Holistic approach of chirality in architectured metamaterials

Context

Chirality is a property of assymetrical geometry with multiple consequences in physics; from spin of electron to spiral galaxies. In solid mechanics, chirality has also a role, especially when considering the behavior of auxetics, or negative Poisson's ratio materials [1] ; they will be refered to as **architectured auxetic metamaterials** (AAM). Architectured materials are heterogeneous materials presenting enhanced specific properties due to a predefined, optimized, morphological and topological design [2]. Such materials generally induce characteristic lengths that are comparable to the dimensions of the structural component, hence violating the classical hypothesis of scale separation in continuum mechanics. Metamaterials can be considered as a subclass of architectured materials with paradoxal physical properties (negative effective mass, invisibility, negative Poisson's ratio or bulk modulus, etc.).

Classical homogenization approaches in mechanics rely on Cauchy-type homogeneous equivalent media, although they cannot render chirality effects and are not sufficient to describe the behavior of AAM. Generalized continua models have been proposed in the past [3], but neither the computational power, nor the appropriate experimental means, were available for concluding on the actual role played by chirality in solid mechanics. The aim of the APHORISME project is to probe the pertinence of generalized continua models by maximizing the non-standard effects of such models. It consists in a holistic approach encompassing experimental, computational and modelling work. This project, funded by CNRS and Arts et Métiers-ParisTech, through F2M (Fédération Francilienne de Mécanique), is a collaboration between several laboratories in the Paris region.

Missions of the postdoc

- Definition of enriched experimental boundary conditions based on computational results, e.g. [4]
- Experimental determination of kinematic fields using multi-axial loading and digital-image correlation
- Computational simulation and homogenization based on generalized continua theories, using FE

The candidate

The candidate should have obtained a PhD in solid mechanics, materials science, or any related field. He/she is expected to conduct advanced experimental work, as well as enriched simulation and modelling. A prior experience with one or more aspects of the project is expected from the candidate, i.e. coding and/or scripting, field measurements, generalized continua, finite element implementation, auxetics, etc.

The experimental work will be conducted in LMT-Cachan (http://goo.gl/f4lJKd), while the modelling and numerical implementation will take place in PIMM (http://goo.gl/3YiZqP), which is located in the heart of Paris. Net pay is about 2000 EUR per month. The position is to be filled as soon as possible, for a period of 12 months, with a possibility of extension.

To apply, please send a single pdf file including a detailed CV, a full list of publications and a cover letter, to the three following e-mail addresses:

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References

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