

## RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

**Field:** Materials Science, Mechanics, Fluids

**Subfield:** Mechanical Engineering

**Title:** Large strain characterization and modeling for sheet metal forming

**ParisTech School:** Arts et Métiers Sciences et Technologies

**Advisor(s) Name:** Tudor Balan

**Advisor(s) Email:** tudor.balan@ensam.eu

**Research group/Lab:** LCFC – Laboratoire Conception Fabrication Commande

**Lab location:** Metz

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

Large strain characterization of sheet metals has become crucial as very high strength materials are being more and more employed in structural automotive components. These advanced materials come with a significantly increased strength, allowing for lightweight structures, but also with a significantly smaller ductility. Accordingly, classical tests do not allow for an accurate characterization at large strains. The only ISO-standardized large strain characterization test is the bulge test, which requires complex equipment and large amounts of materials. The project should deliver an improved version of the so-called plane strain compression test, which was very recently shown to provide a promising alternative [1]. In-depth validation of the method is aimed, along with a robust testing procedure prone for further standardization. The extension of the test to warm conditions is foreseen, depending on the candidate's progress and competences.

### **Required background of the student:**

The candidate should have a good background in mechanical engineering, especially solid mechanics. Plasticity modeling skills would be appreciated, and/or experimental skills in mechanics or material science. Knowledge of metal forming processes would be very useful.

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

- [1] C Chermette, K Unruh, I Peshekhodov, J Chottin, T Balan, A new analytical method for determination of the flow curve for high-strength sheet steels using the plane strain compression test, *Int J Material Forming* 13 (2020) 269-292
- [2] G Venet, T Balan, C Baudouin, R Bigot, Direct usage of the wire drawing process for large strain parameter identification, *Int J Material Forming* 12 (2019) 875–888
- [3] Y Yang, T Balan, Prediction of the yield surface evolution and some apparent non-normality effects after abrupt strain-path change using classical plasticity, *Int J Plasticity* 119 (2019) 331-343
- [4] Y Yang, G Vincze, C Baudouin, H Chalal, T Balan, Strain-path dependent hardening models with rigorously identical predictions under monotonic loading, *Mech Research Com*, in press, 10.1016/j.mechrescom.2020.103615