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Dynamics of microswimmers near deformable and penetrable interfaces

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The hydrodynamics of microswimmers at interfaces is crucial to understand biological processes and develop artificial microswimmers for bio-medical applications. Unfortunately, only limited studies have been performed on microswimmer dynamics near deformable/penetrable interfaces, due to the high computational cost. To address this, we present direct numerical simulations for a microswimmer embedded in a viscosity matched binary fluid mixture. We use the smooth profile method to fully resolve the hydrodynamic flows, together with a squirmer model to represent the swimming motion. Upon approaching the fluid-fluid interface, we observe that the microswimmer can either penetrate the interface, swim parallel to it, or bounce back, depending on the strength and type of swimming (i.e., puller, pusher, or neutral), as well as the angle of approach. We have extended our simulations to also consider binary systems where the two fluids have different viscosities, in order to understand the role of the viscosity ratio on the dynamics.