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Effect of cytoskeleton stress-free state on red blood cell responses in low shear rate flows QIANG ZHU, University of California, San Diego, ZHANGLI PENG, Massachussetts Insititute of Technology, ADEL MASHAYEKH, University of California, San Diego — Inspired by the recent experiment on erythrocytes (red blood cells, or RBCs) in weak shear flows (Dupire et al. 2012), we conduct a numerical investigation to study the dynamics of RBCs in low shear rate flows by applying a multiscale fluid-structure interaction model. By employing a spheroidal stress-free state in the cytoskeleton we are able to numerically predict an important feature that the cell maintains its biconcave shape during tank treading motions. This has not been achieved by any existing models. Furthermore, we numerically confirm the hypothesis that as the stress-free state approaches a sphere, the threshold shear rates corresponding to the establishment of tank treading decrease. By comparing with the experimental measurements, our study suggests that the stress-free state of RBCs is a spheroid which is close to a sphere, rather than a biconcave shape applied in existing models (the implication is that the RBC skeleton is prestressed in its natural biconcave state). It also suggests that the response of RBCs in low shear rate flows may provide a measure to quantitatively determine the distribution of shear stress in RBC cytoskeleton at the natural state.

Qiang Zhu
University of California, San Diego

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