

Mathematics Faculty Search Mathematical Biology

Candidate interview for
assistant professor



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Shuai is a Natural Science and Engineering Research Council of Canada (NSERC) postdoctoral fellow in the Department of Mathematics and Statistics at the University of Victoria.

Research interests include nonlinear differential equations and dynamical systems; mathematical modeling of infectious diseases; and mathematical ecology and epidemiology.

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TEACHING DEMO

401 Carver
Tuesday, February 21 at 9:00 a.m.

HOSPITALITY

404 Carver
Monday, February 20 at 3:45 p.m.

COLLOQUIUM

282 Carver
Monday, February 20 at 4:10 p.m.

Dynamical systems on networks and their applications to ecology and epidemiology

Coupled systems on networks can be used to describe many large-scale dynamical systems arising from different fields of science and engineering. Examples include biological and artificial neural networks, nonlinear oscillators on lattices, complex ecosystems and the transmission models of infectious diseases in heterogeneous populations. A new systematic approach, based on Kirchhoff's Matrix Tree Theorem from graph theory, is developed to guide the constructions of Lyapunov functions for coupled systems on networks. This graph-theoretic approach is applied to investigate global stability problems for several coupled systems in engineering, mathematical ecology, and mathematical epidemiology. The approach allows improvement of existing results in the literature and, particularly, resolution of a 30-year open problem in mathematical epidemiology.

During the second half of this talk, the graph-theoretic approach is further applied to a cholera model with differential infectivity. Cholera is a bacterial disease that can be transmitted to humans directly by person-to-person contact or indirectly via the environment (mainly contaminated water). A compartmental model for cholera dynamics is formulated that includes these two transmission pathways with nonlinear incidence, as well as stages of infection and infectivity states of the pathogen. Lyapunov functions and the graph-theoretic approach are used in the model analysis to show that a basic reproduction number gives a sharp threshold determining whether cholera dies out or becomes endemic