Contributed Session 06: Control and Optimization

Dual representations of cones and functions on mixed domains

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In this study, we establish a platform which enables us to study convexity and duality properties of the cones and functions on discrete and mixed domains.

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Analytical methods in optimal control of HIV treatment

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We formulate nonlinear control models of HIV dynamics withing a host which include nonlytic and lytic immune response and different types of antiviral therapy. The ODE models describe the dynamics of HIV infection and have the following phase variables: infected and uninfected T helper cells count, free virus population, and concentration of the medication. The models reflect differences in multi-drug therapy, virus remission and drug resistance. The medication intake in these models is assumed to be controlled. Though many HIV control models have been suggested and investigated, qualitative analytical methods suitable for constructing the optimal control for complex nonlinear models are very rare. In this talk we present analytical methods for finding the optimal controls for a variety of objective functions and models. These methods allow to reduce a two point boundary value problem for the Maximum Principle to a problem of the finite-dimensional optimization. Computer simulations will demonstrate behavior of the control model for different parameters.

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Optimal control in the treatment of Retinitis Pigmentosa

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Numerous therapies have been implemented in an effort to stop the debilitating progression of the degenerative eye disease Retinitis Pigmentosa (RP), yet none have provided satisfactory long term stoppage of the degeneration of photoreceptors. The recent discovery of the protein termed rod-derived cone viability factor (RdCVF) has provided researchers with a potential therapy that could slow the secondary wave of cone death. In this work, we build on an existing mathematical model of photoreceptor interactions in the presence of RP and incorporate therapy via RdCVF. Our results show that an optimal control exists for the administration of RdCVF. In addition, our numerical solutions show the experimentally observed rescue effect that the RdCVF has on the cones.

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Reliability modeling and analysis of a desalination plant system

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The paper presents a reliability modeling and analysis of an evaporator/system of a desalination plant. The desalination plants are being used to purify the sea water for domestic usage. In the present work, seven years maintenance data on an evaporator is collected and then a robust model is developed by embedding the real failure situations of the evaporator as depicted in the data. The model reflects the various possible state transitions of the system under consideration. There are many reasons for evaporator failure which have been reflected in the model for analysis. Optimized reliability indices of the evaporator/system have been obtained using the model which reveals the evaporator effectiveness. The profit model for the evaporator has also been developed in order to evaluate the optimum profit of the evaporator. The semi-Markov processes and regenerative point techniques are used in the entire analysis.

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