Generation of OLI data products Onboard Earth Observing One: A Preliminary Report

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Goals

- **General**: Demonstrate that hyperspectral data can be used to synthesize multispectral data onboard.
- **Specific**: Demonstrate that Hyperion Hyperspectral data can be used to synthesize OLI multispectral data onboard.
Approach

• Utilize existing capabilities
  – ASE includes
    • Onboard Hyperion Data Analysis
    • Onboard mission re-planning
    • Onboard execution
ASE Usage

• ASE onboard instrument processing used to demonstrate onboard:
  – Surface water extent mapping (Flood detection)
  – Cryosphere tracking (Snow, Water, Ice, Cloud, Land)
  – Thermal Analysis (Volcano, Wildfire)

• Over 5000 onboard products generated 2004-present [Chien et al. 2013 JSTARS]
ASE Instrument Data Processing

• Band stripping capability
  – Implemented by Microtel
  – Enables band stripping of 12 Hyperion Bands
    • Must include at least 1 SWIR and 1 VNIR band
    • Strips out 1024 x 256 pixel image
    • Requires ~ 20 minutes to strip
  – ASE provides
    • Standard interface for accessing the stripped data
    • Standard interface to output data product
    • Data is then downlinked via s-band
Implementation Steps

- Identify selected Hyperion Bands
- Compile out as much computation as possible
- Validate convolution algorithms on ground
  - Convolve ALI data to assist in validation
- Implement to ASE interface spec
- Validate in ground testbeds
- Upload and flight validate
- Operations within current ASE operations framework – no significant disruption to EO-1 operations
Operations Constraints

• Only 12 bands (1 SWIR 1 VNIR)
  – Will need to demonstrate OLI band convolution with not all OLI bands form a single band strip
• WARP contention constraint
  – WARP playback (band stripping) and WARP writing (image acquisition) cannot overlap
In-Band Band-Average Relative Spectral Response

relative spectral response [ ]

wavelength [nm]

relative to radiance
Hyperion / OLI Coastal/Aerosol Band Comparison

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![Graph showing relative response vs. wavelength with data points and curves for Hyperion and OLI bands.](image-url)
Hyperion / OLI Coastal/Aerosol Band Comparison

In-Band Band-Average RSR

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Hyperion / OLI Blue Band Comparison
In-Band Band-Average RSR

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Relative Response

- OLI
- Hyperion
- Convolution
- B9_Gauss
- B10_Gauss
Hyperion / OLI Blue Band Comparison
In-Band Band-Average RSR

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Hyperion / OLI Blue Band Comparison
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Relative response comparison between Hyperion and OLI Blue Band with band-average response surface ratio (RSR) convolution.
Hyperion / OLI Green Band Comparison

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Hyperion / OLI Cirrus Band Comparison
In-Band Band-Average RSR

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relative response vs. wavelength [nm]
Hyperion / OLI PAN Band Comparison
In-Band Band-Average RSR

<table>
<thead>
<tr>
<th>Hyperion Band</th>
<th>Average Wavelength (nm)</th>
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<tr>
<td>B14</td>
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<td>B35</td>
<td>701.5500</td>
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Conclusions

• EO-1 mission has excellent supporting infrastructure to flight validate OLI product generation onboard
  – Hyperion has sufficient spectral resolution to synthesize OLI data
  – ASE FSW on EO-1 supports band stripping access to Hyperion data (with 12 band limitation)
  – Preliminary work to implement convolution, identify candidate relevant bands, overall design is complete
  – Flight validation can be executed with modest effort

• Future enhancement to band stripping could enable even further capability
  – Generation of more OLI bands within single pass
  – Downlink via WARP and X-band