RUTGERS-CAMDEN
MATH SEMINAR SERIES

12:45PM -1:45PM, FEBRUARY 19TH, 2026

ARMITAGE-124

Mauro Maggioni

Johns Hopkins University

Title: On two problems in scientific machine learning: learning interaction laws in particle systems, and digital twins in cardiac electrophysiology

Abstract: I will discuss recent results in two research directions at the intersection of scientific machine learning and modeling of dynamical systems. First, we consider systems of interacting agents or particles, which are commonly used in models throughout the sciences, and can exhibit complex, emergent large-scale dynamics, even when driven by simple interaction laws. We consider the following inference problem: given only observations of trajectories of the agents in the system, can we learn the unknown laws of interactions? We cast this as an inverse problem, discuss when this problem is well-posed, construct estimators for the interaction kernels with provably good statistical and computational properties, even in the nonparametric estimation regime when only minimal information is provided about the form of such interaction laws. We also demonstrate numerically that the estimated systems can accurately reproduce the emergent behaviors of the original systems, even when the observations are so short that no emergent behavior was witnessed in the training data. We also discuss the case where the agents are on an unknown network, and we need to estimate both the interaction kernel and the network. In the second part of the talk, I will discuss recent applications of deep learning in the context of digital twins in cardiology, and in particular the use of operator learning architectures for predicting solutions of parametric PDEs, or functionals thereof, on a family of diffeomorphic domains — the patient-specific hearts -- which we apply to the prediction of medically relevant electrophysiological features of heart digital twins.

Zoom:

https://rutgers.zoom.us/j/96442897289?pwd=bPsYXaIvu0BuaxSVQxU0VTLnRUSotm.1

RUTGERS
UNIVERSITY | CAMDEN