Methods for Engineering Cellular Control

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Abstract:

Despite the rapid success of synthetic biology in recent years, the performance of control circuits, when placed inside a cell, remains poorly understood due to insulation problems. Interference effects arising from cellular resource sharing (both metabolites and machineries) and fluctuating concentrations of low-copy control molecules makes the in vivo performance of biological control circuits quite circumstantial and unpredictable. Furthermore, the performance of such control-circuits is even less predictable in the fluctuations environment in which cells survive and grow. In order to design circuits that perform reliably, we are developing platforms that enable quantitative evaluation of the circuits in vivo with single-cell resolution and near-perfect control of growth-conditions, helping us to analyse and mitigate the effects of stochasticity, cellular interference, and environmental perturbation. In this talk I will describe these developments and illustrate the potential of this pipeline using the reconstruction, optimization, and application of a synthetic oscillator system.