

Abstract:

We consider a mathematical model for two biological species of individuals (cells, birds, fish. . .) that interact with each other. The basic ingredients in the interactions are short-range repulsion and long-range attraction. The model consists of a system of two continuity equations for the densities ρ_1 and ρ_2 , coupled via the velocities v_1 and v_2 . This PDE model is linked to a corresponding particle system (system of ODE's), which allows for convenient numerics, while the PDE formulation itself is used for analytical purposes.

Our aim is to characterize the steady states of the model — which exhibit certain patterns — and to study their stability for varying model parameters. Here, we combine analysis and numerics. For our specific choice of interactions, it is known that the density is constant in a steady state, and the value of the density depends on whether the two species coexist at a certain position or not. The challenge lies in finding the geometry of the area that each species occupies.