Noise-induced oscillations of NF-κB shuttling

Jaewook Joo\textsuperscript{1}, Steven J. Plimpton\textsuperscript{2}, and Jean-Loup Faulon\textsuperscript{1}

\textit{Short Abstract} — NF-κB is a pleiotropic protein whose nucleo-cytoplasmic trafficking is tightly regulated by negative feedback loops embedded in its signaling network. We present numerical evidence for a universal dynamic behavior of NF-κB, namely oscillatory nucleo-cytoplasmic shuttling, due to the fundamentally stochastic nature of the NF-κB signaling network. We simulated the effect of extrinsic and intrinsic noise and demonstrate that extrinsic noise diversifies the shuttling patterns of NF-κB response, whereas intrinsic noise induces oscillatory behavior in many of the otherwise non-oscillatory patterns. We identify two key model parameters which significantly affect the NF-κB dynamic response and deduce two-dimensional phase-diagrams of the NF-κB response as a function of these parameters.

\textit{Keywords} — Noise-induced oscillations, extrinsic noise, intrinsic noise, phase diagram, bifurcation

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\textsuperscript{1}Computational Systems Biology Department, Sandia National Laboratories, NM, USA. E-mail: jjoo@sandia.gov and jfaulon@sandia.gov

\textsuperscript{2}Scalable Department, Sandia National Laboratories, NM, USA. E-mail: sjplimp@sandia.gov