Applied Dynamical Systems Seminar

Speaker:

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Impact of Delay on HIV-1 Dynamics of Fighting A Virus with Another Virus

Abstract:

In this lecture, we propose a mathematical model for HIV-1 infection with intracellular delay. The model examines a viral-therapy for controlling infections through recombining HIV-1 virus with a genetically modified virus. For this model, the basic reproduction number R0 is identified and its threshold properties are discussed. When R0 < 1, the infection-free equilibrium E0 is globally asymptotically stable. When R0 > 1, E0 becomes unstable and there occurs the single-infection equilibrium E1, and E0 and E1 exchange their stability at the transcritical point R0 =1. If 1< R0 < R1, where R1 is a positive constant explicitly depending on the model parameters, then E1 is globally asymptotically stable,while when R0 > R1, E1 loses its stability to the double-infection equilibrium E2. E1 and E2 exchange their stability at the transcritical point R0 =R1, and there exists a constant R2 such that E2 is asymptotically stable if R1< R0 < R2. We use one numerical example to determine the largest range of R0 for the local stability of E2 and existence of Hopf bifurcation. Some simulations are performed to support the theoretical results. These results show that the delay plays an important role in determining the dynamic behaviour of the system. In the normal range of values, the delay may change the dynamic behaviour quantitatively, such as greatly reducing the amplitudes of oscillations, or even qualitatively changes the dynamical behaviour such as revoking oscillating solutions to equilibrium solutions. This suggests that the delay is a very important fact which should not be missed in HIV-1 modelling.