RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Materials Science, Mechanics, Fluids
Subfield: Mechanical/Material/Process Engineering
Title: Improving formability of lightweight metallic materials using process chaining: Incremental Forming and Friction Stir Welding
ParisTech School: Arts et Métiers Sciences et Technologies

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Research group/Lab: LCFC (http://lcfc.ensam.eu) / LAMPA (http://lampa.ensam.eu)
Lab location: Metz and Angers – France

Short description of possible research topics for a PhD:


Friction Stir Welding
on ABB IRB 8700 robot


SPIF
on ABB IRB 8700 robot

The current trends of the "industry of the future" include dramatic product customization (small batch production) along with optimized lightweight construction, in particular in transportation industries. Innovative technologies to answer these challenges include robotized forming and assembly processes like single point incremental forming (SPIF) and friction stir welding (FSW), in conjunction with sheet aluminum alloys. Developed during the last two decades, these promising processes still exhibit numerous scientific and technological challenges. Process chaining, on the same part and robot, would allow for a deeper optimization at an improved cost, allowing for the right material at the right place; however the impact of assembly on the residual formability is little known. Establishing the relationship between process parameters and part quality after welding and further forming would be a significant achievement. Controlling the sheet temperature is one of the promising directions to further improve the formability. The final objective is to propose a numerical approach to simulate the forming processes including the chaining effects. 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 forming processes of metallic materials and in numerical simulation. Some background in metallurgy will be also appreciated.

A list of 5 (max.) 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. D. Rou et al. Experimental and numerical investigation of the mechanical behavior of the AA5383 alloy at high temperatures. Journal of Materials Processing Technology (2020), 281; art. no. 116609.
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).
4. S. Boudhaouia et al. Experimental and numerical study of a new hybrid process: multi-point incremental forming (MPIF). International Journal of Material Forming (2018), 11; 815–827.