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STRUCTURE-PRESERVING REDUCED ORDER MODELS FOR FLUID FLOWS

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ABSTRACT

The development of reduced order models (ROMs) of complex fluid flows is an ongoing challenge in the model reduction community. A popular approach is to use the POD-Galerkin method, in which a reduced order model is formulated by a Galerkin projection of a high-fidelity ('full order') model with an empirical basis. The empirical basis is often constructed from snapshots of this full order model, making the approach a blend between physics- and data-driven approaches.
However, when solving fluid flows several pressing issues remain, such as stability of the ROM for convection-dominated and turbulent flows [1], its extrapolation capabilities outside the range of the training data, and the intrusive nature of the basic method.
Recently, to tackle these issues there is a growing interest in including additional 'structure' in the construction of the ROM, based on physical principles such as symmetries (e.g. turbulent stress tensor) [2], energy or entropy equalities [3], positivity (e.g. density, pressure), and constraints (e.g. incompressibility).
In this minisymposium we want to bring together researchers working in the fields of model order reduction, structure-preserving computing, and computational fluid dynamics to further advance the field of structure-preserving ROMs. Possible contributions could relate to (but are not limited to) including structure-preservation in turbulent flow ROMs, in non-intrusive methods, and in hyper-reduction strategies.

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