FAKULTÄT FÜR MATHEMATIK
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Einladung zur öffentlichen Defensio von

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Thema der Dissertation
Short Filament Approximation to Lamellipodium Dynamics

Abstract:

In contact with flat surfaces, several biological cells develop a thin membrane protrusion called the lamellipodium. Employing a dense actin filament meshwork along with other accessory proteins, the lamellipodium drives the crawling motility of the cell. Cell crawling by lamellipodium dynamics has become the subject of a series of papers under the framework of the Filament Based Lamellipodium Model (FBLM), a two-dimensional continuum model systematically derived from a microscopic description of two interacting families of locally parallel actin filaments.

In contrast to previous works, we have assumed that the width of the lamellipodium around the cell periphery is small relative to the cell circumference. This regime has enabled us to perform short filament approximations to the FBLM, resulting in mathematically simpler and computationally less expensive models. Further, simplifying assumptions that are not too restrictive and concentrate on the mechanical parts rather than the biochemical ingredients of the model have been applied.

First, we derive a rigid filament version of the FBLM that accounts for filament-to-substrate adhesions and the twisting of cross-links. With a vanishing lamellipodium width, this FBLM version has produced a circular-shaped cell in equilibrium, consistent with the numerical findings of available literature. Second, we analyze the FBLM with pressure, where instabilities with respect to non- symmetric perturbations emerge. This issue has been resolved by introducing the tension energy of the center-of-mass curve. Consequently, the competing effects of pressure and tension have generated a pitchfork bifurcation away from the trivial, stationary, steady state when the ratio between the stiffness parameters exceeds a critical value. The nontrivial steady state, on the other hand produces a nonvanishing velocity that allows translocation of the lamellipodial strip.

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Zeit und Ort:

Topic: Thesis defense Gervy Marie Angeles
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