

Red blood cells in low Reynolds number flow: a vorticity-based characterization of shapes in two dimensions

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Abstract-

Studies on the mechanical properties of red blood cells improve the diagnosis of some blood-related diseases. Some existing numerical methods have successfully simulated the coupling between a fluid and red blood cells. This paper introduces an alternative phase-field model formulation of two-dimensional cells that solves the vorticity and stream function that simplifies the numerical implementation. We integrate red blood cell dynamics immersed in a Poiseuille flow and reproduce previously reported morphologies (slippers or parachutes). In the case of flow in a very wide channel, we discover a new metastable shape referred to as ‘anti-parachute’ that evolves into a horizontal slipper centered on the channel. This sort of metastable morphology may contribute to the dynamical response of the blood.

Index Terms-

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