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A new perspective on infection forces with demonstration by a DDE infectious disease model

In this work, we revisit the notion of infection force from a new angle which can offer a new perspective to motivate and justify some infection force functions. Our approach can not only explain many existing infection force functions in the literature, it can also motivate new forms of infection force functions, particularly infection forces depending on disease surveillance of the past. As a demonstration, we propose a SIRS model with delay. We comprehensively investigate the disease dynamics represented by this model, particularly focusing on the local bifurcation caused by the delay and another parameter that reflects the weight of the past epidemics in the infection force. We confirm Hopf bifurcations both theoretically and numerically. The results show that, depending on how recent the disease surveillance data are, their assigned weight may have a different impact on disease control measures.