
# PLENARY SESSION

## Adaptive Data-Driven Modeling of Complex Systems

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**ABSTRACT**

In this talk, we present a multiscale adaptive data-driven framework to simulate the behavior of complex systems. Such complex systems typically display non-linear, non-local, micro-morphic features that have challenged continuum and discrete models for over a century. We use granular materials as canonical examples of complex systems to contextualize our proposed data-driven framework, highlighting its ability to bridge the continuum scale with experimental data or grain-scale physics-based simulations. In contrast to continuum phenomenological models and standard multiscale techniques, our approach is parameter-free, physics-based, and true to the entire data set. Additionally, we show that the adaptive nature of the data-driven approach gives rise to a new generation of models that admit goal-oriented data assimilation as a standard feature. This feature is not readily available in phenomenological models that rely on a posteriori metrics of error, resulting in increased complexity, obscurity, and inaccuracy. Conversely, the adaptive data-driven models can incorporate data seamlessly and thereby increase their accuracy to a priori user-specified levels. We argue that this approach to modeling is fundamentally different from current modeling philosophies.