Wide-field Infrared Survey Explorer (WISE)

WSDC ORT2 Report

Version 1.0

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1 INTRODUCTION

The WISE ORT2 was scheduled to take place 2009 August 24, 11 am PDT until 2009 Aug 30, 11 am PDT. The planned main activities involving the WISE Science Data Center (WSDC) were telemetry ingest, boresight alignment, and coarse and medium scan calibration analysis. The ORT was terminated early on Friday 2009 Aug 28 after the coarse scan calibration activity.

Various data processing problems revealed during the coarse scan calibration analysis made the iteration of this process for the medium scan calibration of questionable value. Issues relating to products generated at JPL as well as WSDC software expectations for those products were encountered and will be addressed.

A further complication to proceeding became apparent on August 28 at approximately 6:35 PM with the announcement that JPL would be closing as a precautionary measure due to the "Station Fire" which was threatening nearby communities at that time. JPL remained closed on Monday, August 31.

1.1 WSDC Participants

R. Cutri, T. Conrow, S. Wachter, R. Beck, H. Brandenburg, D. Kirkpatrick, C. Gelino, H. McCallon, S. Barba, N. Wright (UCLA), B. McMillan (LPL - UofA)

1.2 WSDC Configuration

WSDS utilized int.v3_rc1 software for processing of data received in ORT 2.

The WSDS hardware configuration consisted of 4 Sun ZFS file servers and the 32-node x64 Linux cluster.

2 Summary of Activities and Lessons Learned

2.1 Telemetry Ingest

For deliveries without associated image data, housekeeping telemetry and the corresponding C kernels were received on 13 separate occasions. The transfer occurred on the scheduled pass times, with an average delay of 25 minutes between the end of the downlink pass and the delivery at WSDC (see Table 1). These data were ingested without an events table (pef file) and all of the ingests were successful.

2.1.1 Telemetry Ingest Actions/Lessons learned:

It would be useful to communicate the contents of a given delivery to WSDC, particularly if they

differ from what is expected from the nominal IOC timeline. Currently, deliveries are only differentiated by a time stamp generated when the data arrives at WSDC. This posed some delay and confusion on one occasion during the ORT (see Coarse Scan section below). It is unclear whether or how such information could be conveyed. We also need to clarify whether separate or combined pef files will be associated with these deliveries during IOC and when WSDC will receive those ahead of the telemetry. It is important that WSDC receives the pass list to be able to track expected versus received data deliveries.

Table 1

End of Pass	File arrives at WSDC	Delay time in minutes	Comment
2009 237 02:20:17	2009_237_02_51_05	31	
2009 237 09:01:16	2009_237_09_28_19	27	
2009 237 09:45:44	2009_237_09_59_27	14	
2009 238 01:27:35	2009_238_02_01_55	34	
2009 238 08:16:07	2009_238_08_37_15	21	
2009 238 08:51:38	2009_238_09_11_23	20	
2009 238 09:36:08	2009_238_09_50_28	14	
2009 239 00:09:35	2009_239_00_30_07	20	
2009 239 01:19:34	2009_239_01_33_24	14	
2009 239 08:03:58	2009_239_08_38_41	34	
2009 239 08:41:39	2009_239_08_54_48	13	
2009 239 23:57:07	2009_240_00_49_31	52	Boresight/Coarse Scan Images
2009 240 01:13:50	2009_240_01_31_42	18	
2009 240 07:52:04	2009_240_08_30_59	39	

2.2 Boresight Alignment

Two tasks were associated with the Boresight Alignment Procedure: bright object checking as part of the sequence development, and subsequent analysis of the pipeline processed images. The bright object checking procedure worked as expected. B. Fabinsky relayed the position information for the stare images via email to Jason Rhodes, Bob McMillan and C. Grillmair (on travel) at 8:56 am on Tuesday, Aug 25 2009. Jason Rhodes and Bob McMillan performed the required bright object search for these positions and returned a report of their findings at 10:34 am that same day.

2.2.1 Boresight Alignment Actions/Lessons learned:

The positional (quaternion) information was converted to RA and DEC prior to the start of ORT2. A tool to accomplish this task during IOC is still under development. Various outstanding questions for this procedure have been identified (for details see Section 3). In

particular, an iteration/response procedure in the case that a bright object is found in the target fields still needs to be developed.

2.3 Ancillary Data

Various problems were encountered ingesting the ancillary data associated with the boresight alignment activity. The same problems also affected the coarse scan calibration data delivery, hence all of these issues are discussed together in the coarse scan calibration section. Once these issues were resolved, the boresight data were ingested successfully, however the quicklook pipeline failed for all but one frame. Subsequent runs of the scan frame pipeline resulted in 8 successful position reconstructions. In contrast, previous dry runs with the identical image data (but different ancillary data) provided pattern matches for about 60 frames and only failed for images obtained during simulated slews of the spacecraft.

2.3.1 Ancillary Data Actions/Lessons learned:

It still remains to be determined whether the pipeline failure is related to the problems with the C kernel and reference frame convention. For most images, the difference between the erroneous a priori positions and the actual position on the sky was simply too large to secure a pattern match. It would be extremely helpful to rerun this data set once both the known timing error in the C kernel and the pipeline code have been addressed.

2.4 Boresight Alignment Procedure

Since the boresight alignment procedure was designated as "best efforts" only, Bob McMillan and Davy Kirkpatrick delivered the desired boresight alignment analysis report based on the dry run results. The report was delivered via email to M. Kendall and D. Wiemer at 8:43 am Friday, August 28, 2009.

2.4.1 Boresight Alignment Procedure Actions/Lessons learned:

MK iterated with WSDC about one table content. This clarification will be incorporated in the report format. No feedback has yet been received regarding the subsequent use of the measurements presented in the report. We still need to follow up on the expected definition of the rotation axis/position angle.

2.5 Coarse Scan Calibration

The PEF files for both the boresight alignment and the coarse scan cal procedures were delivered in the morning of Thursday, August 27 2009 (filenames m0946_2A_boresight.pef and m0946_2A_CoarseScanCal.pef). However, pef files need to have a "WIS" prefix to ingest.

2.5.1 Coarse Scan Calibration Actions/Lessons learned:

Files need to be delivered with the correct prefix. JPL has agreed to ensure that the naming convention is adhered to.

2.6 Ingest Failure - pef

Subsequently, ingest failed because it could not ingest two pefs in the same delivery, in particular two pefs with overlapping time ranges. Tim Conrow initially provided a work-around, until MOS sent a merged pef file covering both the Boresight alignment and coarse scan calibration period.

2.6.1 Ingest Failure - pef Actions/Lessons learned:

WSDC needs to know ahead of time when to expect pefs covering specific periods. Pef files cannot overlap in time. Roc asked us to check whether this was a requirement. Don't know where to look that up.

2.7 Ingest Failure -.tls and .tsc time kernels

Another sequence products delivery, 09239M001303, contained a time kernel WIS_SCLKSCET.00000.tsc. Ingest failed, expecting both time kernels, wise.tls and wise.tsc, to be in the same delivery and we received only one. Tim Conrow updated the code as a temporary fix.

2.7.1 Ingest Failure -.tls and .tsc time kernels Actions/Lessons learned:

A roundup ticket has been submitted to make a more elegant ingestpipe change to accommodate single time kernel receipt for ingest at WSDC at a later date. JPL might never deliver a .tls file, so WSDC needs to ensure that all files that are delivered can be ingested separately together with fallback versions of other required files.

2.8 Boresight and Coarse Scan telemetry receipt

The Boresight and coarse scan telemetry delivery was received on Thursday at 5:50 pm PDT. This represented a delay from the previous telemetry deliveries, which on average arrived at WSDC 25 minutes after the end of the pass.

2.8.1 Boresight and Coarse Scan telemetry receipt Actions/Lessons learned:

Determine the probable delay times for the various activities during IOC. Check whether this late delivery was unexpected.

2.9 Boresight and Coarse Scan telemetry C kernel not delivered

The delivery for the boresight analysis and coarse scan calibration data was missing the C kernel. (Why did that fail? JPL never told us). Notification of MOS resulted in Don Royer sending the C kernel in a separate delivery. There was a brief period of confusion at WSDC when this C kernel delivery coincided with the C kernel delivery of the next scheduled downlink.

2.9.1 Boresight and Coarse Scan telemetry C kernel not delivered Actions/Lessons learned:

It would be useful to have content info attached to each delivery; see Actions for telemetry ingest.

2.10 Unsuccessful pattern match

With the correct C kernel, the data was ingested successfully. However, the subsequent quicklook pipeline run failed due to unsuccessful pattern match for the image position reconstruction. The problem was eventually traced to a 66.184 sec erroneous time offset in the C kernel, which was later reported to have been introduced by an incorrect time conversion at JPL. MOS is working on fixing that problem. Unexpected time offsets had been encountered during the dry runs as well, and Tim Conrow had modified the code to handle such offsets. Hence a pattern match was successful on subsequent runs of the pipeline when the appropriate time offset was included manually. NB: even with the time offset, the boresight data did not process successfully (see previous section).

Despite the successful position reconstruction in the coarse scan cal data, the derived scan rates (as indicated by the header keywords) did not reflect the expected values. This problem was eventually (the afternoon of Friday, Aug 29) traced to a mismatch in convention when it comes to angular velocity reference frame between the PGEN predict and MSOPCK tool C-Kernels.

2.10.1 Unsuccessful pattern match Actions/Lessons learned:

A WSDC code change is necessary to include the transformation to the inertial reference frame.

2.11 Incorrect Scan Rate workaround

As a work around to the incorrect scan rates, MOS sent a file containing the scan rates as a function of UTC, which in turn could be matched to the image quality data analysis as a function of UTC. There was some confusion about the expected constancy of the scan rate during the test as it differed from the dry run data, which was based on predicted (constant) scan rates rather than measured ones.

Due to the various data processing issues, WSDC was late in delivering the coarse scan analysis report, which occurred at 3 pm rather than the scheduled 11 am.

2.11.1 Incorrect Scan Rate workaround Actions/Lessons learned:

Develop an algorithm that discards N points during the settling time and then computes an average scan rate from the remaining data to account for slightly varying scan rates. Revisit the format of the scan analysis report and identify ways to speed up its composition, even when delays in the data processing are encountered.

Various additional issues identified by Davy Kirkpatrick are being addressed (see Section 3).

Develop a tool to convert MOS supplied scan rate numbers into units utilized by WSDC if we are unable to derive reasonable scan rates during IOC and need to resort to the work around as done during the ORT.

3 WSDC Post-ORT2 Planned Actions

WSDC

- Operations personnel will be better trained in ingestpipe and wsspipe command line parameters.
- Assemble a list of JPL Contacts and whom to contact for what issue
- Backup of key development personnel is critical, as is development of substantial documentation to specify that understanding.
- Standardize e-mail alerts for quicklooks, and completed scans and their associated e-mail lists.
- Clarify when specific ancillary files will be delivered to WSDC for the various IOC tasks.
- Clarify expected time delay between end of pass and arrival at WSDC
- Code change to address mismatch in convention for reference frame
- SFPRex performance analysis and actions: error exits have been attributed to very bad a priori positions. These very large a priori errors served as a stress test for SFPRex:
    - In a handful of cases they resulted in false pattern matches. The match criteria need to be tightened up (Roundup ticket 210).
    - After a successful pattern match in stand-alone mode with enlarged search windows there appear, based on ds9 overlays, to be errors left after fitting. The Cog developer (H. McCallon) is not yet sure if this is real, since it doesn't show up in the SFMP:2MASS differences.
    - The large residuals seen with the ds9 overlays were due to a shift in the frame center pivot points (CRPIX1 & CRPIX2) between the level 1a FITS files used for the pipeline SFPRex runs and the level 0 FITS files used for the standalone testing. This has been determined to be a “non problem”.
    - The Cog developer is still analyzing the relatively small number of course-scan problems and will advise if anything new will come out of that.

- Several of the course-scan frames (02102a272, 02102a273, 02103b026, 02103c008, 02103c011 & 02103f083 have the false match problem previously identified. They should have aborted. The Cog Developer has been unable to obtain a pattern match for these frames in stand-alone mode despite increasing the search area and look depth.
- The Cog developer's conclusion is that the only SFPRex item of note coming out of the ORT2 test is the false pattern match problem.

Bright Object Checking (B. McMillan, J. Rhodes, C. Grillmair)

- Develop a tool to convert positional information file sent from JPL (B. Fabinksy) into RA and DEC of stare image positions.
- Extract stare image positions from larger scan data file (clarify whether the boresight alignment simulation is representative of the number of frames we expect to be contained in the information sent by B. Fabinsky)
- Confirm the flux limits in Jy (who has final say in this?)
- Confirm flux limits for minor planets in V-Mag (who has final say?)
- Automate procedure (Jason will work on this)
- Compare results to alternative pipeline (J. Rhodes will compare with C. Grillmair)
- Write the procedure document
- Decide on report format (someone must tell us how they want the report to look)

QA

Quality Assurance Science (B. McMillan, D. Kirkpatrick, C. Gelino) identified additional steps planned:

- Create uncertainty images for the composite PSFs in scan synch (RoundUp ticket 207).
- Compute and report uncertainties for other metrics (r_major, rbovera, rPHI, NoisePix, etc.) generated by scan synch (RoundUp ticket 208).
- Make composite PSF generation more robust against rad hits (RoundUp ticket 209).
- QA will take under advisement the suggestion that we not take actual IOC scan rate data through the SAA if it can be avoided.
- QA staff will also remind themselves to make sure that WSDC QA and BATC come to an agreement on what the rotational angle is that we deliver to them for the boresight alignment test. This was left open for ORT2.

- Develop tool to match UTC-scan rate file sent by JPL to UTC-image quality analysis in case of work-around.
- Develop algorithm to average varying scan rate and discard data during settling period.

4 QA Analysis

Thorough analyses for Boresight and Coarse Scan are contained in "WISE Boresight Analysis for ORT2 (Dry Run Analysis)", "WISE Coarse Scan Rate Analysis for ORT2", and "WISE Medium Scan Rate Analysis for ORT2" documents, respectively.

5 Addendum

5.1 WSDC ORT2 Addendum - ORT2 Roundup Tickets

TYPE	#	SUBMITTED	DESCRIPTION	STATUS	WHO
bug	210	an hour ago	Tighten Pattern-Match Criteria in SFPRex	in-progress	hlm
critical	209	yesterday	Making scan synch more robust against rad hits	chatting	dk, fm
urgent	201	yesterday	meta-coad.tbl coad:frm: StdFrmMedA entries can have NaNs	chatting	evans
critical	208	yesterday	More uncertainties for scan synch	unread	dk., tj
urgent	207	4 days ago	Scan-sync PSF Uncertainties	unread	jf, hb
urgent	206	5 days ago	Ingestpipe time kernel bug	in-progress	tim