QUANTITATIVE ASPECTS OF GENE REGULATION IN BACTERIA: AMPLIFICATION, THRESHOLD, AND COMBINATORIAL CONTROL

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Biological organisms possess an enormous repertoire of genetic responses to ever-changing combinations of cellular and environmental signals. Unlike digital electronic circuits however, signal processing in cells is carried out by a limited number of asynchronous devices in fluctuating aqueous environments.

In this talk, I will discuss the control of genetic responses in bacteria. Theoretical analysis of the known mechanisms of transcriptional control suggests "programmable" mechanisms for implementing a broad class of combinatorial control. Further analysis of post-transcriptional control suggests mechanisms for signal amplification, threshold response, and noise attenuation. I will present experimental characterization of some of these bio-computational "devices", as well as experiments illustrating how promoter sequences may be "trained" by directed evolution. Quantitative characterization and controlled manipulation of these devices may bring about predictive understanding of biological control systems, and reveal interesting, novel strategies of distributed computation.