MINES PARIS | PSL | Cemef

UMR CNRS 7635

Centre de Mise en Forme des Matériaux

Post-doctoral Position

FAST-AM: Toward Real-Time Part-Scale Modeling of Additive Manufacturing Processes

Keywords: Additive Manufacturing, part scale modeling, real time prediction

Supervision:

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Partners of project:

The FAST-AM project is under the framework of the SINO-FRENCH INSTITUTE OF COMPUTING TECHNOLOGY FOR ADVANCED MATERIALS (CTAM).

General context of the project:

During the PhD and postdoctoral research of Joël KEUMO TEMATIO [1], a finite element software package was fully developed [2]. It is dedicated to the thermomechanical analysis of the Directed Energy Deposition (DED) additive manufacturing process and incorporates several model reduction techniques [3]. The developed numerical methods have demonstrated significant reductions in computational time for relatively simple DED structures. However, further improvements in efficiency and validation on part-scale components are still required.

Post-doctoral objectives:

Part of the work consists in implementing selected model reduction techniques within the internal numerical platform, while continuously advancing previous package through the integration of more sophisticated reduction strategies and the development of an optimization module at CEMEF.

The Key point of the subject:

The overall objective of FAST-AM is to accelerate the numerical modeling of the additive manufacturing process by developing advanced model reduction techniques and applying them to the design of complex parts.

As illustrated in Fig. 1, the model reduction strategy combines the Inherent Strain Rate (ISR) method and Proper Orthogonal Decomposition (POD). These techniques have been applied to Directed Energy Deposition (DED) simulations for a simple structure with varying curvatures, achieving a speedup of approximately 100× [3]. To further decrease computational cost, an additional reduction step based on hyper-reduction methods is proposed.

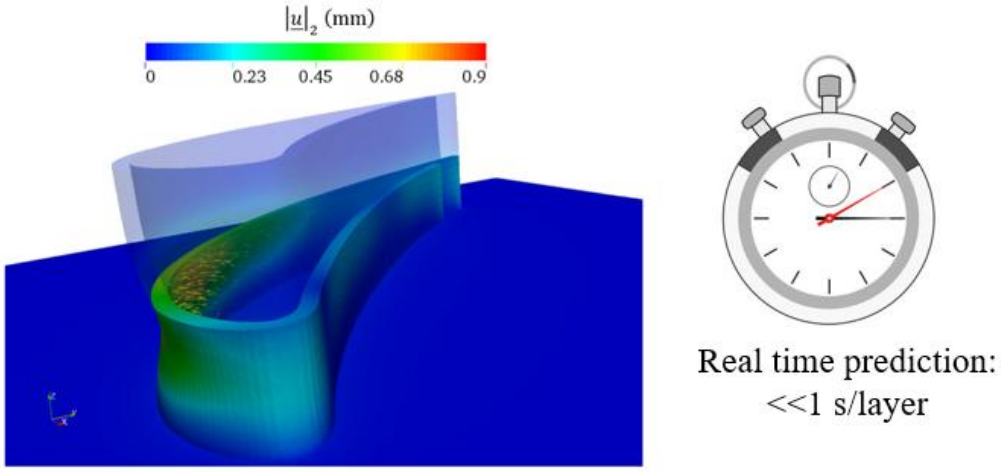

Figure 1: Distortion prediction in the DED process using the ISR–POD simulation approach, achieving a speedup of approximately 100× [3].

Three main tasks are planned in this project:

1. **Implementation of model reduction techniques within the internal library**: Reproduce the part model simplification methods within the internal numerical platform, including the ISR approach and its coupling with POD-based model reduction. Validation will be performed on both simple and complex structures within the additive manufacturing (AM) framework.
2. **Development of hyper-reduction and optimization tools**: Complete the development of hyper-reduction methods in previous numerical package and implement an optimization module to identify optimal process parameters.
3. **Fast residual stress prediction module**: Develop a dedicated module for the rapid prediction of residual stresses under specified constraints.

Finally, an integrated platform for fast additive manufacturing (AM) modeling and optimization will be implemented. By combining physics-based high-fidelity modeling with data-driven prediction, the system will enable high-accuracy simulation, rapid prediction, automated optimization, and real-time process control, providing a digital twin solution tailored to the needs of the AM domain.

Profile sought:

The candidate should hold a PhD degree, or be close to completing a PhD, in numerical methods, particularly in computational mechanics, high-performance computing, or a closely related field. The candidate is expected to demonstrate a strong interest in the numerical modeling of additive manufacturing processes and in model reduction techniques.

Bibliography references:

[1] J. Keumo Tematio, Simulation numérique du procédé de fabrication additive DED : résolution thermomécanique incrémentale complète et modèles réduits de type "inherent strain", PhD thesis, MINES Paris – PSL, 2022.
[2] J. Keumo Tematio, Y. Zhang, M. Bellet. Am ². A fast numerical modeling tool for Additive manufacturing process at part scale, hal-04396479 v1.
[2] J. Keumo Tematio, D. Ryckelynck, M. Bellet, Y. Zhang. Construction of Data Sequence for Model Order Reduction in Thermomechanical Modeling of DED Additive Manufacturing. International Journal for Numerical Methods in Engineering, 2025, 126 (4), e70005.

Overview of CEMEF and of your future research team:

You will join **CEMEF**, the largest research center of **Mines Paris – PSL** associated with the **CNRS**. For more than fifty years, CEMEF has been conducting cutting-edge research in **mechanics, materials, numerical simulation, and artificial intelligence**, in close collaboration with industry and academic partners. The center hosts around **170 people**, including approximately **75 PhD candidates**, within a highly international and multidisciplinary environment.

The doctoral project will be supervised by scientists from the research teams 2MS and CFL.

The research activities of the 2MS and CFL teams focus on the development of numerical methods and their application to additive manufacturing processes.

Type de contrat	CDD	
Working time	Full time	
Duration	2 years	**Online application** https://www.cemef.minesparis.psl.eu/post-doctorat/
Salary	Approximately 35 k€ gross per year (before income tax)	**Application deadline :** 31/08/2026
Location	CEMEF Mines Paris 1 rue Claude Daunesse 06904 Sophia Antipolis, France	
Starting date	October 1st, 26	