Data-driven and projection-based reduced order models for computational sciences and engineering

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ABSTRACT

Numerical simulation is nowadays used to solve a huge variety of problems in Fluid and Structural mechanics, as well as Fluid-Structure Interaction. Often, the discretisation of this type of problem results in high-dimensional systems of equations and requires a high computational effort. For this reason, standard numerical techniques such as the finite element method, the finite volume method, or the finite difference method are not viable when time is tight or a high number of system configurations need to be tested. Typical examples of this case can be found in shape optimisation, uncertainty quantification, or real-time control. Reduced order models (ROMs) offer a possible way to reduce the computational burden. Many different types of ROMs have been developed over the years and a possible distinction is between those of them that are intrusive and require the knowledge of the underlying full order model and those that are merely data-driven and therefore non-intrusive. In the first category fall the reduced-basis method, the POD-Galerkin approach, and the Proper Generalised Decomposition. In the second category, one can find truncation-based methods, the dynamic mode decomposition, neural networks, and in general all the models based on just input-output data. This mini-symposium will be devoted to both types of ROMs with a special focus on those specifically tailored to fluid dynamics, computational mechanics and fluid-structure interaction problems.