A modular nonlinear stochastic finite element formulation for uncertainty estimation

Y. Ammouche, A. Jérusalem

Department of Engineering Science
University of Oxford
Parks Road, Oxford, OX1 3PJ, UK
e-mail: yanis.ammouche@eng.ox.ac.uk, antoine.jerusalem@eng.ox.ac.uk

ABSTRACT

The Monte Carlo method has been widely used for the estimation of uncertainties in mechanical engineering design. However, while extremely flexible, this method remains impractical in terms of computational time and scalability. To bypass these limitations, other more efficient approaches such as the spectral stochastic finite element method (SSFEM) or the collocation method have been proposed. SSFEM, pioneered by Spanos and Ghanem [1], provides accurate statistics of the output, has the advantage of being sampling-independent and can be modular in terms of operations, albeit code intrusive. While linear elasticity has been extensively covered in the literature, the application of SSFEM to nonlinear mechanical behaviour remains relatively unexplored [2]. Our preliminary work focusses on a seamless and efficient modular framework avoiding the need to know a priori the material law. In particular, we i) benchmark our proposed framework with an optimised house-code and ii) make use of a hybrid formulation to capture discontinuous behaviours. The method is finally illustrated with a few applications.

REFERENCES

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