

Remote Infrared Hyperspectral Imaging

For Government and Commercial Applications



Over 40 Years of Remote Sensing Experience

The Aerospace Corporation has designed and built state-of-the-art, proof-of-concept remote sensing instrumentation and components for over 40 years, including:

- The Broadband Array Spectrograph System (BASS)
- Spatially Enhanced BASS (SEBASS)
- Ground-based transportable Raman water vapor LIDAR
- Sensors and sub-assemblies for the Remote Atmospheric and Ionospheric Detection System (RAIDS)
- Optics, electronics and solid-state memory for the High-Resolution Ozone Imager (HIROIG)
- PIRANHA (Predator Infrared Airborne Narrowband Hyperspectral Combat Assessment) a long-wave infrared, 2D scanning Fourier Transform Infrared (FTIR) Sensor System.

The Aerospace Corporation – A Leader in Hyperspectral Remote Sensing

SEBASS is our patented system, which offers some unique capabilities within the hyperspectral remote sensing arena. SEBASS can collect data from a low-flying aircraft or from the ground, depending on the application of interest. Most airborne hyperspectral imagers operate in the visible to short-wave infrared. The SEBASS capability in the mid-wave infrared and long-wave infrared is intended to remotely identify materials in the 3 to 13 μm “chemical fingerprint” spectral region. SEBASS also provides high-resolution temperature data.

SEBASS was originally designed in 1993 and built from an Aerospace-sponsored research program. We are now ready to assist civil and commercial clients with their remote sensing needs.

Airborne Measurements - We have a history of over 37 airborne collections. Our current airborne SEBASS platform is a DeHavilland DHC-6 Twin Otter aircraft that typically operates between 2,000 - 12,500 feet above ground level.

Vehicle Mounted Measurements - Aerospace possesses four mobile 2D scanning long-wave infrared FTIR vehicle mounted sensors. The vehicles can be driven to a site of interest to collect close-range hyperspectral data from 8 to 12 microns. The scanning FTIR sensors have been successfully deployed on over 100 ground-based data collections.

Hand-Held Measurements - Aerospace can provide in situ, ground spectral measurements using hand-held instruments to verify material identifications derived from airborne measurements.

Laboratory Measurements - Aerospace experts can provide laboratory measurements such as UV-VNIR-SWIR-MWIR-LWIR spectral, X-ray diffraction and energy dispersive analysis of X-rays to assist in material characterization of samples taken from regions of interest. These laboratory measurements of samples establish ground truth and improve interpretation of remote sensing data.



SEBASS shown mounted on its roll compensation stage in a Twin Otter aircraft. The sensor is cryogenically cooled with liquid Helium.



Remote Infrared Hyperspectral Applications

Mineral Exploration • Drill Core Analysis • Geothermal Site Characterization • Environmental Assessment • Subsurface Detection • Planetary Exploration • Ore Grading • Slope Stability

SEBASS Instrument Summary

- Spectral coverage 7.8 to 13.5 μm ; 3.0 - 5.5 μm
- 128 Spectral Bands for both MWIR and LWIR
- Effective frame rate up to 120 Hz • IFOV = 1 milliradian; FOV = 128 milliradians (7.3°) • Noise Equivalent Spectral Radiance $< 10^{-6}$ W/cm²/sr/ μm at 120 Hz
- Georeferenced data < 15 m accuracy per pixel • Real-time data processing to find targets of interest • On-board calibration sources

Products

Aerospace can support the entire end-to-end data collection effort starting with site identification, collect planning, collection operations, and data analysis. Typical remote infrared hyperspectral products include:

- Spectrally and radiometrically calibrated hyperspectral data cubes
- Georeference files for all data cubes
- Atmospherically corrected hyperspectral data cubes
- Apparent emissivity data cubes
- Maps of spectral detections for specific materials of interest
- Maps of regions of unknown spectra
- Mosaic products
- Field spectra from hand-held spectrometers
- Laboratory spectra of samples

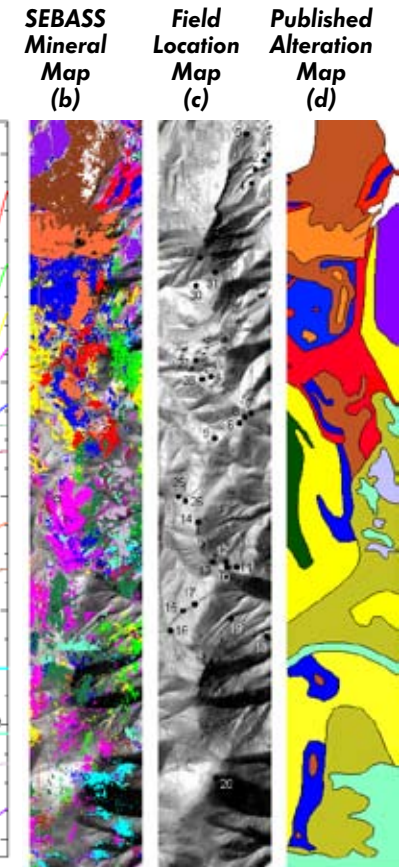
Recent Clients

Aerospace has worked with the following organizations and companies: U.S. Air Force, NASA Mars Research Program, University of Nevada at Reno, City of Tucson, Australia Commonwealth Scientific and Industrial Research Organisation (CSIRO); and other U.S. government clients.



The Aerospace Corporation is a non-profit company dedicated to applying science and technology to the advancement of complex systems. We operate a federally funded, research

and development center for the United States government, providing technical leadership to national-security, civil and commercial space programs since 1960. We provide expertise in all fields and disciplines of systems architecture, engineering, design, development, acquisition, operations, and program management.



This example shows a typical SEBASS data product, which displays colors that represent the presence of various mineral emissivity spectra. This illustration shows (a) emissivity spectra; (b) SEBASS mineral map; (c) SEBASS temperature survey with field sample locations noted; and (d) a geology and alteration map derived from field survey (after Harris and Einaudi, 1982). Note that the SEBASS-derived mineral map (b) closely correlates with the mineral map produced from a field survey (d).

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