XIX International Conference on Computational Plasticity, COMPLAS 2027
September 6-10, 2027, Barcelona, Spain

MODEL IDENTIFICATION AND SELECTION FOR COMPLEX TIME- AND HISTORY-DEPENDENT MATERIAL MODELS

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ABSTRACT

Predictive simulation of nonlinear materials relies on constitutive models that capture complex time- and history-dependent phenomena, including viscosity, damage, fatigue, aging, phase transformation, microstructural evolution, and multiphysics effects. As these models grow in fidelity and complexity, robust methods for identifying material parameters, assessing model adequacy, and selecting among competing constitutive descriptions become essential for reliable computational mechanics.

This session will focus on approaches for parameter identification and model selection for advanced nonlinear material models, with emphasis on materials exhibiting path dependence, rate effects, hysteresis, degradation, and evolving internal state variables. Contributions are invited on experimental design for parameter calibration, inverse methods, uncertainty quantification, Bayesian inference, optimization-based identification, sensitivity analysis, surrogate and reduced-order modeling, machine learning-assisted calibration, and physics-informed data-driven methods. Particular interest will be given to approaches that address non-uniqueness, parameter correlation, limited or noisy experimental data, computational cost, and transferability across loading conditions and scales.

The session aims to bring together developers of constitutive models, experimental characterization methods, inverse analysis techniques, and verification and validation frameworks. Applications may include polymers, metals, composites, geomaterials, energetic materials, biological tissues, architected materials, and other nonlinear material systems where history-dependent behavior plays a central role. By highlighting both methodological advances and practical case studies, the session will provide a forum for

discussing how model identification and selection can improve predictive capability, quantify confidence in simulations, and guide the development of more interpretable and reliable constitutive models for complex material behavior.

SNL is managed and operated by NTESS under DOE NNSA contract DE-NA0003525.