Progress Towards Micromorphic Upscaling Multiscale Damage Models of Fibrous Materials

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Abstract

Fibrous materials are common in engineered structures and biological tissues. Despite significant progress, traditional constitutive models struggle to capture the full range of nonlocal and nonaffine material behavior that is driven from complex microstructures. To fill this gap, upscaling multiscale methods have been developed that can take advantage of the scale separation between the fiber and continuum scales. And, by using GPU accelerated supercomputing and machine learned constitutive models, these multiscale models can be effectively deployed to study problems of interest. However, the current methods rely on strong scale separation which breaks down during localization events such as material fracture. This talk will background on the current state of multiscale modeling of damage in fibrous materials through upscaled computational homogenization including the use of phase-field models for propagation of diffuse microstructural damage. Additionally, it will describe efforts undertaken to incorporate microstructural localization events. And, the inclusion of a micromorphic continuum model which can be used to limit the need for scale separation near fractures.

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