Abstract Submitted
for the 4CS19 Meeting of
The American Physical Society

Discovering Emergent Behaviors in Cellular Networks Using Supremum Models CODY PETRIE, MARK TRANSTRUM, TRAVIS MAEKAWA, CASIE MAEKAWA, Brigham Young University — Biological cells grow and operate through a network of reactions of staggering complexity. Reflecting this complexity, cells can exhibit a wide range of different behaviors depending on their environment and internal state, making them very difficult to model. Dynamical models are often constructed by domain-specific experts who judiciously include only those mechanisms relevant to the phenomenon of interest. Individually these models can capture some of the possible dynamics of the full physical system, however there may be additional emergent dynamics which cannot be described by the reduced models. The problem we consider is how to predict new types of behaviors that the complex system can potentially realize, for example, during a different stage of development or during a disease such as cancer. We observe that the family of all such reduced models form a partially ordered set and propose a method for building "supremum" models using information geometry. These supremum models leverage the insights of the simplified models in order to capture the original dynamics while enabling new emergent behaviors. I illustrate using models of the Wnt signaling pathway, but the process can be applied to many complex systems.

Cody Petrie
Brigham Young University

Date submitted: 12 Sep 2019 Electronic form version 1.4