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COMPUTER MODELLING AND NUMERICAL STUDIES OF CAPSULE DYNAMICS IN FLUID FLOWS: THE MEMBRANE VISCOSITY EFFECTS

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ABSTRACT

The membrane of human red blood cells (RBCs) consists of a lipid bilayer anchored on the cytoskeleton network with transmembrane proteins. This unique molecular structure results in both solid-like elastic and fluid-like viscous mechanical responses to membrane deformation. In this presentation, we first review the typical numerical techniques of modelling the membrane viscous effect for capsule dynamics in flows, and then introduce the finite-difference approach we recently developed for the immersed boundary simulations. Unlike other previous studies, our model has been carefully validated, and the algorithm is relatively simple and efficient. Furthermore, investigations of membrane viscous effects on RBC dynamics in tube and shear flows have been conducted. Key parameters that are commonly used to characterize capsule dynamics, including the deformation index, rotation frequency, inclination angle, and migration velocity, are examined in details. Future research directions in relevant areas will also be briefly discussed.