Large scale fluctuating motion in confluent cell monolayers: particle-based model and normal mode analysis

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Long-range displacement and velocity correlations in epithelial cell monolayers have been linked to active nematics [1], glassy dynamics [2], and active or passive cell intercalation events, i.e., T1 transitions [3]. Here we show that simple uncoordinated, but persistent cell motility coupled with the collective elastic modes of the cell sheet is sufficient to produce characteristic swirl-like correlations, leading to a divergent correlation length in the limit of infinite persistence time. We derive this result using both continuum elasticity and a normal modes formalism, and test our derivation with numerical simulations of a simple soft agent-based model. Finally, we compare our results to the in-vitro experiments of confluent corneal epithelial cell sheets.

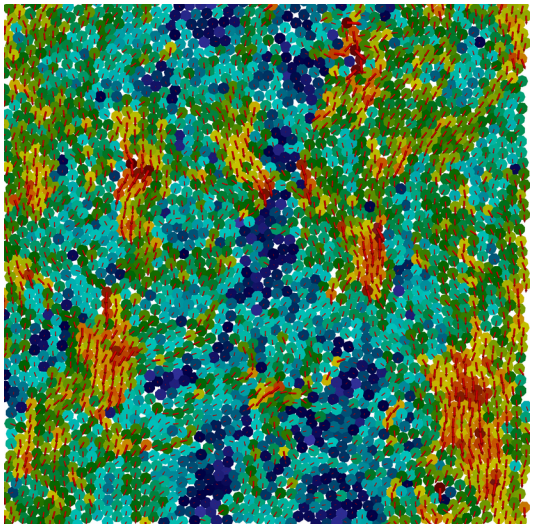

Figure: Velocity map in the particle-based model, showing spatially correlated displacements

[1] A. Doostmohammadi et.al., Soft Matter **11**, *7328* (2015).
[2] O. Chepizhko et.al., PNAS **113**, *11408* (2016).
[3] M. Popovic et.al., New Journal of Physics **19**, *033006* (2017).