MS # 09

# Identification of Swift law and Yld2000-2d parameters using FEMU by a synthetic image approach based on digital image correlation

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## Background

Computer-aided engineering systems rely on constitutive models and their parameters to describe the material behaviour. The calibration of more elaborated material models with a larger number of parameters becomes very time and cost consuming. The development of digital image technology has increased the interest in inverse identification techniques, which when coupled with full-field measurements has the potential to reduce the number of experimental tests required to accurately identify material properties. This is because the experimental test configuration is rich enough, meaning that all material properties take a role in the mechanical behaviour.

## Procedure

The Swift hardening law and Yld2000-2d parameters of a mild steel were identified using a heterogeneous dog-bone test, under uniaxial and quasi-static loading conditions, using Finite Element Model Updating (FEMU) technique. A FEM model was first implemented, followed by the generation of synthetic images taking into account the nodal displacements, which were then processed by digital image correlation (DIC) and used as the reference in the identification procedure. The identification is performed with FEMU by iteratively updating the unknown material parameters set, by means of an optimization procedure. Two different approaches were tested: (i) directly comparing the FEA results to the reference; (ii) using DIC-leveled FEA data by iteratively generating synthetic images and using the DIC filter with the same settings as were used on the reference.

The synthetic image approach addresses several inconsistencies that exist in the direct comparison approach, including different coordinate systems, data locations, strain formulation, spatial resolutions, and data filtering. Furthermore, some pattern-related image artefacts, such as saturation, aliasing and lightning issues, may be easier to distinguish from actual model problems [1].

## Key findings

Although the results of the described work are not yet available, it is anticipated to:

- Obtain accurate results in the parameter identification using FEMU with DIC-leveled FEA data.
- Compare the results of the DIC-leveled FEA approach to the direct comparison approach.

## References

[1] P. Lava, E. M. C. Jones, L. Wittevrongel, F. Pierron, Validation of finite-element models using full-field experimental data: Levelling finite-element analysis data through a digital image correlation engine, Strain (2020) 56:e12350. doi: 10.1111/str.12350