LSU Control and Optimization Zoom Seminar

11:30 AM US Central Time, Friday April 11, 2025
https://lsu.zoom.us/j/98176468969, Passcode 123123

Irena Lasiecka
University of Memphis and University of Virginia

Mathematical Theory of Flow-Structure Interactions

Abstract: Flow-structure interactions are ubiquitous in nature and in everyday life. Flow or fluid interacting with structural elements can lead to oscillations, hence impacting stability or even safety. Thus problems such as attenuation of turbulence or flutter in an oscillating structure (e.g., the Tacoma bridge), flutter in tall buildings, fluid flows in flexible pipes, nuclear engineering flows about fuel elements, and heat exchanger vanes are just a few prime examples of relevant applications which place themselves at the frontier of interests in applied mathematics. In this lecture, we shall describe mathematical models describing the phenomena. They are based on a 3D linearized Euler equation around unstable equilibria coupled to a nonlinear dynamic elasticity on a 2D manifold. Strong interface coupling between the two media is at the center of the analysis. This provides for a rich mathematical structure, opening the door to several unresolved problems in the area of nonlinear PDEs, dynamical systems, related harmonic analysis, and differential geometry. This talk provides a brief overview of recent developments in the area, with a presentation of some new methodology addressing the issues of control and stability of such structures. Part of this talk is based on recent work with D. Bonheur, F. Gazzola and J. Webster (in Annales de L'Institute Henri Poincare Analyse from 2022), work with A. Balakrishna and J. Webster (in M3AS in 2024), and also work completed while the author was a member of the MSRI program "Mathematical problem in fluid dynamics" at the University of California Berkeley (sponsored by NSF DMS -1928930).

Biography: Dr. Lasiecka received her PhD in Applied Mathematics from the University of Warsaw in 1975. Her research interests focus on control theory for infinite dimensional systems, predominantly partial differential equations (PDEs). Here, her work has laid and developed the foundations of the theory with common emphasis on boundary/point control. She published several research monographs and more than 300 research papers on topics such as optimal control theory, controllability, stabilization, and long-time behavior for linear and non-linear problems of relevance to engineering. Her research has advanced the field of problem-oriented boundary control theory for PDEs. For her work, she was awarded the 2011 SIAM W.T. and Idalia Reid Prize, and the 2019 AACC Richard E. Bellman Heritage Award. Her more recent work involves interactive systems with interface, describing fluid-flow/structure interaction and structural acoustics, where the goal is turbulence or noise suppression. She has held full professorships at the University of Florida, and at the University of Virginia where she was the Commonwealth Professor of Mathematics. Since 2013, she has served as a Distinguished University Professor in the Department of Mathematical Sciences at the University of Memphis. She is an AAAS, AMS, IEEE, and SIAM Fellow, and has been an IEEE Distinguished Lecturer, and a plenary speaker at AMS, IEEE, and SIAM conferences. She is Editor in Chief of Applied Mathematics and Optimization [Springer] and Evolution Equations and Control Theory [AIMS]. Her work has been supported by AFOSR, ARO, NASA, and NSF.