MAE Seminar SERIES

From modal analysis to physical exploration and flow control: applications to impinging jet and cavity flows

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ABSTRACT

As an indispensable tool to uncover the underlying flow physics and design flow control, linear modal analysis has been widely applied to various engineering applications. Here we take two examples to explain how the modal analysis leads the role in physical exploration and flow control design. The first example is a supersonic planar impinging jet flow. Such flow is often encountered in vertical takeoff/landing aircraft and launch vehicles. The fluctuation loads associated with hazardous noise levels cause severe infrastructure damage, attracting numerous efforts to understand noise generation and control the flow oscillation. We show the use of resolvent analysis to uncover the noise generation mechanism and the potential to guide flow control for noise suppression. In the second example-supersonic cavity flow, we leverage the physical insights obtained from the resolvent analysis to design active cavity flow controls. The promising control results indicate that the resolvent analysis, an input-output framework, can navigate and pinpoint the potential effective control parameter range and provide efficient active flow control. These two examples provide a glimpse of the use of linear modal analysis for flow-related engineering applications. Owning to the nature of the modal analysis, it has a great potential to positively impact the life of engineering applications, bringing revolutionary perspectives for modern industrial design that commitment to sustainable development.

BIO SKETCH

Dr. Liu Qiong is a postdoctoral research associate in the Department of Aerospace Engineering at University of Illinois at Urbana-Champaign. She received her Ph.D. in Aerospace Engineering from The Technical University of Madrid, Spain. She has extensive cross-cultural research and living experiences in Brazil, Swede, Japan, and Greece. Dr. Liu's research interests are in computational fluid mechanics, modal analysis, flow control, and data science.

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