Numerical Homogenization of Nonlinear Multiscale Diffusion Problems

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Many applications, such as geophysical flow problems, require the combination of nonlinear material laws and multiscale features, which together pose a huge computational challenge.

In this talk, we present a simple yet effective approach on how to construct a problem-adapted multiscale basis in a linearized and localized fashion for strongly monotone quasilinear problems [1]. The corresponding generalized finite element method gives optimal error estimates up to linearization errors. In particular, neither higher regularity of the exact solution nor structural properties of the coefficients such as scale separation or periodicity need to be assumed. Different linearization strategies will also be discussed in theory and practice.

Numerical examples show very promising results illustrating the theoretical convergence rates and showing the possibility to generalize beyond monotone problems.

References

[1] B. Verfürth. Numerical homogenization for nonlinear strongly monotone problems, arXiv preprint 1907.01883 (2019).