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Agent-based models exhibiting spatial aggregation

We discuss two agent-based models which exhibit spatial aggregation. The first example is a simple stochastic model of bacterial aggregation which leads to a novel fourth-order nonlinear PDE in its continuum limit. This PDE admits soliton-type solutions corresponding to bacterial aggregation patterns, which we explicitly construct.

The second example models complex predator-swarm interactions. Here, each prey within a swarm is represented by a point particle, with near repulsion and far-field attraction, in addition to the repulsion from the predator. The resulting system of ODE's can be approximated by a nonlocal PDE whose analysis yields insight about whether swarming behaviour helpful in avoiding a predator.