SINGULAR AND JUMP-DISCONTINUOUS PATTERNS IN REACTION-DIFFUSION-ODE MODELS

Anna Marciniak-Czochra[1]
[1]Institute of Applied Mathematics, IWR and BIOQUANT
University of Heidelberg
Im Neuenheimer Feld 294, 69120 Heidelberg
anna.marciniak@iwr.uni-heidelberg.de

Abstract

In this talk we explore mechanisms of pattern formation arising in processes described by a system of a single reaction-diffusion equation coupled to ordinary differential equations. Such systems of equations arise, for example, in modeling of interactions between cellular processes and diffusing growth factors. Our theory applies to a wide class of pattern formation models with an autocatalytic non-diffusing component. We show that the lack of diffusion in some model components may lead to instability of all regular stationary patterns and emergence of stable patterns with jump discontinuity or of singular spike patters. Investigation of such structures pose challenges for matehmatical analysis as well as numerical simulation and visualisation of the model solutions. We discuss analytical and numerical aspects of the proposed models as well as interprete the results in context of biomedical applications. Moreover, we find a class of reaction-diffusion-ode models with DDI-induced blow-up of spatially heterogenous solutions.

The talk is a based on a joint projects with Kanako Suzuki (Ibaraki University), Grzegorz Karch (University of Wroclaw), and Izumi Takagi (Tohoku University) and Steffen Härting (University of Heidelberg) .

References

[1] S. Härting and A. Marciniak-Czochra *Spike patterns in a reaction-diffusion-ode model with Turing instability.* Math. Meth. Appl. Sci. **37** (2014) pp. 1377–1391.

[2] A. Marciniak-Czochra, G. Karch and K. Suzuki *Unstable patterns in reaction-diffusion model of early carcinogenesis.* J. Math. Pures Appl. **99** (2013) pp. 509–543.

[3] A. Marciniak-Czochra, G. Karch and K. Suzuki *Unstable patterns in autocatalytic reaction-diffusion-ODE systems.* Preprint available at http://arxiv.org/abs/1307.6236.

[4] A. Marciniak-Czochra, S. Härting, G. Karch and K. Suzuki *Dynamical spike solutions in a nonlocal model of pattern formation.* Preprint available at http://arxiv.org/abs/1307.6236. .