OPEN-LOOP TRACKING DURING CRITICAL MISSION PHASES

Sami Asmar, Douglas Johnston
Jet Propulsion Laboratory, 4800 Oak Grove Dr, Pasadena, CA 91109

Planetary probes can encounter a mission scenario where the communication is not favorable during critical maneuvers or emergencies. These can include launch, initial acquisition, landing, trajectory corrections, spacecraft safing, etc. Communication challenges can include sub-optimum pointing of the probes' antenna, sub-optimum transmission power, solar plasma interference, atmospheric and ring particle interference, spacecraft spin, and highly dynamic interactions with planets during encounters; all of which prevent locking on the signal using closed loop receivers, and subsequent extraction of telemetry. Recent examples of these scenarios with spacecraft included the loss of Mars Observer, the characterization of the early nutation of Ulysses, the Mars Pathfinder and Mars Exploration Rovers Entry, Descent, and Landing, and the Cassini Saturn Orbit Insertion.

Since the loss of Mars Observer and Mars Climate Orbiter, NASA has mandated that unless precluded by solar system obstacles, a spacecraft should be configured to allow real time telemetry during critical events. Utilizing the open loop Radio Science Receivers of the Deep Space Network has enabled missions to receive valuable information during these critical times when normal telemetry modes are not feasible. Several sets of specialized software have been developed to help track spacecrafts in these conditions. Real-time detection of signals as weak as -3dB was possible during the Cassini Saturn Orbit Insertion, while unmodeled frequency changes with accelerations over 20 Hz/s^2 were tracked during the MER landings.

This paper will describe the capabilities of the current open-loop tracking mechanisms used, and highlight interesting cases, as examples, such as the critical communications for the Mars rovers and Saturn Orbit Insertion and describe the ongoing preparation for radio tracking of the Huygens probe at (non-DSN) radio telescopes.

Abstract Submission Form

2004 National Radio Science Meeting

Abstract: johnston23809

Date Received: September 24, 2004

1. (a)
Douglas Johnston
Jet Propulsion Laboratory
Radio Science Systems Group
M/S 230-215
4800 Oak Grove Dr
Pasadena, CA
91109 USA
douglas.johnston@jpl.nasa.go

(b) 818.393.0663

(c) 818.393.9282

2. C - Signals and Systems

3. (a)

4. C - Contributed Paper

5. No special instructions