

Derivation of stationary distributions of stochastic chemical reaction networks via network translation

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ABSTRACT

Long-term behaviors of chemical reaction networks (CRNs) are described by steady states in deterministic models, and stationary distributions in stochastic models. Unlike deterministic steady states, stationary distributions capturing inherent fluctuations of reactions are extremely difficult to derive analytically due to the curse of dimensionality. In this presentation, we introduce a new method to derive stationary distributions from deterministic steady states by transforming reaction networks to have a special dynamic property based on chemical reaction network theory. Specifically, we merge nodes and edges to make a steady state complex balanced, i.e., the in- and out-flows of each node are equal, and then we derive a stationary distribution from the complex balanced steady state. Furthermore, we provide a user-friendly computational package, called CASTANET, that transforms CRNs and then analytically derives their stationary distributions.

References

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