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

SHELLS IN STRAIN GRADIENT ELASTICITY: THEORY, ISOGEOMETRIC IMPLEMENTATION AND APPLICATIONS

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Keywords: *Strain gradient elasticity, Shell structures, Isogeometric analysis*

The present work is aimed to reduce the shortage of rigorous shell models in the framework of higher-order strain gradient theories [1]. Such theories show their effectiveness for modelling materials with substructure on different levels: from nano- and micro- to macro-scales (see [2], [3], and references therein), and, consequently, can be applied for solving complex engineering problems of different fields. However, there are no contributions devoted to numerical methods of gradient-elastic shells.

First, the physico-matematical model of the Kirchhoff-Love shell of arbitrary geometry is derived in the form of both differential equations and variational formulations. Second, the model is embedded into a commercial finite element software Abaqus as user subroutines following the isogeometric paradigm [4]. Third, a number of tests including comparisons with analytical solutions and full-scale 3D solid element simulations shows that the shell model and its implementation work properly. Fourth, the presented examples illustrate the applicability of the method for shell structures with microstructure.

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