Bridging classical methods and machine learning for multiscale materials modeling

Sarah Helfert Murphy

Many problems in the physical sciences demand mathematical models that can simulate and predict system behavior, such as solid materials modeling for nanomaterials manufacturing, ice sheet friction modeling for climate science, and particle diffusion in porous materials. A recent research focus has been on the use of scientific machine learning for such physical systems. While data-driven and physics-informed machine learning approaches have shown promise in this direction, in practice they are difficult to train and their performance is not yet well understood. This talk will explore the interplay between classical numerical methods and modern machine learning approaches for multiscale modeling. Emphasis will be placed on how ideas from numerical analysis and stochastic modeling can inform the design of interpretable and efficient physics-informed neural networks and deep operator networks.