ABSTRACT

Discrete Network Approximation for Highly Packed Particle Filled Composites

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We present a new approach for calculation of effective properties of high contrast disordred composites an illustrate it by considering highly packed suspensions of rigid particles in a Newtonian fluid.

The main idea of this variational approach is a reduction of the original continuum problem, which is described by PDEs with rough coefficients, to a discrete random network. This reduction is done in two steps which constitute the "fictitious fluid" approach. In Step 1 we introduce a "fictitious fluid" continuum problem when fluid flows only in narrow channels between closely spaced particles, which reflects physical fact that the dominant contribution to the dissipation rate comes from these channels. In Step 2 we derive a discrete network approximation for the latter continuum problem.

Next we use this approach to calculate the effective viscous dissipation rate in a 2D model of a suspension (a thin film). We show that that under certain conditions the model exhibits an anomalously strong rate of blow up when the concentration of particles tends to maximal. We explore physical ramification of this phenomenon.

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