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Presents

Estimation and Observation of Stochastic Chemical Kinetic Systems

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Abstract: The state of a stochastic chemical kinetic model is a vector where each element is the molecular population of one of the species in the biochemical process. Using such models, we can make predictions regarding the distributions of dynamic behaviors of cellular processes that can be tested using single-cell experiments. However, it is not experimentally possible to completely observe the evolution of the state vector as it varies with time. Time-lapse movies collected using single-cell fluorescence microscopy allows the experimenter to make estimates of the dynamic populations of a few fluorescent species. Observations of dynamic behavior are not made continuously but instead at intermittent time points. A well-designed experiment ensures that these limited observations provide enough useful information to draw conclusions about the behavior of unobservable species. In control theory, the standard approach to dealing with the problem of estimating a dynamically changing state from limited observations is to construct an observer. An observer is a system that receives measurements from a system being monitored and computes an estimate of the monitored system's state. In this work, we develop an observer structure specialized for systems described using the formalism of stochastic chemical kinetics and specialized for quantitative analysis of time-lapse movies made using fluorescence microscopy. We show how observers can be applied to problems such as state estimation, hypothesis testing, and parameter estimation.

About the Speaker: David Thorsley is a Research Associate in the Department of Electrical Engineering at the University of Washington, Seattle. He received a B.E.Sc. in Electrical Engineering from the University of Western Ontario in 2000 and an M.S. and Ph.D. in Electrical Engineering: Systems from the University of Michigan in 2002 and 2006, respectively. His research interests are in the control, estimation, and modeling of stochastic discrete event systems and their applications to systems & synthetic biology, multi-robot systems, and process monitoring.