

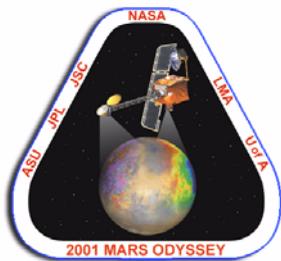
HEND Workshop

Mars Odyssey

Off-Nadir Imaging

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Mars Odyssey

Introduction

- Off nadir imaging to expand the capability of the THEMIS experiment is a stated goal in the Odyssey Extended Mission 2 (E2) proposal
 - Initial analysis was done in 2002/2003 in support of a request by the MER project to provide stereo imaging of potential landing sites
 - A supporting demonstration of this E2 capability is planned for the latter part of Extended Mission 1 (latter part of FY06)
 - Transition to routine use of off-nadir imaging is planned for E2
- Science Objectives for off-nadir imaging
 - Daily observations of high activity and high interest targets in the Polar Regions
 - Daily imaging of regions of gas jetting through vents and the formation of dark spots and fans
 - Increases likelihood of observing these processes in an active phase
 - Stereo imaging for geographical analysis and landing site characterization
 - Fill in existing gaps and gores

- Spacecraft turn axis
 - Currently no constraints are being imposed
 - Previous analysis for MER was done for rolls only
 - THEMIS planning software inheritance currently only supports roll maneuver planning
 - A yaw maneuver was performed on the spacecraft last year
 - Initial demonstration of this capability will be done with rolls only to reduce complexity
- GRS thermal constraints (Chuck Fellows, 7/29/02)
 - Verify that temperature increase is less than 1 Kelvin.
- No telecommunications during turns
 - High gain antenna is placed in idle mode before the turn begins
- Conflicts with relay operations
 - Off-nadir imaging will be constrained to avoid relay windows to reduce complexity
- No known constraints on, or from, HEND or NS

- Work to Date
 - Spacecraft Team operations procedure was written
 - M01-SCT-0100, Targeted Observation Sequence Build, 4/10/2003
 - Two Operations Interface Agreements were written for new products
 - M01-SCT-024, Targeted Observation Pointing File, 1/17/2003
 - M01-SCT-025, GRS Cooler Angles for Targeted Observations, 2/28/2003
 - GRS Team (Chuck Fellows) provided a thermal analysis of the impact of roll maneuvers (7/29/2002)
 - Representative sequences were developed and tested in the testbed
 - Development schedule was outlined (~2 months dev/test)
 - Analysis of latitude coverage over time for various off-nadir angles was performed by Mission Planning (Paul Fieseler, PSG, 2/16/2005)

Additional tool development is required for routine off-nadir operations

- ody_build_roto (Lockheed-Martin Space Systems (Spacecraft Team))
 - Creates context variable file and Spacecraft Activity Sequence File
 - Tool is complete and was used to generate the testbed sequences
 - Revalidation required against the current ground data system
- JMARS (THEMIS Team, ASU)
 - Will be used for roll design and GRS constraint checking
 - MRO adaptation of JMARS can be folded into the THEMIS adaptation
- Mission Planning/Sequence Tools (JPL)
 - Extent of constraint checking on the JPL side is still being studied
 - Development of a pointing block may simplify operations
 - Experience from the E1 demonstration will focus tool development

Mars Odyssey

E1 Demonstration

- Purpose of the demonstration
 - Dust off the work previously done
 - Re-evaluate the potential thermal impacts to GRS
 - Scope the remaining effort involved to support routine targeted observations
 - Incorporate lessons learned from last year's yaw maneuver
 - Accommodate changes in ODY operations since the original study
 - MER relay operations
- Details
 - Scope of demo is a simple turn to a target accompanied by some imaging and a turn back
 - Demonstration will be “hand-built” similar to the yaw maneuver
 - Tools for routine off-nadir activities are not ready yet
 - Modeling indicates that the poles cannot be imaged this summer
 - Roll of 23 degrees is needed to see the pole (Fieseler analysis)

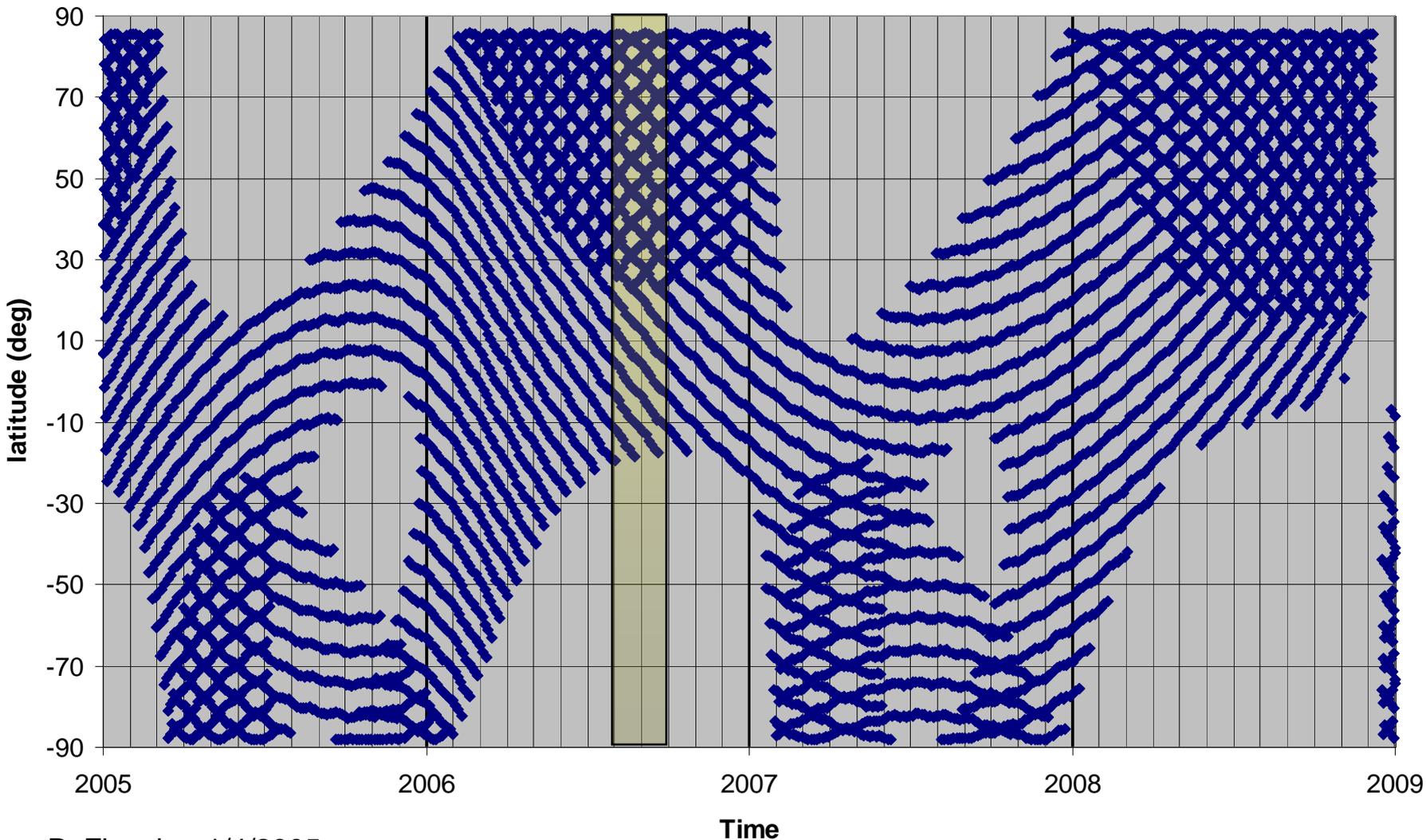


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Mars Odyssey

Sun-lit Latitudes Visible to Themis

Roto = 10 deg



P. Fieseler, 1/4/2005

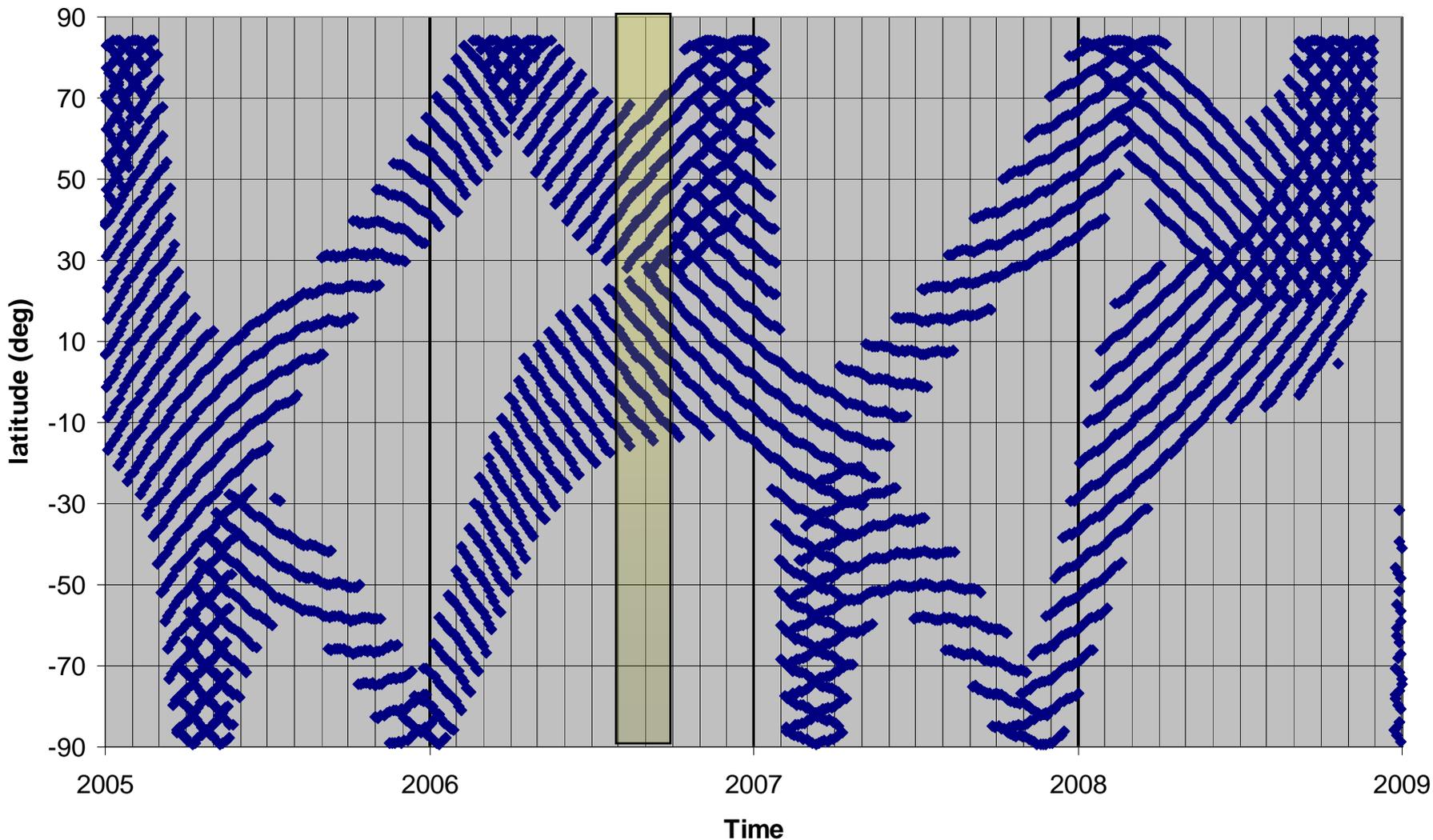


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Mars Odyssey

Sun-lit Latitudes Visible to Themis

Roto = 20 deg



P. Fieseler, 1/4/2005

- Concerns
 - Increased complexity to science operations
 - Spacecraft Team involvement in science data collection
 - Increased possibility of safe mode entry inherent with any “new” activity
 - Additional GRS anneals pose a risk to the instrument

- Outlook
 - No major technical hurdles are apparent
 - Provides additional imaging science opportunities without impact to other science acquisition

Back-up (Fieseler chart description)

The attached charts show the latitude on Mars of the Themis footprint when:

- The center of the footprint hits a part of the Martian surface in sunlight
- All flight rules and constraints are all met

Things to note:

- Rotos were done about the spacecraft velocity vector.
- As the plotting on the following charts look something like a net, fill in the surface in your mind's eye.
- Excel plotting limitations forced me to plot with a larger granularity than I would have liked.
- Where the net is doubled (eg. large areas on the northern hemisphere in 2006 on the Roto = 0 deg chart), this is where the constraints were met on both the ascending and descending parts of the orbit.
- Areas where the lines are thin in a vertical direction may not really be accessible. For example, on the ROTO = 30 deg chart at the start of 2006, the northern hemisphere option shows less than 10 degrees of latitude where all constraints are met; the spacecraft cannot loiter long at that rolled attitude. Each case needs to be looked at individually to see what constraints are violated.
- Previously, I had presented a chart where rolls up to > 60 degrees were possible. These large rolls are still possible without violating any flight rules, but the footprint will always hit in darkness.