HyTI: high spectral and spatial resolution thermal infrared imaging from a 6U CubeSat

Presented by

Robert Wright

Hawai'i Institute of Geophysics and Planetology,
University of Hawai'i at Mānoa

On behalf of the HyTI Team
HyTI Mission Goals

To demonstrate **high spectral, high spatial, and high SNR long-wave infrared imaging**, and **high performance on-board computing** to process the resulting data, on a **6U CubeSat** platform.

1. HIGP Fabry-Perot LWIR imaging interferometer ($\text{TRL}_{\text{H}} = 4$)

2. JPL T2SLS Barrier InfraRed Detector (BIRD) focal plane array ($\text{TRL}_{\text{H}} = 5$)

3. Unibap Deep Delphi iX5 heterogeneous onboard computer ($\text{TRL}_{\text{H}} = 5$)
Relevance of HyTI to NASA’s Earth Science mission

Earth scientists have never had access to high spatial and high spectral longwave infrared image data from Earth orbit.
Acquire L0 frames at 139 Hz
HyTI Thermal Infrared Interferometric Imaging Spectrometer

Window
Dewar Cap
Cold Filter
HOTBIRD FPA
Cold Finger
Dewar Body
Cold Finger End Cap
Cold Shield
Dewar Header Interferometer
Dewar Substrate
Focus motor
Heat sink
Dewar/expander
Compressor
Optical bench
Lens
What HyTI data will look like
Data acquired by prototype HyTI sensor
HyTi spacecraft subsystems

Structure (TRL=9)
- ISIS STS GJLX TRL=9

Payload (TRL=4)
- Multi-element lens (NEOS/FLIR) TRL=6
- Focus motor (Faulhaber AM1020) TRL=4
- Fabry-Perot interferometer (LightMachinery) TRL=6
- BIRD FPA (JPL) TRL=5
- Integrated dewar cooler assembly (AIRS) TRL=4
  - Dewar assembly (AIRS hi-Nyx) TRL=4
  - SIF board (AIRS) TRL=4
  - Dewar board (AIRS) TRL=4
  - Camerlink interface board (AIRS) TRL=4
- Cryocooler (AIM SF070) TRL=4
- Cryocooler electronics (Creare) TRL=5
- Current ripple filter (Creare) TRL=5

Communications (TRL=5)
- X-band downlink (Syrralinks EWC27) TRL=9
- X-band patch antenna (SPAN-X-T3) TRL=9
- S-band transceiver (ISIS) TRL=5
- S-band patch antenna (ISIS) TRL=5
- GlobalStar duplex (NSL EyeStar-D2) TRL=9
- GlobalStar simplex (NSL EyeStar-S3 (STX3)) TRL=8

Command and Data Handling (TRL=5)
- Payload OBC (Unibap DDIxS) TRL=5
- Spacecraft OBC (ISIS iOBC) TRL=9

Attitude determination and Control (TRL=9)
- Reaction wheels (CubeSpace CubeADCS) TRL=9
- Torque rods (CubeSpace CubeADCS) TRL=9
- Star Tracker (CubeSpace CubeStar) TRL=9
- Nadir sensor (CubeSpace CubeSense) TRL=9
- Sun sensor (CubeSpace CubeSense) TRL=9
- Magnetometers (CubeSpace CubeADCS) TRL=9
- ADCS OBC (CubeSpace CubeComputer) TRL=9
- GPS (NovAtel OEM719-5SN-LNN-TBE-H) TRL=9

Electrical and Power (TRL=5)
- Solar panels (x4 ISIS ISPA) TRL=9
- Power distribution and battery pack (ISIS IEPS) TRL=5
A Day-in-the-Life of HyTI

- Slew to nadir
- L0 data collection
- Calibration (slew to space/Moon)
- Payload data D/L to KSAT ground station (X/S-band)
- GlobalStar L-band (Tlm D/L; Cmd U/L)
- Sun soak (L0 to L1/L2 processing)

252 CONUS passes in one month
HyTl Power Budget

- Cool FPA ambient to 68 K
- Cryocooler maintains FPA at 68 K
- Slew spacecraft (deep-space look)
- Payload OBC processes L0 to L1 and L2
- Payload OBC transfers L1/L2 to X-band radio
- Downlink

Power (W)

Time (s)

L0 data acquisition

Power generation
Power consumption
Battery capacity

Power (W)

Time (hours)

Battery capacity (Wh)
HyTI Thermal Control

Temperature [°C], Time = 0 sec

Time (s)
Summary

HyTI will space-validate innovative new technology to provide Earth scientists with high spatial and spectral resolution thermal infrared image data from a 6U CubeSat.

Status: delivery in March 2021, for launch to ISS in Fall 2021.

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