ParisTech

Arts et Métiers Sciences et Technologies

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

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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