

Controlling biological systems: the lactose regulation system of Escherichia coli

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Abstract:

In this talk I present a comprehensive framework for abstraction and controller design for a biological system. The first half of the talk concerns modeling and model abstraction of the system. Most models in systems biology are deterministic models with ordinary differential equations in the concentration variables. We present a stochastic hybrid model of the lactose regulation system of E. Coli bacteria that capture important phenomena which cannot be described by continuous deterministic models. We then show that the resulting stochastic hybrid model can be abstracted into a much simpler model, a two-state continuous time Markov chain.

The second half of the talk discusses controller design for a specific architecture. The architecture consists of measurement of a global quantity in a colony of bacteria as an output feedback, and manipulation of global environmental variables as control actuation. We show that controller design can be performed on the abstracted (Markov chain) model and implementation on the real model yields the desired result.