INNOVATIVE TECHNIQUES FOR REDUCED ORDER MODELS IN FLUID DYNAMICS

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ABSTRACT

Reduced Order Models (ROMs) are approximations of High-Fidelity (HF) models, designed to enable fast and efficient simulations while maintaining an acceptable level of accuracy. This is particularly important when simulations need to be repeated under different input parameters, namely in many-query problems. However, developing ROMs that are accurate and preserve the physical properties and structures of HF models remains a major challenge. Examples of essential features are conservation, positivity, entropy preservation, well-balanced property, and preservation of differential operators. Ensuring that ROMs are accurate is critical for achieving reliable and physically meaningful results.

Recent advancements have introduced techniques such as domain decomposition to address complex geometries or follow particular structures (e.g. shocks, large gradient solutions), data enrichment approaches, and methods like registration and optimal transport to improve the representation of solution spaces, and thus reduce the Kolmogorov n-width. These approaches aim to ensure that ROMs provide fast predictions without overly sacrificing the accuracy of the underlying HF model.

This minisymposium addresses the latest developments in ROM techniques and their applications across various fields of engineering and science. Particular attention will be given to applications in fluid dynamics, such as aerospace, biomedical engineering, geophysics, environmental modeling, and industrial processes. Contributions from other domains are also welcome, to promote interdisciplinary collaboration and investigation of new frontiers in reduced order modeling.