



Semblance of Heterogeneity

By Linus Schumacher, Philip Maini & Ruth Baker

The research story

Recently I became interested in heterogeneity in collective cell migration. If some cells in a group move differently, how does that change the overall group motion? For example, some cells can be more invasive in moving through tissues, which can be important in embryo development as well as cancer metastasis. When one measures how different cells in a group react to each other, however, it can be difficult to know how much variability is biologically relevant and has an effect on the collective cell migration, and how much variability is irrelevant noise. This conundrum led me to a mathematical experiment that produced this image.

The image

The image shows simulated tracks of collective cell migration. Each colored line is the trajectory of a different cell. Cells interact by aligning their motion with their immediate neighbours, as well as pulling towards them and pushing away if they get too close – a much simplified representation of cell interactions. In each group in the image, we see different emergent behaviours depending on the strength of alignment relative to pushing and pulling: disordered clumps, ordered structures, and swarm-like motion. In this model, all cells are identical, yet when you statistically analyse their movement, the population can appear heterogeneous [1]. This “Semblance of Heterogeneity” comes about because of the interactions between many cells. With simplified mathematical models like this one we can calculate what we expect to measure in complex biological settings where our intuition fails, and thus guide the interpretation of experiments.

Reference

[1] Schumacher LJ, Maini PK, Baker RE, Semblance of heterogeneity in collective cell migration, *Cell Systems* 5(2): 119–127.e1, 2017.

