Formal Methods for "Play"-Based Human-Automation Unmanned Air Vehicle (UAV) Mission Planning

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Abstract: Future concepts for unmanned air vehicles (UAVs) envisage teams of UAVs working with human operators to carry out tasks in a wide variety of domains. Implementation of such concepts will require the development of increasingly autonomous UAV controllers, and ensuring the safety and effectiveness of such controllers will be challenging. Toward this end, the Air Force Research Laboratory has been developing "plays" that implement robust autonomous UAV behaviors that are conceptually easy for human operators to understand. Furthermore, recent play design approaches have employed formal methods to ensure plays behave as expected. This talk focuses on two related topics. First is the use of reactive synthesis approaches to design "correct-by-construction" controllers that change UAVs' behaviors in response to events that occur dynamically during a mission. Second is the use of structured probabilistic counterexamples to help human operators understand potential issues that could arise when executing mission plans composed of plays with probabilistic behaviors.

Bio: Laura Humphrey received her Ph.D. in Electrical and Computer Engineering from the Ohio State University in 2009, where she studied biomechanics and robotic control systems. After graduating, she began work as a Research Engineer in the Aerospace Systems Directorate of the Air Force Research Laboratory (AFRL/RQ) at Wright-Patterson Air Force Base, where her original focus was on autonomous cooperative control of multiple unmanned aerial vehicles. She then additionally became interested in problems related to verification and validation of autonomous systems, as well as human supervisory control of multi-vehicle systems. Her research interests include formal methods for system specification, design, and verification; model-based design and automated synthesis of "correct-by-construction" designs; and human-automation interaction and human trust in automation, especially in the context of multi-vehicle mission planning systems.