MS25: Optimal Control, Optimization, Inverse Problems and Numerical Simulations with Applications III

Analysis and Numerics for an Age- and Sex-Structured Population Model

Michael Pokojovy, *University of Konstanz, Germany*

In the present talk, we discuss a linear model of McKendrick-von Foerster-Keyfitz type for the temporal development of the age structure of a two-sex human population. For the underlying system of partial integro-differential equations, we exploit the semigroup theory to show the classical well-posedness and asymptotic stability in a Hilbert space framework under appropriate conditions on the age-specific mortality and fertility moduli. Finally, we propose an implicit finite difference scheme to numerically solve this problem and prove its convergence under minimal regularity assumptions. A real data application is also given.

Lotka-Volterra/Gompertz Competition Model for Tumor Growth

Philippe Laval, *Kennesaw State University*

We modify the Lotka-Volterra competition model by replacing the logistic growth part of one of the species by a Gompertz growth. We then analyze this new model, look at numerical solutions and also estimate the parameters of the model from existing data (inverse problem). An application of this work is in cancer models which use Lotka-Volterra. It has been noted that Gompertz growth was a better fit to describe the growth of tumors than logistic growth.

Parameter Estimation Techniques Applied to Stochastic Models

Thomas Robacker, *East Tennessee State University*

There are natural phenomena which are genuinely stochastic, for example, the spread of a disease where the deterministic system is not the most appropriate model and instead a stochastic model should be implemented. Parameter estimation techniques have been successfully and extensively applied to deterministic models based on ordinary differential equations but are in early development for stochastic models. Well established techniques for parameter estimation for deterministic systems are applied to two stochastic biological models - the Lokta-Volterra predator-prey and SIS epidemic models. We compare and contrast the different approaches and their effectiveness for these two simple models.

Mathematical Modeling of 2014 Ebola Virus Outbreak

Ana-Maria Croicu, *Kennesaw State University*

The last Ebola Virus Outbreak started in February 2014 in Guinea, West Africa, and spread into Liberia in March, Sierra Leone in May, and Nigeria in July 2014. According to WHO's website, as of 31 August 2014, 3685 cases and 1841 deaths have been reported. Due to high Ebola case fatality rate, the analysis of Ebola virus disease is critical to outbreak responses. S-E-I-R and S-I-R mathematical models are used to simulate the 2014 Ebola outbreak in West Africa.