Numerical Computation of Effective Properties for Heterogeneous Materials in Linear Elasticity and Fluid Dynamics

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For the simulation of materials and fluids involving several constitutes at the microscopic level, homogenization methods are usually applied to obtain a homogeneous effective material. We investigate an approach based on the Lippmann-Schwinger equation to compute the effective stiffness of short-fiber reinforced materials as well as the effective viscosity of fiber suspensions in a Stokesian flow regime. The equations are solved within a representative volume element (RVE) with periodic boundary conditions using a non-conforming (Fourier-)Galerkin method, originally proposed by Moulinec and Suquet [1]. The numerical results are compared to existing analytical solutions. Problems with infinite contrast require regularization, which is discussed in terms of a numerical convergence study. Further we discuss some aspects of the implementation, parallelization and scalability of the method.

References:

[1] H. Moulinec and P. Suquet: *A numerical method for computing the overall response of nonlinear composites with complex microstructure.* Comp. Meth. Appl. Mech. Engng., 157 (1998) 69-94.

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