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On the localization problem in numerical homogenization

Numerical homogenization aims to efficiently and accurately approximate the solution space of partial differential partial differential operators with arbitrarily rough (non-periodic) coefficients. The application of the inverse operator to some standard finite element space typically defines an approximation space with uniform algebraic convergence rates with respect to its dimension. However, the canonical basis associated with this construction is non-local and, hence, numerically intractable. That is why the true challenge of numerical homogenization is the identification of a computable local basis for such an operator-dependent approximate solution space. This talk presents a near-optimal constructive solution to this problem in the case of prototypical linear elliptic operators. A sequence of numerical experiments illustrates the significance of the result for the efficient and reliable numerical simulation of physical processes beyond classical homogenization problems.

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