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Reduced-order Models for Migration and Shear-induced Diffusion of Red Blood Cells in Simple Geometries[1] HARRY WANG, JOSEPH SHERWOOD, OMAR MATAR, Imperial College London — From a fluid dynamics perspective, blood can be treated as a suspension of highly-deformable red blood cells (RBCs). The RBCs migrate away from the walls of the confining vessel primarily due to their deformability, resulting in inhomogeneous distributions, distinctive in the microvasculature. Migration away from the walls is countered by shear-induced diffusion effects due to hydrodynamic particle-particle interactions. While mesoscale simulations can capture RBC dynamics well, there is a need for more efficient continuum models that can accurately model RBCs distributions in larger networks that describe the microvasculature. Here, we study the behaviour of RBC suspensions in simple flow configurations using reduced-order models. We use a drift-diffusion equation to describe the evolution of the RBC concentration, coupled to balance equations for the bulk mixture. Different forms for migration and shear-induced diffusion terms in the drift-diffusion equation are compared in rectangular and cylindrical geometries. The problem is reduced to two-dimensions using appropriate scaling, which exploits geometrical length-scale disparity, and asymptotic reduction. Velocity and concentration profiles predicted by our simulations are compared to experimental data in the literature.

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