
MICHAEL LI, University of Alberta

Dynamics of a continuous state-structured model for infectious diseases

In this talk, I will describe a state-structured epidemic model for infectious diseases in which the state structure is nonlocal. The state is a measure of infectivity of infected individuals or the intensity of viral replications in infected cells. The model gives rise to a system of nonlinear integro-differential equations with a nonlocal term. I will show the well-posedness and dissipativity of the associated nonlinear semigroup by overcoming a lack of compactness due to the integral form of the equations. By establishing an equivalent principal spectral condition between the linearized operator and the next-generation operator, I will show that the basic reproduction number R_0 is a sharp threshold: if $R_0 < 1$, the disease-free equilibrium is globally asymptotically stable, and if $R_0 > 1$, the disease-free equilibrium is unstable and a unique endemic equilibrium is globally asymptotically stable. Our proof of the global stability of the endemic equilibrium utilizes a global Lyapunov function whose construction was motivated by the graph-theoretic method for coupled systems on discrete networks developed by Guo-Li-Shuai. This is a joint work with Drs. Zhipeng Qiu and Zhongwei Shen.