APPLIED MATHMATICS SEMINAR:
Reduced-order Modeling for the High-Dimensional Dynamical System: Methodologies and Applications

Yuanran Zhu
Visiting Assistant Professor, Department of Applied Mathematics
University of California, Merced

Date:
11/12/2021

Time:
3:00 PM-5:20 PM

Location:
COB2 170

About The Speaker:

Dr. Yuanran Zhu is a Visiting Assistant Professor in the Department of Applied Mathematics at the University of California, Merced. His research focuses on the dimension-reduction and reduced-order modeling problems for high-dimensional complex systems used in physics and chemistry. Before his appointment at UC Merced, Yuanran was a graduate student at the University of California, Santa Cruz. He obtained his Ph.D. in Applied Mathematics and Statistics in 2019.

Abstract:

Modern computational hardware enables us to perform large-scale simulations for complex systems ranging from turbulence to the molecular dynamics model for proteins with million atoms. These dynamical systems are usually high-dimensional and the exact simulation to capture the physics of the entire system on a long-timescale can be infeasible due to the curse of dimensionality. In practice, however, it is often the case that only some low-dimensional observables of a large system are particularly important for research. Typical examples are the movement of a characteristic Lagrangian particle in fully developed turbulence and the active site of an enzyme where substrate molecules bind and undergo a chemical reaction. This necessitates the development of theoretical and computational strategies to construct effective or coarse-grained models that describe the dynamics of these reduced-order quantities. In this seminar, I will introduce several first-principle and data-driven methods for reduced-order modeling and their applications to turbulent dispersion, far-from-equilibrium heat conduction, rare-event calculations, and other physical problems. Through the relevant discussion, we would like to show that these methodologies not only provide novel computational strategies for the dimension-reduction of high-dimensional deterministic and stochastic systems but also introduce new paradigms to discover hidden physical laws.

For more information, contact : Suzanne Sindi
ssindi@ucmerced.edu