11th. World Congress on Computational Mechanics (WCCM2014)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

IDENTIFICATION OF COHESIVE MODELS USING FULL FIELD KINEMATIC DATA: A VARIANCE BASED GLOBAL SENSITIVITY ANALYSIS

MARCO ALFANO*, GILLES LUBINEAU**
AND GLAUCIO PAULINO†

* Department of Mechanical, Energy and Management Engineering, University of Calabria, Italy

** COHMAS Laboratory, King Abdullah University of Science and Techology, Saudi Arabia

† Department of Civil and Environmental Engineering, University of Illinois, Urbana

Key words: Cohesive Zone Model, Identification, Double Cantilever Beam, sensitivity, analysis, Sobol indexes.

ABSTRACT

Failure of adhesive bonded structures often occurs concurrent with the formation of a non-negligible fracture process zone in front of a macroscopic crack. For this reason, the analysis of damage and fracture is effectively carried out using the cohesive zone model (CZM). The crucial aspect of the CZM approach is the precise determination of the traction-separation relation. Yet the cohesive model is usually determined empirically using calibration procedures combining experimental data, such as load-displacement or crack length data, with finite element simulation of fracture. Thanks to the recent progress in image processing, and the availability of low-cost CCD cameras, it is nowadays relatively easy to access surface displacements across the fracture process zone using Digital Image Correlation (DIC). The rich information provided by correlation techniques prompted the development of versatile inverse parameter identification procedure combining Finite Element (FE) simulations and full field kinematic data [1]. The focus of the present work is to assess the effectiveness of these methods in the identification of cohesive zone models. In particular, the study is developed in the framework of the variance based global sensitivity analysis [2]. The sensitivity of kinematic data to the sought cohesive properties is explored through the computation of the so-called Sobol sensitivity indexes. The results show that the global sensitivity analysis can help to ascertain the most influential cohesive parameters, and to set those which need to be incorporated in the identification process. In addition, it is shown that suitable displacement sampling in time and space can lead to optimized measurements for identification purposes [3].

References

[1] B. Shen, G. H. Paulino, 2011. Direct Extraction of Cohesive Fracture Properties from Digital Image Correlation: A Hybrid Inverse Technique. Exp Mech, 51(2):143-161.

[2] A. Saltelli, M. Ratto, T. Andres, F. Campolongo, J. Cariboni, D. Gatelli, M. Saisana, S. Tarantola. Global Sensitivity Analysis: The Primer. Wiley, 2008.

[3] M. Alfano, G. Lubineau, G. H. Paulino, Global sensitivity analysis in the identification of cohesive zone models using full field kinematic data, *in preparation*.