

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 : Breitkopf Given names : Piotr

Status (prof., assistant prof., ...): CNRS Research Engineer, HDR

Laboratory : Roberval, FRE 2012 UTC-CNRS Website address : roberval.utt.fr

Institution : Université de Technologie de Compiègne Website address : www.utt.fr

Scientific competence of the supervisor:

Research topics

- Computational mechanics
- Multidisciplinary Design Optimization
- Reduced-order modeling
- Parallel and Distributed Computing
- Diffuse Approximation

Two major publications in the field proposed for the PhD :

1. Xia, L., Breitkopf, P. Concurrent topology optimization design of material and structure within FE2 nonlinear multiscale analysis framework (2014).
2. Phalippou, P., Bouabdallah, S., Breitkopf, P., Villon, P., Zarroug, M. Sparse POD modal subsets for reduced-order nonlinear explicit dynamics (2020).

Website address of the personal page : <http://www.utt.fr/~breit>

Supervisor's email : piotr.breitkopf@utt.fr

Description of the research work proposed for a PhD

Topic # (see list) : I-1, IV-6

Title : Ultra-large-scale Topology Optimization

Subject :

Since its initiation three decades ago, topology optimization (TO) has undergone tremendous development and is now used to conceive weight-efficient parts and smaller structures in all major mechanical engineering industries. Despite its successes, still many outstanding challenges before TO approaches remain, including relevant physical modeling and simulation of large complex structures. Such topics as multi-scale TO of and with complex lattice structures, motivated by an extremely fine resolution of the additive manufacturing process, require ultra-high performance simulation and robust approaches. Giga-voxel resolution TO presently requires $+10^6$ CPU hours, which is hardly affordable for a majority of users, hence more efficient, possibly multi-scale, techniques must be developed and implemented. Therefore, to provide breakthroughs, algorithms have to be rethought entirely, possibly using machine learning or reduced order methods.

Rather than aiming at applications, the goal of the proposed Ph.D. thesis project is to explore and develop original numerical approaches, involving mathematical formulations, design of algorithms, further illustrated by software prototypes and validated on high-resolution versions of standard benchmarks of compliant structures and mechanisms. The focus is clearly on fostering future concepts for optimizing ultra-large-scale or ultra-complex structures, including physically relevant

Keywords :

Topology Optimization, High Performance Computing, Reduced-Order Modeling

Expected collaborations :

Dr. Balaji Raghavan, INSA de Rennes

Background required from the applicant :

A solid background from the fields of applied mathematics (Linear Algebra) and/or computational mechanics (linear/nonlinear, static/dynamic finite element simulation techniques) is required as well as a passion for software development (fluency in Matlab is a minimum requirement). Candidates with a documented experience in finite element modeling/TO/Matlab programming are strongly encouraged. A high profile candidate will possess a record of publications in international scientific journals, published during her/his MSc.

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

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