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Numerical homogenization and the Arlequin method

Frédéric Legoll[1]

[1] Ecole Nationale des Ponts et Chaussées (Navier laboratory) and Inria (MATHERIALS team-project), 6-8 avenue Blaise Pascal, 77455 Marne-la-Vallée, FRANCE
frederic.legoll@enpc.fr
http://cermics.enpc.fr/∼legoll

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We numerically investigate and improve upon a computational approach originally introduced by Régis Cottereau in [1] which aims at evaluating the effective coefficient of a medium modelled by a highly oscillatory coefficient. This computational approach is based on a Arlequin type coupling. It combines the original fine-scale description of the medium (modelled by an oscillatory coefficient) with an effective description (modelled by a constant coefficient) and optimizes upon the coefficient of the effective medium to best fit the response of the actual heterogeneous medium using a purely homogeneous medium. The approach can thus be regarded as a way to extract the effective coefficient of a heterogeneous medium without using the standard ingredients of homogenization (computation on large RVEs, ...), and which can also be applied in the case of moderate scale separation.

We present various improvements of the algorithms, in order to obtain a procedure as efficient as possible. Representative numerical results, both for deterministic and random heterogeneous models, demonstrate the added value of our approach in comparison to the original approach.

Joint work with Olga Gorynina and Claude Le Bris (ENPC and Inria).

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