Introduction to FFT-based homogenization

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In recent years, a growing interest has been observed toward spectral "FFT-based" methods originally introduced in the 1990s for simulating the elastic response of heterogeneous materials. In this talk we will give at first a short introduction to the original method which is

- using a discretization by Fourier polynomials [6, 7]

- can be interpreted as gradient descent method [3]

- is applicable to linear an nonlinear problems [7] and

- can be combined with mixed boundary conditions (e.g. uniaxial tensile test) [5]

Afterwards, we will discuss recent improvements that

- accelerated the algorithm for linear problems by conjugate gradients (CG) [11] and for nonlinear problems by combining Newton-Raphson with CG [1],

- changed the discretization [10, 9, 8] to obtain robust convergence for infinite contrast and

- reduced the computational effort by using composite voxel [2, 4]

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