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Bacterial behavioral principles: Learning from Myxobacteria

Many bacteria are able to spread rapidly over surfaces by the process of swarming. Bacterial swarms are model systems for the study of multicellularity and biological self-organization. Swarming bacteria have rod-shaped cells, and are observed to move smoothly even when they are packed together at high density. Why dont swarming cells interfere with each others movements? Using a cell-based biomechanical model, we show that periodic reversals of moving direction in populations of rod-shaped bacteria can lead to extensive ordering of cells, thus enabling them to effectively resolve traffic jams formed during swarming. We also show that an optimal reversal period and an optimal cell length exist for producing such order. The optimal reversal period and the optimal cell length are connected by a simple relation. We suggest that basic behavioral principles exist for bacterial swarming that are independent of detailed motility mechanisms.