Towards real time topology optimization of architectured materials

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. Topology optimization gives a 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. 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 for topology optimization reach their limits when scaling with small microstructures sizes. Moreover, running many computations for parametric studies (e.g. specific case optimization) still remains a challenging issue for many engineering applications. To handle this issue, real time original strategies are combined with multiscale topology optimization. At the offline step, a database of optimized architectured materials is built, it is then called at the online step for real time and rapid topology optimization without any need to rerun the topology optimization process.