
ERIC FOXALL, UBC Okanagan

Optimal control of ribosome population for gene expression under periodic nutrient intake

Ribosomes are molecular machines that build proteins out of available amino acid resources, and are largely made up of those resources. There is evidence that ribosomes are actively degraded when resources are scarce, and then reassembled once resources become more plentiful. In order to understand why, we formulate a model of protein production that allows for varying resource input and control over the ribosome population, and pose the following optimization problem: subject to periodically varying resource input, find the (time-dependent) rates of ribosome degradation and assembly that yield the highest, constant (with respect to time) rate of protein production. Using a quasi-static approximation that we justify analytically, we find that in optimal solutions, the ribosome population varies in response to the input, suggesting that the intense regulation observed in experiments occurs in order to maximize protein production. Joint work with Luca Ciandrini, Khanh Dao Duc and Clément Soubrier.