Attila Csikasz-Nagy
The Microsoft Research University of Trento Centre for Computational and Systems Biology
e-mail: csikasz@cosbi.eu

Cell signaling network unit dynamics

Cells use a dense network of signaling pathways to decide how to respond to various external stimuli. Several dynamic aspects of complex pathways have been already described. Here we show that simple generic motifs of signaling pathways (without any feedback) could show some interesting dynamics. We investigated the dynamics of the simplest dynamical elements in biochemical networks: we analyzed the response dynamics of a signaling protein when it enters the signaling pool in one state (modified or unmodified) and exits in both of these states. When the exit rates of these two states are comparable, a persistent stimulus results in step responses and can produce ultrasensitivity, however, when the exit rates are imbalanced, the signaling protein gives transient responses to persistent stimuli. Such adaptive behavior of signaling pathways could be used by many organisms. We also investigated the dynamical features of phosphorelays: phosphorelays are extended two-component signaling systems found in diverse bacteria, lower eukaryotes and plants. We found that the intermediate layers of phosphorelays can display ultrasensitivity that could result in tolerance of pathway cross-talk. Furthermore, it leads to a high signal to noise ratio for the relay output. We show that these features of phosporelays might be employed by the sporulation network of B. subtilis.