

Transiting Exoplanet WG Meeting

01/26/2016

Meeting Lead: Nikole Lewis
nlewis@stsci.edu

Topics for Today

- Update on DMS work concerning time-series observations
- Time-series pipeline topics
- ETC/Transiting Exoplanet Simulators
- Data Challenges
- Community Efforts
- CV3 Updates?

DMS for TSO

- Exercising Build 5 of the pipeline is underway.
- Need to ensure that the data management system (DMS) can handle the 'volume' of a TSO observations.
 - I will try and establish tests using TSO-like data sets, but good for this to be on everyone's radar
- JWST DMS Systems Design Review will take place in early February.
 - Sean Carey (Spitzer/IPAC) will provide external review from TSO perspective.

TSO Pipeline

- Key Topics for Today:
 - Additional Data products in ‘Ramps-to-Slopes’
 - Single Read Calibration Strategy
 - Outlier Detection in CALTSO3
 - Spectral/Photometric Extraction in CALTSO3

CALDETECTOR1

This stage takes the raw images and returns the level 2a files, calibrated to slope (counts/sec) images.

The current status of the algorithms for this pipeline stage is summarized below. Links are provided to individual pages where the details of the algorithms are given along with notes on why those algorithms were picked.

The algorithms for each step in each pipeline stage are split into "vanilla" and "optimal" versions. See [Vanilla and Optimal Algorithms](#) for more details.

Step	Vanilla	Build	Optimal	Build	NIRCam	NIRSpec	NIRISS	MIRI	TSO
Data Quality Initialization	DECIDED etails	5/6	VANILLA		X	X	X	X	X
Saturation Check	ALMOST etails	6	VANILLA		X	X	X	X	X
IPC Deconvolution	DECIDED etails	5/6	VANILLA		X	X	X	X	
Error Initialization	NOT USED		IN PROGRESS etails	D 7.1+	X	X	X	X	
MIR Linearity Correction	ALMOST etails	6	IN PROGRESS etails	D 7.1+				X	X
Superbias Subtraction	DECIDED etails	5/6	VANILLA		X	X	X		X
Reference Pixel Correction	DECIDED etails	6	VANILLA		X	X	X	X	X
Reset Anomaly	DECIDED etails	5	VANILLA					X	X
Last-Frame Correction	DECIDED etails	5	VANILLA					X	X
NIR Linearity Correction	ALMOST etails	6	IN PROGRESS etails	D 7.1+	X	X	X		X
Dark Subtraction	DECIDED etails	5	VANILLA		X	X	X	X	X
Persistence Correction	IN PROGRESS etails	7	IN PROGRESS etails	D 7.1	X	X	X	X	
Jump Detection	ALMOST etails	6	IN PROGRESS etails	D 7.1+	X	X	X	X	X
Slope Fitting	DECIDED etails	5/6	IN PROGRESS etails	D 7.1+	X	X	X	X	X

Vanilla Slope Fitting

Status	DECIDED
Stakeholders	Michael Regan, Massimo Robberto, Karl Gordon, Philip Hodge, Stephan Birkmann, Kevin Volk, Nikole Lewis
Outcome	Use linear least square fitting with optimal weights
Due date	Past
Owner	Karl Gordon

Background

The algorithm used to perform slope fitting is described in the document "Data Models and Algorithms Employed in Build 3 of the JWST Data Calibration Pipeline," [JWST-STScI-004355](#), available from SOCCER. Here's what it says:

This step determines the mean count rate for each pixel by performing a linear fit to the jump-free ramp intervals for each pixel. Jump-free intervals are determined from the GROUPDQ array of the input data set, under the assumption that the jump step has already flagged cosmic rays. Ramp intervals flagged as saturated are ignored. No weighting is used in the linear fit.

After computing the slopes for all of the sufficiently long intervals for a given pixel, the final slope is determined as a weighted average of all intervals. If the input exposure contains more than one integration, the resulting slope images from each integration are stored as a data cube in a single output data product. Each plane of the 3-D SCI, ERR, and DQ arrays in this product is the result of a given integration. For each integration, the DQ array is a copy of the PIXELDQ array with the SATURATED and JUMP_DET bits set for any pixel that experienced saturation or a jump during the corresponding integration. A slope image computed as the weighted average over all integrations is also produced and is considered the primary output product.

An optional output product is produced when the step parameter **save_opt** is True (the default is False). This optional product contains 4-D arrays called SLOPE, SIGSLOPE, YINT, SIGYINT, and WEIGHTS, which contain the slopes, uncertainties in the slopes, y-intercept, uncertainty in the y-intercept, and fitting weights for each ramp interval of each pixel. This product also contains a 3-D array called PEDESTAL, which gives the y-intercept at zero exposure time for each pixel in each integration, and the 4-D array CRMAG, which contains the magnitude of each interval that was flagged as having a CR hit.

The pedestal array is calculated for each integration by extrapolating the final slope for each pixel from its value at the first sample to an exposure time of zero. Any pixel that is saturated on the first read is given a pedestal value of 0. The CRMAG array begins as a copy of the input 4-D SCI array. All values are set to zero except those flagged in the input GROUPDQ as cosmic-ray hits. The array is compressed by removing any planes in which all of the values are 0. The order of the cosmic rays within the ramp is preserved.

This step handles subarray exposures by computing the slope of all pixels within the science data arrays, including reference pixels.


The read-noise reference files used by the Build 5 pipeline are documented on the Confluence page [JWST Calibration Reference Files: File Formats for the Build 5 Pipeline](#).

Linear least square fitting of a line is the simplest and fastest solution. It will produce good slopes. Using optimal weighting based on photon+read noise for the NIR detectors and photon+read noise+nonlinearity[TBR] for the MIR detectors.

Information:

- The "optimal weighting" algorithm for linear least square fitting is presented by [Fixsen et al. 2000, PASP, 112, 1350](#)

save_opt = True will be default for all TSO observations



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Action items

- Add a link to the report by Regan on the difference between uniform weighting and optimal weighting linear least square fits.
- Need to explicitly decide what to do with multiple integrations in an exposure. Definitely for TSO and AMI, we need to retain them all for the full processing. Do we need this for other modes? Do we want to just do this for everything?
- Need to develop a strategy for handling single read/group integrations.

- Need to consider fidelity of darks/biases in small read/group regime.

CALTSO3

Individual exposures taken in the Time Series Observation (TSO) mode are processed here.

The current status of the algorithms for this pipeline stage is summarized below. Links are provided to individual pages where the details of the algorithms are given along with notes on why those algorithms were picked.

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Step				Imaging			Spectroscopy			
	Vanilla	Build	Optimal	Build	NIRCam	MIRI	NIRCam	NIRISS	NIRSpec	MIRI
Outlier Detection	IN PROGRESS Details	7	VANILLA		X	X	X	X	X	X
Extract Photometry	DECIDED Details	7	VANILLA		X	X				
Extract 1D Spectrum	DECIDED Details	6	VANILLA				X	X	X	X
White-Light Photometry	DECIDED Details	7	VANILLA				X	X	X	X

- Current plan for outlier detection:
Using the full history of a given pixel in an exposure, use a 3 iteration, 3 sigma clipping algorithm. Outliers will be flagged, not corrected.
- Method used for Hubble/WFC3 and Spitzer/IRAC TSOs
- Need to decide how outlier detection flows into spectral/photometric extraction (Background vs. source regions, correct vs. toss?)

Articulate your ideas in <1 page 'flyers' and post to confluence!!!!

<https://confluence.stsci.edu/display/JTEWG/JWST+Transiting+Exoplanet+Working+Group+Home>

ETC/Transiting Exoplanet Simulators

- STScI ETC group will be holding a 3 week 'sprint' to define UI for slitless spectroscopy modes (kickoff 01/27/16).
- Exoplanet simulator/ETC web interface to be released this spring. This is a wrapper for the STScI Webb ETC.
- Many IDTs developing in-house exoplanet ETC/simulators. Plans for public release?

Community Data Challenges

- Current timeline is for preliminary data challenges to be released in Fall/Winter 2016.
 - ‘Raw’ data: allows users to get a
 - Could simply be a repeated set of a real/synthetic integration with variable noise properties
 - These can be used to exercise pipeline/DMS
 - Calibrated integrations
 - Extracted Spectra (with appropriate noise)

Community Efforts

- Currently several white paper efforts underway as a result of the workshop in November:
 - JWST ERS targets and strategies for transiting exoplanets
 - JWST giant transiting exoplanet science and observation strategies
 - JWST terrestrial transiting exoplanet science and observation strategies
- Forming JWST Transiting Exoplanet User WG this spring.

Closing Remarks

- Everyone should be able to edit the confluence site. Feel free to start discussions.

<https://confluence.stsci.edu/display/JTEWG/JWST+Transiting+Exoplanet+Working+Group+Home>

- Plan to start formulating quick-look guides for each instrument specific to transiting exoplanet science capabilities.
- Next meeting February 23rd, 2016.