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Time-Delay Induced Oscillations in Gene-Regulatory Networks
DMITRY BRATSUN, DMITRI VOLFSON, JEFF HASTY, LEV TSIMRING, University of California, San Diego — We develop both deterministic and stochastic models of transriptionalregulation in small genetic circuits taking into account the effect of time delay occuring in the production of protein monomers. We show that delayed transcription and translation can drastically change the behavior of the system from stationary to oscillatory. Neutral curves of the Hopf bifurcation are derived and studied as a function of the system parameters. In the framework of the stochastic description based on the master equation we analyze the role of fluctuations in the transition to oscillations. We derive the analytical expression for the correlation function and compare it with the results of numerical simulations based on direct Gillespie method.

Lev Tsimring
University of California, San Diego

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