2010 HyspIRI Science Workshop

NIRST Description & operation

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### BANDS

<table>
<thead>
<tr>
<th></th>
<th>MWIR2 (Band 1)</th>
<th>LWIR2 (Band 2)</th>
<th>LWIR3 (Band 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central wavelength</strong></td>
<td>3.8 µm</td>
<td>10.85 µm</td>
<td>11.85 µm</td>
</tr>
<tr>
<td><strong>Band Limits</strong></td>
<td>3.4 – 4.2 µm</td>
<td>10.4 – 11.3 µm</td>
<td>11.4 – 12.3 µm</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min.</td>
<td>400K</td>
<td>250K</td>
<td></td>
</tr>
<tr>
<td>Max.</td>
<td>1000K</td>
<td></td>
<td>500K</td>
</tr>
<tr>
<td><strong>NEΔT</strong></td>
<td>&lt;1.5K @ 400K</td>
<td>&lt;0.8K @ 300K</td>
<td>&lt;0.4K @ 300K</td>
</tr>
<tr>
<td><strong>Temp. accuracy</strong></td>
<td>2.5K @ 400K</td>
<td>1.5K @ 300K</td>
<td>&lt;2K @ 300K</td>
</tr>
<tr>
<td><strong>Detectable size of fire event</strong></td>
<td>200m² @ 1000K</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conceptual design
NIRST COMPONENTS

GREEN: INO-CSA
BROWN: IAR
YELLOW: TINI AEROSPACE
BLUE: GEMA
MAGENTA: CDA INTERCORP
ORANGE: CIOP-GEMA
LIGHT BLUE: SFK-AMPEP
RED: AXSYS TECHNOLOGIES
Active lines:

- **Band 1:** MWIR2
- **Band 2:** LWIR2
- **Band 3:** LWIR3

Optical Axes:

- MWIR: 3.8 µm
- LWIR: 10.8 µm, 11.8 µm

Pixel 1, Pixel 512, co-registration
NIRST Fields of View

Accessible Swath
FOV: 75.6 deg

Swath-Width
FOV: 15.6 deg

182 Km

1064 Km

26 Km (3.9 sec)
**Revisit Scenario**

### Virtual (1000 km swath)

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Example location</th>
<th>Average revisit interval (days)</th>
<th>Maximum missing days</th>
</tr>
</thead>
<tbody>
<tr>
<td>±67°</td>
<td>Northern Canada</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>±55°</td>
<td>Tierra del Fuego, mid Canada</td>
<td>0.7</td>
<td>1</td>
</tr>
<tr>
<td>±23°</td>
<td>Jujuy</td>
<td>1.2</td>
<td>2</td>
</tr>
</tbody>
</table>

### Nadir pointing (182 km swath)

![Map showing revisit scenario with color-coded response time]
System Transfer Function

\[
<SITF> = \frac{\Delta \text{count}}{\Delta T} \approx 2
\]

- SITF@500K = 3.8
- SITF@300K = 1.15

\[\text{SITF} = \frac{\Delta \text{count}}{\Delta T} \approx 0.8\]

- SITF@600K = 1.33
- SITF@373K = 0.4

LWIR2 pixel 253

MWIR2 pixel 253
Power vs counts

Pixel 255 MV/IR Line 2 Beta 45 Counts vs Power with fit

Pixel 255 LWIR Line 2 Beta 45 Counts vs Power with fit
Heaters off
Cameras on

TECs on
(stabilization in less than 2 m)

Move mirror 0 s to 30 s

Acquire data 26 s to XX s

Repeat as necessary

TECs off
Cameras off
Heaters on

timeline

-4 m
0 m
~+10 m

2010 HysPIRI Science Workshop
NIRST Marraco

August 24-26, 2010
NIRST over Argentina & Canada
Data acquisition rate: 53 kbytes/sec

*Weekly (103 rev.) statistics:*

29 downloads when SAC-D is 5 over horizon at Córdoba Ground station.
92 virtual overflights of Canada and Italy.
185 possible inland waters acquisitions (only those necessary to get weekly complete data).

*Assumptions:*

1. All acquisitions over Argentina and inland waters in neighboring countries are downloaded in real time.
2. Data stored in mass memory is downloaded at 130 kbytes/sec.
3. Canada and Italy are covered in a TBD%.
4. Inland waters are covered in a TBD%.
Weekly memory budget

Memory budget

Canada + Italy 100%
Lakes 100%

megabytes

days within cycle

0 1 2 3 4 5 6 7

0 50 100 150 200 250

memory
next week BU
Weekly memory budget

Memory budget

Canada + Italy 100%
Lakes 80%

megabytes

days within cycle

next week BU
Back up slides
What we measure

Voltage across a bolometer is the result of its temperature change, which is proportional to the incident power. This whole process is known as responsivity and is a characteristic of each pixel. A typical value of responsivity is $4.4 \times 10^4 \text{V/W}$.

The relationship between the bolometer temperature and the electrical signal is almost linear. This linearity is affected by an offset and a gain that are fixed in the electronics but slightly different from pixel to pixel.

$\Phi(T) = \Omega A \int L(\lambda, T) \Psi(\lambda) d\lambda$
Where:
- $\Omega$: solid angle of optics as seen from earth
- $L(\lambda, T)$: specific Planck's law
- $\Psi(\lambda)$: area of pixel on earth
- $\Phi$: power radiance

$\text{DN} = \text{counts}$
$\Delta V = [\mu \text{V}]$

Power [pW]
DVF (power)
Pixel variety

LWIR2 pixels 251–254

MWIR2 pixels 251–254

LWIR2 pixels 255–258

MWIR2 pixels 255–258
Active and reference (blind) pixels
Blind pixel

Profile of BB at 4 μ

Signal level as one illuminating spot of a size equal to a pixel is moved perpendicular to the array line.

| BAND   | |Signal@C| / |signal@B| [%] |
|--------|---------------------|--------------|
| MWIR   | 51% 18%             |
| LWIR   | 13% 2%              |
Blind pixel (MWIR)

Position “A”

Position “B”

Position “C”

Position “D”
1. Emergencies
2. Instrument Health Care
3. Science Group & AOs
4. Common Users
Calibration setup
Scans at the optical lab
Pixel variety
Pixels along track (nadir)

\[ 59 \text{ ms} @ 6.9 \text{ km/s } \cong 410 \text{ m} \quad \text{0.53 mrad} @ 657 \text{ km } \cong 350 \text{ m} \]