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REDUCED ORDER MODELING BASED ON GALERKIN METHODS FOR FLUID DYNAMICS PROBLEMS

FRANCESCO BALLARIN [*], **ENRIQUE DELGADO ÁVILA** [†]

[*] Department of Mathematics and Physics, Università Cattolica del Sacro Cuore
via Garzetta 48, 25133 Brescia, Italy
francesco.ballarin@unicatt.it, https://www.francescoballarin.it

[†] Universidad Loyola Andalucía,
Avenida de las Universidades 2, 41704, Dos Hermanas (Sevilla), Spain.
edelgado@uloyola.es, https://sites.google.com/view/endelgado/home

ABSTRACT

Numerical modeling and simulation play a crucial role in numerous fluid dynamics applications, ranging from industry to medicine. Key mathematical models in this field include the Navier-Stokes equations, Euler equations, and the Darcy problem, possibly combined with other equations in a multiphysics context.

Solving these complex problems typically demands significant computational resources, especially when using high fidelity methods like the finite element or finite volume methods. In many practical scenarios the computational effort can become prohibitively high, particularly in settings requiring multiple simulations, such as those involving inverse problems, data assimilation or control. To address these challenges, reduced order models (ROMs) have been developed over the past few decades as cost-effective, accurate alternatives to traditional high-fidelity methods in a wide range of fluid dynamics problems.

This minisymposium will focus on a specific class of reduced order models, those based on Galerkin methods. Noteworthy examples include Reduced Basis Methods (RBMs), Proper Orthogonal Decomposition (POD)-Galerkin methods, and Hierarchical Model Reduction (HiMod). Techniques aimed at integrating Galerkin-based ROMs with other model reduction approaches are also of interest for the scope of the minisymposium.

The discussions will cover the development of new Galerkin-based ROMs, their numerical analysis tailored to fluid dynamics, and their application to significant fluid dynamics challenges. In essence, this minisymposium aims to bring together mathematicians, engineers and practitioners with an interest in Galerkin-based ROMs to explore and exchange ideas on their application to a diverse array of fluid dynamics problems.