Workshop on Experimental and Computational Fracture Mechanics
March 4-6, 2024, Baton Rouge, LA

STOCHASTIC REPRESENTATIONS OF MODEL-FORM UNCERTAINTIES IN BRITTLE FRACTURE SIMULATIONS

H. Zhang, J. Dolbow, and J. Guilleminot

ABSTRACT

In this work, we address the construction of stochastic representations for model-form uncertainties in phase-field models of brittle fracture [1]. Such uncertainties can arise from the choice of the degradation function for instance, and their consideration has been unaddressed to date. The framework involves a stochastic reduced-order model in which the projection operator is randomized. Riemannian projection and retraction operators, as well as an information-theoretic formulation, are specifically introduced to enforce proper concentration in the convex hull defined by a set of model proposals. The model thus obtained is mathematically admissible (in the almost sure sense) and involves a low-dimensional hyperparameter, the calibration of which is facilitated through the formulation of a quadratic programming problem. An extension based on localized randomization is also proposed to handle the case where the forward simulation is highly sensitive to sample localization. The relevance of the modeling approach is finally demonstrated on one- and two-dimensional applications.

REFERENCES

[1] H. Zhang, J. Dolbow, and J. Guilleminot, Representing model uncertainties in brittle fracture simulations, *Computer Methods in Applied Mechanics and Engineering*, **1**, 1–10, 2014.