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Particle-based modeling effect of shape transform of single sickle red blood cells JUN YANG, MIT, GEORGE KARNIADAKIS, Brown University, MING DAO, MIT — Sickle red blood cells often exhibit various sickled shapes as well as higher shear and bending stiffness. To study the membrane biomechanical properties related to cell morphology, we employed multiscale coarse grain models based on dissipative particle dynamics (DPD). Through the proper orthogonal decomposition (POD) we analyst the membrane fluctuation of a single cell which probe the membrane mechanical properties. In this work, the membrane mechanics alteration caused by cell volume and surface area variation are tested. We verified that with same ratio of surface area and volume, volume differences will not affect the membrane fluctuation. We also found that by expanding the whole cell the membrane fluctuation performance does not change. To further quantify the pure shape effects, we generate cells with different aspect ratio of major axis and minor axis at which membrane exhibit different fluctuation indicating the mechanical properties divergence. Through the spatial-temporal autocorrelation of membrane fluctuations characteristics, the membrane bending stiffness and shear modulus are carefully calibrated against QPI experimental data.

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