

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 : Rachik Given names : Mohamed

Status (prof., assistant prof., ...) : Assistant professor (with Habilitation to supervise research)

Laboratory : Laboratoire Roberval, FRE UTC-CNRS 2012, Centre de recherche Royallieu Website address : <http://roberval.utc.fr/>

Institution : Sorbonne universités, Université de technologie de Compiègne Website address : www.utc.fr

Scientific competence of the supervisor:

- Constitutive modeling of materials including rate dependent and pressure dependent elastoplasticity and hyperelasticity.
- Algorithms for constitutive model integration
- Constitutive model calibration with inverse analysis
- Development of load stepping algorithms for non linear problems with special interest in non iterative schemes (4th order Runge-Kutta)

Two major publications in the field proposed for the PhD :

1. Raelison et al., Modeling and numerical simulation of the resistance spot welding of zinc coated steel sheets using rounded tip electrode, Applied Mathematical Modelling, 38 (9), 2505-2521, 2014
2. C. Darcourt, J.M. Roelandt, M. Rachik, D. Deloison, B. Journet, Thermomechanical analysis applied to the laser beam welding simulation of aeronautical structures, Journal de Physique IV 120, 785-792, 2004.

Website address of the personal page : https://www.researchgate.net/profile/Mohamed_Rachik2

Supervisor's email : mohamed.rachik@utc.fr

Description of the research work proposed for a PhD Topic # (see list) : VI-1

Title : Multiphysics computation and phenomenological analysis of SLM additive manufacturing

Subject :

This PhD work focuses on the predictive simulation of multiphysical and transient phenomena during SLM AM process. The research works fall into three major parts, firstly: the simulation of phenomenological interactions between the laser impulse and the powder media, to characterize the thermal kinetics during the formation of a layer due to both heat transfer involved by the fast laser heating and solid/fluid kinematics of the particles. This part investigates the temperature gradients, the thermal kinetics, and the transient fluid flow of molten media within the powder bed during a single layer step. A second part focuses on the metallurgical transformation within powders governed by the thermal kinetics generated by the SLM process. This work package relies on mesoscale thermo-metallurgical simulations that compute the metallurgical zones within individual powders and across the consolidated bed. This task will include a coupling with a mechanical analysis for investigating structural distortion due to thermal dilatation and metallurgical strain during cooling. The third part deals with the computation of microstructure formation and growth governed by the thermal gradient and kinetics during SLM. The major objective is to analyze the effects of heating and cooling on microstructure orientation. Steel is the material we choose as material of reference. The numerical simulation will be performed using Fluent, Abaqus, and LS-Dyna packages.

Keywords :

SLM, computation, transient processes, structural changes, thermomechanical analysis

Expected collaborations :

Co-supervisor: R.N. Raelison
Université de Bourgogne Franche-Comté - UTBM, Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR 6303 CNRS, 90100 Belfort, France

Background required from the applicant :

Computational material science, Mechanics of materials, Finite element method, Heat transfer, Computational fluid dynamics

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

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