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PROCEEDINGS

Energy Relations in the Phase Field Approach to Fracture

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ABSTRACT

The phase field approach to fracture originates from the variational formulation of brittle fracture proposed by Francfort and Marigo. The regularized version of the latter formulation by Bourdin et al. is also dubbed the phase field approach to fracture. Compared with explicit crack methods such as the extended finite element method, the phase field approach to fracture does not require additional criteria for crack simulation and can naturally simulate complex fracture behaviors such as crack initiation, propagation, branching and merging with a fixed mesh and fixed shape functions. This work examines the energy relations in the phase field approach to fracture. First, the relation of the elastic potential energy and the fracture energy is revisited from the Γ-convergence point of view. Second, the energy balance relation is carefully investigated from the thermodynamic perspective. For this both the first law of thermodynamics and the second law of thermodynamics are considered, and the role of the degradation function and the asymmetric relation for distinguishing tension and compression will be reviewed. Finally, some existing phase field models for fracture are evaluated based on the energy relations. Some popular models will be shown not to always obey thermodynamic laws. With this opportunity, some of the recent works of our research group are showcased from the energy perspective.

KEYWORDS

Phase field approach to fracture; energy relations

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