RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Materials Science, Mechanics, Fluids
Subfield: Mechanical/Material/Process Engineering

Title: Optimization of Robotic Friction Stir Welding through monitoring

ParisTech School: Arts et Métiers Sciences et Technologies

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Research group/Lab: LCFC (http://lcfc.ensam.eu) /
Lab location: Metz - France

Short description of possible research topics for a PhD:

Friction Stir Welding, *on ABB IRB 8700 robot*

Friction Stir Welding (FSW) is an innovative solid-state welding process which will be fully implemented in the "industry of the future" in assembly line. To reduce weight, FSW will allow to weld the entire range of aluminum alloys and to reduce production costs, the use of robot is recommended. To promote FSW in production for complex and high value added workpieces, many scientific and technological challenges needs to be solved. Based on the study of the friction stir welding forces applied during the process, many research topics to optimize the process can be driven. The first one is the optimization of the tool in order to reach a high quality weld and low process forces. It will enable to weld higher thickness with a robot or lowering the robot deflections it undergoes under the load, leading to non-acceptable tool path trajectory modification. The second one is to create a database to define a way to monitor the process thanks to the recorded forces and to detect welds with quality problems. Therefore, an automatic weld quality evaluation, based on recorded force data, will be developed and implemented on a FSW system in order to reduce control after welding. Depending on the abilities of the candidate, one or the other of these research directions will be further developed.

Required background of the student:

The student must have very good knowledge in mechanical engineering.

A list of representative publications of the group:

1. Y. YANG and T. BALAN. Prediction of the yield surface evolution and some apparent non normality effects after abrupt strain-path change using classical plasticity. Int. Journal of Plasticity (2019), 119; 331-343.
2. ZIMMER et al. Experimental investigation of the influence of the FSW plunge processing parameters on the maximum generated force and torque, International Journal of Advanced Manufacturing Technology (2010)
3. K. KOLEGAIN et al. Off-line path programming for three-dimensional Robotic Friction Stir Welding based on Bézier curves. Industrial Robot: An International Journal (2018).