UCI Samueli School of Engineering | Department of Mechanical and Aerospace Engineering

Seminar Series

Control and Estimation of Turbulent Shear Flows using Modal Analysis

Mitul Luhar
Associate Professor and Henry Salvatori Early Career Chair
Department of Aerospace and Mechanical Engineering
University of Southern California

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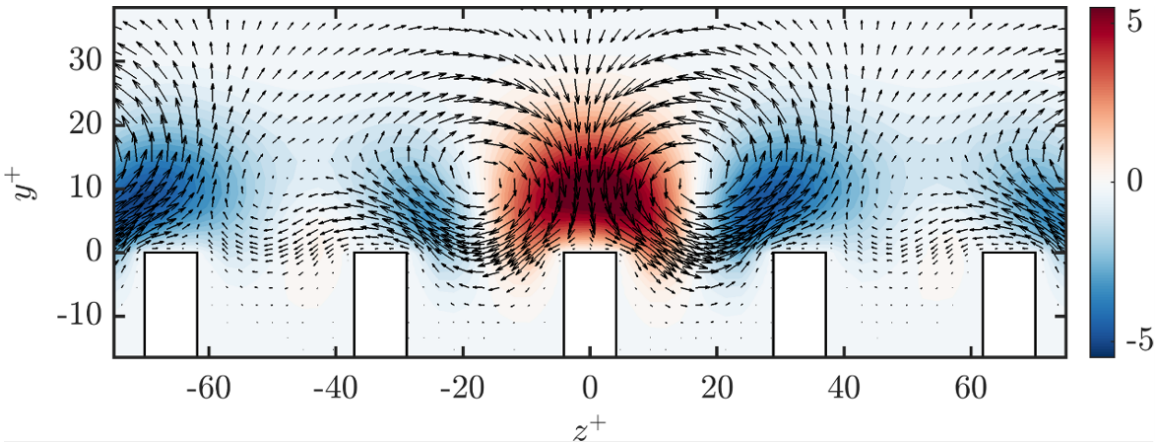
McDonnell Douglas Engineering Auditorium (MDEA)

Abstract: Modal analysis methods can serve as powerful tools in the development of reduced-complexity models for fluid flow. This talk presents two applications of modal analysis involving control and estimation of turbulent shear flows. First, we consider the development of passive control techniques for wall-bounded flows. We show that the drag reducing effect of sharkskin-inspired riblet surfaces is reproduced by a limited number of modes obtained via a gain-based decomposition of the Navier-Stokes equations. This reduced representation enables optimization of riblet geometry and provides insight into the development of permeable materials for turbulence control. Next, we attempt parameter estimation and flow reconstruction for stratified wakes from limited and noisy measurements. We create a library of flow features from prior simulation data using dynamic mode decomposition (DMD). We then use a stepwise regression technique to sequentially identify DMD modes that best represent the measurements. The resulting sparse model enables flow reconstruction as well as estimation of Reynolds and Froude numbers for the wake creator.



Bio: Mitul Luhar is Associate Professor of Aerospace and Mechanical Engineering at the University of Southern California. Research in his group tackles control of wall-bounded turbulent flows and fluid-structure interactions. This work combinates laboratory experiments and reduced complexity modeling. Mitul is the recipient of the NSF CAREER Award and the AFOSR Young Investigator Award. He is a member of the Frontiers of Engineering community at the National Academy of Engineering and the New Voices cohort at the National Academy of Sciences, Engineering, and Medicine. Prior to joining USC, Mitul was a Postdoctoral Scholar in the Graduate Aerospace Laboratories at Caltech. He earned his Ph.D. in Civil and Environmental Engineering from MIT in 2012 and B.A. and M.Eng. degrees in Engineering from the University of Cambridge in 2007.