Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Three-dimensional simulation of pseudopod-driven swimming of amoeboid cells[1] ERIC CAMPBELL, PROSENJIT BAGCHI, Rutgers University — Pseudopod-driven locomotion is common in eukaryotic cells, such as amoeba, neutrophils, and cancer cells. Pseudopods are protrusions of the cell body that grow, bifurcate, and retract. Due to the dynamic nature of pseudopods, the shape of a motile cell constantly changes. The actin-myosin protein dynamics is a likely mechanism for pseudopod growth. Existing theoretical models often focus on the acto-myosin dynamics, and not the whole cell shape dynamics. Here we present a full 3D simulation of pseudopod-driven motility by coupling a surface-bound reaction-diffusion (RD) model for the acto-myosin dynamics, a continuum model for the cell membrane deformation, and flow of the cytoplasmic and extracellular fluids. The whole cell is represented as a viscous fluid surrounded by a membrane. A finite-element method is used to solve the membrane deformation, and the RD model on the deforming membrane, while a finite-difference/spectral method is used to solve the flow fields inside and outside the cell. The fluid flow and cell deformation are coupled by the immersed-boundary method. The model predicts pseudopod growth, bifurcation, and retraction as observed for a swimming amoeba. The work provides insights on the role of membrane stiffness and cytoplasmic viscosity on amoeboid swimming.

[1]Funded by NSF CBET 1438255

Prosenjit Bagchi
Rutgers University

Date submitted: 29 Jul 2016 Electronic form version 1.4