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PATTERN FORMATION IN REACTION-DIFFUSION SYSTEM WITH GIERER-MEINHARDT REACTION TERM

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ABSTRACT

In this work, we will explore the stability of a model incorporating the Gierer-Meinhardt reaction term. Our focus will be on analyzing stability and understanding how diffusion can cause a steady state to shift from stable (without diffusion) to unstable (with diffusion), a phenomenon known as Turing instability. Turing instability occurs under certain conditions, one of which is that the standard diffusion ratio must differ from 1 (i.e., $d \neq 1$). However, when cross-diffusion is introduced, this requirement is relaxed, allowing for $d = 1$. Through mathematical analysis and numerical simulations, we demonstrate that in competitive models, cross-diffusion can significantly influence the emergence of spatial patterns. Moreover, we show that cross-diffusion can induce pattern formation even when $d = 1$.

Keywords Reaction-diffusion · Stability · Turing instability

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