High Performance Multi-Spectral Observation and Real-Time Video Sighting Enabled by NEMO-HD

Dr. Benoit P. LAROUCHE, Luke STRAS, Jakob LIFSHITS, Dr. Simon GROCOTT, Dr. Robert E. ZEE
Space Flight Laboratory, Microsatellite Science and Technology Centre, University of Toronto, CANADA

Tomaz RODIČ, Drago MATKO, Kristof OŠTIR, Marko PELJHAN, Ana URBAS, Hubert FRÖHLICH, Saso BLAŽIČ, Ales MARSETIČ
SPACE-SI, Slovenian Centre for Excellence for Space Sciences and Technologies, Ljubljana, SLOVENIA
Mission Overview

- **Mission objectives:**
  - Responsive multi-spectral imaging
  - Real-time control

- **Organizations**
  - Bus design and Payload by SFL
  - Experimental Technologies by SPACE-SI
    - Secondary X-band transmitter
    - Image Processing Pipeline
    - Real-time interactive ACS

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Primary Payload

High-Resolution Imaging
- Fast 155 mm f/2.3 optics
- 300 lp/mm resolution at focal plate
- 5 Still image channels

<table>
<thead>
<tr>
<th>Channel</th>
<th>Band (nm)</th>
<th>GSD</th>
<th>Swath</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAN</td>
<td>400 – 900</td>
<td>2.8 m</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>420 – 520</td>
<td>5.6 m</td>
<td>10 km</td>
</tr>
<tr>
<td>Green</td>
<td>535 – 607</td>
<td>5.6 m</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>634 – 686</td>
<td>5.6 m</td>
<td></td>
</tr>
<tr>
<td>Near-IR</td>
<td>750 – 960</td>
<td>5.6 m</td>
<td></td>
</tr>
</tbody>
</table>
Video Channels

High-Resolution Video
• Same optics as the primary instrument

Low-Resolution Video
• Wide-angle context

Capable of dual real-time or recorded video streams
• Resolution of 1920 x 1080 (full HD)
• H.264 encoding
• Up to 25 Mb/s per channel

<table>
<thead>
<tr>
<th>Channel</th>
<th>Band (nm)</th>
<th>GSD</th>
<th>Swath</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>RGB</td>
<td>2.8 m</td>
<td>5 km</td>
</tr>
<tr>
<td>Secondary</td>
<td>RGB</td>
<td>40 m</td>
<td>75 km</td>
</tr>
</tbody>
</table>
**NEMO-HD Bus**

**Mass** 65 kg

**Dimensions** 600 x 600 x 300 mm

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NEMO-HD Bus

- Uplink antennas
- Solar Panels
- Downlink antennas
- X-band antennas
- Star Trackers x2
NEMO-HD Power, C&DH

- Modular Power System
  - 5 W keep-alive
  - 215 W peak
  - 5.8 Ah battery

- Housekeeping and Attitude Computers
  - SFL flight heritage
  - some cross-strapping for redundancy
NEMO-HD ADCS

- Reaction Wheels
- Rate Sensors
- GPS
- Magnetic Torquer
- Magnetometer
- Star Trackers
- Sun Sensors

**Determination** < 15° 1-σ

**Pointing** < 120° 2-σ

**Slew Rates** 1.5°/s

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NEMO-HD T&C

S-Band Transmitter  UHF Receiver

<table>
<thead>
<tr>
<th></th>
<th>UHF</th>
<th>4 kb/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T&amp;C downlink</td>
<td>S-Band</td>
<td>up to 1 Mb/s</td>
</tr>
<tr>
<td>Payload downlink</td>
<td>X-Band</td>
<td>50 Mb/s</td>
</tr>
</tbody>
</table>

Space-SI X-Band
Primary X-Band
NEMO-HD Payload Electronics

- Ethernet-serial converter
- Payload Recorder
- Ethernet Switch
Concept of Operations

<table>
<thead>
<tr>
<th>Action</th>
<th>Real-time</th>
<th>Real-time (auto)</th>
<th>Time-tagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select channels</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>View video</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Record video</td>
<td>opt</td>
<td>opt</td>
<td>opt</td>
</tr>
<tr>
<td>ACS</td>
<td>user</td>
<td>target-based</td>
<td>commanded</td>
</tr>
<tr>
<td>Frame/swath</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquisition</td>
<td>on command</td>
<td>on command</td>
<td>timed</td>
</tr>
</tbody>
</table>

- Payload data can be downlinked at any point
- Automatic slew to sun point when idle
Flexible Earth Observation Platform

- NEMO-HD bus driven by payload size
- Heavy optics driven by
  - channel count
  - resolution
- Change instrument specs for a smaller spacecraft
- Flexible multi-channel architecture easy to adapt to other missions
- Power systems scales 2 W < P_{max} < 1 kW
Current Status

- Payload environmental qualification complete
- Satellite assembled ready for integration
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