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On a parabolic model for particle alignment

In [1] we proposed a model for the initiation on cell polarization at the first steps of cellular motion. Now, numerical simulations indicate the emergence of shocks in the solution to these equations which may be interpreted as fronts of active barbed ends of actin filaments being established in the cell.

The original model included the description of actin monomers and filaments without taking into account the mutual alignment of the latter. In order to understand the effect of aligning filaments we deduced from the given model a simple parabolic system describing the motion of oriented particles with fixed velocity, undergoing diffusion and mutual alignment. This system, consisting of no more than two equations, may be used to model different kinds of aligning particles, e.g. myxobacteria.

For this model we analyze the stability of the totally symmetric state which corresponds to a non polarized cell against small perturbations. Here, the influence of different types of alignment terms will be discussed. We furthermore derive traveling wave solutions to the system and show how they emerge numerically from small initial data. We will thus observe polarization fronts developing from an initially almost symmetric state.

References

[1] J. Fuhrmann, J. Käs, A. Stevens, *Initiation of cytoskeletal asymmetry for cell polarization and movement.* J Theor Biol **249.2** 278–288.