سمینار هفتگی ماده چگال نرم

ANDOR and beyond: Dynamically switchable logic gates as modules for flexible information processing in biochemical regulatory networks.

Abstract

Understanding how complex (bio-)chemical pathways and regulatory networks may be capable of processing information in efficient, flexible, and robust ways is a key question with implications touching fields across biology, systems biology, biochemistry, synthetic biology, dynamical systems theory, and network science. Considerable effort has been focused on the identification and characterization of structural motifs in these signaling networks, and companion efforts have also sought to cast their operation as controlled by dynamical modules that appear out of dynamical correlations during information processing. While both these approaches have been successful in many examples of biological information processing, cases in which the signaling or regulatory network exhibits multi-functionality or context dependence remain problematic. We here propose a small set of higher-order effective modules that simultaneously incorporate both network structure and the attendant dynamical landscape. In so doing, we render effective computational units that can perform different logical operations based purely on the basin of attraction in which the network dynamics resides or is steered to. These dynamically switchable biochemical logic gates require fewer chemical components or gene products overall than their traditional analogs where static, separate gates are used for each desired function. The multi-stability employed by these circuits emerges from interactions between the components making the switchability an emergent behavior of the system. We demonstrate the applicability and limits of these flexible gates by determining a robust range of parameters over which they correctly operate and further characterize the resilience of their function against intrinsic noise of the constituent reactions using the theory of large deviations. We also show the capability of this framework for general computations by designing a binary adder/subtractor circuit composed of only six components.

MohammadReza Bahadorian

Max Planck Institute for Molecular Cell Biology and Genetics (MPI-CBG)

Center for Systems Biology Dresden (CSBD)

زمان: شنبه ۱۴۰۰/۱۱/۹ ساعت ۱۵:۳۰

مکان: کلاس مجازی دکتر اجتهادی

https://vc.sharif.edu/ch/ejtehadi