

Intergraph's PhoWo Message

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ABSTRACT

Large format digital camera systems have been successfully introduced into the earth imaging market. This paradigm shift from analogue to digital technology has created a big impact not only to the technical workflow, but also to business models and data utilization. Data production times are drastically going down, the multiple one-shot data output generates a broader range of applications. To meet these needs as a leading edge technology provider Intergraph has clearly focused on permanent enhancements for the DMC camera technology as well as the ImageStation workflow, in particular the orthophoto production. Thus, Intergraph's PhoWo message will follow the motto "Smaller-Lighter-Faster" and introduce new DMC features including SSD storage technology plus PixelQue, the latest ImageStation development for high productive QA/QC tools along with the orthophoto production.

1. DMC – PRODUCT AND WORKFLOW EVOLUTION

Having more than 85 years experience in camera development Intergraph's Z/I team has put many efforts into a very robust and reliable camera design. This includes high requirements on the geometric and radiometric results coming from high quality components like a stabile camera frame, Dalsa CCDs, Zeiss optics and the special designed flight data storage units (FDS). Today the Digital Mapping Camera DMC is well known in the industry and accepted as the leading large format camera in the market. In addition the concept of fully field-serviceability managed through a world wide support was and is a key factor to success.

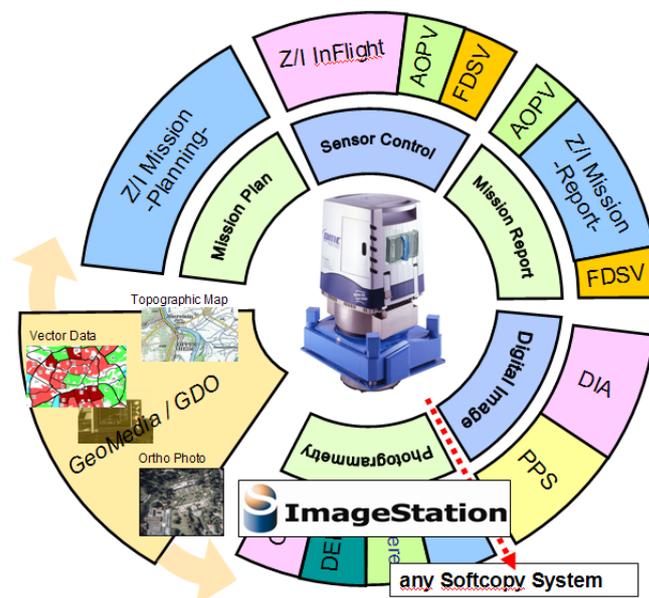


Figure 1: DMC Software products and data workflow 2007

However, technologies are evolving and business models become adjusted. This leads to a permanent need to enhance the entire data production workflow. Flight companies and photogrammetric production shops have to generate faster results with different end user requirements on quality and accuracy in order to meet market needs and to stay competitive. Consequently these are the objectives:

- New features and productive enhancements along with the complete digital workflow
- Protecting customers investments through scalable and upgradable solutions
- Continue to offer complete solutions for those who prefer one-stop-shopping

It is not only the sensor, but all components of the operational workflow composing high quality and fast throughput. Therefore, within the last 12 months Intergraph has released several new hardware and software features. Latest highlight is the DMC's Solid-State-Disk storage technology, which is first time ever introduced to the photo flight business and leads to another level of quality and flexibility during the airborne operation. This is what's new:

1. Using Geomedia's data object Technology (GDO) to manage and monitor all project data
2. Z/I MISSION for full 3-D Mission Planning and Reporting
3. Z/I INFLIGHT to replace former Zeiss and Z/I Flight Management Systems
4. Solid-State Disk Storage Technology (SSD) – no cables, less weight, less space
5. Many enhancements within the Post Processing Software PPS

1.1. Z/I Mission

The new Mission planning and reporting tool is fully redesigned. It has no need for using the MicroStation platform anymore, which has drastically reduced costs. The graphical features for designing the flight plan are made available through embedded Geomedia tools with no need for an extra Geomedia license. In addition the Geomedia Data Object technology (GDO) is used to manage all camera and flight related meta data in one common data base along the complete DMC data workflow from planning to flight operation to Mission reporting and post processing (see Figure 1). Once flight and image data are downloaded Z/I Mission allows the user even to select images, blocks or sub-blocks and immediately start post processing.



Figure 2: Z/I Mission planning result (here: corridor footprints)

Z/I Mission is designed to generate full 3-D flight plans. This allows an excellent flight preparation also in mountainous areas. Consistency checks indicate overlaps running out of specifications and help to adjust mission parameter or to break flight lines. The software allows to upload any type of popular DTM formats available. For backdrop information any kind of raster maps or geo-referenced imagery are accepted. This includes standardized products like the CAA charts. Results are available in digital form or by hardcopy. The popular KML/KMZ output format allows to easily forward planning results within the enterprise or to customers for review and approval (s. Figure 2).

1.2. Z/I INFLIGHT

The new Flight Management system Z/I InFlight is the core component for the complete airborne camera environment. It is the only system to support, control and monitor both the flight and the camera operation at the same time and through one operator interface only. There is no need for a separated laptop anymore. Keyboard and mouse are optional. It comes with a high resolution graphical colour touch screen and a pilot display (2 screen sizes available). Special characteristic is the extreme small form factor. The ruggedized hardware secures high reliability up to 8.000 m flight (valid for the complete DMC system). Z/I InFlight is ready to operate the DMC as well as the RMK TOP analogue cameras. The design is prepared to easily run different sensor control modules (SCM) in the future.

Z/I InFlight includes many In-Flight-Control tools to monitor flight parameter as well as the camera operation. The Airborne Onboard Project Viewer (AOPV) displays the flight lines, mid exposure points and the video images from the integrated lipstick video camera. To control the DMC image quality the operator is able to pre-process raw image data during the flight operation (FDS Viewer; Z/I ImageView). He may check image histograms as well as camera setting for review and adjustments. In summary please pay attention to the following product highlights:

- Only system with integrated video camera support
- Independent display for pilot and camera operator (user selectable)
- Only system with integrated camera control
- In-flight project overview (Airborne Onboard Project Viewer AOPV)
- Real time digital data access (during operation via FDS Viewer)
- In-flight data Quality Control (Z/I ImageView)



Figure 3:

Z/I InFlight for Flight Management and Camera Control (front and back plane)

1.3. DMC with Solid state disk technology (DMC SSD)

System reliability, robustness, quality and a fast workflow in line with minimum cost of ownership are the key success factors in today's (digital) flight business. For this reason and among other camera features Intergraph has introduced very soon the Flight Data Storage units (FDS). They have replaced the very first generation off-the-shelf storage design and increased storage security

drastically to best rates ever with no need for a redundant data storage concept. Installation needs just 3 cables and for FDS transportation no cable connectors need to be touched at all.

However, storage technology does never stop evolving. Meanwhile new solid state disk drives (SSD) are introduced to the market. Nowadays the increasing capacities have become extremely interesting also for volumes of image data, even if still pretty expensive. Since the DMC's architecture does easily allow to integrate these cartridges into the camera housing Intergraph was the first vendor to introduce SSD technology within a large format camera, the DMC SSD.



Figure 4:

DMC with Solid-State-Disk (SSD)
Storage Technology

The SSD storage design represents another major step to reduce operational flight costs. It will allow customers to operate much smaller aircrafts like a Cessna 206 without any power modification. Other important features are

- Plugs directly into side of DMC housing
- Usage in unlimited altitude (non-pressurized aircraft)
- High Reliability (no cables at all!)
- Drastical weight reduction (eliminates 87kg of 3 FDS)
- Reduced power consumption
- Smaller system installation footprint
- Extra SSD cartridges available and can be exchanged in flight
- First version with 1000 images capacity
- Download via Read out station in 1 hour (1000 images)
- Future enhancements planned (capacity, download time)

The SSD technology fits perfectly into the DMC design concept and offers customers different options to meet different requirements. The DMC SSD configuration works with both storage media: SSD cartridges or 2 FDS units. Existing DMC customers can upgrade to SSD storage for operations in smaller aircrafts, but still use FDS technology, if in need.

1.4. Post Processing System (PPS)

The Post Processing software converts DMC's raw high resolution panchromatic and low resolution RGB and NIR data into complete images ready to be used for further exploitation. The DMC PPS

software runs usually on an office server, but can also be installed on any workstation, e.g. the copystation for mobile and remote operations. DMC post processing involves the following steps:

- Definition and selection of output formats
- Applying for radiometric calibration
- Applying for geometric correction
- Matching of the 4 panchromatic high resolution Images
- Co-registration and upscaling of the RGB and NIR data
- Pan sharpening

All these steps have been well investigated and established. They are described in several presentations starting at ISPRS congress 2000 in Amsterdam. Beside that, a close relationship with the DMC user community guarantees an excellent procedure to permanently update the quality of PPS results due to existing requirements. The latest version completes

- Enhancements on radiometric and geometric post processing
- Options for distributed and batch processing to reduce processing times

/Doerstel, 2007/ presents latest news on radiometric and geometric post processing. The principles on Distributed processing (PPS-DP) have been introduced already in 2005 /Rosengarten, 2005/. Intergraph offers different configurations and options on post processing due to customers requirements and throughput. Today's specification for a standard dual processor server guarantees about 1 min 30 sec full processing time per one image, which meets most of the requirements. However, for high speed post processing with PPS-DP this can be drastically reduced to 20 sec. Figure 5 shows a high speed PPS-DP server configuration.

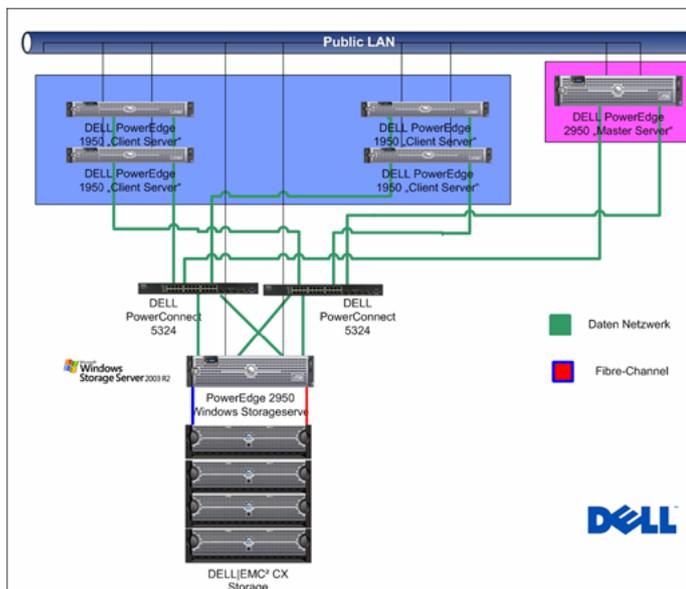


Figure 5:

PPS-DP Server configuration
for high speed post processing

2. PROJECT PIXELPIPE

Initiatives like Google Earth and MicroSoft Maps Live have drastically increased the demand for imagery. Many large national and regional imagery programs are established. Disaster management requires fast response. Environmental and agricultural projects like NAIP in the US or IACS in the EU require permanent monitoring. These circumstances result into

- Larger projects and more images per year
- Increase of multi spectral and near infrared data
- Faster orthophoto production and reduced project times

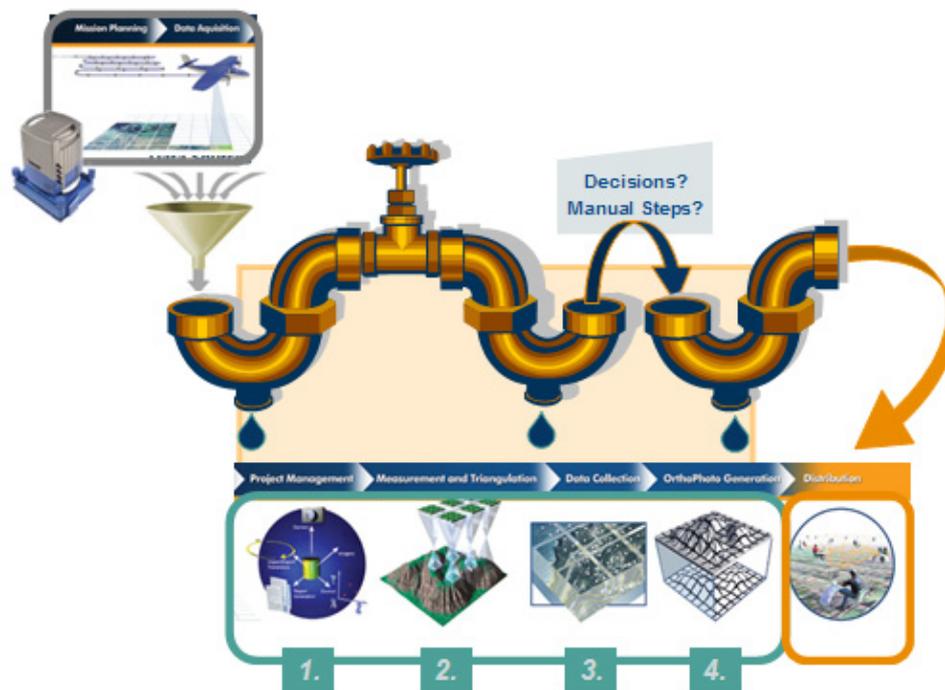


Figure 6: PixelPipe - A highly automated Ortho Production Process

Therefore future photogrammetric data production and orthophoto production in particular will require more than just high sophisticated automated features and algorithms. There is a need for an optimized workflow with technics and tools to help reducing production cost. Intergraph has initialized a project called PixelPipe which will meet all these demands. It is designed to be completed and implemented in different phases (see also Figure 6):

- Quality enhancements for OrthoPro including semi-automatic tools for the time consuming QA/QC work as well as automated tools for radiometry and color management (PixelQue). This phase is completed, PixelQue was released in Q2 of 2007
- Productivity gains through high automation and scalable IT architectures adapted to the workload and including distributed processing (e.g. DMC PPS-DP, Ortho rectification, AT, DTM matching) - ongoing

- Enhanced production management and status review including Graphical Project View, Task management and seamless production tracking almost in real time - next phase
- Redesign of DTM production including QA/QC - next phase

/Madani, 2007/ explains details on project PixelPipe and the different phases supposed to be completed in 2008. The entire photogrammetric production will become a faster “straight forward” process with a chance for a more cost effective output within larger projects. This tendency will be underlined by extreme productive digital large format camera technologies. The latest DMC news as well as project PixelPipe document Intergraph’s involvement to meet this goal.

3. REFERENCES

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