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A PDE model of aggregation formation in bacterial colonies

We study pattern formation in a model of cyanobacteria motion recently proposed by Galante, Wisen Bhaya and Levy. By taking a continuum limit of their model, we derive a novel fourth-order nonlinear parabolic PDE. Using this PDE, we derive the instability thresholds for the onset of pattern formation. We then compute analytically the spatial profiles of the steady state aggregation density. These profiles are shown to be of the form sech^p where the exponent p is related to the switching rates and other parameters of the model. Full numerical simulations give a favorable comparison between the continuum and the underlying discrete system, and show that the aggregation profiles are stable above the critical threshold.