MS09

On the inverse identification of sheet metal constitutive parameters using a virtual experiment and the Arcan test

João Henriques[1,2,a *], António Andrade-Campos[1,2,b] and José Xavier[2,3,c]

[1]TEMA, Department of Mechanical Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

[2]LASI, Intelligent Systems Associate Laboratory, 4800-058 Guimarães, Portugal

[3]UNIDEMI, Department of Mechanical and Industrial Engineering, NOVA School of Science and Technology, NOVA University Lisbon, 2829-516 Caparica, Portugal

[a,*]Corresponding author: joaodiogofh@ua.pt, [b]gilac@ua.pt, [c]jmc.xavier@fct.unl.pt

Keywords: Inverse identification; Arcan test; Digital image correlation; Sheet metal.

Background In the modern industry, modelling and simulation are crucial phases of product development. Simulation tools in solid mechanics use constitutive models and their parameters to describe the behaviour of materials. Classically, each homogeneous experimental test represents a single stress/strain state. Therefore, an extensive experimental campaign is typically required to fully characterise the material behaviour. Nowadays, with the use of heterogeneous test configurations and full-field measurements, it is possible to measure a combination of multiple stress/strain states, therefore, being able to identify several parameters from a single test with reduced cost and time.

Procedure

This study aims to investigate the use of the virtual fields method (VFM) in combination with the Arcan experimental test for the simultaneous calibration of an isotropic hardening law and an anisotropic yield criterion. Using an Arcan specimen with a smooth arc section [1] a finite element model was developed in which the loading and material directions varied in directions, producing tensile, shear, or mixed mode responses. The most promising combination of loading and material directions was chosen using a heterogeneous criterion, and the numerical results were used to generate synthetic images, which were then processed using digital image correlation (DIC) and the VFM.

Key findings

Although the outcomes of the described work are not yet available, it is expected to:

- Select the most promising test configuration in terms of load and material directions.
- Obtain accurate results using the virtual experiment results with the VFM.
- It is shown that the Arcan test is able to produce a large richness of strain states, making it suitable for the models' identification process.

References

[1] A. Kumar et al., Structures, 26 (2020) 915-933

Acknowledgements

J. Henriques is grateful to the FCT for the PhD grant 2021.05692.BD. This project has received funding from the Research Fund for Coal and Steel under grant agreement No 888153. The authors gratefully acknowledge the financial support of the Portuguese Foundation for Science and Technology (FCT) by the projects UID/EMS/00481/2013-FCT under CENTRO-01-0145-FEDER-022083 and UIDB/00667/2020 (UNIDEMI).