RADAR Titan Flyby during S60/T69

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- Sequence: s60
- Rev: 132
- Observation Id: t69
- Target Body: Titan
- Data Take Number: 218
- PDT Config File: S60_ssup_psiv1_100322_pdt.cfg
- SMT File: S60_100326.rpt
- PEF File: z0600c.pef

1 Introduction

This memo describes the Cassini RADAR activities for the T69 Titan flyby. This SAR data collection occurs during the S60 sequence of the Saturn Tour. This is a partial radar pass with high altitude imaging. A sequence design memo provides the science context of the scheduled observations, an overview of the pointing design, and guidlines for preparing the RADAR IEB.

2 CIMS and Division Summary

CIMS ID	Start	End	Duration	Comments
132TI_T69WARMUP001_RIDER	2010-155T17:08:27	2010-155T21:26:27	04:18:0.0	
132TI_T69INRAD001_PRIME	2010-155T21:26:27	2010-156T00:26:27	03:00:0.0	
132TI_T69INSCAT001_PRIME	2010-156T00:26:27	2010-156T01:14:27	00:48:0.0	
132TI_T69IHISAR001_PRIME	2010-156T01:14:27	2010-156T02:11:27	00:57:0.0	

Table 1: t69 CIMS Request Sequence

Each RADAR observation is represented to the project by a set of requests in the Cassini Information Management System (CIMS). The CIMS database contains requests for pointing control, time, and data volume. The CIMS requests show a high-level view of the sequence design. Table 1 shows the CIMS request summary for this observation. Although the CIMS requests show Low-SAR intervals, in reality the radar will be operated in Hi-SAR mode through most of this flyby.

Division	Name	Start	Duration	Data Vol	Comments
a	Warmup	-9:20:0.0	04:30:0.0	16.1	Warmup
b	standard_radiometer_inbound	-4:50:0.0	00:05:0.0	0.3	Inbound radiometry scans
c	standard_radiometer_inbound	-4:45:0.0	02:45:0.0	9.8	Inbound radiometry raster
d	standard_scatterometer_inbound	-2:00:0.0	00:42:0.0	70.6	Inbound scatterometer scan
e	scatterometer_imaging	-1:18:0.0	00:02:0.0	12.6	Inbound scatterometer imaging
f	scatterometer_imaging	-1:16:0.0	00:03:0.0	18.9	Inbound scatterometer imaging
g	scatterometer_imaging	-1:13:0.0	00:15:0.0	94.5	Inbound scatterometer imaging
h	scatterometer_imaging	-0:58:0.0	00:01:0.0	6.3	Inbound scatterometer imaging
i	scatterometer_imaging	-0:57:0.0	00:06:0.0	37.8	Inbound scatterometer imaging
j	scatterometer_imaging	-0:51:0.0	00:02:0.0	12.6	Inbound scatterometer imaging
k	scatterometer_imaging	-0:49:0.0	00:04:0.0	25.2	Inbound scatterometer imaging
l	scatterometer_imaging	-0:45:0.0	00:01:48.0	11.3	Inbound scatterometer imaging
m	scatterometer_imaging	-0:43:12.0	00:00:24.0	2.5	Inbound scatterometer imaging
n	scatterometer_imaging	-0:42:48.0	00:02:18.0	14.5	Inbound scatterometer imaging
o	standard_radiometer_inbound	-0:40:30.0	00:25:30.0	1.5	Inbound radiometry scans
Total				334.5	

Table 2: Division summary. Data volumes (Mbits) are estimated from maximum data rate and division duration.

Div	Alt (km)	Slant range (km)	B3 Size (target dia)	B3 Dop. Spread (Hz)
a	184146	off target	0.23	off target
b	94055	off target	0.12	off target
c	92397	off target	0.12	off target
d	37815	off target	0.05	off target
e	23998	24128	0.03	440
f	23342	24097	0.03	451
g	22360	23050	0.03	468
h	17470	17817	0.03	581
i	17145	17435	0.02	590
j	15205	15587	0.02	654
k	14560	15210	0.02	679
l	13277	13587	0.02	734
m	12702	13235	0.02	761
n	12575	13320	0.02	768
o	11844	off target	0.02	off target

Table 3: Division geometry summary. Values are computed at the start of each division. B3 Doppler spread is for two-way 3-dB pattern. B3 size is the one-way 3-dB beamwidth

The CIMS requests form the basis of a pointing design built using the project pointing design tool (PDT). The details of the pointing design are shown by the PDT plots on the corresponding tour sequence web page. (See https://cassini.jpl.nasa.gov/radar.) The RADAR pointing sequence is ultimately combined with pointing sequences from other instruments to make a large merged c-kernel. C-kernels are files containing spacecraft attitude data.

A RADAR tool called RADAR Mapping and Sequencing Software (RMSS) reads the merged c-kernel along with other navigation data files, and uses these data to produce a set of instructions for the RADAR observation. The RADAR instructions are called an Instrument Execution Block (IEB). The IEB is produced by running RMSS with a radar config file that controls the process of generating IEB instructions for different segments of time. These segments of time are called divisions with a particular behavior defined by a set of division keywords in the config file. Table 2 shows a summary of the divisions used in this observation. Table 3 shows a summary of some key geometry values for each division.

3 Overview

T69 has inbound radiometry, scatterometry, and high altitude imaging in scatterometer mode. No outbound data is collected. The radiometry and scatteormetry raster scans provide fill in coverage for Titan global mapping. The high altitude imaging provides four scan lines aimed at connecting the Ta and T3 swaths.

4 Mode Specific Operation and Performance

Many details of standard radar sequencing during the 4 main modes (Radiometry, Scatterometry, Altimetry, and SAR) have been discussed in previous sequence memos for prior observations. Refer to these for details. Some selecte performance highlights are illustrated in figures and explained in the following subsections.

4.1 High Altitude Imaging

The high altitude imaging segments are designed to optimize range-doppler ambiguities, resolution, number of looks and noise-equivalent cross-section. These segments push against the 7% duty cycle limit, the 32 Kbyte size of the science data buffer, the round trip time limitation, and the number of pulses that the ESS can put out. To allow the best possible azimuth resolution, the duty cycle is reduced to allow a longer pulse train while still remaining below the 7% duty cycle limit. This trades SNR for resolution as was done in T19. Resolution in these segments will be in the 1 to 2 km range. For more technical details on range and doppler ambiguities, refer to the discussion in the T19 sequence design memo.

5 Revision History

1. Mar 15, 2011: Final release

6 Acronym List

ALT	Altimeter - one of the radar operating modes
BAQ	Block Adaptive Quantizer
CIMS	Cassini Information Management System - a database of observations
Ckernel	NAIF kernel file containing attitude data
DLAP	Desired Look Angle Profile - spacecraft pointing profile designed for optimal SAR performance
ESS	Energy Storage System - capacitor bank used by RADAR to store transmit energy
IEB	Instrument Execution Block - instructions for the instrument
ISS	Imaging Science Subsystem
IVD	Inertial Vector Description - attitude vector data
IVP	Inertial Vector Propagator - spacecraft software, part of attitude control system
INMS	Inertial Neutral Mass Spectrometer - one of the instruments
NAIF	Navigation and Ancillary Information Facility
ORS	Optical Remote Sensing instruments
PDT	Pointing Design Tool
PRI	Pulse Repetition Interval
PRF	Pulse Repetition Frequency
RMSS	Radar Mapping Sequencing Software - produces radar IEB's
SAR	Synthetic Aperture Radar - radar imaging mode
SNR	Signal to Noise Ratio
SOP	Science Operations Plan - detailed sequence design
SOPUD	Science Operations Plan Update - phase of sequencing when SOP is updated prior to actual sequencing
SSG	SubSequence Generation - spacecraft/instrument commands are produced
SPICE	Spacecraft, Instrument, C-kernel handling software - supplied by NAIF to use NAIF kernel files.
TRO	Transmit Receive Offset - round trip delay time in units of PRI