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# Numerical model reduction with adaptive basis enrichment for computational homogenization of porous media

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Computational homogenization can be used in order to model the effective mechanical behavior of fluid saturated porous rock with heterogeneous properties. A standard approach is the "finite element squared" ($FE^2$) procedure, where a new boundary value problem for the coupled porous media problem is defined on a Representative Volume Element (RVE) in each quadrature point of the (macroscale) mesh. The effective macroscopic response is obtained from solving the RVE problem. The $FE^2$ strategy can be computationally expensive and it is therefore of interest to reduce the cost of solving the individual RVE problems by introducing a reduced basis, here denoted Numerical Model Reduction (NMR).

Jänicke et al. [1] used proper orthogonal decomposition (POD) to find a reduced basis for homogenization of quasi-static linear poroelasticity and it was demonstrated that the apparent macroscale properties pertain to viscoelasticity. Naturally the richness of the reduced basis will determine the accuracy of the (reduced) solution, which calls for error control. Ekre et al. [2] developed an *a posteriori* error estimator for estimating the error stemming from the application of the reduced basis.

The POD strategy used in [1], [2] represent an *a priori* approach where the basis is identified in a pre-processing ("offline") step, and then kept fixed during the "online" simulation. This is not always a good strategy since, for example, the geometry and physics of the problem may change during the simulation such that the basis is sub-optimal. This was demonstrated for the non-linear problem [2]. In this contribution we present a preliminary strategy for efficiently adapting the basis during the "online" computation using the error estimator as a guide.

## REFERENCES

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