Stochastic and Deterministic Computation in the regulation of Decision – Making Genetic circuits by Energy Availability.

Rajneesh Kumar
University of Bergen, Norway
Rajneesh.Kumar@uib.no

All living organisms require energy because it is a driven, non-equilibrium system at all scales, from the cellular to the evolutionary. Like human society, a consistent energy supply is essential for cells to process information and take actions, and when cellular energy supplies are challenged, disorders can result. Here we use a mathematical model of gene expression in a bistable decision-making regulatory network to explore cellular bifurcation behaviour when we vary the energy availability. We impose that the rates of the associated gene expression processes in our model are reliant on an ATP concentration parameters since we know that each step in transcription and translation requires energy in the form of ATP. We discuss both a deterministic model, to explore the emergence of different attractors under different ATP concentration parameters, and a stochastic simulation case to explore how ATP influences the noisy dynamics and magnitude of protein expression and importantly whether switching between two protein concentration become more or less common.

Joint work with Iain G. Johnston (University of Bergen, Norway).