Digital Mapping Camera System

Optimize the accuracy of your data acquisition

INTERGRAPH®

Digital Mapping Camera System

Intergraph®'s Z/I Imaging® Digital Mapping Camera (DMC®) is the industry's most innovative and precise turnkey digital camera system. The DMC supports aerial photogrammetric missions for the broadest range of mapping, geographic information systems (GIS), and remote sensing applications.

The complete data acquisition system delivers small-scale or large-scale images with high-quality resolution at engineering-scale accuracy – supplying images with ground resolutions of less than four centimeters (1.5 inches). The modular system consists of state-of-the-art components centered on frame sensor technology and solid-state data storage to enhance all aspects of the digital workflow. The reliability and accuracy of the DMC exceeds the level of expectation for the industry – ensuring high geometric and radiometric resolution. The system delivers images digitally, enabling direct production of a wide range of mapping and image analysis deliverables, including orthophotos, digital terrain models (DTMs), and more.

The combination of innovative components makes the DMC ideal for capturing data for all mapping applications, including agriculture, cadastral mapping, cartography, forestry, land use/land cover mapping, environmental studies, natural hazard assessment, flood risk management, transportation engineering, urban planning, civil engineering, oil and gas exploration, and geology.

AN INVESTMENT THAT YIELDS ACCURACY AND PROFIT

Companies that employ digital camera technology can rapidly increase their return on investment. Films, scanning, and processing account for the majority of the cost for typical photo flights using a film-based camera. With a digital camera, the laborious and time-consuming tasks of processing and scanning film are eliminated, resulting in significant savings in both time and money.

For a typical photo flight with a DMC to capture imagery of a city with an area of 890 square kilometers at a photo scale of 1:5000 with 60 percent overlap and 20 percent sidelap – an estimated total of 3,600 images – the DMC system can deliver savings of 50 to 75 percent of acquisition costs. This means companies can recover their investment very quickly. Return on investment for companies of varied ranges of image production will depend upon the size, type, and number of annual projects.

ACCURACY THROUGH INNOVATIVE DESIGN

The DMC system was developed to bring the benefits of digital technology to aerial mapping cameras.

Exceeding the highest accuracy and rigid image geometry (repeatability), the DMC incorporates rigidly mounted frame sensors, giving stable internal geometry. Frame geometry is the preferred method for producing stable and reliable digital imagery. In addition, the new camera was designed to perform under diverse light conditions with a wide range of exposure times and utilizes electronic forward motion compensation (FMC).

CHARGE COUPLED DEVICE (CCD) SENSORS RECORD PRECISE GEOMETRY

Employing CCD frame (matrix) sensor technology allows the DMC to meet rigorous goals and offers advantages not seen with small-format framing sensor technology or line sensor technology. The technology ensures rigid image geometry in a fashion analogous to a precision film platen. The DMC is not dependent upon a global positioning system (GPS), if used. Even if GPS lock is completely lost, flight conditions are severely turbulent, or light conditions are poor, users can be assured that high-quality metric imagery is “in the can” and ready to exploit using traditional photogrammetric methods.

Tokyo Tower, Tokyo, Japan

Rising 333m above the city, the Tokyo Tower stands as the symbol for Tokyo. It is the world’s highest self-supporting steel tower and the tallest man-made structure in Japan. This image of the landmark was captured using a DMC system. Image courtesy of Aero Asahi Corp., Japan.

Features such as completely electronic FMC and 12-bit per pixel radiometric resolution for each of the panchromatic and color channels ensure image quality that is stunning compared to scanned aerial films. Because the DMC exposes a square pixel footprint and all camera heads are exposed simultaneously, the image is frozen in one shot and adverse influences due to airspeed fluctuation, sudden aircraft movement, or objects moving within the frame are minimized.

The CCDs are full-framed sensors with high optical fill factor and sensitivity. DMC offers pixel size of 12 microns by 12 microns (square) and with a high linear dynamic range of 12-bit. The architecture of the CCDs offers parallel readout registers on all four corners of the chip.

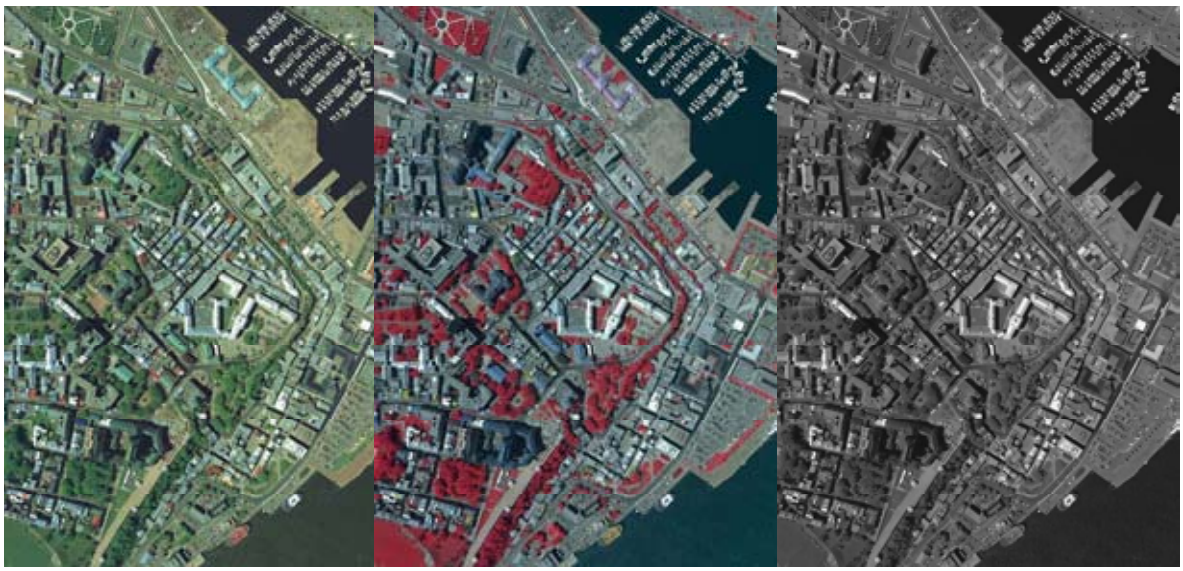
Because of the two-dimensional area sensor, the image data has a known and precise geometry in both X and Y directions. This provides a repetition rate for the system of one image every 2.1 seconds and high readout rates, which is important for a good signal-to-noise (S/N) ratio. The DMC ensures optimum precision results. For example, a photo flight at an altitude of 500 meters (1,640 feet) at an approximate speed of 140 knots produces images with 60 percent overlap in the flight direction and with a ground sampling distance of five centimeters (less than two inches).

INNOVATIVE CAMERA, LENS, AND SHUTTER TECHNOLOGY

Z/I Imaging partnered with Carl Zeiss to develop a unique lens design, minimizing distortion and maximizing resolution. The DMC's innovative design solves the problem of the size limitation of array CCDs by amalgamating eight individual CCD array cameras into a composite system. The DMC possesses a unique lens system, featuring minimal distortion, large (f/4) aperture, high resolution, and homogenous field response.

The eight individual camera modules are autonomous units and capture a central perspective view. Since separate lenses are used for each of the eight camera heads, the resulting overall image produces higher optical performance than can be achieved in a single, large-diameter lens. The high-resolution panchromatic channel contains four 7k x 4k large-area CCD chips and high-performance lenses with 120-millimeter focal length at a maximum aperture of f/4. For the simultaneous collection of color and false color infrared images, four multi-spectral camera heads are incorporated in the camera base unit.

To achieve high-quality color separation, each color channel features a separate high-performance, wide-



Quebec City, Quebec, Canada

These color, color infrared, and panchromatic images of Quebec City's historic old town, a UNESCO World Heritage Site and North America's only walled city, were captured using a DMC system. The year 2008 marks Quebec city's 400th anniversary. Image courtesy of Groupe ALTA.

Redfish Bay, Texas, USA

This image of Redfish Bay, Texas, was captured at 8,200 feet above ground using a DMC system. The purpose of this flight was to identify through image analysis any scarring to the state-protected, natural sea grass by boat propellers at Redfish Bay. Image courtesy of Photo Science.

angle lens with a maximum aperture of f/4 and 25-millimeter focal length, a 3k x 2k CCD chip, and a high-performance color filter based on non-organic material. The cameras are mounted inside a rigid optics frame designed specifically to ensure precise alignment of the optical axes.

The front-end electronics, with signal conditioning, analog-to-digital conversion, CCD timing, and processing, are directly integrated inside the camera module. This integrated design technique ensures a very high S/N of the CCD and minimizes the electromagnetic interference (EMI) within the system. Shutter development was focused on achieving precise synchronization to exclude geometric errors. An electromechanical shutter placed in the center of each of the camera lenses exposes all image points through the optical paths at the same moment, resulting in a distortion-free image. The DMC shutters provide the operator superior performance over slit shutters used in standard reflex cameras by preventing geometric distortion inside the image field caused by aircraft movement during exposure time.

On top of the optics frame is the camera electronics unit. This enclosure houses the complete camera head electronics that control the camera modules, includes the power electronics for the shutters, collects the image data, and communicates with the camera control unit. The camera control unit configures the complete system, communicates with the external systems, monitors the data flow, and stores data on solid state disks (SSD).

FORWARD MOTION COMPENSATION (FMC)

Electronic FMC is an absolute necessity for acquiring a blur-free image under large-scale mapping conditions. To allow fully electronic FMC of the digital image, the CCD matrix sensors used in the DMC camera heads are operated in time-delayed integration mode.

This technique is similar to the image blur removal concepts used in film cameras but without the limitation and potential failure modes of moving parts. The FMC used within the DMC is capable of compensating for much higher Velocity/Height (V/H) ratios than mechanical systems, thus greatly extending the operating envelope of the DMC. A large sensor area along the flight strip allows long exposure times while maintaining a high enough air speed for a photo flight with a fixed wing aircraft at low altitudes. This type of FMC cannot be achieved in standard linear CCD or “push broom” sensors. Electronic FMC, with the combination of precision optics and framing CCDs, allow the DMC to achieve high ground resolutions of only a few centimeters.

FLEXIBLE ON-BOARD SYSTEM

To ensure a smooth transition when replacing cameras in the aircraft, the DMC fits into the same form factors as existing film-based cameras, such as the RMK family of cameras, the LMK, or the RC camera series. This eliminates the need, in most cases, to modify the dimensions of an existing camera hole in the aircraft floor. The DMC also takes into account the maximum operational flexibility needed while transitioning to an all-digital configuration. Included as part of the system is Z/I Inflight, an integrated flight management system (FMS), which can also manage film-based cameras.

PHOTO FLIGHT SCOPE OF ACTION

Besides adding flexibility for transitioning to a digital system, the Z/I Mount (the digital replacement for the industry-leading T-AS) Gyro Stabilized Suspension Mount compensates for the roll, pitch, and yaw of the aircraft. State-of-the-art digital microgyros, active control components, and passive vibration damping are used to stabilize the camera. Stabilization combined with improved vertical alignment of the camera ensures better image quality. The Z/I Mount is also compatible with RMK-TOP film cameras and incorporates a digital interface for full control of the camera mount.

ON-BOARD DATA STORAGE CAPACITY

When operated in full-color, 12-bit per pixel mode, the camera system generates about 272 megabytes of raw image data per exposure. Therefore, the control electronics require a special high-throughput design, which is capable of managing this data stream. It consists of two complete PCI-bus-based slot PCs operating in parallel. The image data of the camera modules is transferred via a parallel bus to high-speed, frame-grabber PCI-bus cards. Finally, the data is transferred via a separate data link from each of the CPU systems onto a removable, ruggedized storage system. This solid state disk system is a removable, solid-state RAM storage cartridge with a capacity of 1,200 images or 660 gigabytes. This high-speed, high-capacity solid state/storage is unique in the industry, providing unlimited storage with the use of multiple cartridges. These low-weight, compact units can be swapped out during the mission for unprecedented storage capacity and reliability. Since they are incorporated within the camera body itself, the space, weight, and power consumption

The DMC's solid state disk technology has the capacity to store 1,200 images in a single cartridge.

Z/I Mission includes 3D mission planning capabilities. This image shows the exposure centers at their precise position and the photo footprints projected onto the DTM surface exported into Google Earth.

of disk drive units is completely eliminated. This allows the DMC system to be flown in an aircraft as small as a Cessna 206. Another important point to note is all previous DMC systems can be upgraded to SSD technology, again protecting our customers' investment in Intergraph's data acquisition solutions.

IMMEDIATE STORAGE AND RAPID PERFORMANCE

The DMC system includes a complete post-processing system for converting the raw DMC exposures into standard central-perspective images. The system includes an optional rack-mounted server, high-performance RAID for data storage, and a multi-processor server for rapid, post-processing performance. Processed images, along with flight metadata, are stored in standard, non-proprietary formats for immediate use within ImageStation® solutions or any third-party softcopy system.

ACCURACY FROM START TO FINISH

The DMC system provides a complete digital acquisition solution, including all of the hardware and software components necessary to address every stage of the workflow – from mission planning through post-processing.

COMPREHENSIVE MISSION PLANNING

Successful data acquisition starts with proper mission planning to set up and plan necessary flight lines to acquire imagery of target areas. The DMC utilizes newly designed software to implement and manage aerial surveys. Z/I Mission is a comprehensive mission planning, reporting, and post-processing tool that provides an innovative solution for aerial survey procedures – from creating the initial flight plans to generating reports and indices for the final exposures. Z/I Mission provides a rich data environment that can access vector mapping data, digital orthophotos, or any georeferenced raster backdrop, including KML or KMZ format of Google Earth. This mission planning system addresses usual functions such as flying a particular azimuth, planning the most economical mission for a given region of interest, 3D mission planning, and more. The geospatial software is an integrated system requiring no computer-aided design (CAD) or GIS software, and may be operated as a standalone product. It can incorporate CAD and GIS data in a seamless flight planning environment.

An added advantage is that Z/I Mission can utilize the data files from our previous flight planning software packages, thereby protecting our customers' technology investment.

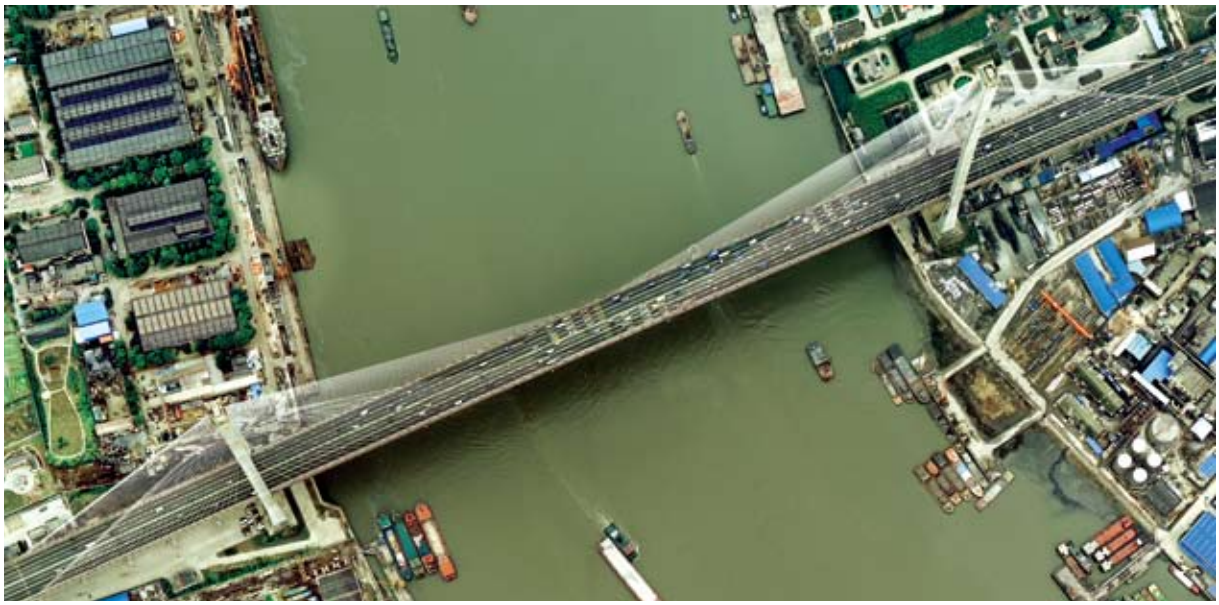
INTEGRATED SENSORS AND IN-FLIGHT FEEDBACK

A tight coupling between the mission planning and photo flight operations, along with applications that perform automatic V/H and drift correction, eliminates the use of multiple tools and programs to convert and assemble the data for a photo flight and results in more efficient photo flights. The DMC system seamlessly integrates with Z/I Inflight to reach the highest possible level of automatic system control and monitoring of the camera. The FMS console gives the operator complete control of the DMC as well as an interface to all sensors within the airborne system. This includes the image acquisition sensors and the auxiliary sensors such as GPS, Gyro Stabilized Suspension Mount, inertial measurement unit (IMU), and more.

The flight management segment of the Z/I Inflight system manages the sensor environment during the actual data acquisition process of the photo flight. The DMC system moves this technology to the next generation by fully integrating the on-board systems and providing a modular architecture that allows the integration of additional sensors – multi-sensor platforms and ancillary mission support sensors, such as an optional IMU.

Intergraph's pilot display interface gives you easy readability.

Z/I Inflight also incorporates a video camera to facilitate and enhance its ability to control and command attached sensors. The video camera is an intrinsic part of the base system and provides input for several functions. First, it serves as the input device to provide real-time feedback to the camera operator on the ground coverage of the sensor. The video frame-grabber can be synchronized with the sensor trigger to acquire a low-resolution video image of each image taken. A second function of the video images is to provide input to a computation algorithm within the sensor control that, combined with input from the GPS, performs a V/H computation used for FMC input for



Xupu Bridge, Shanghai, China

Completed in 1997, the Xupu Bridge spans the Huanpu Rier suspended by 240 cables and boasts a 590 meter-long deck. The engineering feat is captured using a DMC system. Image courtesy of Xing Tian Di Information Technology Co. Ltd.

the sensor. A third function of the video images is to provide input to the sensor control for a platform drift angle calculation. This calculation is used to drive the drift control of the stabilized Z/I Mount and to compensate the drift angle. As another option, if the system uses an optional IMU, measurements taken directly from the IMU can control the drift of the DMC.

Once the flight mission is planned, the information from the mission planning workstation is transferred to the FMS in preparation for photo flights via a USB memory stick. During the photo flight, Z/I Inflight records camera statistics, including video thumbnails, for analysis during the mission for post-mission review and processing. An optional IMU can be integrated directly inside the camera frame, minimizing the length of the lever arm for optimal coupling to the system and making it possible to work without ground control or with a reduced set of ground control points. Z/I Inflight can also control standard film-based cameras such as the RMK TOP systems, allowing quick interchanges between film-based and digital systems within the same aircraft using the same control interface.

RAPID DATA ACCESS

Upon completion of the photo flight, the DMC provides a quick analysis of the success of the mission and enables a seamless flow of the acquired data into the digital workflow. Mission data is transferred from the on-board system directly onto the SSD, along with all other flight information. This eliminates the need for other media and keeps all flight data in one place for easy access and transfer.

During the photo flight, the operator can utilize the Airborne On-board Project Viewer (AOPV) to assemble the video thumbnails into a rough mosaic of the flight thus far to judge the quality of the imagery taken. For example, the operator can use the AOPV to view the images in detail while looking for cloud or cloud shadows. Imagery can then be immediately replaced as necessary by reflying at that time rather than at a later date, thereby saving significant time and money.

For missions involving multi-day remote operations, the latest Copy Station and Readout Station solutions provide extremely fast data copy from the SSDs. Copy Station is a mobile server with LCD display and keyboard in a rugged aluminum chassis. It contains 2 x 640 GB SATA disk arrays with a high-speed data interface, and can copy two of the previous generation FDS in about an hour. Copying 1,000 image FSD takes only about 40 minutes. Data post-processing in the field is also possible on this machine.

The Readout Station is a field copy device with built-in computer and SSD adaptor. It can copy to a variety of devices, including LT04 high-speed tape.

The true systems' approach of the post-processing system design is evident through the immediate availability of the planning information in the overall data management of the production system. Mission reporting available in the Z/I Mission software automatically sets up the project information when the data is downloaded. Project management systems can be automatically populated with the actual mission data.

With Intergraph's ImageStation Photogrammetric Manager, the planning information will automatically generate project information such as camera name, flight line IDs, photo IDs, photo center parameters, and more. This ensures a smooth, post-flight workflow. Planned data within the management system is updated with the actual mission parameters. For example, planned photo centers are updated to reflect true photo centers.

The Solid State Disk Readout Station (left) and the Flight Data Storage Copy Station (right) each offer the perfect solution for field data copy of raw DMC data.

If the mission is output into TerraShare®, Intergraph's automated data management system, as the actual images are introduced into the system, the data management system graphically indicates the status of the project through a symbolic representation. This allows the production manager to assign operators to the project in a phased manner.

SIMPLIFIED POST-PROCESSING

Once the images are acquired and the photo flight is complete, the imagery and actual mission parameters are downloaded from the SSD cartridge. The DMC post-processing system outputs images from the raw image data stored on the SSD. The ImageViewer software is used to preview actual post-flight image data, particularly for multi-day missions unable to return to home base.

Post-processing is completed in two steps: radiometric processing and geometric processing. Through the DMC post-processing software interface, the user enters parameters that specify the processing step options. First, the raw image data from the SSD is radiometrically processed to compensate for the effects of vignetting, aperture, and other radiometric factors. The intermediate images, generated from radiometric processing, are written to the RAID storage. Once this step is complete, the SSD may be removed and returned to the camera. The intermediate images are then geometrically corrected for lens distortion and tilt and combined by a mosaicking module.

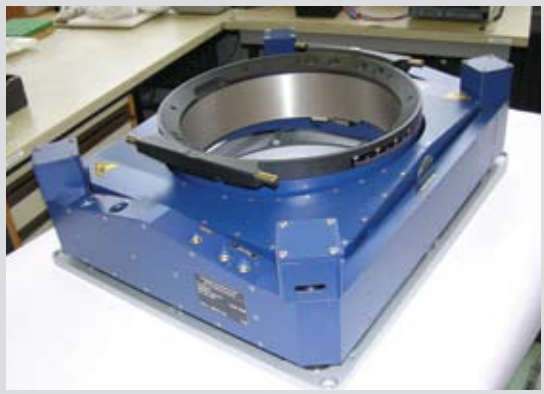
The post-processing software can produce several different types of output files from the set of raw images stored on the SSD. These outputs include high resolution 7,680 x 13,824 panchromatic; color (RGB) and color infrared; and lower color resolution (2048 x 3072) outputs (color [RGB], color infrared, four band, and near infrared).

With even higher geometric accuracy and improved color (Brovey pan-sharpening) processing options, PPS produces the highest possible quality output data in high throughput data processing situations.

Components

The DMC system includes the following components:

- DMC main camera assembly
  - 4 high-resolution 7k x 4k PAN camera heads
  - 4 multispectral 3k x 2k camera heads
  - Camera electronic unit
  - 1 SSD cartridge with 1,200 image capacity (approximately 330 GB) replaceable in flight. Extra cartridges are available.
- Z/I Mission software
- Z/I Inflight, including the following components:
  - Inflight core software
  - Inflight sensor control module for the DMC
  - Integrated computer system (eliminates the need for a laptop computer)
  - Video camera
  - Pilot display
- Z/I Mount Gyro Stabilized Camera Suspension Mount
- Z/I Mount Adapter Ring Kit
- Turnkey post-processing application software for converting raw DMC imagery to "ready-to-use" images
- Installation supervision
- One-week operational training



The Z/I Mount allows you to take highly accurate images even in challenging flight conditions.

The output image data resulting from these processing steps can be transferred to a data management system, such as TerraShare, where it can be archived or distributed to the destination defined by the operator. Digital measurement in support of triangulation or input into an automatic triangulation process can proceed immediately rather than delaying the start of production until the entire project has been scanned.

DATA ACCURACY

Imagery from the DMC is ready for the exploitation process within the end-to-end workflow. The accuracy of the data produced by the DMC enables a more automated process for downstream applications, thus resulting in faster throughput. After post-processing, imagery can immediately be brought into all stages of the photogrammetric workflow – aerotriangulation, feature collection, DTM generation, orthorectification, and more. Whether you employ the complete photogrammetry suite or third-party digital photogrammetry software, the DMC provides the imagery you need to meet the demands for small- or large-scale mapping at engineering-scale accuracy.

IMMEDIATELY ACCESSIBLE ACCURACY

The adoption of a digital workflow for aerial photo flight missions results in the need to manage and store large quantities of image data. TerraShare makes this possible by streamlining and speeding the distribution and retrieval process with enterprise production management tools designed specifically for the earth imaging market.

TerraShare is Intergraph's cost-effective, automated data management system. It provides accessible and secure long-term storage and management of digital imagery files, DTMs, vector data, and geospatial information in a work group or enterprise setting. The modular integrated design of TerraShare addresses geodata management and distribution needs within a single environment – regardless of the number of operational workflows that exist in the organization.

San Miguel de La Palma Island, Canary Islands, Spain
Image courtesy of Stereocarto, S.L., Spain.

ACCURACY FOR MARKET ADVANTAGE

The DMC system is capable of tackling the challenges of tough environmental conditions and the demands of daily project workloads and deadlines for multiple or large projects. With other systems, time of day and unfavorable weather conditions pose obstacles to achieving the best results in one flight. With high flexibility to allow recording of complete data by varying altitude and aircraft speed, the DMC ensures the maximum capture rate is achieved despite flight conditions. And with embedded technology to capture multispectral and panchromatic images in one flow, an on-board video image control can help identify environmental changes. Issues such as reflections and shadowing can be detected immediately so blocks or strips can be reshot during the same mission, avoiding landing and post-mission reflights.

In addition, the DMC offers a first, on-site quality check of acquired images without the delay associated with film processing, thereby helping to simplify logistics for out-bound missions and flights covering areas with restricted permissions. Designed to give flight companies a market advantage as they deliver extremely accurate data for imagery or as the basis for exploitation processes, the DMC vastly improves productivity in acquiring data by providing the following capabilities:

- A complete digital workflow adds precision and efficiency to earth data capture. With the camera, on-board data storage, airborne system management, and post-processing hardware and software, the DMC addresses every stage of the

Specifications

- 4 high-resolution 7K x 4K panchromatic cameras
- Final output image: 7,680 x 13,824 pixels
- Field of view: 69.3° cross track x 42° along track
- Lens system: 4: x f = 120mm/f:4.0
- Four multispectral 3K x 2K cameras: red, green, blue, and near infrared
  - Spectral sensitivity:
    - Blue: 400-580 nm
    - Green: 500-650 nm
    - Red: 590-675 nm
    - Near infrared: 675-850 nm
    - Near infrared alternate: 740-850 nm
    - Custom filters available upon request
- Final output image pan-sharpened RGB or CIR: 7,680 x13,824 pixels
- Lens system: 4: x f = 25mm/f:4.0
- Shutters and f-stop: continuously variable 1/50 – 1/300 sec f/4-f/22
- SSD in-camera removable storage, capacity 330 GB ~ 1,200 images. Extra cartridges available.
- Maximum frame rate: 2.1 sec/image.
- Radiometric resolution: 12 bit (all cameras)
- Operation envelope: up to 8,000 meters (non-pressurized)
- Camera weight: 88 kg
- Z/I Mount weight: 48 kg

workflow – from mission planning through post-processing – to capitalize on the accuracy, speed, and simplicity of digital technology.

- CCD frame sensor technology delivers the best geometric accuracy. The DMC is designed around matrix array CCD imaging elements to ensure rigid image geometry equivalent to a precision-film platen. Furthermore, the DMC extends the size of array CCDs by amalgamating eight individual array cameras into a composite system.
- FMC eliminates image blur. Operating in Time Delayed Integration (TDI) mode, fully electronic FMC greatly extends the operating envelope by compensating for much higher V/H ratios than mechanical systems. Enabling a large sensor area along the flight strip allows long exposure times while maintaining safe air speeds with a fixed wing aircraft at low altitudes.
- Twelve-bit per pixel radiometric resolution ensures exceptional image clarity. Twelve-bit data depth enables better exposure sensitivity, allowing details to be recorded on the CCD even in bright or dark exposures due to reflections, shadowing, or clouds, thus increasing the number of flying days considered acceptable.
- Imagery is ready for the direct production of all types of mapping and image analysis activities and products. Based on proven, central-perspective geometry that is currently employed in all commercial softcopy photogrammetric systems, imagery collected from the DMC is ready for the exploitation process without the addition of front-end software modules.
- Modular system ensures access to the latest, most advanced aerial photogrammetric functionality. Equipped with next-generation technology in electronics, optic design, storage media, and sensor technology for the best aerial photogrammetric functionality available, the DMC's modular design also offers the flexibility to interchange components with new, proven technology as it becomes available.

Integrated Photogrammetric Workflow

With the ImageStation photogrammetric software suite, GIS and remote sensing deliverables can be produced easily and efficiently in a reliable, integrated environment. ImageStation features innovative and flexible functionality for project and data management, scanning, orientation and triangulation, feature collection, DTM generation, and orthophoto generation. The ImageStation suite of products includes:

- **ImageStation Photogrammetric Manager** – Provides the photogrammetric data management tools required for a production workflow, including features to perform bulk input and output of photogrammetric data and to archive and restore projects.
- **ImageStation Digital Mensuration** – Provides a powerful, multi-image point transfer and measurement environment for a photogrammetric triangulation workflow.
- **ImageStation Automatic Triangulation** – An automatic image point extraction and triangulation package that delivers the best-matched, multi-ray tie points by using robust, built-in bundle adjustment during all the phases of the image matching operation.
- **ImageStation Stereo Display/Feature Collection** – Provides easy-to-use tools for interactively collecting map feature geometry (2D and 3D) and attributes.
- **ImageStation DTM Collection** – Provides an interactive method for collecting DTM data, elevation points, breaklines, and other geomorphologic features in stereo models.
- **ImageStation Automatic Elevations** – Provides automatic extraction of DTM elevation points from aerial or satellite stereo imagery.

- Large-capacity data storage increases data-capture capability. Our lightweight SSD system contains no moving parts for superior performance and reliability. SSD's RAM system will store 1,200 images and can be changed during flight operations providing unlimited storage capacity. This is the equivalent of more than two 500 foot film rolls.
- Simultaneous capture of panchromatic and multispectral data in one pass speeds successful mission completion. The unique camera assembly of four high-resolution 7k x 4k panchromatic camera heads and four 3k x 2k multispectral camera heads captures exactly the same portion of the earth's surface in one exposure. Image output from one exposure includes a full-resolution panchromatic output (7680 x 13824). The red, green, blue, and near-infrared outputs maintain a 3K x 2K resolution but are co-registered to and cover the entire panchromatic scene.

WHY SWITCH TO DIGITAL?

Undeniably, digital cameras offer clear advantages over film-based cameras. The most significant advances the DMC provides over a film-based approach include:

- Superior radiometric resolution
- Increased accuracy of photogrammetric measurements
- Reduction of materials and labor costs to produce digital imagery
- Faster turnaround time from flight to image data
- Multispectral image acquisition during one flight
- Electronic FMC
- Clean digital data for better-quality image products (orthos)
- Enables more potential flying days and flying hours per day
- Completely digital workflow throughout GIS and remote sensing projects

Additional advantages provided by the DMC compared to other large-format digital cameras include:

- **The only totally field-serviceable, completely self-calibrating, large-format frame sensor in the world;** modular design ensures it does not have to go back to the factory, giving you far greater uptime than other large format sensors
- Best optics module on the market, featuring extended signal quality and high image contrast from Carl Zeiss
- Pressure-compensated lenses for stable focal length
- Custom-built, stable, and reliable shutters designed for airborne operation with only seven moving parts; automatically synchronized and self-adjusting
- Independent aperture settings on all eight heads with auto or manual exposure
- Robust and reliable camera frame design
- Gyro-stabilized digital Z/I Mount ensures quality images during extreme flight conditions
- Easy-to-use Z/I Inflight FMS with new in-flight control utilities and integrated computer (separate laptop computer no longer required)
- Modular commercial off-the-shelf (COTS), peripheral hardware design, enabling easy upgrade of components (e.g., electronic boards, hard disks)
- High-grade industry components for safe and reliable aircraft installation and operation (high-grade connectors, environmental tests against DO160, a minimum of cable connections, crash load tests against DO160, acceptance tests against RTCA/DO160D, and ISO 7137 for flight height up to 8,000 meters in non-pressurized aircraft)
- CAN logger for remote diagnostics and proactive maintenance
- Flexible field data transfer concept for all types of project scenarios (direct post-processing, field data copy, field data post-processing, removable media for data transfer)
- Post-processing software offers users a wide variety of different output formats (B/W, RGB, CIR, 4-channel TIFF)
- Standard computer hardware for image data post-processing
- Complete camera system, including all components and peripherals, provided through a single source
- Customizable solution; components already available can be integrated (e.g., camera mount, sensor management, computer hardware)
- Complete photogrammetric softcopy solution can be provided from a single source
- Product quality and operational stability provide operational cost savings for the user
- Worldwide service network ensuring on-site service in more than 70 countries
- "Central perspective" image data similar to analog aerial images
- Optional GPS/IMU system
- Outstanding results – even in unfavorable weather/lowlight conditions

MGGP Aero, Kosciuszko Square, Gdynia, Poland
Image courtesy of MGGP Aero SP z o.o.

About Intergraph

Intergraph Corporation is the leading global provider of spatial information management (SIM) software. Security organizations, businesses, and governments in more than 60 countries rely on the company's spatial technology and services to make better and faster operational decisions. Intergraph's customers organize vast amounts of complex data into understandable visual representations, creating intelligent maps, managing assets, building and operating better plants and ships, and protecting critical infrastructure and millions of people around the world.

For more information, visit www.intergraph.com.

Front cover image of Cruther's Point, St. Martin's, Isles of Scilly, courtesy of Ordnance Survey.