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Complexity of model testing for dynamical systems with toric steady states. (English)

Summary: In this paper we investigate the complexity of model selection and model testing for dynamical systems with toric steady states. Such systems frequently arise in the study of chemical reaction networks. We do this by formulating these tasks as a constrained optimization problem in Euclidean space. This optimization problem is known as a Euclidean distance problem; the complexity of solving this problem is measured by an invariant called the Euclidean distance (ED) degree. We determine closed-form expressions for the ED degree of the steady states of several families of chemical reaction networks with toric steady states and arbitrarily many reactions. To illustrate the utility of this work we show how the ED degree can be used as a tool for estimating the computational cost of solving the model testing and model selection problems.

MSC:
37N99 Applications of dynamical systems
92C42 Systems biology, networks
92C05 Biophysics

Keywords:
toric steady states; chemical reaction networks; euclidean distance degree

Software:
PHCpack; SageMath; Bertini

Full Text: DOI arXiv Link

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arXiv preprint


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