The Hyperspectral Thermal Emission Spectrometer's (HyTES) July 2014 Science Deployment
Jet Propulsion Laboratory, California Institute of Technology

HyTES Background
Visible Shortwave Infrared (SWIR) Imaging Spectrometer
Multiplexed Thermal Infrared (TIR) Imager

VHMTIR: Plant Physiology and Function Types (VPF)

Multi-pixel TIR Imager

HyTES Laboratory Testing

HyTES shown with high accuracy cavity blackbody. This is the set-up used for measuring system linearity, brightness temperature and NEDT.

HyTES Rational and Objective
• Develop a thermal infrared imaging spectrometer with high spatial and spectral resolution which will provide precursor thermal infrared data for the NRC Recommended HySIPR mission.
• Build and deploy an airborne Hyperspectral Thermal Emission Spectrometer (HyTES) with 512 pixels across track with pixel sizes in the range of 5 to 50 µm depending on aircraft flying height and 256 spectral channels between 7.5 and 12 µm.
• Key enabling JPL technologies:
1. Dyson spectrometer: small form factor with high throughput, self-baffling
2. Quantum well infrared photodetector: high uniformity and yield
3. Precision slit: enables low distortion and additional baffling
4. Convex diffraction grating: low scatter, high efficiency

HyTES Measured Spectral Response: A nonmonochromatic beam is cycled through each spectral band while positioned at the entrance aperture.

Key Results for 2014
1. Detections of methane over challenging areas, e.g., sites where thermal in some clutter makes detection difficult. This includes detection of natural (road) and managed systems (e.g., landfills, pipelines, oil fields, landfill, storage facilities)
2. Development of additional gases, e.g., new sensors:
   a. Carbon Monoxide (CO)
   b. Nitric Oxide (NO)
   c. Carbon Dioxide (CO2)
   d. Water Vapor
   e. Formaldehyde
3. Anomalous and baseline performance: e.g., noise levels, linearity, etc.
4. Procedure procedures: e.g., calibration, preflight, on-orbit data
5. On-orbit data acquisition and testing in the field

Examples of improved imagery

HyTES 2014 Science Flights

• Objectives:
  1. Acquire data from a range of targets for evaluation in various disciplines: Solar-Earth, Environments, Atmospheric composition
  2. Evaluate upgrades made to instrument after previous campaigns
  3. Evaluate improved algorithms for geo-location and gas detection
  4. Implement improved imaging and operations procedures

Examples of improved imagery

HyTES Instrument Layout

Characteristic Pre-Flight Calibration Results for 25 C Black Body (7/12/14, 8 am)

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