GEOPOD™ MAPPING SYSTEM

Make Every Pixel Count

This simple statement governs what we do: Jacobs' Aeroptic® product line aims to ensure the highest quality data is produced at every stage of image capture through processing. To achieve our goals, we leverage state-of-the-art components available from the commercial market, and leverage our expertise on calibration and integration for the airborne environment.

System Overview

The GeoPodTM System is a culmination of cutting edge technology, hardware integration and custom software to create an integrated system that uniquely enables geographically-distributed imagery mapping of the highest grade and reliability.

System Hardware

- GeoPodTM Imaging Sensor Pod (with mounting hardware)
- Sensor Control Laptop
- Flight Management System (FMS) Tablet

System Software

SUMMIT – Operations Management System

- Mission Acceptance and Management
- Capture Management
- Imagery Processing Software and delivery
- Asset Management
- Software Version Control and Dissemination

- **FAA Supplemental Type Certificate (STC)**
  – Allows the pod to be attached to and legally used on a group of commonly available Cessna aircraft.
- **Direct geo-referencing technology, and the highest grade commercially available IMU**
  – Delivers exceptional geospatial accuracy.
- **Cloud-based mission management software (SUMMIT)**
  – Enables enterprise, remote, collaborative, and distributed control of the tasking of sensor pods across wide areas.
- **Rugged, electronic shutter sensor systems**
  – Ensures reliability and long life in the harshest operating conditions.
- **Aberration-corrected apochromatic optical assemblies, combined with high dynamic range and superior signal-to- noise ratio sensors**
  – Enables the generation of imagery data of unsurpassed quality, leading to high grade imagery maps.
- **System Hardware ships in rugged case suitable for commercial checked luggage**
  – Rapid and efficient provisioning of sensor systems anywhere in the world.
- **Intuitive, automated Flight Management System (FMS)**
  – Quick pilot-operator training.

Jacobs Challenging today. Reinventing tomorrow.

End-to-End Integration

An end-to-end system, handling mission planning through capture and delivery, is a vital to the ability to scale collection and delivery of data. Whether the client has one plane or thirty planes in the air on any given day tasking, collecting and processing the data is not easily achieved without a fully integrated system. Electronic -+handshakes between subsystems ensures that vital information such as camera lens models for specific sensors and plane-specific lever arms that have an immense impact on quality flow through with the collected imagery data to final processing

GeoPod™ Mapping Sensor

The camera system is comprised of commercial off-the-shelf components that are packaged into a 20-in long, 6.5-in diameter pod. The small lightweight pod is mounted to the aircraft using the entry step that is available on the right wheel landing gear. The pod consists of an aerodynamic carbon fiber tube that contains the digital cameras, the GPS receiver and command/control electronics. The digital cameras are industrial 12MP cameras, configured in a splayed arrangement to provide a wider cross- range footprint. The cameras are triggered simultaneously with an electronic pulse from the pod electronics that is precisely timed using the commercial GPS receiver. Camera system specifications are provided in Table 1. The camera, navigation system, flight computer, and pilot command systems work together to achieve parallel flight lines that cover the user Area of Interest (AOI).

Flight Management and Processing

Mission planning, flight management and processing are all key links in the chain to collecting high quality imagery data quickly and efficiently. Online mission planning tools from Aeroptic allow a user anywhere in the world to task a sensor. Online mission planning software feeds all the necessary location and sensor information directly to the flight management software housed on the sensor. After in-field data capture, the flight management software releases the data to the processing suite where all of the metadata from the flight and collected imagery and navigation data is automatically reviewed for quality and to ensure mission coverage. The processing software is highly automated and delivers the data automatically back to the online mission planning portal for review by the tasking party.

Sensor Specifications

Sensor Type	3x 12MP, >12,000 pixel swath (RGB)
Lens Type	50mm Fixed Focal Length (to infinity)
Pixel Size	Approx. 3.45µm square
System Weight	11.2 lbs / 5 kg
Recording Format	RAW frame imagery
Output Formats	JPG, TIF, JPG2, geo-referenced GMLJP2, KML, and GeoTIFF
Interface	USB
Dimension	22" length x 6.5" diameter
Power	12-24v DC

SUMMIT Operations and Management

Managing numerous activities in the field simultaneously is seamless, with SUMMIT, a fully automated database operations system. Connected to all of the various software modules including mission planning, flight management and processing, SUMMIT maintains all of the information necessary to feed these programs vital feedback to allow a project to move forward effortlessly and accurately. In addition, SUMMIT maintains and distributes all the necessary calibration files and software updates to ensure high quality processing.

About Jacobs

Jacobs leads the global professional services sector providing solutions for a more connected, sustainable world. With more than $12 billion in revenue and a talent force of more than 50,000, Jacobs provides a full spectrum of services including scientific, technical, professional and construction- and program-management for business, industrial, commercial, government and infrastructure sectors. For more information, visit www.jacobs.com, and connect with Jacobs on LinkedIn, Twitter, Facebook and Instagram.

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GEOPOD™ MSI MULTISPECTRAL MAPPING SYSTEM

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High Grade Data Made Economical

With an 8,000 pixel swath width and a total of 120 Megapixels, the MSI GeoPod™ is the highest collection rate, true-multispectral sensor pod on the market. The dual thermal LWIR sensors collect >1000 pixel swath, allowing for efficient collection at high resolution. MSI resolution varies with altitude, with 10cm data being acquired from 3,250′ AGL.

The Aeroptic® GeoPod™ System delivers GIS-grade accuracy at a significantly lower cost than its competitors through advanced GPS and Inertial Measurement Unit (IMU) performance optimization. Using the latest in IMU and GPS technology, the Aeroptic navigation system collects location data capable of producing an end-product that meets +/- 1m (CE90) specifications. A direct geo-referencing workflow provides a high accuracy solution immediately after landing, enabling fast turnaround of ortho-imagery and efficient high-volume production.

System Hardware

- GeoPodTM Imaging Sensor Pod (with mounting hardware)
- Sensor Control Module (SCM) – small, ruggedized onboard computer
- Flight Management System (FMS) Tablet

- **FAA Supplemental Type Certificate (STC)**
  – Allows the pod to be attached to and legally used on a group of commonly available Cessna aircraft.
- **Direct geo-referencing technology, and the highest grade commercially available IMU**
  – Delivers exceptional geospatial accuracy.
- **Rugged, electronic shutter sensor systems**
  – Ensures reliability and long life in the harshest operating conditions.
- **Intuitive, automated Flight Management System (FMS)**
  – Quick pilot-operator training.
- **Aberration-corrected apochromatic optical assemblies, combined with high dynamic range and superior signal-to-noise ratio sensors**
  – Enables the generation of imagery data of unsurpassed quality, leading to high grade imagery maps.

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Reinventing tomorrow.

GeoPod™ Mapping Sensor

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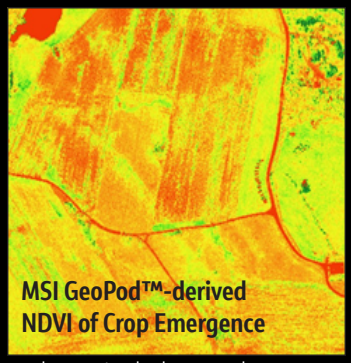
Multi-Spectral Technology

Jacobs has integrated the latest in remote sensing technology to create a revolutionary camera system that achieves extreme fidelity and unsurpassed efficiency and reliability. Housed in a custom structure containing ten multispectral cameras and two thermal (LWIR) cameras, the system collects VNIR MSI & LWIR simultaneously, with a 42 degree FOV. The high dynamic range (>70dB) multi-spectral cameras have narrowband filters, capturing only the data desired and recording it with precise fidelity. Information-packed pixels improve success of computer analytics by offering true multispectral data for every pixel (unlike its Bayer-pattern or pan- sharpened competitors). All capture data is linear, with multispectral being in radiance or reflectance, and thermal data being calibrated temperature. Full electronic global shutter cameras ensure the imagery is clear and precisely located, avoiding errors introduced by the more common rolling shutter sensors. To maximize accuracy, Jacobs performs extensive calibration procedures on each sensor and tests the results in a closed loop, real-world environment.



MSI GeoPod™-derived NDVI of Crop Emergence

Intelligent Processing

When coupled with the Aeroptic GeoProcessor, newly collected imagery is converted from its raw format into a viewable file format along with the associated geospatial metadata. The GeoProcessor performs a wide range of data enhancement operations such as: Lens Distortion Correction, Radiometric Effects, Exposure Compensation, and Color Balancing. Additionally, it will perform Ortho- Projection, Ortho-Mosaicking, Image Tiling, and Image Compression to produce a final mosaic output.

Sensor Specifications

Sensor Type	VNIR Multi-spectral + LWIR Thermal
Sensor Bands	Blue: 460-490nm; Green: 550-570nm; Red: 660-680nm; RE1: 690-710nm; LWIR: 7.5-13.5µm
Lens Types	38mm MSI, 18mm Thermal
GPS Position Solution	L1/L2/L5/Glonass/Galileo <0.03m post-processed
IMU Attitude Solution	Realtime: 0.004° pitch/roll, 0.02° yaw Post-processed: 0.002° pitch/roll, 0.005° yaw
Recording Format	RAW frame imagery, GML / NetCDF metadata
Data Storage	6 removable solid state drives (4TB each)
Interface	Ethernet to Sensor Control Module (SCM) Wifi to Android tablet Flight Management System
GeoPod™ Size, Weight & Power	50cm length / 15 cm diameter; 9.1 kg; 280 W max
SCM Size, Weight & Power	28cm x 23cm x 14cm (L x W x H) 6kg / 125W (typical) / 140W (peak) / 10-30VDC

User-Friendly Output

Aeroptic systems support interoperability of tools and open support for industry standards. RAW imagery is stored in Adobe's open Digital Negative (DNG) format and developed imagery in JPEG2000.

Specialized binary data is stored in the free and widely accepted Hierarchical Data Format, version 5 (HDF5).

Geospatial output is based on Open Geospatial Consortium (OGC) XML- based standards and can therefore be used in any common geospatial toolset.

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