Singular behavior of solutions to reaction-diffusion-ODE systems

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Abstract

I shall review results, obtained jointly with Anna Marciniak-Czochra, Kanako Suzuki, and Szymon Cygan, on a certain class of reaction-diffusion systems from Mathematical Biology, where ordinary differential equations are coupled with one reaction-diffusion equation. Such systems may have regular (*i.e.* sufficiently smooth) stationary solutions, however, all of them are unstable. We showed that solutions to initial-boundary value problems for such reaction-diffusion-ODE systems may behave in a singular way for large values of time which means that they may blowup in a finite time or converge towards discontinuous stationary solutions.

These results are contained in our works:
– A. Marciniak-Czochra, G. Karch, K. Suzuki, *Unstable patterns in reaction-diffusion model of early carcinogenesis*. J. Math. Pures Appl. (9) 99 (2013), no. 5, 509–543.
– A. Marciniak-Czochra, G. Karch, K. Suzuki, J. Zienkiewicz, *Diffusion-driven blowup of nonnegative solutions to reaction-diffusion-ODE systems.* Differential Integral Equations 29 (2016), 715–730.
– A. Marciniak-Czochra, G. Karch, and K. Suzuki, *Instability of Turing patterns in reaction-diffusion-ODE systems*, J. Math. Biol. 74 (2017), 583–618.
– S. Cygan, A. Marciniak-Czochra, G. Karch, and K. Suzuki, *Instability of all regular stationary solutions to reaction-diffusion-ODE systems*, preprint (2021), arXiv:2105.05023.
– S. Cygan, A. Marciniak-Czochra, G. Karch, and K. Suzuki, *Stable discontinuous stationary solutions to reaction-diffusion-ODE systems*, preprint (2021).