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Forward ray tracing method for simulating transient cell optical deformation IHAB SRAJ, University of Maryland Baltimore County, DAVID MARR, Colorado School of Mines, CHARLES EGGLETON, University of Maryland Baltimore County — The mechanical deformation of biological cells using optical forces may be used to study the cellular properties and identify diseased cells. Optical stretchers generally require minimal direct contact compared to other experimental techniques (micro-pipette aspiration, atomic force microscopy). A pseudo steady-state high-throughput optical stretcher can be implemented where anisotropic forces stretch red blood cells (RBC) ghosts within rapidly flowing microfluidic environments. This approach employs a single linear optical trap instead of a focused spot using an inexpensive diode laser bar. In this work we simulate an optical stretcher based on a single light source. We model the RBC ghost deformation induced by this stretcher as a function of applied optical trap power using the immersed boundary method (IBM) coupled with ray-optics. Cells are considered as 3D elastic capsules immersed in fluid exposed to a light source. The optical forces distribution is first calculated using a forward ray tracing method on the cell surface for different geometrical shapes (spheres, ellipsoids or even biconcave). Then the transient deformation of RBC ghosts due to the applied optical forces was simulated. The simulation results are used to develop a method for calculating cell stiffness properties based on static deformation.

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