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Simulation of Anisotropic Fracture within Composite Materials by a Phase-Field Method

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Fracture plays a particularly important role in industrial application. Beside the experimental investigation of complex fracture patterns, several numerical methodologies are intensively studied to simulate crack's initiation, direction, propagation as well as branching. During the last decade, the phase-field method has been proved to satisfy Γ-convergence of fracture, and is widely employed for structural analysis. One of the obvious advantages is that fracture evolution does not depend on any explicit criterion. Besides, tracing the discontinuous displacement is not required. Furthermore, the simulation results shows good agreement with other numerical strategies and experiments.

With respect to composite material, not only the mechanical property behaves anisotropic, but also the fracture patterns show quite different results compared to isotropic media, since fracture resistance along the different directions is not identical. In order to investigate a robust fracture evolution in an anisotropic media, an anisotropic phase-field model is proposed in this contribution. This model rewrites the fracture energy density function and introduces the gradient of phase-field as a directional dependent term. Thus, the strong or weak direction is controlled by this directional dependent tensor. This proposal is formulated and implemented by means of Finite Element Analysis (FEA) is the work. For verification, some numerical examples are presented and discussed. Last but not least, conclusions are drawn and future perspectives are proposed.

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