Internship topic. Characterisation of damping properties of metallic parts fabricated by means of Selective Laser Melting process

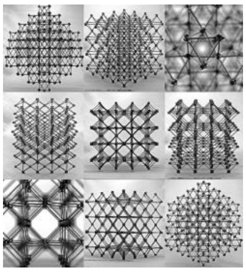
Context. OCEAN-ALM Project: Optimisation et Conception pour une mEthodologie AvaNcée pour l'ALM (*Additive Layer Manufacturing*).

This internship is part of the OCEAN-ALM Project co-funded by Nouvelle-Aquitaine Region and Commisariat de l'Energie Atomique (CEA). The consortium is composed by two academic partners, i.e. I2M laboratory (Bordeaux) and ESTIA (Bayonne) and two industrial partners, i.e. CEA-CESTA and SEIV (both located in Bordeaux). The OCEAN-ALM project aims at:

- defining new CAD parametric tools (i.e. new geometric entities) to be used in classical topology optimisation problems;
- develop a new topology optimisation algorithm in the context of differential and variational geometry (not FE-dased);
- integrating the manufacturing constraints due to the ALM technology into the CAD and the proposed algorithm in order to get complex optimum geometries that could be really fabricated through the ALM process.

Internship goals

The experimental and numerical evaluation of the natural frequencies of a given structure is a rather classical topic in engineering. The determination/prediction of natural frequencies is of paramount importance especially to understand the dynamic behaviour of the structure but this information can be exploited also for different purposes. For example, natural frequencies can be utilised as reference data to characterise the elastic properties of the material/s constituting the structure (at each pertinent scale) in the framework of a multi-scale inverse approach. However, the frequencies measured experimentally are always affected by the material damping properties, therefore the identification of the structure/material damping capability (i.e., the so-called material loss factors) at each relevant scale as well as its evolution with the frequency is very important for structural application involving vibration.
In this background, this internship aims at generalising the multi-scale identification strategy (MSIS) developed at I2M by taking into account for the viscoelastic behaviour of the structure. The goal is to utilise the MSIS to characterise the material loss factors at each pertinent scale (micro-meso-macro). The effectiveness of the proposed approach will be proven firstly on a meaningful benchmark, i.e., on a simple structure fabricated by means of the SLM process, and then applied to complex metallic lattice structures.
In a second time, the topology of the representative volume element (RVE) of the lattice structure will be optimised in order to maximise the damping capabilities and to satisfy mass and stiffness requirements imposed by a real-world engineering problem.



Internship tasks

1. Bibliographic analysis on viscoelastic materials.
2. Bibliographic analysis on non-linear modal analysis and harmonic analysis
3. Development of a FE model for predicting non-linear damped natural frequencies
4. Fabrication of a reference structure through SLM process
5. Experimental modal analysis
6. Application of the MSIS to the reference structure
7. Fabrication of the reference lattice structure
8. Application of the MSIS to the lattice structure
9. Topology optimisation of the lattice RVE

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