26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations:26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

Author: Mr. Thomas Cunningham
Purdue University, United States, cunnin85@purdue.edu

Dr. David Spencer
Purdue University, United States, dspencer@purdue.edu

AUTOMATED ONBOARD MISSION PLANNING FOR ROBUST AND FLEXIBLE SPACECRAFT OPERATIONS

Abstract

During mission operations, spacecraft activities are typically initiated via commands that are uplinked by ground controllers. In a traditional mission operations system, command sequences are validated on the ground, reviewed, and approved prior to uplink. The impact of the planned activities on the spacecraft technical resources are evaluated using ground software, and the activity plans are tailored to stay within the resource constraints.

Automated mission planners offer the capability to schedule engineering and science activities onboard, without ground-in-the-loop interaction. Resource modeling can be done onboard, reducing the need for modeling and validation by ground operators. Further, automated mission planners may incorporate an optimization executive that maximizes the mission return within the available resource constraints.

This paper presents an automated mission planning framework and applies it to a resource-constrained science orbiter mission case study. Using optimization methods, the developed automated mission planner establishes the planned sequence of science payload data acquisition while adhering to battery state of charge and data throughput constraints. Optimized activity plans are produced that coordinate instrument on/off states and science data acquisition within the context of the evolving orbit and tracking station overflight schedule.

The automated mission planning framework is designed to be adapted based upon the application. Optimization methods suitable for different mission planning problems are presented, comparing methods on the basis of computation speed, resources required and solution optimality. Measures of “robustness” and “flexibility” are incorporated into the framework to enable the system to adapt to changing conditions without violating constraints, and to provide additional criteria with which to evaluate and compare produced activity plans.