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COMPARISON OF HOMOGENIZATION SCHEMES TO PERIODIC AND RANDOM SIMULATIONS

Assessment of the efficiency of the Interaction Direct Derivative homogenization scheme by comparison to Finite Element Simulations.

We modify the IDD scheme to improve the results according to a simple geometrical rule and an optimization procedure. The aspect ratio of the atmosphere needs to change from 1 to that of the inclusion 0.1 when the volume fraction $f$ increases.

Fig. 3: Two possibilities for the evolution of the aspect ratio of the atmosphere.

Fig. 4: Efficiency of this modification. ($\times$): simulations, (●): geometrical rule, (−−): optimized shape.

The geometrical rule is less satisfactory than the optimized shape, but is simpler. We call the IDD estimate built by this modification IDD-A. It is not new [3].

Isotropically oriented elliptical pores, aspect ratio 0.1

Finally we compare three estimates to simulations in the case of randomly oriented pores. The results obtained with IDD-A are very satisfactory.

Aligned elliptical pores, aspect ratio 0.1

We compare random simulations simu, periodic simulation with isotropic cell perEC and elliptic cell perEE, to the IDD scheme with circular atmosphere and the MT scheme. The IDD is failing because some coefficient reach their bound (0 or 1) far too early. MT does not show this problem. IDD needs to be used more carefully. perEC is accurate but cannot reach high volume fractions, perEE gives unsatisfactory results at intermediate volume fractions.

References