APPLIED MATHEMATICS SEMINAR SERIES: Dynamic-Mode Decomposition: Analysis and Prediction

Dr. Chris Curtis
San Diego State University

Date:
2/13/2024

Time:
3:00 PM–4:15 PM

Location:
COB2 170

About The Speaker:

Prof. Curtis works in the areas of equation free modeling, machine learning, and dynamical systems. This is an outgrowth of his background in nonlinear waves and partial differential equations, which was the basis of his PhD in 2009 from the University of Washington and his postdoctoral work at CU Boulder from 2009-2013. He has been as SDSU since 2013, where his work has been supported by the NSF and ONR.

Abstract:

With regards to data-driven modeling and analysis in dynamical systems, the Dynamic-Mode Decomposition (DMD) has become one of the most powerful approaches for developing deep insights into complex physical processes. In this talk, we explore novel contributions to both the descriptive and predictive aspects of DMD. With regards to modal analysis, through our development of a mode selection process, we look at how the DMD is able to identify coherent structures and relatively stable low dimensional subspaces of dynamics in weakly turbulent flows. Thus our selection method illustrates the power of the DMD to help quantify and elucidate structure in complex dispersive flows.

With regards to prediction, we show that by merging Takens embeddings with neural networks that we are able to extend DMD to an adaptive and thereby accurate equation free modeling framework. We show that our method is able to produce good forecasts and modal decompositions across a range of chaotic dynamical systems, including a PCA reduced version of the Kuramoto-Sivashinksy equation. We likewise explore the role that information theory plays in describing the dynamics of our learning process, which hints at further improvements to our method.

For more information, contact: Maxime Theillard
mtheillard@ucmerced.edu