

Research Topic for the ParisTech/CSC PhD Program

Subfield: Mechanical Eng. & Manufacturing Eng.

Title: Data driven manufacturing imperfections prediction – Digital twin for geometrical quality management

ParisTech School: Arts et Métiers ParisTech

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Short description of possible research topics for a PhD:

This aim of this proposal is the development of approaches and techniques to characterize the inherent imperfections of manufacturing processes and resources. Effective reuse of enterprise data about manufacturing processes is a key strategic component of the robust design, tolerance allocation ... Process capability approach allows for an understanding of the capability of machines, tools, and operators to manufacture a particular feature of a particular dimension. With the data captured in digital twins, it is possible to evaluate the process capability in real time, and also to predict the realized shape with geometrical deviations (predictive modeling). The digital twins will allow the check for conformance of the product specifications with the design intent and customer requirements. To do so, the digital twin is insufficient possibilities for synchronization between the physical and the digital world to establish closed loops:

- the missing of high-fidelity models for simulation and virtual testing at multiple scales,
- the lacking uncertainty quantification for such models,
- the difficulties in the prediction of complex systems, as well as the challenges for gathering and processing large data sets.

Required background of the student: Mechanical / Manufacturing engineering, Data mining

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

- HUANG, Z., DANTAN, J.-Y., ETIENNE, A., BONNET, N., RIVETTE, M., “Geometrical deviation identification and prediction method for Additive Manufacturing”, 2018, Rapid Prototyping Journal, in press.
- BEAUREPAIRE, P., MATTRAND, C., GAYTON, N., DANTAN, J.-Y., “Tolerance Analysis of a Deformable Component Using the Probabilistic Approach and Kriging-Based Surrogate Models”, 2018, ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, 4 (3)
- MORSE, E., DANTAN, J.-Y., ANWER, N., SÖDERBERG, R., MORONI, G., QURESHI, A., JIANG, X., MATHIEU, L., “Tolerancing: Managing uncertainty from conceptual design to final product”, 2018, CIRP Annals, 67 (2), pp. 695-717.
- HOMRI, L., GOKA, E., LEVASSEUR, G., DANTAN, J.-Y., “Tolerance analysis — Form defects modeling and simulation by modal decomposition and optimization”, 2017, CAD Computer Aided Design, 91, pp. 46-59.
- DANTAN, J.-Y., HUANG, Z., GOKA, E., HOMRI, L., ETIENNE, A., BONNET, N., RIVETTE, M., “Geometrical variations management for additive manufactured product”, 2017, CIRP Annals - Manufacturing Technology, 66 (1), pp. 161-164.