AUTONOMOUS AEROSPACE SYSTEMS

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Autonomous systems have become a critical tool for both military and scientific missions. Vehicles like the Mars Exploration Rovers, which can autonomously drive through a cluttered environment to a goal and autonomously identify and extract interesting science features (e.g., dust devils and clouds) from images taken by onboard cameras, and the Boeing X-45A unmanned air vehicle, which demonstrated the first autonomous flight of a high-performance combat-capable unmanned air vehicle and the first autonomous multi-vehicle coordinated flight, have reduced the level of human intervention from inner-loop control to high-level supervision.

However, human involvement is still a critical component of robotic systems. In some cases this is necessary from a legal and arguably moral standpoint (e.g., in autonomous strike missions) but in most cases it is due to the limits of current technology. It is still impossible for a robot to navigate autonomously along a crowded sidewalk, and it is impossible for a robotic explorer to demonstrate initiative or “decide what is interesting.” Even recovering from an error such as a stuck wheel or actuator fault generally requires human intervention. This session will focus on aspects of autonomy which will bring robotic systems from the level of controlled systems which can function for a few minutes without human intervention up to systems which can function autonomously for days or weeks in poorly characterized, or even unknown, environments.

The speakers in this session represent academia, government and industry. Both aeronautical and space autonomous systems are covered. Talks are organized to progress from the single vehicle (including human interaction with the vehicle) to teams of robots to the effect of incorporating autonomous systems into the National Air Transportation System.

The talk by Campbell will focus on techniques for enabling “intelligence” in autonomous systems through probabilistic models of the environment and the integration of human operators in the control/planning loop. Frost will provide an overview of the challenges for automation posed by NASA’s current and future space missions, highlights of successfully deployed examples and discussion of some of the lessons learned from those experiences. Bieniawski will discuss the role of health awareness in systems of multiple autonomous vehicles, thus addressing problems such as failures of components in a vehicle or failure of a vehicle in the team. Finally the presentation by Atkins will discuss the formidable challenges associated with safely and efficiently integrating unmanned air systems into the national airspace system, and the role of automation and autonomy in the deployment of the next generation air transportation system (NextGen).