



CECS Seminar

“Scalable Set-based Analysis for Verification of Cyber-Physical Systems”

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10:00 a.m. – 11:00 a.m.
Engineering Hall 2430



Abstract: Cyber-physical systems combine complex physics with complex software. Although these systems offer significant potential in fields such as smart grid design, autonomous robotics and medical systems, verification of CPS designs remains challenging. Model-based design permits simulations to be used to explore potential system behaviors, but individual simulations do not provide full coverage of what the system can do. In particular, simulations cannot guarantee the absence of unsafe behaviors, which is unsettling as many CPS are safety-critical systems.

The goal of set-based analysis methods is to explore a system's behaviors using sets of states, rather than individual states. The usual downside of this approach is that set-based analysis methods are limited in scalability, working only for very small models. This talk describes our recent process on improving the scalability of set-based reachability computation for LTI hybrid automaton models, some of which can apply to very large systems (up to one billion continuous state variables!). Lastly, we'll discuss the significant overlap of techniques used for our scalable reachability analysis methods with set-based input/output analysis of neural networks.

Biography: Stanley Bak is a research computer scientist investigating the formal verification of cyber-physical systems. He strives to create scalable and automatic formal analysis methods for complex models with both ordinary differential equations and discrete behaviors. The ultimate goal is to make formal approaches applicable, which demands developing new theory, programming efficient tools and building experimental systems.

Stanley Bak received a Bachelor's degree in Computer Science from Rensselaer Polytechnic Institute (RPI) in 2007 (summa cum laude), a Master's degree in Computer Science from the University of Illinois at Urbana-Champaign (UIUC) in 2009, and a PhD from UIUC in 2013. He received the Founders Award of Excellence for his undergraduate research at RPI in 2004, the Debra and Ira Cohen Graduate Fellowship from UIUC twice, in 2008 and 2009, and was awarded the Science, Mathematics and Research for Transformation (SMART) Scholarship from 2009 to 2013. Stanley worked as a research computer scientist for the Air Force Research Laboratory (AFRL) from 2013 to 2018, both in the Information Directorate and the Aerospace Systems Directorate. Currently, he helps run Safe Sky Analytics, a small research consulting company working with the FAA and the Air Force.