spoken and written English proficiency is expected.

Keywords:
Architectured materials, topology optimization, additive manufacturing, aerospace.

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[3] C.A. Steeves, S.E. Lucato, L. dos Santos, M. He, E. Antinucci, J.W. Hutchinson, A.G. Evans, *J. Mech. Phy. Sol.,* 55(9), pp.1803-1822, 2007.
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