Fully funded PhD position – 2025/2028

Project Title

Efficient numerical framework for the design of lattice structures with advanced dynamic behaviour.

Key Information

Expected start date: November 1, 2025
Application deadline: September 30, 2025
Location: UTBM – Sévenans Campus (Belfort, France)
Funding: ANR project DynOpt4Lattice (Agence Nationale de la Recherche)

Keywords

Computational mechanics, additive manufacturing, machine learning, high-performance computing, CAD/CAE integration, applied mathematics, structural dynamics, architected materials.

Candidate Profile

Required degree : Master's degree (MSc)

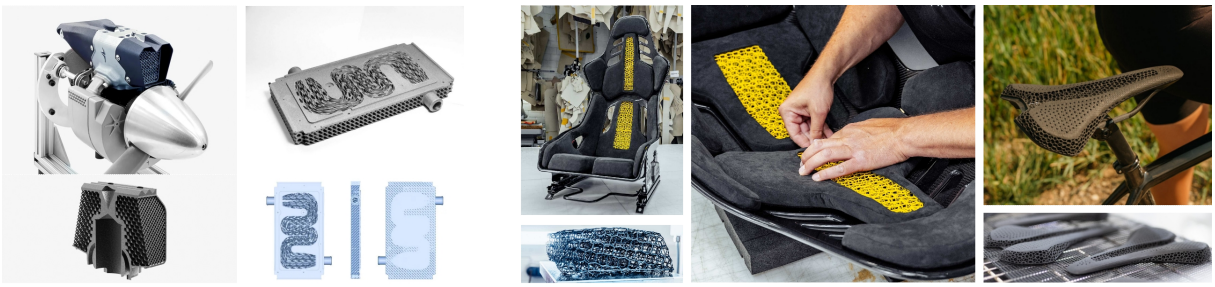
Two typical profiles are possible:

- A mechanical engineer with strong interest in numerical methods development (programming, applied mathematics),
- An applied mathematician/numerical analyst interested in modelling and applications in mechanics.

Examples of relevant skills/knowledge:

- Finite element method (formulation, implementation, usage),
- Optimisation (formulation, algorithms, applications in structural mechanics),
- HPC computing, reduced-order modelling, machine learning,
- Vibrations and structural dynamics, architected materials,
- Additive manufacturing, mechanical testing.

Project Overview: Context and Objectives



(a) (b)

Figure – Example of additively manufactured lattice structures. Credits: (a) nTopology, (b) OECHSLER.

The emergence of ***additive manufacturing*** (commonly referred to as 3D printing) has opened new perspectives in engineering. It is now possible to produce highly complex geometries, leading to superior mechanical behaviours compared to conventional structures. In this context, there is growing interest in ***lattice structures*** (also called architected or architectured structures/materials). These approaches are directly inspired by architectural forms found in nature: the core of the structure is

porous, and the arrangement of void and material is carefully designed to achieve optimised global properties. Examples include honeycomb structures or the porous microstructure of bone tissue.

This PhD project will investigate lattice structures designed to achieve optimal dynamic performance, as for instance advanced dampers to mitigate unwanted vibrations, or high-performance absorbers providing enhanced impact protection. Potential applications are broad and cover many industrial sectors.

Conventional numerical approaches used in design offices are inefficient for simulating such complex geometries. For example, the memory and computation time required become prohibitive with standard "black-box" finite element methods. ***The objective is therefore to develop a dedicated numerical workflow for the dynamic analysis and the design optimisation of lattice structures.*** Promising preliminary results motivate the following strategies:

- Use of isogeometric analysis (tight CAD/CAE integration, improved numerical approximation, advantages for shape optimisation),
- Development of surrogate/reduced-order models (including data-driven approaches, significant computation time reduction),
- Dedicated HPC solvers (domain decomposition, parallel/distributed computing),
- Formulation and solution of optimisation problems (automation, optimal structural design)

The developments will follow ***open science practices***. The PhD will result in a ***demonstrator***: selected lattice structures will be produced and tested experimentally using the laboratory's additive manufacturing and testing facilities.

Funding and Supervision

This PhD is funded by the ANR project DynOpt4Lattice (Agence Nationale de la Recherche). The host institution is the *Laboratoire Interdisciplinaire Carnot de Bourgogne* (ICB), CNRS UMR 6303, within the CO2M research team ("Conception, Optimisation et Modélisation en Mécanique"), located on the Sévenans campus of the *Université de Technologie de Belfort-Montbéliard* (UTBM).

Supervision:

- **Thibaut Hirschler** (Assistant Professor, UTBM/ICB), coordinator of DynOpt4Lattice,
- **Dominique Chamoret** (Associate Professor, HDR – Habilitation, UTBM/ICB).

Collaborations:

- A postdoctoral researcher and a master student will also be involved in the project,
- Close collaboration is established with the MNS research group led by Prof. Annalisa Buffa (Institute of Mathematics, EPFL), including possible short research stays in Switzerland,
- The PhD candidate will also interact with the project's industrial advisory board.

Application

Applications (CV + cover letter or detailed email) should be sent to Thibaut Hirschler, clearly stating the candidate's motivation for the position and the good fit with the profile.

Deadline: September 30, 2025.

Contacts for further information:

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