

AAE SPECIAL SEMINAR

Understanding Crossflow Instability Through Computations: From Model Flows to Hypersonic Configurations

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ARMS 1103 10:30AM-11:20AM



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Abstract

The crossflow instability is a major contributor to laminar-to-turbulent boundary-layer transition across a wide range of speed regimes and vehicle configurations. Accordingly, crossflow instability has been the subject of numerous investigations. While much of this work has focused on low-speed applications, the push toward hypersonic flight has spurred a growing number of investigations at high speeds.

This seminar will cover three cases in which crossflow instability was investigated using computational tools, with relevant comparisons to experimental measurements. The first case considers transition on the swept fin of a cone/single-fin configuration, where the harmonic linearized Navier-Stokes equations were used to interrogate crossflow growth near the fin leading edge. Energy-budget analysis revealed the dominant mechanisms responsible for disturbance growth. The second case considers transition over a “delta slab,” a geometry designed to facilitate aero-optical investigations of traveling crossflow. The final case focuses on a model flow for crossflow instability, described by the Falkner-Skan-Cooke equations, and investigates nonlinear interactions between stationary and traveling crossflow that appear to influence the saturation amplitude of stationary crossflow.

Biography

Madeline Peck is an assistant professor at the University of Notre Dame. Her research focuses on boundary-layer transition, including both the extraction of physical insight from established stability-analysis tools and the development of advanced stability methods that incorporate additional physical effects. She completed her Ph.D. at Texas A&M University in 2023 and a postdoctoral appointment at Los Alamos National Laboratory in 2025 before joining Notre Dame. Her work is currently supported by the National Science Foundation, the University Consortium for Applied Hypersonics, and other sponsors.