Model Order Reduction of 1D nonlinear transport PDEs in porous media

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The goal of this project is develop model reduction strategies for parametric nonlinear transport equations in porous media. This task is challenging due to the transport of discontinuites in the PDE solutions, and makes that one cannot expect to approximate the set of solutions with linear spaces as in classical model reduction approaches.

A strategy recently proposed in [1] is to work on the space of Wasserstein measures, in which translations are naturally encoded in the notion of distance. The approach, based on Wasserstein barycenters, could be interpreted as an interpolation strategy which is inherently nonlinear. In the online phase, the barycentric weights are selected with an interpolation stratgy, which is non-intrusive manner but it does not take into account the PDE structure (the computation does not involve any residual evaluation).

In this project, we propose to apply the methods proposed in [1] to address one-dimensional parametric nonlinear transport equations in porous media, and we will explore the potential of considering more intrusive approaches involving residual computations in the process of computing the barycentric weights.

References

[1] V. Ehrlacher, D. Lombardi, O. Mula, and F.-X. Vialard. Nonlinear model reduction on metric spaces. Application to one-dimensional conservative PDEs in Wasserstein spaces. *ESAIM, Math. Model. Numer. Anal.*, 2020.