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Measuring and modeling cellular contact guidance through dynamic sensing of nanotopography CAN GUVEN, MEGHAN DRISCOLL, XIAOYU SUN, JOHN FOURKAS, WOLFGANG LOSERT, University of Maryland — We investigate the shape dynamics of the amoeba Dictyostelium discoideum on nanotopographical gratings. Multiple studies have previously implicated the patterning of focal adhesion complexes (FACs) in contact guidance. However, we observe significant contact guidance of Dictyostelium along ridge-shaped nano- and microtopographic surface features, even though Dictyostelium lacks FACs. We measure the surface contact guidance efficiency, which we calculate from the statistics of cell orientations, as a function of the distance between parallel ridges. Ridges with a spacing of about 1.5 μm lead to the greatest contact guidance efficiency. We previously observed that Dictyostelium cells exhibit oscillatory shape dynamics. Therefore, we model contact guidance as a resonance between the cell oscillations and the nanogratings. In particular, we model cells as stochastic cellular harmonic oscillators that couple to the periodicity of the ridges. The spatial and temporal scales of the oscillations that best couple to the surface are consistent with those of protrusive dynamics. Our results suggest that the coupling of protrusive dynamics, which are governed by actin dynamics, to surface topography is one possible mechanism for contact guidance.

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