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Simulation of cellular interactions in the microcirculation HONG ZHAO, AMIR H.G. ISFAHANI, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, JONATHAN B. FREUND, Department of Mechanical Science and Engineering and Department of Aerospace Engineering, University of Illinois at Urbana-Champaign — The flow dynamics of the microcirculation is dominated by multi-body cell interactions. We present a simulation technique based on the Stokes-flow boundary integrations for solving such systems of interacting cells. The cell structures are modeled as elastic membranes with finite bending modulus that enclose a more viscous hemoglobin solution relative to plasma. The surface is mapped from a sphere, upon which variables are discretized through truncated spherical harmonic series. This spectral representation is highly accurate, has uniform error distribution over the cell surface, and facilitates stabilization through dealiasing without affecting the resolved features of the cells with unphysical dissipation. The algorithm evaluates the boundary integrals with an overall computational cost of $O(N \log N)$ by using Ewald sums and subsequently smooth particle-mesh Ewald method. We present the simulation results for the relaxation time scale for deformed cells and the apparent viscosity of blood flow through narrow cylindrical tubes. These results agree well with the published experimental results.

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