

An optimal control approach to cell tracking and the Surface Finite Element Method (SFEM)

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Abstract

Cell migration is of vital importance in many biological studies, hence robust cell tracking algorithms are needed for inference of dynamic features from (static) in vivo and in vitro experimental imaging data of cells migrating. In recent years much attention has been focused on the modelling of cell motility from physical principles and the development of state-of-the-art numerical methods for the simulation of the model equations. Despite this, the vast majority of cell tracking algorithms proposed to date focus solely on the imaging data itself and do not attempt to incorporate any physical knowledge on cell migration into the tracking procedure. In this talk, I will present a mathematical approach for cell tracking, in which we formulate the cell tracking problem as an inverse problem for fitting a mathematical model for cell motility to experimental imaging data. The novelty of this approach is that the physics underlying the model for cell migration is encoded in the tracking algorithm.

In the second part of the talk, I will give an introduction to Surface Finite Element Method (SFEM). Furthermore, in order to demonstrate the applicability and the generality of this method, I will present numerical simulations on two different surfaces: a stationary sphere and the realistic surface of a neutrophil from the zebrafish *Danio rerio larvae*.