

Running computations with the Multi-scale Finite element approach (MsFEM) in FreeFem++

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The Multi-scale Finite element approach (MsFEM) is a finite element approach designed to solve PDEs with highly oscillatory coefficients. In contrast to standard Finite Element approaches, the MsFEM basis functions used to generate the approximation space are precomputed. They encode the fine-scale details of the oscillatory coefficients, and are thus specifically adapted to the problem at hand. Given a coarse discretization of the domain, the computation is performed in a two-stage procedure: (i) a offline stage, in which basis functions are computed as solutions to local fine scale problems, and (ii) a online stage, in which the global problem is solved using an inexpensive Galerkin approximation using the coarse mesh.

Several variants of the approach have been proposed, which differ by the precise definition of the local problems: they can e.g. be posed on each coarse element with Dirichlet boundary conditions (the so-called linear MsFEM variant) or with Crouzeix-Raviart type boundary conditions, on enlarged elements (the so-called oversampling variant), ...

In this talk, we will discuss a generic template that allows to easily implement the various MsFEM variants in FreeFem++.