

RAGTIMER Tool Assists with Chemical Reaction Network Model Accuracy

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USU Doctoral student Landon Taylor set out to solve a particular issue in computer engineering: predicting rare events in biological systems. His solution? RAGTIMER, a tool which automates the analysis of chemical reaction networks to better predict and understand these rare events.



Landon Taylor and his mentor, computer engineering assistant professor Zhen Zhang, present RAGTIMER, a tool which automates the analysis of chemical reaction networks, or CRNs to better predict and understand these rare events.

With guidance from faculty mentor Zhen Zhang in the department of electrical and computer engineering, Taylor's tool is designed to model chemical reaction networks, or CRNs, and its impacts on natural resources as it attempts to model the behavior of real-world chemical reactions.

"CRNs are probabilistic, highly concurrent and cyclical systems that challenge cutting-edge verification tools," Taylor said. "Understanding and predicting rare events in biological systems modeled by CRNs can be difficult because their low occurrences make them difficult to study with traditional methods. RAGTIMER provides a framework to rigorously analyze synthetic biological systems. Synthetic biologists can also use RAGTIMER with any Chemical Reaction Network model."

Taylor's work has interesting implications in the booming field of synthetic biology, since new technologies benefit from the ability to analyze a model before building the system.

"Analyzing and re-designing a model using software tools is a huge step forward, and our work helps integrate engineering design principles and formal methods into synthetic biology design," Taylor said. "Our work focuses on using formal verification techniques to find the probability of rare events in biochemical reaction networks, or properties that have an extremely low chance of being observed but could have catastrophic effects."

The tool includes two key features: one to analyze the independence of reactions in CRNs and another to rapidly explore multiple variables during each case and the issues that might occur.

Taylor also had the opportunity to share his work at the 23rd International Conference on Formal Methods in Computer-Aided Design in late October. He will continue his research for the time being under Zhang.

RAGTIMER can be used for free at <https://github.com/fluentverification/ragtimer>.

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