Proposition de stage pour Master 2 au LaMCoS – INSA Lyon
Période : dès que possible (6 mois)
Internship proposition (Master 2) at LaMCoS – INSA Lyon
Internship period: as soon as possible (6 months)
Internship funded by the LABEX IMUST Université de Lyon

Towards real time topology optimization of architectured materials

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Architectured materials are artificial composites possessing specific properties obtained thanks to adequate topology or morphology designs. They are given high attention in many industrial applications (aeronautic, biomedical, building, vehicles, …) thanks to their enhanced performances (e.g. auxetic materials with negative Poisson ratio and negative thermal expansion materials). *Topology optimization* gives an efficient and practical way to distribute the material within a design domain and thus achieve the optimized performances. Such materials can be easily manufactured using 3D printer (additive manufacturing). The high power resolution of the recent 3D printers allows to achieve billion voxels design of architectured materials opening so the possibility to develop materials with original microstructures. However, the algorithms usually used in industrial as in house software for topology optimization reach their limits when scaling with small microstructures sizes. Moreover, running many computations for parametric studies (specific optimization) still remains a challenging issue for many engineering applications. To handle this issue, we propose in this project to extend the application of original real time strategies[1] developed in the Contact and Structure Mechanics Laboratory (LaMCoS, INSA Lyon) to the case of topology optimization. The idea is to go towards real time designs fulfilling the designer dream to have between hands an efficient and rapid tool making him able to instantaneously choose the optimized design for a given exigence. The milestones to be studied by the student are:

- ***Offline learning stage***: building a database of optimized architectured materials
- ***Online design stage***: adopting an original real time approach leading to rapid topology optimization without rerunning the topology optimization process

An experimental verification of the behavior of the designed architectured materials can be hold out finally using additive manufacturing techniques.

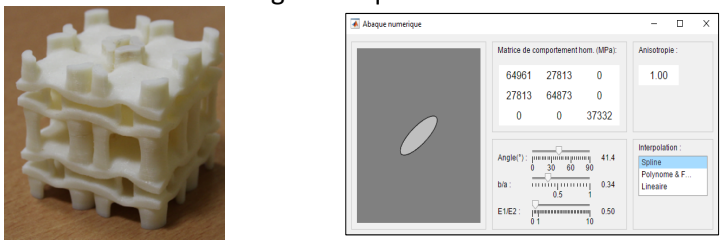

Figure 1: example of an auxetic material obtained with topology optimization and printed using additive manufacturing (left) and example of a new developed computational vademecum for real time computations over parametric microsctructures (right)

Software: Matlab, Fortran
Keywords: Multiscale Topology optimization, Free material optimization, ROM,
We are looking for a Master 2 student with a high level in applied mathematics or/and computational mechanics. To apply, send your CV and a cover letter (in French or English)

[1] Y Lu, N Blal, A Gravouil. Adaptive sparse grid based HOPGD: Toward a non-intrusive strategy for constructing space-time welding computational vademecum. *IJNME*, 114(13):1438–1461, 2018
N Blal, A Gravouil. Non-intrusive data learning based computational homogenization of materials with uncertainties, Comp. Mech. 64 (3), 807-828, 2019