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Robust numerical simulation of reaction-diffusion models arising in Mathematical Ecology

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Abstract

In this work, we consider numerous types of reaction-diffusion models arising in mathematical ecology. Using local analysis theory applied to ecological modeling, we study four important ecological systems describing some prey-predator models. We address the interaction between two species in terms of predator-prey systems and the biological system displaying the formation of chaotic spatiotemporal patterns arising from a community of three competitive species. Then we design and analyze robust time-integration techniques to simulate these models. Two competing exponential time-differencing methods that are of order-four are used as the major time stepping methods. We justify the supremacy of these two schemes when applied to above mentioned dynamical systems and compared our results with those obtained by other existing multistep exponential integrators of orders four, five and six.

Key words: Reaction-diffusion models, Mathematical Ecology, Exponential time-differencing methods.