MAR11-2010-020134

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

A tunable sequential and periodic pattern formed by coupling cell motility with density

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The ability of living organisms to form patterns is an untapped resource for synthetic biology. We aim to generate unique patterns by rewiring the genetic circuitry controlling cell motility. Specifically, E. coli cells are programmed to regulate their movement by sensing local cell density. Interesting patterns are formed by newly engineered cells. An engineered low-density mover strain spreads outwards and autonomously forms a sequential and periodic pattern. Moreover, we build a theoretical model that satisfactorily fits our current experimental data, and also predicts some parameters which may significantly affect the pattern formation. The study of this self-organized spatial distribution of cells may help us to probe the principles underlying the formation of natural biological patterns, and to prepare for future engineering of biological structures.