

Contribution ID: 146

Type: **Oral Presentation**

Spatial moment models for collective cell behaviour

Wednesday, 11 July 2018 10:30 (30 minutes)

Many PDE-based models of collective cell behaviour implicitly assume that the population of cells is ‘well mixed’. This is called a spatial mean-field assumption. In reality, populations often have a more complex spatial structure, such as clusters and/or spatial segregation of cells. This spatial structure is both a cause and an effect of non-local interactions among cells and can make a significant difference to model predictions about, for example, cell densities and invasion speeds. I will describe an individual-based model of collective cell behaviour that is based on interactions between pairs of cells, including a novel neighbour-dependent directional bias. I will then show how a continuum approximation to the individual-based model can be derived using spatial moment dynamics. This approximation tracks important features of the population spatial structure and incorporates non-local interactions that affect processes such as movement and mortality. Finally, I will show how experimental data can be used to estimate model parameters.

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Session Classification: Nonlocal models in biology

Track Classification: Minisymposium: Nonlocal models in biology