MODELLING CELL SHAPE AND MIGRATION WITH A PHASE FIELD MODEL

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ABSTRACT

One of the most fundamental abilities required for the sustainability of life is active cell migration. The movement of a cell is an extremely complex process, involving a coordination of mechanical forces with biochemical regulatory pathways and environmental cues. Cell migration plays a key role in several biological processes in complex organisms, from morphogenesis to leukocytes seeking pathogens in the blood stream. In this work we use a phase-field model in 3D to describe endothelial cells. We explore how parameters such as adhesion, fibre density and internal force balance can affect their morphology and migration. We look into cell shape and movement in two different computational setups: a) micro-patterned fibronectin surfaces, and; b) three-dimensional complex fibre network. For the first case, preliminary results show that the surface pattern is the main responsible for the shape geometry, affecting directly the way a cell exerts force and migrates. The adhesion strength reinforces the cell deformation, allowing an increase of the adhered area. In the fibre network we study the effect of spatial restriction on cell migration strategies and on the regulation of the cell's morphology. We quantified the migration and compared our results with experimental data and with coarse-grained dissipative molecular dynamics simulations.

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