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# On the energy decomposition in variational phase-field models for brittle fracture under multi-axial stress states

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Phase-field models of brittle fracture are typically endowed with a decomposition of the elastic strain energy density in order to realistically describe fracture under multi-axial stress states. In this work, we define essential requirements for this type of models to correctly describe both nucleation and propagation of cracks. In light of these requirements we review some available models, namely the volumetric-deviatoric, the spectral, the no-tension and the DP-like models, and find that none of them is able to meet all the requirements. Finally, we propose a new model that we denote as star-convex model. This model, based on a minimal modification of the volumetric-deviatoric decomposition, is equipped with a parameter that allows for independent calibration of compressive and tensile strengths. Additionally, the model satisfies all other requirements. Thus, it represents a very simple but effective step forward towards the realistic prediction of brittle fracture mechanisms under multiaxial stress states.

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