Collective behaviour of epithelial cells under different coordinated dynamics of cell polarisation

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The coordinated motion of epithelial cells is determined by dynamics of cell polarisation through cell-cell interactions. According to experimental results, cell polarisation may couple to different variables such as local velocity [1], orientation of cells [2] etc. which leads to different collective motions. For example, aligning cell polarisation to its local velocity can result in flocking motion [3]. While the coupling between polarisation and anisotropy in cell shape is still not fully understood.

We apply phase field method to model cells, which incorporates features of cell elasticity, cell-cell adhesion, steric interaction and polarisation of cells. In addition, deformation of cells caused by actin-myosin cortex is modelled by nematic dipolar stress. To unveil the effect of coordinated dynamics, we impose different polarisation coordinated dynamics to the system.

We compare the difference between different dynamics. In our simulation, the coupling between cell polarisation and elongation can give rise to gap formation where there is free space with no cell but only ECM. Also, cell-cell adhesion inducing deformation plays an important role in this polarisation-elongation coupling dynamics.

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[2] Tambe, Dhananjay T., et al. "Collective cell guidance by cooperative intercellular forces." *Nature materials* 10,468, (2011)

[3] Giavazzi, Fabio, et al. "Flocking transitions in confluent tissues." *Soft matter* 14, 3471-3477, (2018)