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PHASE-FIELD MODELING OF FRACTURE IN THIN SHELLS WITH MAXIMUM ENTROPY APPROXIMANTS

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The prediction of fracture is of major importance in engineering applications such as aircraft fuselages, pressure vessels, automobile components and castings. Fracture mechanics has motivated during the last decades the development of numerous computational approaches trying assess crack growth, including the difficult problem of assessing crack paths. The phase-field modeling of Griffith's theory of brittle fracture [1] has been established by [2], in which cracks propagate along a path of minimizing energy with respect to any admissible crack and displacement field. The phase-field model frees itself from usual constraints of the classical Griffith theory, which are a preexisting crack and a well-defined crack path. Since the crack is a natural outcome of the analysis it does not require an explicit representation and tracking, which is an advantage over techniques like the extended finite element method that requires tracking of the crack paths. Furthermore the model allows crack nucleation, path identification, kinking, oscillatory instabilities and branching.

We apply the fourth order phase-field formulation of [3] to model crack propagation in thin shells under the Kirchhoff-Love assumptions. We exploit our research experience in dealing with thin shells in a meshfree context based on statistical learning techniques, this allows us to handle general point set surfaces avoiding a global parametrization, which can be applied to tackle surfaces of complex geometry and topology [4,5]. Our approach involves two coupled higher-order PDEs, which precludes usual discretization techniques based in the finite element method. Here we resort to smooth local maximum-entropy meshfree approximants [6]. We show the flexibility and robustness of the present methodology dealing with standard benchmark tests as well as point-set surfaces of complex geometry and topology.

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