

A phase-field method for computational modeling of interfacial damage interacting with crack propagation in realistic microstructures

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In this work, a formulation is developed within the phase field method [1] for modeling interactions between interfacial damage and bulk brittle cracking in complex microstructures. The method is dedicated to voxel-based models of highly complex microstructures, as obtained from X-ray microtomography images [2]. A smoothed displacement jump approximation is introduced by means of level-set functions to overcome the issue of pixelized interfaces in voxel-based models. A simple technique is proposed to construct the level-set function in that case. Compared to recent work aiming at modeling cohesive cracks within the phase field method [3], our framework differs in several points: the formulation is such that interfaces are not initially damaged; no additional variables are required to describe the discontinuities at the interface and fatigue cracks can be modeled. The technique allows interaction between bulk and interface cracks, e.g. nucleation from interfaces and propagation within the matrix, and for arbitrary geometries and interactions between cracks. Several benchmarks are presented to validate the model. The technique is illustrated through numerical examples involving complex microcracking in X-ray CT image-based models of concrete microstructures.

Keywords: Cracks, Phase field, Highly heterogenous materials, Interfacial damage, Voxel-based models, Microcracking

References

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