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# Effect of time delay on pattern dynamics in a spatial epidemic model

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## Abstract

Time delay, accounting for constant incubation period or sojourn times in an infective state, widely exists in most biological systems like epidemiological models. However, the effect of time delay on spatial epidemic models is not well understood. In this paper, spatial pattern of an epidemic model with both nonlinear incidence rate and time delay is investigated. In particular, we mainly focus on the effect of time delay on the formation of spatial pattern. Through mathematical analysis, we gain the conditions for Hopf bifurcation and Turing bifurcation, and find exact Turing space in parameter space. Furthermore, numerical results show that time delay has a significant effect on pattern formation. The simulation results may enrich the finding of patterns and may well capture some key features in the epidemic models.

*Key words:* Epidemic model, Nonlinear incidence rate, Time delay, Turing instability, Patterns

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