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COMPUTATION OF THE EFFECTIVE MAGNETOSTRICTIVE COEFFICIENT OF MAGNETO-MECHANICALLY COUPLED COMPOSITES

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Magnetostrictive composites are of high interest in the field of magneto-mechanically coupled applications. Such composites can enhance the effective mechanical properties and show advantages to homogeneous magnetostrictive materials. By combining the magnetoactive phase with polymers or metals the composite is for instance mechanically more flexible, tougher under tensile loading or less brittle. An analytical method for the simulation of such composites based on Green's function technique is developed by [1]. Further works dealing with the calculation of effective magnetostrictive properties are for example [2] and [3].

In this talk we present a two-scale homogenization procedure for magnetostrictive composites involving a non-linear material behavior with dissipative magnetostriction. One focus of this talk is the proposed direct homogenization procedure which is implemented into the FE^2-method, see [4] for the application to electro-mechanically coupled boundary value problems. With this homogenization approach the effective properties of magnetostrictive composites can be determined. Furthermore the multiple-scale transition between the macro- and microscale enables the computation of magneto-mechanically coupled macroscopic boundary value problems taking into account microscopic material properties. Different volume fractions of the phases and inclusion geometries of the magnetostrictive material influence the macroscopic magnetostriction behavior and are considered by using representative volume elements (RVEs).

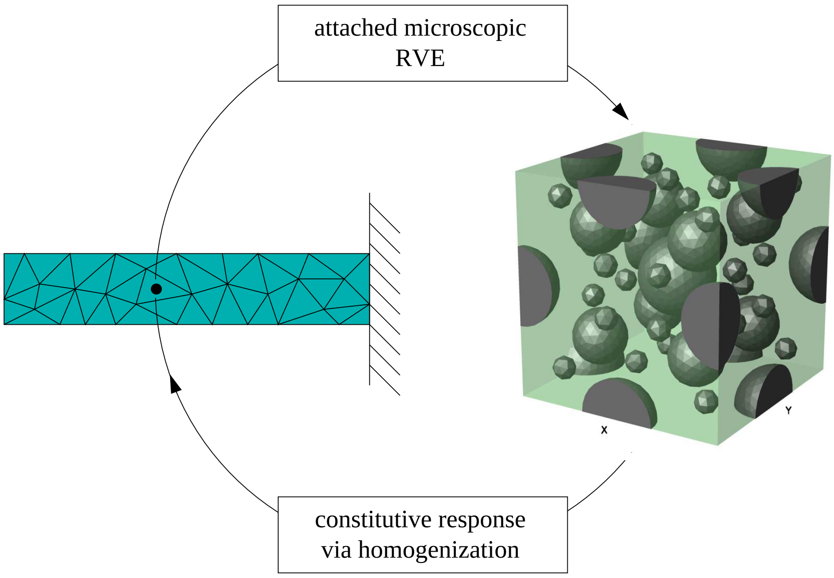

Figure 1: Computational homogenization using the FE^2-method with attached magnetostrictive RVE.

On the microscale we consider a constitutive rate-dependent model for non-linear magnetostriction, see [5] and [6]. Numerical examples then demonstrate that the proposed formulation is capable of showing the characteristic ferromagnetic and field-induced strain hysteresis curves of magnetostrictive composites.

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