JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

SPRING 2021 CEAFM VIRTUAL SEMINAR

"Turbulence Structure and Modeling in the Frequency Domain"

Presented by Prof. Tim Colonius

California Institute of Technology
Department of Mechanical Engineering
Hosted by Rui Ni (MechE)

Amongst many available data-driven modal decompositions of utility in fluid mechanics, the frequency-domain (spectral) version of the proper orthogonal decomposition (SPOD) plays a special role in the analysis of stationary turbulence. SPOD modes are optimal in expressing structures that evolve coherently in both space and time, and they can be regarded as optimally-averaged DMD modes. Importantly, the SPOD spectrum is also related to the resolvent spectrum of the linearized dynamics and examination of the relationships between the SPOD and resolvent modes yields information about how coherent structures are forced by nonlinear interactions amongst coherent and incoherent turbulence. We discuss the application of these tools to analyze and model turbulence in high-speed jets and boundary layers. We highlight recent developments including (a) utilizing eddy-viscosity models in resolvent analysis to enable RANS-based prediction of coherent structures, and (b) nonlinear extensions of resolvent analysis to discover worst-case disturbances for laminar-turbulent transition, and (c) the development fast spatial marching methods for large-scale resolvent problems.

Friday, March 19, 2021 at 3:00 PM EDT
https://wse.zoom.us/j/93762992307