New models for optimizing mission control of unmanned aerial vehicles

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Engineers at Boston University are working on a theoretical approach to improve automated mission control and decision-making for fleets of unmanned aerial vehicles (UAVs). Automating these functions would let UAVs adapt their actions more rapidly in response to unforeseen events and ultimately require less human supervision. Credit: (Photo Credit: Dr. David Castañón, Boston University)

With funding from the Air Force Office of Scientific Research, engineers at Boston University are working on a theoretical approach to improve automated mission control and decision-making for fleets of unmanned aerial vehicles.

While unmanned systems currently rely on the automation of low-level functions, such as navigation, stabilization and trajectory, operating these systems is still quite labor-intensive for Air Force pilots given the variable flying conditions experienced by UAVs.

The BU team, led by Dr. David Castañón and Dr. Christos Cassandras, has focused their work on optimizing "mission control," which describes mid-level control approaches that go beyond simply improving stability and tracking trajectories.

"We were interested in automating functions such as partitioning of tasks among members of teams of UAVs,...monitoring the success of the individual activities, and re-planning to accommodate contingencies or failures in executing the planned tasks," explained Castañón.

Automating these functions would let UAVs adapt their actions more rapidly in response to unforeseen events and ultimately require less human supervision.

To date, the team has developed mathematical algorithms that can make nearly optimal decisions under realistic model conditions. Their approach thus far has been based on the need to account for a number of uncertainties requiring complex computations nearly impossible to implement in real-time systems.

"Our research approach has been to exploit classes of models for which fast algorithms can be developed and to extend these algorithms to generate decisions in more complex models that capture the relevant features of the UAV problems of interest," said Castañón.

While much of Cassandras and Castañón's research is based on mathematical analysis, they have also developed a robotics test scenario for evaluating their approach. Both graduate and undergraduate students at BU are involved in this testing, which uses teams of small robots equipped with sensors to represent the UAVs. In these tests, the robots have to function in a mid-level control environment while being distracted by unforeseen events such as loss of team members, arrival of new tasks and discovery of new information.

As the BU team learns more about the environments in which UAVs operate, they will continue to hone their results, with the long-term goal of increasing the level of self-sufficiency available to future Air Force UAV fleets.

Provided by Air Force Office of Scientific Research