The Hyperspectral and Multispectral Cameras for Airborne Mapping (HAMCAM) System

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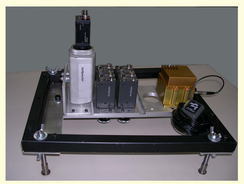
www.cnrhome.uidaho.edu/remotesensing/hamcam

ABSTRACT

This poster describes a newly implemented airborne remote sensing system for hyperspectral and multispectral data acquisition. The Hyperspectral and Multispectral Cameras for Airborne Mapping (HAMCAM) system was designed and developed at the Remote Sensing & Spatial Ecology Research Lab at the University of Idaho. The system integrates a hyperspectral sensor, four multispectral frame camera sensors and an inertial navigation system (IMU, GPS) controlled by a custom-built airborne computer. Custom developed software synchronizes image acquisition and aircraft positioning and movement parameters. The system acquires georeferenced and high resolution imagery for use in a broad-range of natural resource management applications. The system is available for tasking within the northern Rocky Mountain region.

SYSTEM DESCRIPTION

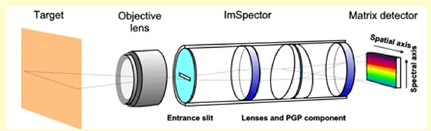
HAMCAM is a dual-use system for hyperspectral and multispectral airborne data acquisition. HAMCAM is intended for flexible aerial hyperspectral and multispectral image data acquisition using a light aircraft platform. The system combines: hyperspectral sensor, four multispectral frame camera sensors, an Inertial Navigation System (INS), a data acquisition computer, and HAMCAM software.



SENECA II aircraft is used to carry the airborne sensor

Hyperspectral Sensor

The hyperspectral imager (HSI) is based on a grating imaging spectrometer design using a 2/3 CCD camera that has a 16 mm focal length lens. The sensor splits the visible and infrared light spectrum into 240 bands with a spectral resolution better than 2.5 nm within the 445-900 nm range. It has a 10-bit per band radiometric resolution, and a swath width of 752 pixels. The HSI captures images sequentially of the moving target by the movement of the aircraft.



Hyperspectral imager

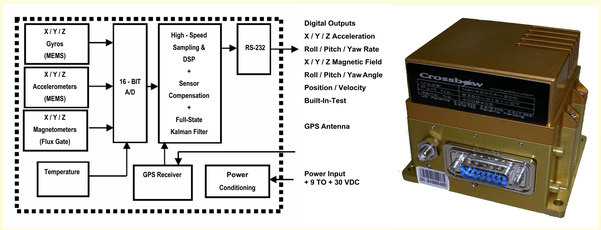
Multispectral Cameras

The multispectral imager (MSI) consists of four-mega-pixel CCD cameras with interchangeable filters that are capable of acquiring data in four bands at user-selected wavelengths. The MSI features a 1392 x 1040 CCD array of progressively scanned images formatted with 10-bit quantization. Four 10 nm bandwidth interference filters with center pass wavelengths of 450, 550, 650, and 800 nm are mounted on the 16 mm focal length lenses.

Multispectral imager and acquisition over the UI golf course. (Moscow, ID)

Inertial Navigation System

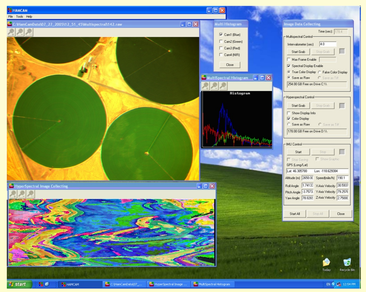
The INS consists of the following subsystems: an inertial sensor array which is an assembly of three accelerometers, three gyros (rate sensors) and four temperature sensors; a three axis fluxgate magnetometer board used to compute heading; a Wide Area Augmentation System (WAAS) capable GPS receiver; and a digital signal processing (DSP) module, which receives the signals from the inertial sensors and magnetometers. The inertial sensor unit and the magnetometers keep track of the airplane's tilt (pitch, roll, and yaw), the Differential GPS (DGPS) locates the aircraft position and calculates velocity within high accuracy, and the DSP unit converts and integrates signals from other subsystems to filtered digital data.



Inertial Navigation System

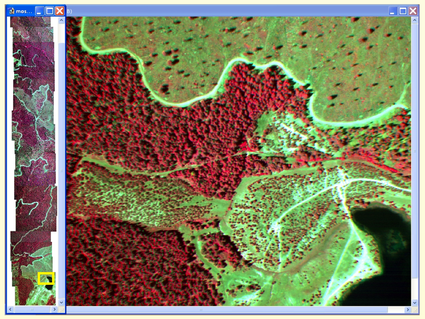
Software

A single airborne data acquisition computer supports synchronous data collection from the hyperspectral/multispectral sensor and the GPS/IMU sensor. User-friendly HAMCAM software includes in-flight configuration settings, which allow for alterations to be made easily for different conditions. Also, removable hard drives can be changed in-flight for additional recording capacity. After the flight, data is transferred to a post-flight-processing computer for further band-to-band registration and image geocorrection.

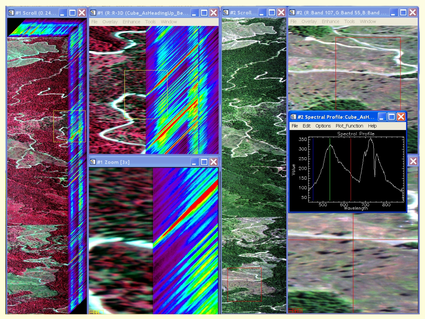


Data acquisition screen capture

True and false color imagery of Hells Gate State Park, Lewiston ID (acquired June 2005 with HAMCAM's multispectral imager at 7000 ft AGL)



A HAMCAM multispectral image. Imagery acquired July 2004, Moscow Mountain - Idaho



A HAMCAM hyperspectral image which shows spatial and spectral dimensions. Imagery acquired July 2004, Moscow Mountain - Idaho

APPLICATIONS

Applications of this advanced airborne system range from: wildland fire severity assessment; monitoring forest ecosystems and assessing degradation of forest health following insect outbreaks; invasive weed species mapping; and various uses for agriculture, environmental studies, water quality assessment, and emergency response. The new system has been fully operational for use since the summer of 2005 and can be requested for use in pilot studies in federal, state, and/or private sectors for research and related applications.

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