

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

Subfield: Mechanical Engineering, Applied Mathematics.

ParisTech School: Arts et Métiers – ParisTech

Title: Mechanical characterization of aluminum friction stir welded (FSW) joint using digital image correlation.

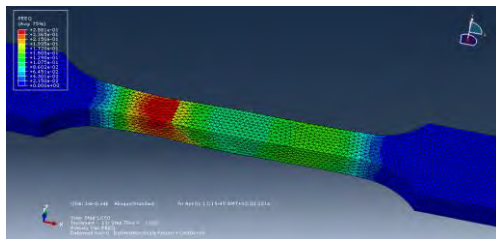
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Short description of possible research topics for a PhD:

Friction Stir Welding (FSW) is a solid state joining technology patented since 1991 by The Welding Institute (TWI). It is used to joint strength alloys when conventional welding techniques are unusable. The PhD project will focus on the development of a new, fast and accurate identification protocol of the parameters of the mechanical behavior. This protocol will be used to study the influence of the technological parameters of the FSW (i.e. tool rotation speed, tool advancing speed, tool shape and inclination, revolutionary pitch, normal welding force) on the mechanical behavior of a dissimilar assembly of aluminum alloys.

For each set of FSW parameters, the mechanical characterization will be performed using full-field strain measurements over the 7 zones situated in the welded joint (the “nugget” zone, 2 thermo-mechanically affected zones TMZ-A and TMZ-B, 2 heat affected zones HAZ-A and HAZ-B, and 2 base metals A and B). These strain fields will be measured during one tensile test. The identified set of parameters of the mechanical constitutive laws of the theses zones will be validated by finite element analysis of the tensile test, and compared with micro-hardness profiles along the welded joint.

Finally, numerical cross-curves will be determined in order to correlate the obtained mechanical performances of the welded joint with the base metals properties and the processing parameters.



Tensile test on a weld joint obtained by FSW : longitudinal strain field. [Hadjji, Haddadi, Badji, 2016, internal report]

Required background of the student:

- Mechanical engineering, Mechanical behavior of materials
- Finite element method and Matlab tools will be appreciated.

A list of 5 (max.) representative publications of the group: (Related to the research topic)

- H. Haddadi, S. Belhabib, (2012), Improving the characterization of a hardening law using digital image correlation over an enhanced heterogeneous tensile test, International Journal of Mechanical Sciences, 62, 1, 47-56.
- H. Haddadi, S. Belhabib, (2008), Use of rigid-body motion for the investigation and estimation of the measurement errors related to digital image correlation technique, Optics and Lasers in Engineering, 46, 185-196.
- S. Belhabib, H. Haddadi, M. Gaspérini, P. Vacher, (2008), Heterogeneous tensile test on elastoplastic metallic sheets: Comparison between FEM simulations and full-field strain measurements, International Journal of Mechanical Sciences, 50, 14-21.
- H. Haddadi, S. Bouvier, M. Banu, C. Maier, C. Teodosiu, (2006), Towards an accurate description of the anisotropic behaviour of sheet metals under large plastic deformations: Modelling, numerical analysis and identification, International Journal of Plasticity, 22, 2226-2271.

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