Bayesian Calibration of Lattice Discrete Particle Model for Concrete

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Abstract

In lattice or particle formulations of models for quasi-brittle materials, a medium is discretized “a priori” according to an idealization of its internal structure. Geometrical parameters of particles or lattice equip these type of formulations with inherent characteristic lengths and they have the intrinsic ability of simulating the geometrical features of material internal structure. This allows the accurate simulation of damage initiation and crack propagation at various length scales, however, at increased computational costs.

Here we employ the so-called Lattice Discrete Particle Model (LDPM) recently proposed by Cusatis et al. (2011). LDPM was calibrated, and validated against a large variety of loading conditions in both quasi-static and dynamic loading conditions and it was demonstrated to possess superior predictive capability, see Cusatis et al. (2011b). Nevertheless, the utilized calibration procedure was based on a hand-fitting, which complicates further practical applications of the model. Here we present a Bayesian inference of model parameters from experimental data obtained from notched three point bending tests and cube compression tests. The Bayesian inference allows to solve the inverse problem as well-possed and to quantify posterior uncertainty in parameters by combining a prior knowledge about the realistic parameter values and uncertainty contained in measurement errors. In particular, we obtain the posterior distributions by robust Markov chain Monte Carlo sampling, where the computational burden, arrising from repeated model simulations, is overcome by using a polynomial chaos-based surrogate of the LDPM.

References

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