MAX-PLANCK-INSTITUT
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CSC Seminar

SPEAKER

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TITLE

Adjacency-based non-intrusive reduced-order modeling for incompressible Navier Stokes and Fluid-Structure interactions

ABSTRACT

Non-intrusive model reduction is a promising solution to computationally efficient dynamics forecasting, especially in cases where data are collected from experimental campaigns or proprietary software simulations. In this work, we present a method for non-intrusive model reduction, applied to incompressible fluid dynamics and fluid-structure interaction (FSI) systems. The approach is based on the a priori known sparsity of the full-order system operators (e.g. of the discretized Navier-Stokes equations), which is dictated by grid adjacency information. In order to enforce this type of sparsity, we solve a "local", regularized least-squares problem for each degree of freedom on a grid, considering only the training data from adjacent nodes, thus making computation and storage of the inferred full-order operators feasible. After constructing the non-intrusive, sparse full-order model, the Proper Orthogonal Decomposition is used for its projection to a reduced dimension subspace. This approach differs from methods where data are first projected to a low-dimensional manifold, since here the inference problem is solved for the original, full-order system. We consider the construction of a parametric, quadratic, reduced order model for the flowfield prediction over a cylinder at a low Reynolds numbers range. Considering FSI simulations, a quadratic-bilinear model is constructed for both solid and fluid subsystems and tested for the Hron-Turek benchmark. Results considering the accuracy and predictive capabilities of the inferred reduced models are discussed.

Tuesday, November 22, 2022 at 2 pm
seminar room Prigogine