MAX-PLANCK-INSTITUT
FÜR DYNAMIK KOMPLEXER
TECHNISCHER SYSTEME
MAGDEBURG

CSC Seminar

SPEAKER

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TITLE

GAMM test talk: Autoencoders with CUR decompositions for physics-preserving low-order models in fluid flow

ABSTRACT

Model order reduction is a technique for reducing the complexity of high-dimensional systems by employing a low-dimensional parametrization of system states. It facilitates efficient computations and reduces memory requirements, albeit at the expense of decreased simulation accuracy and challenges in preserving essential system properties such as sparsity, positivity, and physical laws. Thus, selecting an appropriate model order reduction method with a suitable latent dimension is crucial for achieving a trade-off between accuracy and efficiency.

In this work, we propose autoencoders that decode latent states using actual system states selected from a dataset (known as the matrix C from CUR decompositions). We compare this approach with two established techniques: proper orthogonal decomposition and proper CUR decomposition. To evaluate the methods, we construct reduced-order models and simulate the wake flow past a single cylinder governed by the incompressible Navier-Stokes equations. The investigation focuses on simulation accuracy and the ability to preserve underlying physical laws, such as incompressibility, in the reduced-order models.

Tuesday, April 1, 2025 at 2 pm

seminar room Prigogine