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A Nonlocal Model for Cancer Invasion

Adhesion of cells to one another and their environment is an important regulator of many biological processes, but has proved difficult to incorporate into continuum mathematical models. I will describe a new approach to the mathematical modelling of adhesion in cell populations, based on an integro-partial differential equation for cell density, in which the integral represents the sensing by cells of their local environment. This enables an effective representation of cell-cell adhesion, as well as random cell movement, and cell proliferation. I will show how this modelling approach can be applied to cancer growth. In this context, the model is capable of supporting both benign (non-invasive) and invasive growth, according to the relative strengths of cell-cell and cell-matrix adhesion. I will go on to describe the use of the model to investigate the criticality of matrix heterogeneity in shaping invasion, making the testable prediction that highly heterogeneous extracellular matrix can result in a "fingering" of the tumour front, which is a hallmark of invasive cancers.