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# Phase-Field Fracture Propagation in Thermo-Hydraulic-Mechanical Systems

*Tuesday 20 May 2025 12:20 (15 minutes)*

This presentation introduces a diffraction-based thermo-hydraulic-mechanical (THM) model for fracture propagation using a phase-field fracture (PFF) approach. The THM-PFF model integrates four primary solution variables—displacements, phase-field, pressure, and temperature—each governed by distinct principles: conservation of momentum (mechanics), a variational inequality (constrained minimization), mass conservation (pressure), and energy conservation (temperature). This results in a novel coupled variational inequality system. The system is sequentially solved based on the fixed stress iteration, for displacements, phase-field, pressure, and temperature in a staggered manner. The model features global coupling of pressure and temperature across the domain via diffraction systems, where diffraction coefficients are determined by material parameters weighted by the diffusive phase-field variable. To ensure robust local mass and energy conservation, enriched Galerkin finite elements (EG) are employed for the pressure and temperature diffraction equations. By enriching continuous Galerkin basis functions with discontinuous piecewise constants, EG accurately captures solution and parameter discontinuities while preserving local conservation laws—critical for realistic THM simulations. In addition, a predictor–corrector local mesh adaptivity scheme is implemented, enabling the model to handle small phase-field length-scale parameters with high numerical accuracy and computational efficiency. These advancements in modeling and algorithm design represent a significant contribution to the field and are validated through rigorous numerical experiments.

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United States

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## References

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