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Discrete and continuum modelling of growth and signalling in biological tissue

In the recent work [1], we examined methods for deriving continuum approximations of one-dimensional individual-based models (IBM) for systems of tightly adherent cells, such as an epithelial monolayer. Each cell occupies a bounded region, defined by the location of its endpoints, has both elastic and viscous mechanical properties and is subject to drag generated by adhesion to the substrate. The evolution of the discrete system is governed by a system of differential-algebraic equations. This IBM is then approximated by a system of partial differential equations in the limit of a large number of cells. We consider two different techniques: the usual continuum approximation which is appropriate when cellular properties vary slowly between neighbouring cells, and a multiple-scales approach which is appropriate when cellular properties are spatially periodic (so may be heterogeneous, with substantial variation between adjacent cells). In the latter case, the relationship between mean cell pressure and mean cell lengths in the continuum model is found to be history-dependent when cell viscosity is significant. We apply this model to examine the acceleration of a wound edge observed in wound-healing assays.

References

[1] Fozard JA, Byrne HM, Jensen OE, King JR, *Continuum approximations of individual-based models for epithelial monolayers.* Math Med Biol. (2010) **27**(1) 39–74.