Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : DRUESNE Given names : FREDERIC

Status (prof., assistant prof., …) : Professeur

Laboratory :	Roberval	Website address : https://www.utc.fr/
Institution :	UTC, Alliance Sorbonne Université	Website address : https://roberval.utc.fr/

Scientific competence of the supervisor:

The supervisors' skills are in the field of computational mechanics. In particular, they have contributed to the development of metamodels within the framework of stochastic approaches to assess the robustness of beam, shell and solid structures. This experience in metamodel development will also be valuable for the proposed topic on optimisation, in order to achieving robust optimization of truss structures. The supervisors have also developed an adaptive methodology to identify, in the context of linear static analysis, optimal finite element models from a theory choice point of view.

Two major publications in the field proposed for the PhD :

1. M. Mahjudin, P. Lardeur, F. Druesne, I. Katili, Extension of the CGSM for the stochastic analysis of homogeneous and laminated shells, Computer Methods in Applied Mechanics Engineering, 2020
2. Guoqiang Wei, J. Paroissien, P. Lardeur, F. Druesne, M. Oujdene, An adaptive modeling method with a local choice of optimal displacement fields for FE analysis of structures, Thin–Walled Structures, 2024

Website address of the personal page : https://www.researchgate.net/profile/Frederic-Druesne

Supervisor's email : fdruesne@utc.fr

Description of the research work proposed for a PhD ***Topic # (see list) :*** VI-4

Title : Heuristic methods for robust optimization of bar and beam truss structures

Subject :

One challenge in structural design is successfully balancing optimization and robustness. The goal is therefore to design a lightweight structure that takes into account the variability of its properties, it is referred to as optimization under uncertainty. Then, the minimization of the variability of the structural behavior under load leads to designs which are more robust to material and physical uncertainty. For truss structures, these objectives can be achieved through the following proposition. First, an uncoupled approach can be proposed, consisting of a deterministic design optimization step to obtain minimum mass structures and a stochastic modeling step to evaluate the robustness of the optimized structure. Then, the development of a coupled approach is necessary, which performs the design optimization considering stochastic modeling. A new optimization algorithm needs to be developed, based on the use of meta-models as local approximation and optimality criteria. The methodology is thus an heuristic for robustness optimization. These approaches will be tested and validated progressively for academic structures, followed by more complex ones. Truss structures will be modeled using the finite element method, with modeling choices including 1D bars, 2D bars, 3D bars, 2D beams and 3D beams.

Keywords :

robustness optimization - stochastic modeling - heuristics – optimality criterion

Expected collaborations :

The heuristic methods used in this thesis will result in optimised and robust lattice structures. Collaboration is planned with a research team specialising in materials and manufacturing processes. In particular, additive manufacturing appears to be a highly suitable process. Finally, in order to evaluate the robust optimisation of these manufactured structures, it is also planned to carry out mechanical tests on several specimens.

Background required from the applicant :

Finite element method, Continuum mechanics, Programming with Matlab or Python

Existence of a PDF file detailing the proposal ("yes" or "no") : no

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