From linear mappings to deep learning for model order reduction of numerical simulations of industrial interest

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ABSTRACT

The solutions to the parametrized equations governing a physical phenomenon of engineering interest lie in the so-called solution manifold. The different Model Order Reduction (MOR) techniques attempt to construct fast and inexpensive, yet accurate, models for obtaining such solutions, by somehow approximating the solution manifold.

The aim of this work is to present a set of approaches for model order reduction. We start with one of the classical techniques for constructing reduced order models (ROM), the proper orthogonal decomposition (POD), which employs a linear subspace for the approximation of the manifold. Then we explore the use of a set of linear subspaces tailored for approximating specific regions of the manifold. We conclude by covering methods that attempt to unveil the manifold structure by using nonlinear mappings, for example different manifold learning methods or deep convolutional autoencoders.

A comparison of the different approaches is presented for different cases of industrial interest by using the open source FEM software KratosMultiphysics [1].

REFERENCES

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