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Computational explorations of cellular blebbing

Blebbing occurs when the cytoskeleton detaches from the cell membrane, resulting in the pressure-driven flow of cytosol towards the area of detachment and the local expansion of the cell membrane. Recent interest has focused on cells that use blebbing for migrating through three dimensional fibrous matrices. In particular, metastatic cancer cells have been shown to use blebs for motility. A dynamic computational model of the cell is presented that includes mechanics of and the interactions between the intracellular fluid, the actin cortex, the cell membrane, and the cytoskeleton. The computational model is used to explore the relative roles of cytoplasmic viscosity, intracellular drag, and cytoplasmic elasticity on bleb expansion dynamics. The model is also used to investigate outstanding hypotheses on intracellular pressure propagation.