11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

ELASTO-PLASTIC PARAMETERS IDENTIFICATION THROUGH FINITE ELEMENT MODEL UPDATING

Pierre BAUDOIN[1,2,4], Jean-François WITZ[3,4], Vincent MAGNIER[1,2,4], Ahmed EL BARTALI[1,3,4], Philippe DUFRENOY[1,2,4], Éric CHARKALUK[1,3,4]

[1] Univ Lille Nord de France F-59000 Lille, France, eric.charkaluk@univ-lille1.fr
[2] Université Lille 1, LML, F-59650 Villeneuve d'Ascq, France
[3] ECLille, LML,F-59650 Villeneuve d'Ascq, France
[4] CNRS, UMR 8107, F-59650 Villeneuve d'Ascq, France

Key words: *F.E.M.U., plasticity, D.I.C., Mixed numerical/experimental setup*

Introduction One way of exploiting the rich results given by digital image correlation (D.I.C.) results is to compare relevant fields obtained from finite element computations (assuming a certain constitutive law for the material) to those obtained from the measured displacements fields [1]. A possible application of this method is the inverse identification of elasto-plastic parameters. In particular, given a specific plastic behaviour, it should be possible to identify local, heterogeneous plastic properties such as yield strengths inhomogeneously distributed in a material, as can happen after forging or nitriding in steels for instance.

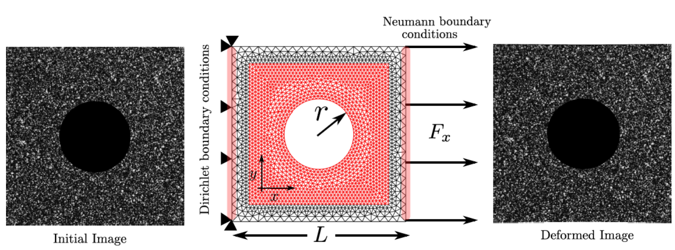
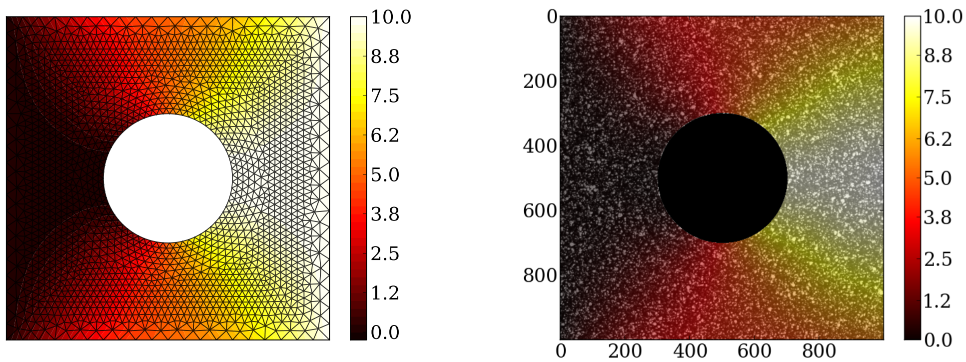


Figure 1: Virtual sample images and mesh

As a first step in that direction, the present paper presents a framework to obtain yield strengths from homogeneous tensile iron specimens, described with bilinear von Mises isotropic hardening.

Tests and results According to the bibliography review conducted by [2], one of the only works dedicated to this problem is [3] whose methodology is adapted to this study.

As a validation step, the virtual testing procedure described in [4] is adopted; a first simulation is run to deform images on which the correlation will be performed (fig. 1).The correlation results are then used as a classical experimental D.I.C. result in the F.E.M.U. procedure. The cost function chosen here aims at minimizing the gap in displacements between computations and experiments on a given mesh area. The minimization itself is done using the Levenberg-Marquardt algorithm, through a python subroutine. On this simple test, the results of the identification was in good accordance with the yield strengths prescribed in the initial F.E. simulation as shown in fig. 2.



(a) Final horizontal displacements given by the F.E.M.U. method [px]

(b) Horizontal displacements obtained by D.I.C. on the deformed image [px]

Figure 2: Discrepancies between F.E.M.U. and pseudo-experimental displacements

Perspectives include tests on real specimens, and tests on specimens with heterogeneous properties in terms of yield strength, obtained through recrystallization.

REFERENCES

[1] Michel Grédiac and François Hild, *Mesures de champs et identification en mécanique des solides*, Hermes, 2011.

[2] Stéphane Avril, Marc Bonnet, Anne-Sophie Bretelle, Michel Grédiac, François Hild, Patrick Ienny, Félix Latourte, Didier Lemosse, Stéphane Pagano, Emmanuel Pagnacco and Fabrice Pierron, *Overview of Identification Methods of Mechanical Parameters Based on Full-field Measurements*, Experimental mechanics, Vol. **48**, 381–402, 2008.

[3] Marcel Meuwissen, *An inverse method of the Mechanical Characterisation of Metals*, Technische Universiteit Eindhoven PhD Thesis, 1998.

[4] Julien Réthoré, Muhibullah, Thomas Elguedj, Michel Coret, Philippe Chaudet and Alain Combescure, Robust identification of elasto-plastic constitutive law parameters from digital images using 3D kinematics, *International Journal of Solids and Structures*, Vol. **50**, 73–85, 2013.