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TRUSTWORTHY AND AGENTIC AI FOR DAMAGE, FRACTURE, AND MULTIPHYSICS SIMULATION

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ABSTRACT

Artificial intelligence is advancing beyond surrogate modeling and is beginning to take an active role across the simulation workflow, configuring solvers, coupling codes, and checking results. A central challenge to the broader adoption of AI in predictive computational mechanics is demonstrating its reliability. This Invited Session is devoted to AI methods that operate within simulation workflows for nonlinear materials, damage, fracture, and coupled multiphysics problems, together with the verification and validation practices needed to establish confidence in their results. Contributions are invited on: (i) agentic and language-model-based frameworks that set up, execute, couple, and verify simulations across one or several codes, ranging from early prototypes to mature systems; (ii) physics-informed learning, neural operators, surrogate models, and learned world models for representing and accelerating complex physical systems, including phase-field, peridynamics, and continuum damage formulations, as well as degradation processes such as corrosion and fatigue; (iii) machine learning for coupling, adaptivity, and information transfer between local and nonlocal descriptions; and (iv) verification, validation, and uncertainty quantification for AI-enabled simulation, including benchmarks, reproducibility, and computational cost. The session aims to connect advances in AI-enabled simulation with rigorous methods for assessing their performance and reliability, supporting credible computational workflows for complex mechanics and multiphysics problems.