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In-silico studies of the collective motility of cells crawling on a thick elastic substrate[1] APARNA BASKARAN, ARVIND GOPINATH, MICHAEL HAGAN, Brandeis University — Self-propelling cells crawling on elastic substrates are an example of a collective system that is driven away from equilibrium. Experiments show that such cells communicate with their neighbors by sensing the deformation of the underlying elastic substrate. We propose a minimal, overdamped Brownian dynamics simulation to mimic and study this emergent collective motility. The simulations incorporate intrinsic activity at the single cell level due to self-propulsion, noise and inter-cell interactions via the underlying elastic substrate. Elastic interactions are modeled on a pair-wise additive basis by treating each cell as a force dipole deforming the substrate. We find that self-propulsion, combined with elastic interaction is sufficient to generate the coordinated large scale streaming, migration, jamming and swirling motions observed in experiments. We extract the length and time scales characterizing these correlated motions and thresh out their dependence on activity and elastic interactions. The results are rationalized by deriving a mean-field hydrodynamic theory and studying the linear stability of the equations. Our results provide a unified picture of the patterns of collective migration resulting from mechanical interactions without overlying chemical cues.

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Arvind Gopinath
Brandeis University

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