"Model Form and Parameter Uncertainty in Multiscale Mesoscopic Dislocation Plasticity"

Professor David L. McDowell
Georgia Institute of Technology, USA

We consider crystal plasticity model constructs with complexity arising from multiple phases at micron scale and/or many body dislocation interactions. For alpha-beta Titanium colony microstructures, a three-step strategy is employed using Gaussian Process Regression as a rapid emulator with Bayesian inference and Markov Chain Monte Carlo sampling to consider the likelihood of one model form versus another in light of available spherical indentation data. For the most likely constitutive framework, it is demonstrated using this strategy that certain slip transfer parameters are more likely than others to describe the available experimental data. We close by considering the efficacy of bridging from atomistic simulations to inform the rate-dependent flow rule of crystal plasticity for bcc Fe based on coordinated kink pair formation on screw dislocations, introducing the need for a model discrepancy layer to inject the role of sources.