Mechanochemical pattern formation: far-from-equilibrium patterns on a deforming surface

Frits Veerman

1. Abstract

The appearance of Turing patterns is generally believed to depend on an underlying activator-inhibitor mechanism. However, in a number of biological applications, the experimental identification of these components has been problematic. The hypothesis of mechano-chemical interaction, where the morphogen and the surface dynamically interact, provides an alternative to the activator-inhibitor paradigm. We present a mechano-chemical model, where the surface on which the pattern forms being dynamic and playing an active role in the pattern formation, effectively replaces the inhibitor. We show how existing ideas and techniques for the rigorous analysis of far-from-equilibrium patterns can be extended to the mechano-chemical context, and demonstrate the use of geometric singular perturbation theory in the construction of patterns on (and of) a planar curve. We highlight and discuss mathematical challenges posed by this particular interplay of partial differential equations and differential geometry. Joint work with Anna Marciniak-Czochra, Moritz Mercker (U. Heidelberg), and Daphne Nesenberend (U. Leiden).