

## Research Topic for the Arts et Métiers ParisTech - CSC PhD Program

### Arts et Métiers ParisTech – LCFC – DANTAN 02

**Subfield:** Mech. Eng. Manufacturing Eng.

**ParisTech School:** Arts et Métiers Paris Tech

**Title:** Models and Methods for quality prediction in Additive Manufacturing for Tooling

**Advisor(s):** Prof. Jean-Yves DANTAN, Dr Nicolas BONNET, Dr Mickael RIVETTE

[Jean-yves.dantan@ensam.eu](mailto:Jean-yves.dantan@ensam.eu); [nicolas.bonnet@ensam.eu](mailto:nicolas.bonnet@ensam.eu); [mickael.rivette@ensam.eu](mailto:mickael.rivette@ensam.eu)

#### **Short description of possible research topics for a PhD:**

Additive Manufacturing for tooling compresses the whole product development cycle and acts as a driver for innovation. By reducing lead time of tooling production and enabling for quick updates of an existing tool design, AM enables companies to afford for more frequent tooling replacement and improvement. It allows tooling design cycles to keep pace with product design cycles.

To maintain quality, process variability must be reduced, as must the sensitivity to process variations. To achieve this, research in the following areas is needed:

- Develop predictive process-structure-property relationships,
- Develop modeling systems that combine design and manufacturing. The ability to predict manufacturing outcomes would decrease defects and increase part quality. Geometrical accuracy is crucial in the manufacturing for a process to be competitive.

The scientific main objective is to improve models and methods for variation prediction during this design phase. This proposal will focus on a contribution in developing:

- Models to predict the quality of additive manufactured tool (Prediction of surface roughness and dimensional deviation) and the quality of the final product. Prediction of surface finish and dimensional deviation is an essential prerequisite for developing an Additive Manufacturing process for tooling. Two main attributes of job quality are surface roughness and dimensional deviation.
- Methods for model assessment. Due to its importance regarding model performance an analysis of the geometrical accuracy will be conducted by an experimental approach.

**Required background of the student:** Mechanical eng. and Manufacturing eng.

#### **A list of 5 (max.) representative publications of the group:**

- Parlad Kumar, Rupinder Singh, I.P.S. Ahuja, "Investigations on dimensional accuracy of the components prepared by hybrid investment casting", Journal of Manufacturing Processes, Vol. 20 (2015) pp. 525 - 533
- Berumen, Sebastian, Florian Bechmann, Stefan Lindner, Jean-Pierre Kruth, and Tom Craeghs. 2010. 'Quality Control of Laser- and Powder Bed-Based Additive Manufacturing (AM) Technologies'. Physics Procedia 5: 617–22.
- Huang, Qiang, Jizhe Zhang, Arman Sabbaghi, and Tirthankar Dasgupta. 2015. 'Optimal Offline Compensation of Shape Shrinkage for Three-Dimensional Printing Processes'. IIE Transactions 47 (5): 431–41.
- Dumas A., Gayton N., Dantan J.Y., Sudret B., "A new system formulation for the tolerance analysis of overconstrained mechanisms". Probabilistic Engineering Mechanics, Volume 40, April 2015, Pages 66-74.

**FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:**

[ali.siadat@ensam.eu](mailto:ali.siadat@ensam.eu) AND [yvon.velot@ensam.eu](mailto:yvon.velot@ensam.eu)