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Characterization of Intracellular Streaming and Traction Forces in Migrating Physarum Plasmodia SHUN ZHANG, MAE Dept, UC San Diego, RUEDI MEILI, Biology Dept, UC San Diego, ROBERT D. GUY, Math Dept, UC Davis, JUAN C. LASHERAS, JUAN C. DEL ALAMO, MAE Dept, UC San Diego
— Physarum plasmodium is a model organism for cell migration that exhibits fast intracellular streaming. Single amoebae were seeded and allowed to move on polyacrilamide gels that contained 0.2 μm fluorescent beads. Joint time-lapse sequences of intracellular streaming and gel deformation were acquired respectively in the bright and fluorescent fields of a confocal microscope. Images were analyzed using particle image velocimetry (PIV) algorithms, and the traction stresses applied by the amoebae on the surface were computed by solving the elastostatic equation for the gel. These measurements provide, for the first time, a joint characterization of intracellular mass transport and the forces applied on the substrate of motile amoeboid cells with high resolution in both time and space, enables a through study about the locomotive mechanism and the relation between intracellular flow and traction stress, shedding light on related biomimetic research. The results reveal a pronounced auto-oscillation character in intracellular flow, contact area, centroid speed and strain energy, all with the same periodicity about 60 seconds. Adhesion sites are found to be almost stationary while a traction wave propagates from the tail to the anterior region in each cycle.

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