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Corning® microHSI™ 410 SHARK

Integrated, Coherent, Airborne Hyperspectral Imaging System

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Hyperspectral Imaging System

Corning Advanced Optics has developed the Corning® microHSI™ 410 SHARK (Selectable Hyperspectral Airborne Remote sensing Kit), an integrated, coherent hyperspectral imaging (HSI) sensor system designed specifically for integration with highly compact Unmanned Aerial Vehicles (UAVs), including low cost multi-rotor copters. With a weight of just 1.8 lbs., inclusive of self-contained battery, data acquisition and storage, and inertial navigation subsystem, the microHSI™ 410 SHARK enables HSI technology to be applied to a new world of applications using low-cost compact drones.

The microHSI™ 410 SHARK is not only compact and lightweight, it delivers exceptional spectral imaging performance. The microHSI™ 410 SHARK system includes Corning's 0.4 - 1.0 um hyperspectral sensor that employs state-of-the-art high quantum efficiency (QE) CMOS focal plane array (FPA) technology and a patented solid optical block Offner relay spectrometer. The microHSI™ 410 spectrometer features a high efficiency reflective, optimally blazed diffraction grating that is precision manufactured using Corning's proprietary diamond machining processes. The result is outstanding throughput and signal to noise ratio (SNR) performance combined with exceptional spectral fidelity and spatial resolution.

The microHSI™ 410 SHARK is a complete turn-key sensor system solution including the 0.4-1.0 um HSI sensor, a high efficiency microprocessor control and data acquisition subsystem with solid state data storage, a precision MEMS-based close coupled GPS/Inertial Navigation System (INS) generating navigational data for accurate geo-referencing of the HSI data, and a rechargeable, swappable battery. The standard microHSI™ 410 SHARK is designed for a minimum of 30 minute durations with a hot-swap of battery and data for minimal ground time. Extended mission duration options are available. HSI data can be saved as raw data (minimum size), and/or radiometric calibrated data, significantly reducing post-process time and streamlining workflow.

Corning has paid special attention in the design of the microHSI™ 410 SHARK to optimize it for the commercial remote sensing market and in particular, for precision agriculture, environmental terrain and vegetation assessment and management, and mineral exploration. The sensor and system are designed to for enhanced performance in the important near infrared (NIR) region of the spectrum. This is achieved through judicious high QE FPA selection and through Corning's proprietary grating technology.

Unique Capabilities and Features

The microHSI™ 410 SHARK command and control functions are preprogrammed into the embedded processor. Users can simply access command and control functions with a browser from any PC, laptop or tablet.

For direct control of the SHARK from the UAV's on-board flight controller, an Ethernet socket-based message application program interface can be used to start, stop, calibrate, check status, and receive the waterfall, navigation, and histogram multicast data. Imagery can be recorded in raw or calibrated (radiance) form, with or without navigation data. The user can choose to record the full hyperspectral data cube or a subset of the bands. User defined band subsets can be created to reduce storage requirements enabling longer mission times, quicker data offloading and faster post-processing.

The user may operate the system manually, or choose from three pre-programmed, autonomous image/data collection modes.

Digital Elevation Models (DEMs) can be downloaded from the NASA EARTHDATA web site for the area to be imaged, and pre-programmed into the microHSI™ 410 SHARK. This, in combination with the integrated dual channel GPS, enables improved image geo-registration accuracy.

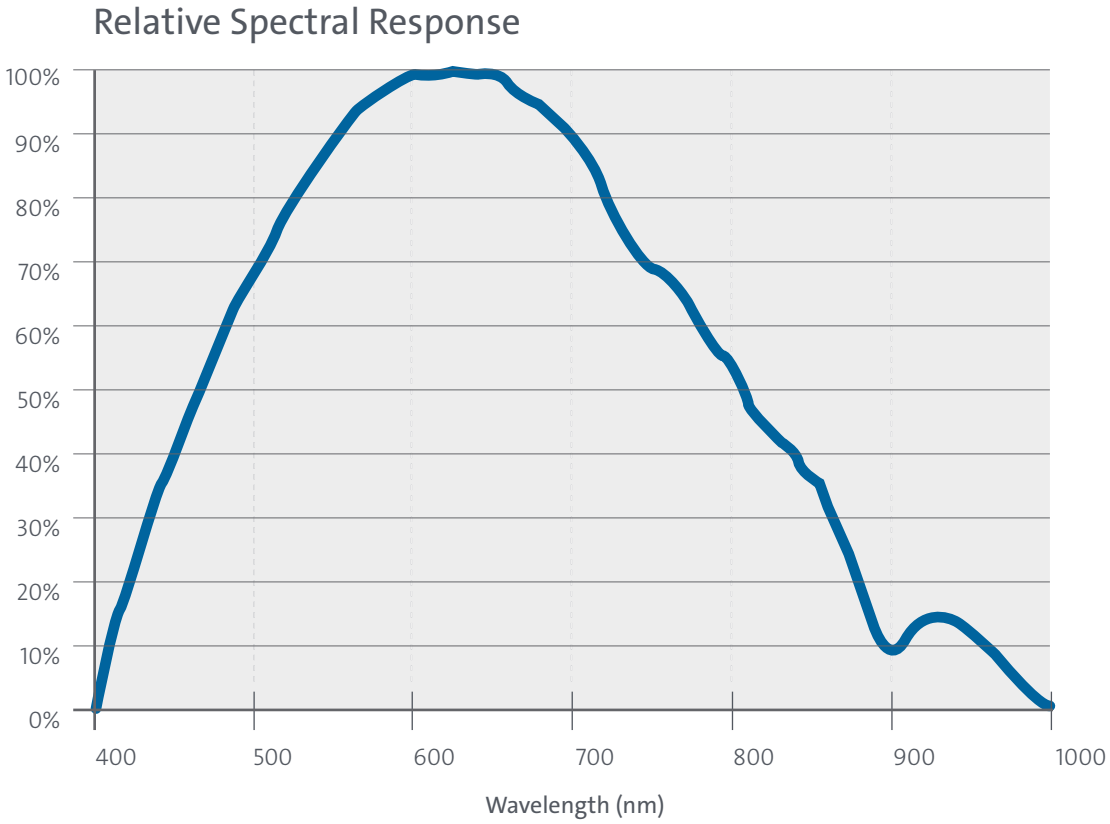
ENVI compatible Input Geometry (IGM) files containing latitude and longitude for every spatial pixel are created in real-time. The IGM files are used during post-flight geo-registration, image display and analysis.

Imagery can be displayed and analyzed using most commercially available spectral image processing software and web-based services that have an ENVI reader option or offer ENVI as part of their product portfolio.

Corning® microHSI™ 410 SHARK Hyperspectral Imaging System Performance Characteristics

Sensor Type	Push-broom Line Imaging Spectrometer
Spectrograph	Solid Block Offner
Grating	Diamond-ruled High Efficiency Reflective Blazed
FPA Detector	CCD/CMOS Hybrid 1408 spatial pixels
Effective Pixel Size - 2x binned	11.7 µm
Effective Array Size - 2x binned	704 spatial x 155 spectral
Focal Length, f/#	16 mm, f/1.4 standard
Full FOV	29.5 degrees (516 mrad) standard
IFOV	366 µrad standard
Spectral Range	400 nm - 1000 nm
Spectral Bin Size (per pixel)	2nm
Maximum Frame Rate	>300 Hz (profile dependent)
Data Readout	12-bit
INS	GPS + Mems IMU + Kalman filtered solution
Size (Standard Lens, Processor, Data storage, INS)	5.37" x 3.44"x 2.77" with lens (3.77" x 3.44" x 2.77" without lens)
Weight (Standard Lens, Data Storage, INS)	1.5 lb. (0.68 kg)
Power Consumption (Complete System)	<19W @ 12VDC
Etendue	50 steradian um^2

Relative Spectral Performance



Potential Applications for the Corning® microHSI™ 410 SHARK Include:

Commercial Remote Sensing

- Precision agriculture
- Mineral / petroleum exploration
- Pipeline / power line / thruway inspection
- Terrain / vegetation / urban characterization

Reconnaissance Applications

Dual-use UAV Applications

- Search and rescue
- Disaster mitigation
- Environmental assessment and monitoring
- Humanitarian assistance

About Corning Advanced Optics

Corning Advanced Optics is a world leader in the design, fabrication, and system integration of compact, high performance HSI sensors and sensor systems. Corning's line of microHSI™ sensors achieve their combination of low Size, Weight, and Power (SWaP) and high spatial and spectral performance through a patented miniaturized solid optical block spectrometer design. This configuration embeds an inherently low optical aberration Offner relay spectrometer, with integrated high efficiency convex diffraction grating, into a solid optical block. Without air spacing, the light ray paths are highly condensed, resulting in the low SWaP and also providing mechanical and thermal robustness. Corning's microHSI™ solid block spectrometers are automatically aligned by design and manufacture, minimizing the thermal and shock misalignment risk due to independent optical component mounting in conventional sensors. The Offner configuration yields impeccable spectral fidelity and exceptional spatial resolution. The high efficiency reflective blazed grating and minimization of optical component surfaces due to the solid block design results in maximal transmission for superior signal to noise ratio performance. Corning microHSI™ sensors are co-developed with in-house designed high performance lenses to ensure preservation of both spectral and spatial fidelity. The microHSI™ spectrometer is designed specifically to work with a particular state-of-the-art FPA detector, ensuring integrated sensor performance optimization from the face of the lens to the digital electronic data output.

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