Università degli Studi di Pavia
Computational Mechanics & Advanced Materials Group - DICAr

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Virtual Modeling and Additive Manufacturing for Advanced Materials

SEMINAR

Isogeometric phase-field modeling of brittle fracture in thin plates and shells

Phase-field modeling of brittle fracture is a modern promising approach that enables a unified description of complicated failure processes, including crack initiation, propagation, branching, merging, as well as its efficient numerical treatment [1]. In this work, we apply the phase-field fracture approach to plates and shells, using an isogeometric Kirchhoff-Love shell formulation for structural analysis [2].
In order to avoid fracture in compression, we perform an additive split of the deformation tensor in tension and compression terms as proposed in [3]. We show that this requires special attention in structural models like plates and shells, where bending deformation typically induces both tension and compression at opposite sides of the structure. We propose a new approach [4] to take this effect correctly into account and verify it by detailed comparisons with results from 3D simulations.

References:

[1] M. Ambati, T. Gerasimov, L. De Lorenzis. A review on phase-field models of brittle fracture and a new fast hybrid formulation. Computational Mechanics, 55:383-405 (2015).
[2] J. Kiendl, K.-U. Bletzinger, J. Linhard, R. Wuechner. Isogeometric shell analysis with Kirchhoff-Love elements.Computer Methods in Applied Mechanics and Engineering} 198:3902-3914 (2009).
[3] C. Miehe, M. Hofacker, F. Welschinger. A phase field model for rate-independent crack
propagation: robust algorithmic implementation based on operator splits. Computer Methods in Applied Mechanics and Engineering, 199:2765-2778 (2010).
[4] J. Kiendl, M. Ambati, L. De Lorenzis, H. Gomez, A. Reali. Phase-field description of brittle fracture in plates and shells. Computer Methods in Applied Mechanics and Engineering, 312:374-394 (2016).

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