Invited session - COMPLAS 2027

Title: Predicting Plasticity and Damage Beyond Observed Data

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Myriads of plasticity and damage models successfully reproduce experimental observations but far fewer can reliably predict material behavior beyond the testing domain used for calibration. Fewer still can capture local responses, where heterogeneity, localization, and failure arise. Models that capture the dominant mechanisms that drive deformation and damage may support the extrapolation within that mechanistic domain. In practice, nearly every prediction involves a transfer from incomplete evidence to previously unobserved conditions. We seek to identify and discuss the modeling attributes required to render material behavior predictive.

This symposium is motivated by the view that predictive capability depends less on the amount of information available than on whether that information can diagnose the mechanisms controlling material behavior. While agreement with experimental results is a necessary condition, the mere availability of larger quantities of data is not sufficient to ensure predictive fidelity. Trustworthy predictions require models grounded in mechanisms that retain their validity under changing conditions, experiments designed to reveal the dynamics of those mechanisms, and formulations and calibration strategies that yield interpretable and identifiable parameters. Equally important are transparent assessments of uncertainty and clear articulation of model limitations.

We seek to bring together modeling and experimental perspectives that advance the predictive capability of plasticity and damage models beyond the conditions used for their calibration. Relevant themes include governing mechanisms of deformation and failure, physics-aware calibration and interpretable parameterization, mechanism-revealing experimentation, prediction of local fields and failure initiation, and the quantification of predictive uncertainty and model transferability or generalizability across materials, microstructures, and loading conditions.