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Self-organization in crawling cells through mechano-sensing

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Communication between cells is essential for correct tissue formation and morphogenesis. Here, I investigate the ability of crawling cells to coordinate their motion through mechano-sensing. The basic model considers the cell crawling motion as a cycle of cell elongation and contraction, accompanied by modification of the friction with the underlying substrate through adhesion to and de-adhesion from it. Due to the different surface frictions in the adhered and de-adhered states, the cell is able to effectively push itself forward during the motile cycle. A feedback is then introduced between the experienced force (from neighbouring cells pushing against the cell), and the intracellular dynamics given by the speed at which the motile cycle advances as well as the magnitude of the cell elongation during the cycle. The results for the one-dimensional case show a multitude of dynamical modes, including synchronization and travelling wave formation, depending on the feedback strength. These results are a first step to understanding how self-organization of cells may occur in biological systems, with the larger goal of understanding cell dynamics up to the tissue scale, including morphogenesis and organ formation.