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Calculating Intercellular Stress in a Model of Collectively Moving Cells

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Cells move together in groups during development, wound healing, and cancer metastasis. It remains unclear how collectively moving cells coordinate their motion. In addition to external chemoattractants and exchanging signaling molecules, cells may also respond to mechanical cues. We developed a model of collective cell migration under the assumption that cells align their motility force with the direction of their velocity. This simple mechanism leads to large scale velocity correlations, swirling motion in the bulk of monolayers, and finger-like protrusions at the edge [1]. In experimental studies, the inter- and intracellular stress in the monolayer has been calculated from measured traction forces between the cells and the substrate. Stress builds up successively towards the center of the tissue as the majority of the cells pull outwards [2]. While one dimensional stress profiles are based on a simple force balance, two dimensional stress maps require the additional assumption of an elastic tissue [3], and the validity of this assumption remains disputable. In our model simulations, both the forces on the substrate and the intercellular forces are accessible. We can therefore apply a second method to calculate the stress based on forces between cells. Stress patterns calculated with both methods agree, showing that recovery of the intercellular stress is indeed mostly independent of specific material properties.

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