New Products and Services from IGI

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INTRODUCTION

Founded in 1978, IGI has been active in the field of aerial survey since 1982. That work resulted in *CCNS – Computer Controlled Navigation System*, the first guidance and management systems for aerial survey flight missions. Since the ISPRS Amsterdam Congress, *AEROcontrol*, based on fibre optics, is offered, which has prooven as a very accurate and reliable GPS/IMU system. In 2004 IGI introduced a mid-format digital camera of the type *DigiCAM-K/14* with 14 Mpixel and combined this unit with the IGI airborne laser of the type *LiteMapper*.
At the 2006 InterGEO, IGI in cooperation with 3DLM, came down from the air to the ground, presenting a mobile terrestrial laser system of the type *StreetMapper*. At this years PhoWo IGI is pleased to present the upgraded *DigiCAM-H/39*, which can be operated together with the *LiteMapper* or as a single airborne camera or even in a combined four (4) camera solution with appr. 150 Mpixel. For servicing all type of analogue and digital cameras and other sensors, the earlier *WWMP - World Wide Mission Planning* and *WinMP - Windows based Mission Planning* and documentation are replaced by a new *Mission Planning and Documentation Software*.

1. NEW PRODUCTS

In the last decade, the introduction of digital cameras and airborne laserscanners have lead to a rapid increase in the speed of product cycles of aerial mapping sensors. In this context, the modularity of the systems, becomes more important. In a modular system, existing components can be re-used in combination with new components and therefore reduce the cost of a system modernization substantially.
With the products described in the chapter, IGI provides a maximum of modularity and flexibility. All components can be combined with the other products and with nearly all main airborne sensors available today.

1.1. Mission Planning & Documentation Software

In company to *CCNS*, IGI provides interactive programs to plan survey flight missions and to document the flown missions. The first software was *WWMP* (world wide mission planning). This was replaced by *WinMP* (windows based mission planning). Due to the evolving field of airborne photogrammetry (new digital sensors, better DTM support due to higher ground sample resolutions) new features have to be added to mission planning. IGIs next mission planning software contains the following highlights:

- Advanced sensor support for required altitude determination and coverage simulation. In addition to traditional analogue cameras, newer sensors are fully supported: digital cameras, LiDAR, line scanner etc. Special attributes, e.g. for the determination of the required altitude take special sensor features into account (GSD, Swath width, ...).
- Combination of sensors is supported, too. E.g. the combination of a *DigiCAM* and a *LiteMapper* will be considered in respect to combined coverage.
- Advanced coordinate system support provides the operator with tools to define coordinate systems. Vertical aspect of plane systems refers to EGM96 datum by default if not stated different. To precisely adapt to local maps it will be possible to create correction system based one or more local identical points.

- Advanced map support: maps can be associated with different coordinate systems then used in the mission planning.
- Advanced DTM support, with
  - real time calculation of coverage / overlap,
  - dynamic base length adoption for fixed forward overlap with analogue / digital frame sensors
  - dynamic flight levels for given acceptable sampling resolution interval
- Planning objects for fast and easy interactive creation of missions
  - Flight line: creation by giving/modifying start and end position. Levels by DTM, dynamic base length by DTM.
  - Block: create a block mission by giving/modifying reference line and number of copies via mouse or keyboard input. Levels and dynamic line distance by DTM.
  - Area Propose: automatically create mission planning to cover a given area by a closed polygon. Higher complexity of areas possible (holes, span many polygons). Levels by DTM.
  - Track Propose: automatically create mission planning to cover a given track by a polygon & margin. Levels by DTM.
- Export / import mission planning and executed mission to *Google Earth*™.

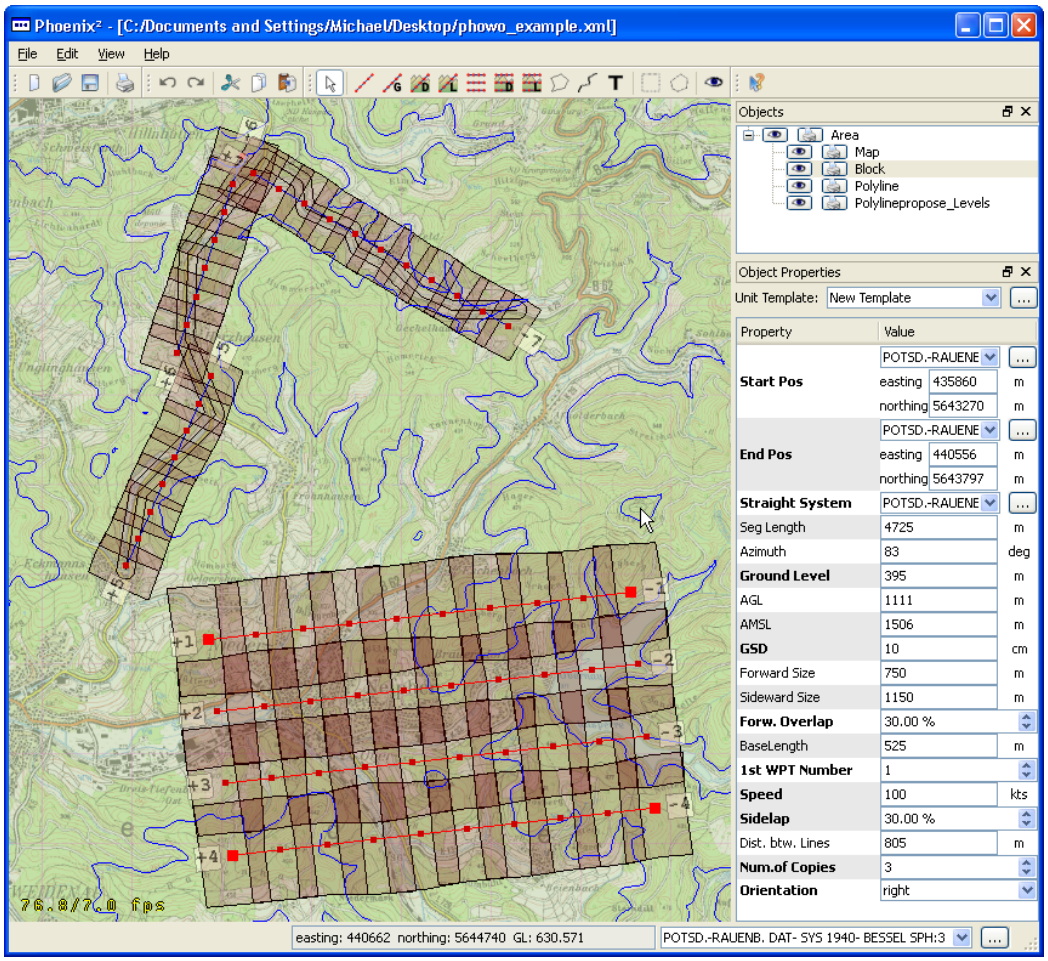

Fig. 1: Screenshot from the new Mission Planning and Documentation Software

1.2. CCNS & DCI

The *CCNS4* (Computer Controlled Navigation System) is able to operate and control most airborne large-format digital and analog cameras [Kremer 2001]. While the analog cameras are mostly connected directly, the integration of the digital cameras function takes place via the *DCI – Digital Camera Interface*.

By the following noted interfaces, the digital cameras can be adapted to CCNS/AEROcontrol:

- *DCI/UC-D* --> VEXCEL, *UltraCam-D*
- *DCI/UC-X* --> Microsoft/VEXCEL, *UltraCam-X*
- *DCI/DMC* --> Intergraph, *DMC*
- *DCI/JAS* --> Jena-Optronik, *JAS*
- *DCI/DAS* --> GeoSystem, *3-DAS-1*
- *DCI/DiM* --> DIMAC Systems, *DiMAC*

On operating a *CCNS/AEROcontrol* with a *DCI*, the following functions are available as well:

- Precise drift setting of the mount according to
  - planned track or
  - flown track
- Precise leveling - nadir direction - of the gyro-mount:
  - *GSM-3000*
  - *T-AS*
- Reading and storage of the mounts heading/pitch/roll values for the instant of exposure for a correct lever-arm correction, resulting in NO drift and shift parameters:
  - *GSM-3000*
  - *T-AS*
  - *PAV30*

Naturally all noted functions are available for IGIs *DigiCAM-H/39* as well.

1.3. AEROcontrol

The *AEROcontrol-IId* GPS/IMU system with its related *AEROoffice* post-processing software has become a standard product for most aerial sensors, because of its excellent results and reliability. The IGI AEROcontrol was appointed by Intergraph and Jena Optronik as the first choice GPS/IMU system and is recommended by Microsoft Vexcel.
For applications where the high accuracy of *AEROcontrol-IId* is not necessary, *AEROcontrol-Id* is an alternative with a lower performance for a lower price. As an option, the *AEROcontrol-Id* can be upgraded to *AEROcontrol-IId* level.
AEROcontrol systems are typically operated with the following types of sensors:

- Analog mapping cameras
  - Wild/Leica*: RC10, RC20, RC30*
  - Carl Zeiss Jena: *LMK, LMK-1000, LMK-2000*
  - Zeiss-Oberkochen: *RMK-A, RMK-TOP*
- Digital mapping cameras
  - VEXCEL: *UltraCam-D*
  - Microsoft/VEXCEL: *UltraCam-X*
  - Intergraph: *DMC*

    - Jena-Optronik: *JAS*
    - GeoSystem: *3-DAS-1*
    - DIMAC Systems: *DiMAC*
    - Rollei: *AIC*
    - IGI: *DigiCAM-K/14, DigiCAM-H/22, DigiCAM-H/39*
- Hyperspectral scanner
    - Norsk Elektro Optikk: *VNIR-1600, SWIR-320i*
- LiDAR
    - IGI: *LiteMapper-2800*, *LiteMapper-5600*, *LiteMapper-5600/200*
    - IGI + 3DLM: *StreetMapper*
    - Riegl: *LMS-S560*
- SAR systems
    - DLR, Oberpfaffenhofen
    - ONERA, Fort de Palaiseau

1.3.1. AEROcontrol-Id

The specifications of AEROcontrol-Id are as follows:

- position/height: <0.1m RMS (dGPS)
- phi/omega/kappa: 0.008/0.008/0.012 deg RMS
- Options:
    - RT-dGPS via *OmniSTAR-HP / -XP*
    - Glonass
    - Direct Inertial Aiding
    - Upgrade to *AEROcontrol-IId* level

1.3.2. AEROcontrol-IId

The specifications of *AEROcontrol-IId* are as follows:

- position/height: <0.1m RMS (dGPS)
- phi/omega/kappa: 0.004/0.004/0.010 deg RMS
- Options:
    - RT-dGPS via *OmniSTAR-HP / -XP*
    - Glonass
    - Direct Inertial Aiding

1.4. DigiCAM-H/39

The all new *DigiCAM-H/39* is the successor of IGIs *DigiCAM-H/22* [Grimm & Kremer 2005]. The main changes of this new development are:

- Nearly doubled amount of pixels (22Mpixel --> 39Mpixel)
- Improved image repetition rate, earlier 2.5sec now 1.9sec even with shorter repetition rates for a certain amount of images (“burst mode”)
- Increased image storage capacity from 1x *ImageBank* = 850 images (22Mpixel) to 2x *Storage Unit* = 3.600 images (39Mpixel)

- Easy switching from one *Storage Unit* to the other by software
- Shortening of down-load times after a mission earlier *ImageBank*, 850 images --> 85min new *Storage Unit*, 1.800 images --> 35min
- Optional Solid State based *Storage Unit* for high altitude operations
- Large flexibility on data download from the *Storage Unit* to an office PC via
    - USB2.0,
    - IEEE 1394a (Firewire) and
    - External SATA
- Deep integration of *DigiCAM-H/39* and *CCNS* or *CCNS/AEROcontrol* resulting in storage of meta data for each image
- Easy addressing of the images taken to mission planning and events registered during flight
- Possibility for easy software upgrades for *DigiCONTROL* computer on site by the operator
- Reduced cabling
- Variety of high quality, calibrated lenses for RGB or CIR, e.g.
    - 35mm --> wide angle
    - 50mm --> LiteMapper operations
    - 80mm --> standard lens
    - 100mm --> orthophoto production
    - 150mm --> special projects, e.g. taking images of highly frequented objects with 5cm GSD, e.g. London Heathrow, Amsterdam Schiphol or Frankfurt Rhein/Main
    - 210mm --> Special mission application
    - 300mm --> Special mission application

Fig. 2: DigiCAM-H/39 system

1.5. LiteMapper-5600/200

The *LiteMapper-5600* LIDAR terrain mapping system described in [Grimm & Kremer 2005] was improved by the following topics:

- 200kHz pulse rate
- Range up to 1800m
- Indication of scanned altitude in navigation display
- Redundant hard disk array (RAID)
- Optional: removable hard disks

Results of the *LiteMapper* system are reported later in this book [Flatman & Vinther 2007].

1.6. StreetMapper

The *StreetMapper* terrestrial 3D laserscanning system is described in detail later in this book [Kremer & Hunter 2007].
As can be seen from Fig. 3, an *AEROcontrol-IId* system, usually operated in a survey aircraft or helicopter is mounted on top of a vehicle together with four scanners and two cameras.

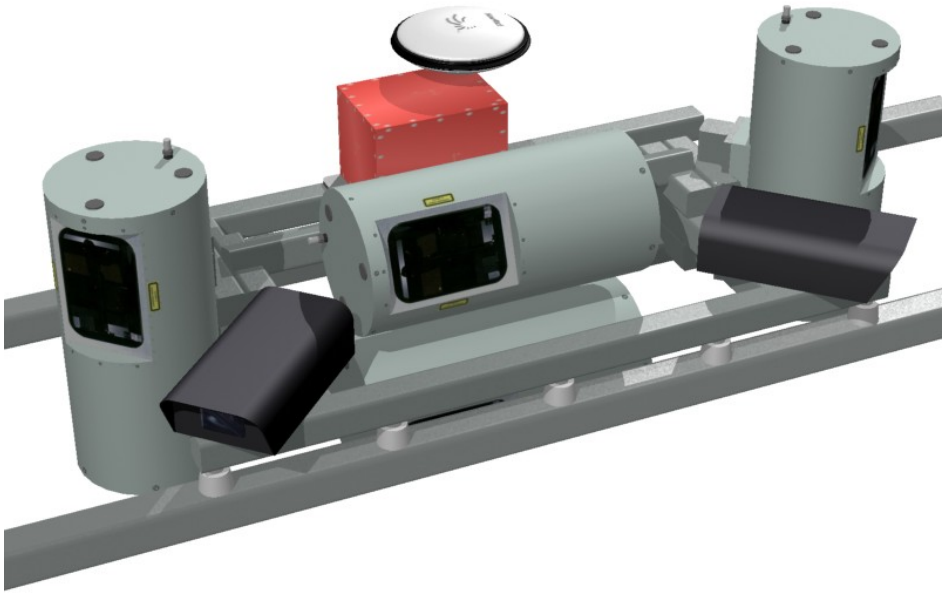

Fig. 3: The StreetMapper sensor platform

2. OPTIMIZING AIRBORNE OPERATIONS

The availability of modern technologies like GPS/IMU systems or advanced airborne GPS leads to a significant commercial advantage for the user. To optimize this advantage, the user shall adapt the workflow to take the maximum benefit of the additional information that new technologies can provide.
This fact should be demonstrated with the two following examples:

2.1. Modularity of Equipment

Modern systems for aerial surveys often represent a large investment. A large-format digital mapping camera, inclusive guidance/management, GPS/IMU, stabilized mount, office computers and software easily reaches an amount of more than one million Euros.

For that reason IGI has taken care that different sensors for airborne and terrestrial operations can be combined or exchanged. This means one sensor can be operated in multiple applications for airborne and terrestrial ones.
For example, the IGI *LiteMapper* system contains several independent subsystems, providing a max. flexibility in operation. E.g. the included CCNS and AEROcontrol systems also can be operated with any else airborne camera. The LiteMapper can be combined with one or several IGI DigiCAM systems for efficient data collection of LiDAR data and images at the same mission. Also IMU data is provided for both or multiple sensors. The combination of LiteMapper & DigiCAM is most favored by clients. If other sensors, like one or two hyper spectral scanners should be operated, they can easily be combined with *CCNS/AEROcontrol* and *DigiCAM*. During periods of bad weather, the IMU can be used together with a *StreetMapper* system for terrestrial operation. De-installation and new installation can be within ½ hour by the operator.

2.2. Optimizing Airborne Operations

During the 50th PhoWo, IGI has shown a poster noting that, on operating *CCNS/AEROcontrol* the following changes in the workflow can be established:

- No AT with DG
- No limitation of length of flightlines with ISO
- No Cross-lines
- No GPS shift & drift parameters
- No S-turns or 8-turns
- Corridor Projects: Single strips with four (4) GCPs instead of three parallel lines

What do these changes mean?

It means that a large amount money can be saved, if the new possibilities are operated.
An example:
Our investigations have shown that approximately 20% is the amount of the flying, if cross-lines with related turns are operated. This can lead to the following:

Single engine a/c	Twin engine jet
300h á 700 EUR/h = 210.000 EUR	200h á 2.500,- EUR/h = 500.000 EUR
effort for cross-lines: 20%	effort for cross-lines: 25%
possible SAVINGS: 42.000 EUR/year	possible SAVINGS: 125.000 EUR/year

The noted savings may demonstrate that it is worth thinking on making use of modern GPS/IMU technology, where cross-lines are not necessary any more!
At least the same or more savings can be seen on operating the survey aircraft without S-turns or 8-turns, which (according to the actual manufacturer brochures) are still needed by competing GPS/IMU systems.

If modern instruments are used and the related techniques are operated meaningful, the modern systems pay for themselves on one larger project, at least within one year!

3. CONCLUSION

With its high modularity and compatibility, IGI systems do represent state of the art solutions for modern digital surveying. This includes all considerations to turn step by step from analog to digital equipment.
Nowadays the most sensitive and accurate sensors are available for aerial survey application. A positioning accuracy in the centimetre range and an attitude accuracy within 2 - 3 thousands of a degree can be provided even over areas of several hundred of square-kilometers. For a lot of companies and institutions this already represents the results of their daily operations.
Special expert knowledge is required to operate and manage aerial survey projects in the most efficient way to make the company earn more profit. Also for receipt of high accurate results, the needed knowledge and care of involved work-flows is required.
It starts to choose the right sensor equipment and continues in a careful selection of required software for data or image processing. For example some aerial triangulation software, offered on the international market, is not able to handle GPS/IMU data correctly.
For this reason IGI undertakes special consideration to customer consultancy and an efficient training. This is done in order to transfer the knowledge for efficient system operation with respect to the changes in the overall workflow that come along with modern digital survey equipment. Further more IGI does appreciate the newly introduced *GEOENGINE* course now established by the Institute of Photogrammetry of Stuttgart University.

4. REFERENCES

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