

Energy consideration in a model of nematode sperm crawling, *Mathematical Biosciences and Engineering*, 3, № 2 (2006), 347-370. (Yar. Bazaliy, A. Friedman and B. Hu).

Abstract

We propose a mathematical model of cell crawling produced in the process of polymerization/depolymerization of a lamellipod with the nucleus carried above it. This model is specific to the motion of a nematode sperm cell, which uses the major sperm protein (MSP) as a specific biomotor. It is shown that by specifying the efficiency of the MSP biomotor a self-consistent problem of the lamellipodium-nucleus motion can be formulated. This is obtained by taking into account not only the difference between the elastic states of the gel before and after the transition but also the balance of energy released in the contraction process and in the mechanical work required to drag the nucleus forward. We analyze the steady crawling state for a particular efficiency function and establish that all nonzero modes, up to a large magnitude, are linearly asymptotically stable, as put into evidence by experimental observations of the long periods of steady crawling exhibited by the nematode sperm cells.