MAE Seminar SERIES

THURSDAY,
FEBRUARY 21

3:30 PM

114 HOCHSTETTER

PERFORMANCE EFFECTS OF VORTEX FORMATION AND SHEDDING

ABSTRACT

We study the formation and shedding of vortices in vortex-dominated flows in order to detect the formation of coherent structures objectively (i.e., in a frame invariant fashion), and to determine how the formation and shedding of those structures relates to pressure and force in the different applications. We specifically employ the Lagrangian technique of the finite-time Lyapunov exponent (FTLE). The FTLE analysis yields ridges of Lagrangian repulsion and attraction that have been shown to identify transport barriers in a range of flow fields, and vortex boundary features in vortex-dominated flows. In recent work, we have shown that using FTLE to identify and track material trajectories associated with forming and shedding vortices can indicate a shedding time that correlates well to surface pressure and body force extrema on a stationary circular cylinder in cross-flow. In bio-inspired flow, specifically the wake structure generated by a pitching caudal fin model, the release of material trajectories from the trailing edge also correlates well with thrust extrema. These results prompt us to question whether robust control of performance metrics (force, efficiency) may be accessible by exploiting the evolving flow structure available from the FTLE results. More simply, can we be more successful at flow control by targeting FTLE ridges?

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BIO SKETCH

Melissa Green received her BS in Aerospace Engineering from the University of Notre Dame and her PhD in Mechanical and Aerospace Engineering from Princeton University. She was an NAS/NRC Postdoctoral Research Associate at the Naval Research Laboratory from 2009 to 2011. Since 2012, she has been an Assistant Professor in the Department of Mechanical and Aerospace Engineering at Syracuse University. She received the Air Force Office of Scientific Research Young Investigator Award in 2014. Her research interests are primarily in the field of experimental fluid dynamics, particularly in vortex-dominated and bio-inspired applications.

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