The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

# ACTIVE LEARNING FOR NON-INTRUSIVE MODEL REDUCTION OF PARAMETRIC DYNAMICAL SYSTEMS

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**Keywords**: *Active learning, Non-intrusive model reduction, Parametric systems*

We discuss model order reduction of large-scale nonlinear systems. In situations where the governing equations are not accessible, non-intrusive reduced-order modeling techniques are preferred. To assess the quality of a constructed reduced-order model, we need an estimate of the error inherent in the reduced approximation compared to the full-order solution. In this direction, we propose a non-intrusive error estimator for nonlinear parametric dynamical systems. It is computed by learning the relative norm of the solution-vector error using interpolation in parameter-time space. We utilize a radial kernel-based shallow neural network to perform this interpolation. The reduced model is also constructed by such a shallow network, in combination with proper orthogonal decomposition (POD), similar to [1]. Moreover, using the proposed error estimator, we iteratively update the training data and adaptively change the POD basis dimension to actively learn the reduced model.

The developed active learning framework iteratively detects locations in the parameter domain where the variation in solution features is high, and generates new snapshot in those regions. This improves the accuracy of the surrogate solution, and refines the active learning process over subsequent iterations. The non-intrusive reduced model obtained using the shallow network is computationally inexpensive, and good for multi-query parametric evaluations. We demonstrate the performance of the proposed framework by numerical tests on some benchmark fluid-flow problems.

## REFERENCES

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