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Deep generative models for simulation of geometric trajectories

Abstract: Machine learning offers a powerful alternative to traditional simulation methods, particularly for complex systems where symbolic models are lacking or computationally prohibitive. This talk explores how incorporating geometric symmetries—such as E(n) equivariance, permutation, and scale invariance—into deep learning models enables building efficient simulators for graph dynamical systems. By leveraging the inherent geometric structure of data, these models can achieve more efficient learning from high-dimensional data with significantly lower computational complexity than traditional methods. We will discuss the successful application of such geometric deep learning approaches for simulating dynamic trajectories in diverse domains, including pedestrian dynamics, meta-material homogenization, and bubbly flows.