



THE UNIVERSITY OF
CHICAGO

THE COMMITTEE ON
COMPUTATIONAL AND
APPLIED MATHEMATICS

COLLOQUIUM

GIANLUIGI ROZZA

SISSA mathLab, Mathematics Area, SISSA-International School for Advanced Studies

Enhancing Computational Fluid Dynamics Simulation with Model Reduction and Scientific Machine Learning: State of the Art and Perspectives

THURSDAY, November 13th at 4:00 PM

Jones 303, 5747 S. Ellis Ave. Chicago, IL 60637

ABSTRACT

Partial differential equations (PDEs) are invaluable tools for modelling complex physical phenomena. However, only a limited number of PDEs can be solved analytically, leaving the majority of them requiring computationally expensive numerical approximations. To address this challenge, reduced order models (ROMs) have emerged as a promising field in computational sciences, offering efficient computational tools for real-time simulations. In recent years, deep learning techniques have played a pivotal role in advancing efficient ROM methods with exceptional generalisation capabilities and reduced computational costs to enhance surrogate simulation tools.

In this talk we explore how classical ROM techniques can be elevated through the integration of some deep learning models in view of more demanding applications involving complex phenomena. We will introduce hybrid approaches, which consider both physics-based and purely data-driven techniques, as well as aggregated ones, where the model is built as the combination of different pre-trained models.

Our discussion encompasses a review of existing (intrusive and data driven) approaches to enhancing ROM by means of neural operators with applications in Computational Fluid Dynamics, also in presence of turbulence and compressibility.

Organizers:

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