

SIAM/APPLIED AND NUMERICAL ANALYSIS SEMINAR

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Title: Large Eddy Simulation Reduced Order Modeling

Abstract: In this talk, we propose a large eddy simulation reduced-order model (LES-ROM) framework for the nonlinear fluid dynamics. In the LES-ROM framework, proper orthogonal decomposition is used to define the ROM basis. Under this framework, we introduce the ROM spatial filter and two novel methods to solve the ROM closure problem. One approach is the approximate deconvolution (AD-ROM) based on the structural reconstruction of the fluid field. Another way is data-driven operator learning-based modeling (DDF-ROM). In the second approach, we use data-driven modeling to close the filtered ROM, i.e., to model the interaction between the resolved and unresolved modes. To this end, we use a quadratic ansatz to model this interaction and close the filtered ROM. To find the new coefficients in the closed filtered ROM, we solve an optimization problem that minimizes the difference between the full order model data and our ansatz. We emphasize that the new DDF-ROM is built on general ideas of spatial filtering and optimization and is independent of (restrictive) phenomenological arguments.