

## SCIENTIFIC MACHINE LEARNING FOR NONLINEAR MODEL REDUCTION

500 – COMPUTATIONAL APPLIED MATHEMATICS

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### ABSTRACT

Model reduction is concerned with reducing the degrees of freedom of high-dimensional state-space models of complex systems. Traditionally, model reduction is performed by approximating the dynamics on linear subspaces, building on concepts from (Petrov-) Galerkin projection, transfer function interpolation, and/or systems theory. Recent breakthroughs in scientific machine learning opened entirely new avenues for model reduction using, e.g., manifold approximations, autoencoders and online-adaptive bases, to address a longstanding approximation barrier when using linear subspaces.

This minisymposium will present a timely snapshot of the state of the art in nonlinear model reduction enabled by scientific machine learning. The themes of the minisymposium will revolve around the development of nonlinear model reduction methods with polynomial manifolds, sparse manifold constructions, data-driven nonlinear model reduction, structure-preserving nonlinear model reduction, adaptive model reduction with specific enablers for online efficiency and accelerators for integrating the the reduced-order models forward in time (such as hyper-reduction).

Applications for the developed methods may come from a wide range of computational mechanics, such as fluid and solid mechanics, plasma physics, electromagnetism, biological systems, and many more. These applications will have the shared complexities of high dimensionality paired with nonlinearity and a strong need for model reduction to enable many query applications.