Autonomous Planning and Execution for a Titan Aerobot

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We are developing onboard planning and execution technologies to provide robust and opportunistic mission operations for a Titan aerobot. Aerobots offer traversal capabilities, geographical coverage, and speeds that are orders of magnitude greater than rovers, leading to an enormous science data collection potential. However, bandwidth constraints, communications latencies and blackouts, and flight maneuvering limitations require these vehicles to have onboard autonomous science capabilities in order to provide timely response and make effective use of vehicle resources. This will allow science data acquisition to be planned and executed in real time, and will consequently increase mission science return.

One of the significant challenges faced by an aerial vehicle is handling the large degree of uncertainty in the environment. For example, the system must respond to unexpected wind conditions as well as take advantage of new science opportunities. Using the CASPER continuous planning and executing system, we have developed autonomous technology that enables an aerobot to generate mission operation plans and adjust the plans to accommodate unexpected events during execution (Figure 1). This enables the system to appropriately respond to unexpected events and to take advantage of new science opportunities.

This technology is based on prior work we have performed for rover operations. However, some significant developments were required to address the unique challenges of an aerobot platform. This includes the fact that the aerobot platform is never stationary and is traveling at a significantly greater rate than a rover. In the paper we will describe these challenges and discuss how we addressed them.

In November, 2008, we successfully demonstrated this technology an the JPL aerobot platform at the Southern California Logistics Airport (SCLA) in Victorville, CA (Figure 2). The flight demonstrated the system's ability to generate mission operations plans given science goals, to command the aerobot control software and monitor plan execution, and to successfully modify the operations plan to respond to dynamic, opportunistic science events.

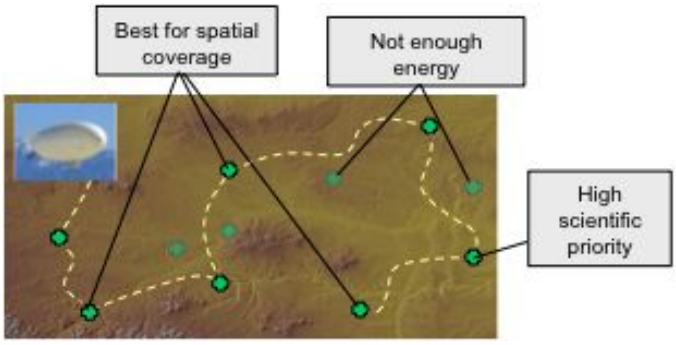

Fig. 1. An aerobot science operations plan showing goals that made it into the plan and goals in reserve for potential replanning.

Fig. 2. JPL Aerobot flying during field trials at the Southern California Logistics Airport (SCLA) in Victorville, CA.