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MODELING AND SIMULATION FRACTURE IN BRITTLE MATERIALS WITH ANISOTROPIC SURFACE ENERGY

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Crack propagation in brittle materials with anisotropic surface energy is important in applications involving single crystals, extruded polymers, or geological and organic materials. Furthermore, when this anisotropy is strong, the phenomenology of crack propagation becomes very rich, with forbidden crack propagation directions or complex sawtooth crack patterns. This problem interrogates fundamental issues in fracture mechanics, including the principles behind the selection of crack direction. Here, we propose a variational phase-field model for strongly anisotropic fracture, which resorts to the extended Cahn-Hilliard framework proposed in the context of crystal growth. Previous phase-field models for anisotropic fracture were formulated in a framework only allowing for weak anisotropy. We implement numerically our higher-order phase-field model with smooth local maximum entropy approximants in a direct Galerkin method. The numerical results exhibit all the features of strongly anisotropic fracture, and reproduce strikingly well recent experimental observations.