6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

EXTENDED ISOGEOMETRIC ANALYSIS OF GRADIENT-ELASTIC PLATES WITH CRACKS

Hoang X. Nguyen[1], Elena Atroshchenko[2], H. Nguyen-Xuan[3] and Thuc P. Vo[1]

[1] Department of Mechanical and Construction Engineering, Northumbria University, Newcastle upon Tyne NE1 8ST, UK, xuan.h.nguyen@northumbria.ac.uk, thuc.vo@northumbria.ac.uk

[2] Department of Mechanical Engineering, University of Chile, Santiago 8370448, Chile, eatroshch@gmail.com

[3] Center for Interdisciplinary Research in Technology, Hutech University, Ho Chi Minh City 700000, Vietnam, ngx.hung@hutech.edu.vn

Keywords: *Functionally Graded Materials, Strain-Gradient Elasticity, Vibration Analysis, Extended Isogeometric Analysis*

This study aims to investigate the free vibration responses of small-scale functionally graded cracked plates using the strain-gradient theory and the extended isogeometric analysis. While the strain-gradient elasticity is employed to account for the size-dependent effects, the displacement fields of plate structures are described based on the refined plate theory. The simple strain-gradient theory with one additional length scale parameter, apart from Lamé's constants, is capable of effectively capturing the small-scale effects in nano/micro structures [1]. The RPT with four unknowns not only is able to improve the accuracy of the results for both thin and thick plates but also helps to describe the nonlinear distribution of the shear stress through the plates thickness without using shear correction factor. The isogeometric analysis [2] is employed as a prominent numerical method to solve the problems that require higher-order elements. This recently developed method utilises the non-uniform rational B-splines functions to establish approximation functions and describe geometry domains simultaneously. In order to model the discontinuity at the cracks within the plates, the extended IGA with enrichment functions for crack path and crack tip is involved. For the vibration analysis of cracked microplates, the approach yields appropriate and reliable results in which the stiffness of the structures, consequently the fundamental frequency, is increased as the length scale ratio becomes larger. It also demonstrates that strain-gradient theory plays a significant role in prediction of size-dependent effects of nano/micro structures which classical continuum theory fail to capture.

REFERENCES

[1] R.D.Mindlin, Micro-structure in linear elasticity, *Archive for Rational Mechanics and Analysis*, Vol. **16**, pp. 51–78, 1964.

[2] T.J.R. Hughes, J.A. Cottrell and Y. Bazilevs, Isogeometric analysis: CAD, finite elements, NURBS, exact geometry and mesh refinement. *Computer Methods in Applied Mechanics and Engineering*, Vol. **194**, pp. 4135–4195, 2005.