MAE *Seminar* SERIES

THURSDAY, MARCH 28

3:30 PM

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ACCURATE AND EFFICIENT METHODS FOR REDUCED -COMPLEXITY MODELING IN FLUID MECHANICS

ABSTRACT

This talk will explore several recent developments that improve upon the efficiency, accuracy, and theoretical understanding of methods for modal decomposition and reduced-order modeling in fluid mechanics. First, I will propose a method for approximating leading resolvent (pseduospectral) modes for shear-driven turbulent flows using prescribed analytic functions. I will demonstrate that these functions, which arise from the consideration of wavepacket pseudoeigenmodes of simplified linear operators, in particular give an accurate approximation of the class of wall-detached modes that are centered about the critical layer. This approach allows for the prediction of both the dominant mode shape and amplification at a given spatiotemporal wavenumber without the need for any numerical discretization. Next, I will focus on the dynamic mode decomposition (DMD), which provides a means of extracting dynamical information from fluids datasets. I will show that DMD is biased to sensor noise, and will subsequently present a number of modifications to the DMD algorithm that eliminate this bias, even when the noise characteristics are unknown. Lastly, I will discuss a number of approaches by which linear data-driven modeling techniques may be utilized and extended for accurate modeling of nonlinear systems.

BIO SKETCH

Scott Dawson is an assistant professor in the Mechanical, Materials and Aerospace Engineering Department at the Illinois Institute of Technology. Prior to this, he was postdoctoral scholar at the California Institute of Technology, and he completed his Ph.D. in Mechanical and Aerospace Engineering at Princeton University. His research interests include modeling, optimization and control in fluid mechanics, with a particular focus on turbulent shear flows, unsteady aerodynamic systems, and data-driven approaches.

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