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Three-dimensional simulation of 10^3 deformable capsules in Poiseuille flow[1] R. MURTHY KALLURI, SAI DODDI, PROSENJIT BAGCHI, Rutgers University — Three-dimensional simulation using front-tracking methods are presented on the motion of 10^3 deformable elastic capsules at semi-dense suspension in Poiseuille flow in microvessels, typical of microcirculation and microfluidic devices. The computational framework considered here can resolve the dynamics of individual deformable cell with high fidelity, yet can consider a large number of hydrodynamically interacting cells. In the simulations, the flow field is resolved using up to 300^3 Eulerian grid points, and each capsule surface is resolved by up to 1280 triangular elements. Flow visualization, and analysis of cell trajectory and velocity of the multi-file motion are presented as functions of the cell deformability, and volume fraction. The simulations are computation- and data- intensive, and the first of their kind in the context of deformable capsule suspension. They provide a wealth of information on the dynamics of semi-dense suspension of liquid capsules, in particular, and of deformable particles, in general. The numerical results allow us to analyze various microrheological phenomena, such as the particle migration and formation of near-wall depletion layer, plug-flow velocity, and Fahraeus and Fahraeus-Lindqvist effects.

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