OCI ETU Calibration and Characterization

Shihyan Lee
and
OCI Calibration Team

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IOCCG Calibration Working Group
Summary

- OCI ETU calibration/characterization testing campaign:
  - Performance verification (requirements)
  - Characterization, potential new capability, issues and limitation.
  - Aid instrument development R&D (Feedback, components test, modeling)
- OCI complexity poses challenges in test design and data analysis
- ETU Tests & results
OCI Calibration Challenges

- 3 focal planes:
  - Blue/red CCD: 340 – 890 nm
    - Hyperspectral, 0.625 – 5 nm bands
    - time delay integration (TDI)
    - Variable spectral/spatial aggregation modes
  - SWIR: 940 – 2260 nm
    - 9 multi-spectral bands
    - No TDI or spectral/spatial aggregation
- Rotating Telescope Assembly (RTA)
- Solar-cal: diffusor, port angle not in EV

- Challenges:
  - Hyper and multi-spectral bands + RTA design
  - Very high sensitivity and requirement
  - Multiple data collection configurations
  - Ever evolving test configuration and data formats
  - High data volume and complexity (128-1024 CCD bands + 9 (32) SWIR bands)

- ETU:
  - Red FPA only (no blue FPA)
  - only 10 SWIR detectors (vs 32 in flight)
  - no solar diffuser
Test setup

- Source:
  - Integrating sphere
  - Monochromatic: GLAMR
  - Flood: Tungsten, or others
- Optional adaptor
  - Collimator, slit (LSF)
  - polarizer
- OCI
  - GAToR (spatial position)
- A web based, searchable interface
- Record each test’s configuration and associated GSE data
- Greatly facilitated data analysis

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<th>DOY</th>
<th>Duration</th>
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<th>Sec ID</th>
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Real-time Quick-look Tool

- A real-time quick-look tool to facilitate QA and trouble shooting prior to taking data
- Spotter for issues for further analysis
- Example show CCD dark pulses
Response vs. source intensity

- Power stepping
  - Monochromatic: GLAMR
  - Flood: Tungsten, or others
- Progressive TDI (hyperspectral bands only)

Results: Gain, SNR, saturation, linearity
- GLAMR power stepping vs. pTDI
GLAMR power stepping performed one band per tap (20 nm) and all SWIR bands.

pTDI performed for all CCD bands

(Left) Verify linearity for pTDI matches GLAMR power stepping.

Linearity characterization: CCD bands - pTDI, SWIR bands - GLAMR
• Left: SNR vs. power level, red CCD
• Mid: 5nm band SNR@Ltyp
• Right: multi-spectral band SNR@Ltyp. (heritage sensor)
Spectral Response

- Source: GLAMR spectral scans
- Absolute spectral response (ASR), RSR
- Gain, OOB, band center, bandpass.
Spectral response vs. Temperature

- Track spectral shift due to temperature change using OCI hyperspectral band response
- Left: OCI response to GLAMR
- Right: GLAMR: hot/cold plateaus at all wavelengths
- Pen-Ray: Few selected wavelengths to track OCI spectral shift during temperatures transition
Scene Masks

“1-SP” 1-Science Pixel Masks (1km x 1km equiv.)

“1-PYP” 1-Physical Pixel Mask

“MS-1” Multi-Slot Mask for Higher Detail LSF Measurement

“J-1” Jitter, Along-Track iFOV, LSF etc.

- Line Spread Function (LSF), BBR (band-to-Band Registration), GSD (Ground sample distance), IFOV, MTF
Straylight / Crosstalk

Stress vs. Science scene impact
- spatial dimension (track/scan), spectral (xtalk)
- Build a straylight/xtalk model base on GLAMR data.
- Estimate science impact in 1-day MODIS data.

<table>
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<tr>
<th>wave (nm)</th>
<th>straylight (%)</th>
<th>crosstalk (%)</th>
<th>total (%)</th>
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<td>0.017</td>
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<tr>
<td>748</td>
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<td>869</td>
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Response vs. view angle: RVS

- Change OCI view angle to the source
- OCI response vs. scan angle
Polarization Sensitivity

- OCI response vs. polarizer angle
  - CPT1 has a different setup, results not comparable with the rest CPTs.
OCI sensitivity is most sensitive to FPA temperature. Slightly sensitive to MOB temperature.

Top: OCI response vs. FPA CCD temperature.

Bottom: OCI gain before and after temperature correction.

Response vs. Temp
Additional Tests

- Cal2: gain/SNR/offset stability test
- EMI/EMC test: radiation susceptibility test
- Repeat tests to track instrument performance over time
  - CPT: comprehensive performance trending
  - LPT: limited performance trending
Going Forward

- OCI Flight Unit (FU) testing
- New hardware and tuning
  - Both blue/red CCD + complete SWIR band assembly
- Test program updates based on lesson learned
  - GLAMR radiance sweeps
  - LSF slits, timing delay
  - pTDI steps
Backup
Key GAToR specs demonstrated with OCI mass and CG:

- Rotation: +/-100deg Az, +90deg, -30deg El.
- Step Precision: sub-physical pixel equivalent stepping (<40arcsec)