Resilient Autonomy via Formal Methods

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Computer Studies Building (CSB) 209

Abstract: Autonomous systems are increasingly becoming a part of our daily lives. For example, we envision drones to be used in security, delivery, mapping, and surveying applications, self-driving cars to share the roadways with human-driven vehicles, and service robots to assist humans in houses, hotels, or hospitals. Such autonomous systems are enabled by the recent developments in computing, manufacturing, and networking technologies. However, continuous progress in autonomy faces several challenges. For instance, such systems usually operate in dynamic environments in close proximity to humans or other robotic systems. Accordingly, safety guarantees are required to ensure that catastrophic events do not occur, especially near humans. Furthermore, resilience becomes a critical system property for preventing severe performance loss and recovering performance in the face of uncertainty. In this talk, I will discuss the use of formal methods in developing resilient autonomy. We will consider dynamical systems, which operate under disturbances and need to satisfy a desired specification (e.g., reachability, safety, persistence). First, I will present how to generate online control policies that guarantee the satisfaction of the desired specification. Then, I will discuss cases where the desired specification is not achievable due to some disturbance. For such cases, I will introduce how to formulate relaxed specifications and propose algorithms for generating control policies that satisfy minimal relaxations. I will then talk about how to use reinforcement learning with formal methods to learn control policies for the robust satisfaction of desired specifications. Finally, I will discuss the application of the proposed methods to other complex systems such as cyber-physical systems and human-robot teams.

Bio: Derya Aksaray is a post-doctoral associate in the Computer Science and Artificial Intelligence Laboratory at MIT. Before joining MIT, she was a post-doctoral researcher at Boston University. She received her Ph.D. degree in Aerospace Engineering from the Georgia Institute of Technology in 2014. She received her M.S. and B.S. degrees in Aerospace Engineering from Georgia Tech in 2011 and from Middle East Technical University, Turkey in 2008, respectively. Her research interests primarily lie in the areas of control theory, formal methods, and machine learning. Recently, her work is mainly focused on achieving safe and resilient operation of autonomous robotic systems.

Pizza and soda provided.