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Multiscale analysis of pattern formation and wave propagation in a discrete cell signalling model

It is well known that cell-scale interactions can have profound effects on macroscale tissue growth. I will discuss two approaches to analysing such phenomena within a continuum framework, allowing their inclusion within macroscale models of tissue growth.

Firstly, a multiscale asymptotic method with which to analyse fine-grained patterning patterning in cellular differentiation within a continuum framework is introduced, based on a generic discrete signalling model. Most applications of such methods are to continuous systems, while here discreteness on the short lengthscale must be taken into account.

An important feature of such systems is the progression of pattern-forming modulated travelling waves across the discrete lattice. Such phenomena have been widely studied within discrete diffusion equations for monotone waves; employing a WKBJ technique in place of the standard travelling wave ansatz, I show how analysis of such waves is greatly simplified and highlight the crucial dependence of wave propagation on the underlying lattice geometry. In addition, I extend this analysis to the modulated travelling waves exhibited in cell signalling models.