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Self-Replicating Spots for Reaction-Diffusion Models in Two Space Dimensions

We analyze the dynamical behavior of multi-spot solutions in a two-dimensional domain Ω for certain two-component reaction-diffusion models, including the Gray–Scott model, in the singularly perturbed limit of small diffusivity ϵ for one of the two components. A formal asymptotic analysis, which has the effect of summing infinite logarithimic series in powers of $-1/\log \epsilon$, is used to derive an differential algebraic system of ODE's characterizing the slow dynamics of the spot locations. By numerically examining the stability thresholds for a single spot solution, a specific and simple criterion is formulated to theoretically predict the initiation spot-replication events. The analytical theory is compared with full numerical results.