Fraunhofer
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FRAUNHOFER INSTITUTE OF OPTRONICS, SYSTEM TECHNOLOGIES AND IMAGE EXPLOITATION

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1 System attached to plane and ready for flight.

2 System open for inspection.

HYPERSPECTRAL MULTISENSOR PLATFORM

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Airborne sensor platforms allow rapid large scale data acquisition, even in difficult terrain.
Simultaneous employment of complementary sensors increases the potential information gain significantly. Prominent features of the hyperspectral multisensor platform are its powerful sensors, ease of attaching to an airplane, the software with optimized data fusion and geo-referencing, as well as the optional real-time processing. Examples of its applications include disaster management, environmental monitoring and reconnaissance.

System

Sensors / Platform

- Hyperspectral, infrared and high resolution RGB sensors, combined with IMU and GPS in a single pod
- Platform Stemme S10 usable as Optionally Piloted Vehicle
- Prepare and attach sensors in minutes

Processing

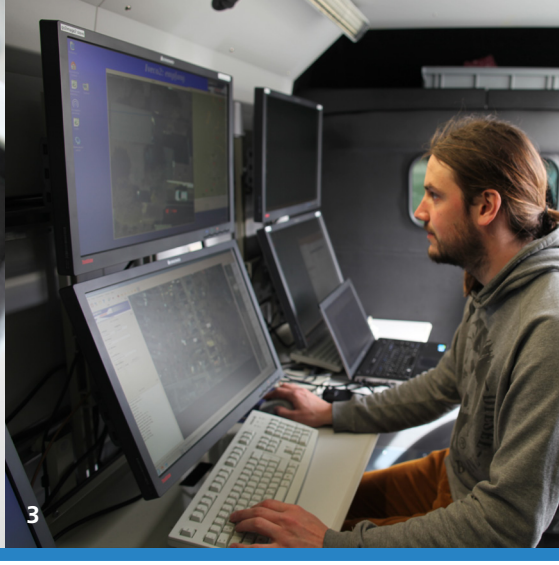
- Automatic processing, mosaicing, co-registration and geo-referencing of all recorded data
- Data prioritization and fusion
- Real-time capable data processing and online analysis algorithms
- Remote analysis via web client

Background

Capture of hyperspectral data in spectral bands of visible light as well as near and mid infrared open up new opportunities for differentiation. Different materials, such as minerals and vegetation, possess different spectral absorption and reflection bands. They can be identified using these spectra. In the case of environmental monitoring, important factors include vegetation state (damaged forests), material properties (environmental pollution) or even water temperature (acquired using the thermal sensor).

1 Communication module by OHB Systems AG.

2 RGB and thermal sensors from below.



3 Operator in the mobile ground control station.

During disaster management, timely situational awareness is critical, such as detecting heat sources to find victims. Additional applications are the identification of dangerous situations that are difficult to detect visually, such as leaking fuel.
In order to meet these challenges, Fraunhofer IOSB has developed a hyperspectral multisensor platform with an efficient processing system.

Applications

The hyperspectral multisensor platform has two modes of operation. In offline mode, all data is recorded during flight and made available for preprocessing and evaluation afterwards. In online mode these steps are instead performed on the ground in near real-time, if the data is transferred to a mobile ground control station (such as one by OHB System AG) using a broadband data connection. This minimizes the delay between data acquisition and processing, which is invaluable in disaster management or conflict zones. All sensors are in a fixed configuration installed in a pod. Especially useful in time-critical situations, the system can be attached to an airplane in minutes and thus allows data acquisition in very little time.
Powerful processing modules enable efficient interaction between the multisensor platform, the carrier platform Stemme S10 and the mobile ground control station. Additionally, these can be remotely controlled using a web interface. Depending on the location, this allows an operation to run without an analyst to be present, reducing cost and potential danger to the analyst.

Development

The base system of the multisensor platform was finished at the end of 2012 by Fraunhofer IOSB in cooperation with OHB System AG and Geosystems GmbH. During the course of the year 2013 the system was successfully employed during several demonstrations and flights.
Fraunhofer IOSB researches and develops already for years automatic evaluation methods for hyperspectral data. This knowledge consequently influences the development of operational systems.
Our focus is on designing an easy and intuitive workflow of data acquisition, pre-processing and evaluation. At the same time research is done on new robust and more efficient evaluation methods, in order to match our customers' requirements at best.
Current research topics are evaluation methods that are specially designed for fusing different spectral ranges.

System specification

Overall system

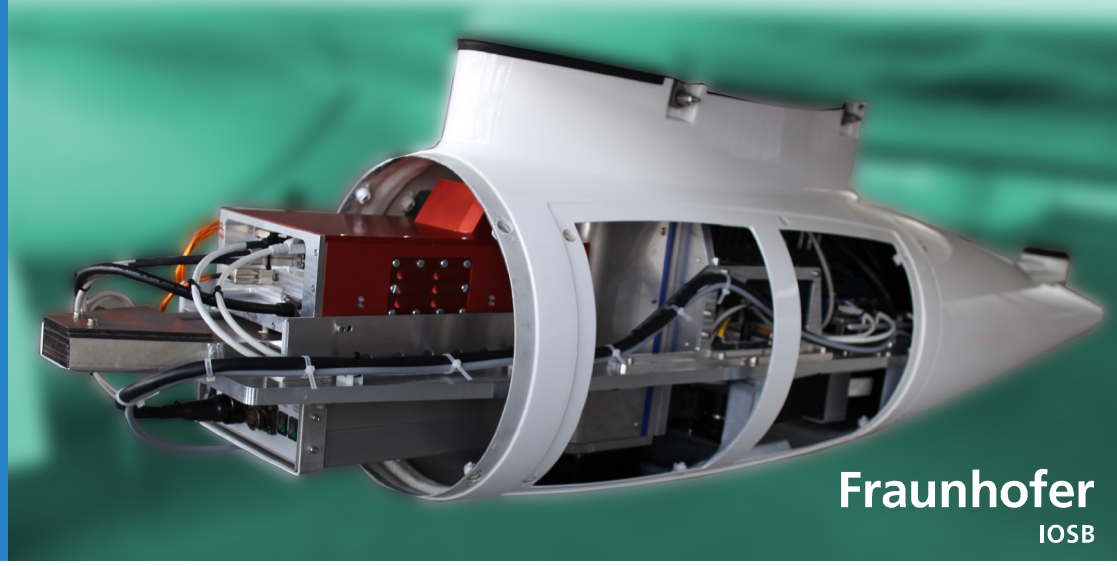
- Hyperspectral multisensor platform
- Motor glider type Stemme S10
- Broadband data link
- Mobile ground control station

Multisensor platform

- Hyperspectral sensor AISA Eagle II Push-Broom (127 bands, 400 – 990 nm, up to 120 Hz)
- Infrared camera IR-TCM 640
- High-resolution RGB single-frame camera SVCam-SVS 16000
- GPS and inertial measurement system Applanix POS AV V5
- Compact data acquisition unit

Data transfer and processing

- Data link with 80 Mbit/s
- Range up to 250 km
- Real-time data processing at ground control station



HYPERSPECTRAL MULTISENSOR PLATFORM DATASHEET

Overall system

- hyperspectral multisensor platform
- motor glider type Stemme S10
- broadband data link OHB ARDS
- mobile ground control station

Sensors

Hyperspectral sensor
Specim AISA Eagle II

- resolution
  - spectral: up to 512 bands
  - spatial: 1024 Px across track
  - radiometric: 12 bit
- spectral range: 400-990 nm
- frame rate: up to 120 Hz
- FOV across track: ~37.7°
- GSD @ 600 m altitude: ~0.5 m

Infrared camera IR-TCM 640

- resolution
  - spatial: 640 x 480 Px
  - radiometric: 16 bit
  - temperature: 0.03 K
- spectral range: 7.5-14 µm
- measurement accuracy: +- 1 K
- frame rate: up to 60 Hz
- FOV across track: 30°
- GSD @ 600 m altitude: ~0.6 m

Industrial RGB camera
SVCam-SVS 16000CUGE

- resolution
  - spatial: 4872 x 3248 Px
  - radiometric: 12 bit
- frame rate: 4 Hz
- lens: Zeiss Planar T*1.4/50ZF-I
- FOV across track: ~ 38°
- GSD @ 600 m altitude: ~0.1 m

Inertial navigation system
Applanix POS AV 510

- absolute accuracy: RTK postprocessing
  - position: 1.5 – 3 m / 0.05 – 0.3 m
  - roll, pitch: 0.008° / 0.005°
  - true heading: 0.070° / 0.008°
- frame rate: 250 Hz

Data Acquisition Unit

- custom made industrial computer
- CPU: Intel i7
- frame grabber card for AISA Eagle
- 2 GigE Ethernet Ports
- 750GiB SSD storage

Aircraft

Motor glider Stemme S10 VC

- crew: 1 pilot, 1 operator
- length / wingspan: 8.42 m / 23 m
- gross weight: 850 kg
- cruising speed: 259 km/h
- stall speed: 78 km/h
- range: 1730 km
- 2 wingpods 60 kg payload, 400 W max. power consumption

Downlink

OHB ARDS

- line of sight, point to point transmission
- bandwidth 83 Mbit/s
- frequency Ku-band
- range: 250 km

Ground control station

Mobile ground control station

- antenna pedestal with 1.2 m parabolic dish
- 4 workstations for
  - flight control
  - data link control
  - imaga data screening
  - data processing and analysis

Online processing

- HS realtime geo-referencing on DEM
- VIS realtime geo-referencing on DEM

Data handling

- geodata server ERDAS Apollo
- real-time spectral re-identification Fraunhofer IOSB-IHOCC
- interfaces for further image exploitation algorithms