UNIVERSITY of HOUSTON

Department of Mathematics

Scientific Computing Seminar

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Bridging Large Eddy Simulation and Reduced Order Modeling of convection-dominated flows through spatial filtering

Thursday, March 27, 2025 1 PM- 2 PM Room 646 PGH

Abstract: Reduced order Models (ROMs) are inexpensive surrogates for expensive models. The surrogate is constructed by extracting the dominant system dynamics from selected high-resolution simulations. Leveraging the so-called offline/online paradigm, the expense incurred in the construction process is amortized over many surrogate solutions. The presence of flow phenomena over large spatial and temporal ranges in convection-dominated flows poses significant challenges to traditional ROMs: a large number of modes may be required to accurately describe the fluid dynamics, which limits the computational efficiency. On the other hand, if one chooses to reduce the number of modes to improve efficiency, a severe loss of information compromises the solution accuracy. We propose to recover stability for classical ROMs through closures and stabilizations that are inspired by Large Eddy Simulation (LES). A key ingredient for the construction of these ROMs, which we call LES-ROMs, is spatial filtering, i.e., the same principle used to build classical LES models. This ensures a modeling consistency between LES-ROMs and the approaches that generated the data used to train them. We will show that LES-ROMs are extremely easy to implement, very efficient, and, when carefully tuned, accurate in capturing the average physical quantities of interest in challenging convection-dominated flows.

This seminar is easily accessible to persons with disabilities. For more information or for assistance, please contact the Mathematics Department at 743-3500.