SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

OPTIMAL CONTROL IN GENE MUTATION

DISSERTATION DEFENSE
by

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Abstract: Gene mutations are the radical causes of many diseases, including inheritance diseases and cancers. Current medical treatments usually focus on changing the concentrations of related chemicals or mRNAs at the cellular level to stop protein productions or cell duplications, which can only control the diseases under certain circumstances but cannot cure them. Little research work has been done at the molecular level, the fundamental of inheritance, to search possible ways to cure those severe diseases.
We propose a molecular level control system view of the gene mutations in DNA replication from the finite field concept. By treating DNA sequences as state variables, chemical mutagens and radiation as control inputs, one cell cycle as a step increment, and the measurements of the resulting DNA sequence as out- puts, we derive system equations for both deterministic and stochastic discrete-time, finite-state systems of different scales.

Defining the cost function as a summation of the costs of applying mutagens and the off-trajectory penalty, we solve the deterministic and stochastic optimal control problems by dynamic programming algorithm. In addition, given that the system is completely controllable, we find that the global optimum of both base-to-base and codon-to-codon deterministic mutations can always be achieved within a finite number of steps.

Our model and solution to optimal control problem provide instrumental information for biological systems at the cellular and tissue levels, and suggest an innovative method to cure inheritance disease and cancers at the lowest cost and in a relative safe way.

DATE: Wednesday, Aug 24, 2011
TIME: 3:00 p.m.
PLACE: Green Hall, Room 0120

Dissertation advisors:
Dr. TJ Tarn
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This seminar is in partial fulfillment
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