ASTRODYNAMICS SYMPOSIUM (C1)
Mission Operations (3)

Author: Mr. Teck Choo
The John Hopkins University Applied Physics Laboratory, United States, Teck.Choo@jhuapl.edu

Dr. Brian Anderson
The John Hopkins University Applied Physics Laboratory, United States, Brian.Anderson@jhuapl.edu
Mr. Peter Bedini
The John Hopkins University Applied Physics Laboratory, United States, peter.bedini@jhuapl.edu
Mr. Joseph Skura
The John Hopkins University Applied Physics Laboratory, United States, Joe.Skura@jhuapl.edu
Mr. Robert Steele
The John Hopkins University Applied Physics Laboratory, United States, Josh.Steele@jhuapl.edu
Mr. Eric Finnegan
The John Hopkins University Applied Physics Laboratory, United States, eric.finnegan@jhuapl.edu

AN AUTOMATED SCIENCE OBSERVATION SCHEDULING SYSTEM FOR MESSENGER

Abstract

We present an efficient, semi-automated planning and scheduling system developed for the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) mission. This system, referred to as the Optimizer, begins with science objectives and ends with commands ready to be sent to the mission operations team for uplink to the spacecraft. The Optimizer reduces cost, improves system response, and maximizes science return.

NASA's MESSENGER spacecraft was launched on 3 August 2004 and has twice flown by Mercury successfully, on 14 January 2008 and 6 October 2008. It will fly by Mercury a third time on 29 September 2009 before being propulsively inserted into orbit about Mercury in March 2011. During the mission orbital phase, the spacecraft will be in a non-Sun-synchronous and highly elliptical 200 km x 15,200 km orbit with an approximately 80 orbital inclination. The orbital period will be approximately 12 hours. MESSENGER will acquire scientific observations with seven on-board instruments as well as radio science. These instruments and spacecraft systems other than solar panels are mounted behind the sunshade that protects the spacecraft from the intense insolation. As MESSENGER orbits Mercury, the guidance and control system must keep the spacecraft attitude within a range such that spacecraft components and instruments are never directly illuminated by the Sun and thermally sensitive parts of the spacecraft are not directly exposed to thermal radiation from the planet when the spacecraft is near Mercury.

The Optimizer uses a full mission simulation to allow detailed analysis and scheduling of the entire orbital operations phase. This system was required to meet the challenges presented by the combination of ambitious measurement objectives, complicated orbit geometry, and constraints on spacecraft operations and pointing necessitated by the harsh thermal environment. The Optimizer begins with opportunity analysis, to find all observation opportunities that satisfy the operational constraints and scheduling observations according to science-measurement priorities. Observations are scheduled until the guidance and control (GC) constraints, spacecraft operational schedule, available on-board storage and downlink resources, and instrument operational schedules are fully allocated. Detailed reports and observation-coverage and spacecraft-resource-use plots are automatically generated for evaluation and validation. In addition, commands for GC and instruments are automatically generated for submission to the mission operations team for uplink to the spacecraft.