Wang, Zihao; Zhang, Zhenquan; Zhou, Tianshou

Exact distributions for stochastic models of gene expression with arbitrary regulation.


Summary: Stochasticity in gene expression can result in fluctuations in gene product levels. Recent experiments indicated that feedback regulation plays an important role in controlling the noise in gene expression. A quantitative understanding of the feedback effect on gene expression requires analysis of the corresponding stochastic model. However, for stochastic models of gene expression with general regulation functions, exact analytical results for gene product distributions have not been given so far. Here, we propose a technique to solve a generalized ON-OFF model of stochastic gene expression with arbitrary (positive or negative, linear or nonlinear) feedbacks including posttranscriptional or posttranslational regulation. The obtained results, which generalize results obtained previously, provide new insights into the role of feedback in regulating gene expression. The proposed analytical framework can easily be extended to analysis of more complex models of stochastic gene expression.

MSC:
37N25 Dynamical systems in biology
92C42 Systems biology, networks
92D10 Genetics and epigenetics

Keywords:
gene expression; feedback regulation; chemical master equation; stationary distribution

Full Text: DOI

References:

Kepler, T. B.; Elston, T. C., Stochasticity in transcriptional regulation: Origins, consequences, and mathematical representations, Biophys J, 81, 3116-3136 (2001)


Liu, P.; Yuan, Z.; Wang, H., Decomposition and tunability of expression noise in the presence of coupled feedbacks, Chaos, 26, 043108 (2016) · Zbl 1361.92026


Suter, D. M.; Molina, N.; Gatfield, D., Mammalian genes are transcribed with widely different bursting kinetics, Science, 332, 472-474 (2011)


Yu, J., Probing gene expression in live cells, one protein molecule at a time, Science, 311, 1600-1603 (2006)


This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.