News from IGI

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ABSTRACT

In 2009 IGI introduced its new Sensor Management Units (SMU) with its modular concept to exchange certain system components for different project and seasonal requirements. At the heart of nearly every precise system is its *AEROcontrol/TERRAcontrol* unit which can be used for airborne and terrestrial missions in order to be flexible and cost-saving [cf. 1, p. 41ff].
Taking the strength of this Modular System Concept, IGI now introduces its new *RailMapper* – mobile mapping system. Based on the world's most accurate mobile mapping system, *StreetMapper*, the new *RailMapper* system is applicable for clearance measurement, sign detection, new construction, refurbishment and monitoring of rails and tunnels.
IGI with its partners designed this new system and established a complete solution with related workflow. By using the unique modularity of IGI equipment, one mobile mapping system can be used for various tasks and applications. Completing todays requirements, the test area was also surveyed with an airborne *LiteMapper* system to get very high accurate railway crossing scheme results.
Quattro DigiCAM is a large format digital aerial camera system. Also based on IGI's Modular System Concept it is possible to configure one camera to capture both nadir and oblique imagery. *Quattro DigiCAM* – IGI's versatile aerial camera system is presented in this paper.
IGI, the first company to introduce a GPS based flight management system or Computer Controlled Navigation System for sensor flights worldwide, is taking the next step and developed a brand new *CCNS* system – version 5.

1. RAILMAPPER – A MOBILE MAPPING SOLUTION FOR RAILS

1.1. Introduction

Capturing data with mobile mapping systems using laser scanners and cameras represents a well-established survey technique. Introducing this survey technique on rails, IGI and its partners 3D Laser Mapping, Nottingham, UK and data analyst Nebel & Partner, Schleswig, Germany broaden their field of experience.

Figure 1: Test track no. 3710, km 23 – km 35

After installing the system on a TVT-700 (fig. 2) a test track was organized in collaboration with German Railways (Deutsche Bahn) on track 3710 from Weilburg to Aumenau (fig. 1) covering several tunnels.

The test track was nominally surveyed at 60 km/h, although some sections of it were performed at higher rates using a TVT-700 train with a top speed of 90 km/h; in general rail surveys may be performed at speeds of 100 km/h, or higher. Implementing result experiences directly into the hardware and software, *RailMapper* is now fully tested, operational and available.

1.2. RailMapper System Components

The new *RailMapper* system is equipped with

- two 360° high performance class 1, eye-safe laser scanners and
- a time-stamped video-camera system,
- a RGB-camera system for colouring the point cloud and
- a thermal-camera (*DigiTHERM*) system to detect overheated transformers.

Measuring up to 600,000 points/s the system has 2x250GB hot-swap disk drives to capture all laser data. For synchronizing each sensor IGI's *TERRAcontrol* system is used. *TERRAcontrol* is a GNSS/IMU system for precise determination of position and orientation of the sensors during data acquisition. To gain the best possible aiding of the inertial navigation system during periods of poor GNSS, the GNSS/IMU navigation system incorporates an integrated optical odometer and **D**irect **I**nertial **A**iding (deeply coupled real-time GNSS/IMU processing for improved GNSS data capture).

1.3. RailMapper Interoperability

The *RailMapper* is interoperable on different kind of vehicles. With this kind of solution, surveyors are flexible in their missions with one high-tech cost-saving solution. Fig. 2 shows a *RailMapper* installation on a TVT-700 tower railcar, fig. 3 shows the *RailMapper* mobile mapping system on a tram in Helsinki.

Figure 2: TVT-700 equipped with the RailMapper system

Figure 3: RailMapper as fitted to a tram in Helsinki

1.4. RailMapper Applications

Clearance measurements are used for the safe usage of railroads by normal trains and especially for oversize trains of enormous importance. Even small objects that protrude into narrowings or minimal displacement of railroads can cause great damage and costs. Possible slight rail movements or relocation of structures both require regular inspections and surveying. Interference with daily

train travel may not result from surveying activities. A prerequisite is a surveying train with a minimum speed of 90 km/h or more, so that it can be used on high-speed tracks [cf. 4, p. 305].

Additional *RailMapper* applications and functions are as following:

- Complete clearance measurement and analysis for safe train transfers and construction projects
- Track geometry, determination of the inner and upper edge of rails
- Quality assurance checks can be carried out
- Absolute track position, cross-sections and alignment
- Detection of overheated transformers
- Tunnel clearance and surface checks as well as profile measurements
- Collision detection
- Simulation of tree fall
- Update / continuation of infrastructure databases like DBGis

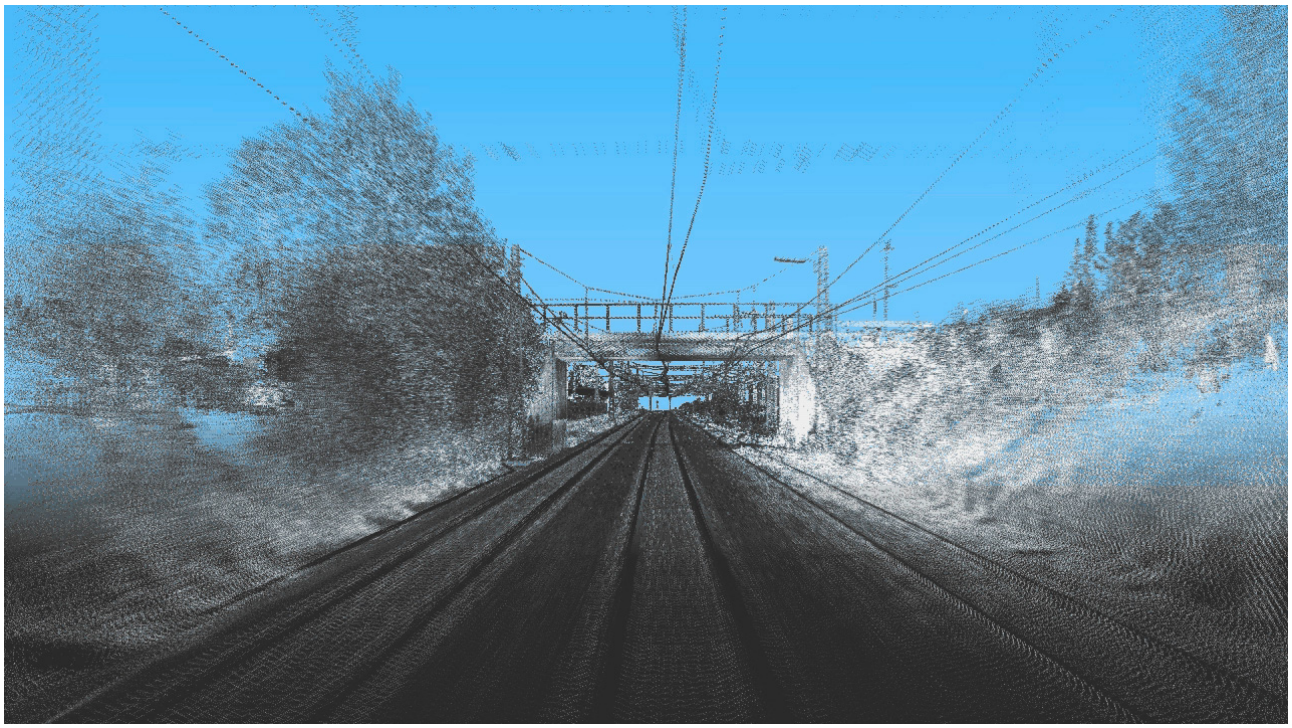


Figure 4: Survey of an electrified railroad with 90 km/h

Fig. 4 shows a screenshot of the survey with 90 km/h. After classification of the point cloud railroads, signs and surroundings are easily detected. Modelling in the point cloud for clearance measurement is available for freely definable reference blocks. For fast clearance of narrowings by track staff, a video with exact position coordinates and kilometer information can be generated.

1.5. Conclusion

The *RailMapper* system has been adapted from a well-proven system for streets and taken to railroads. Based on IGI's Modular System Concept the system is interchangeable to different vehicles. High accuracy levels and dense point cloud data make the *RailMapper* practical for many mapping applications such as clearance measurement or rail surveying with overhead wires.

2. QUATTRO DIGICAM – IGI'S VERSATILE LARGE FORMAT AERIAL CAMERA SYSTEM

The efficient capturing of nadir aerial imagery and the collection of oblique aerial images require different aerial cameras. Because of its modular design, the *Quattro DigiCAM* can be configured in different ways to equally fulfill both tasks [2, p. 1].

2.1. System configuration

The modular *Quattro DigiCAM* aerial camera system contains of four camera heads. Each head has up to 60 megapixels full colour resolution. Stitched large format images have an overall resolution of up to 236 megapixels. Four Sensor Management Units (SMUs) controling the camera are also used as image tanks and contain of 4 x 250GB solid state disk drives with no moving parts (fig. 5). The camera is operated with a single Graphical User Interface on a touch screen monitor. The operator can check quick-views and exposure histograms of the actually taken photos in real time and change all necessary settings of the camera. The *Quattro DigiCAM* can be changed to the oblique setup. Modification from a nadir to an oblique camera are made within two hours [cf. 2, p. 2-3], [cf. 1, p. 45f].

Figure 5: Quattro DigiCAM compact, rugged computer and storage unit (SMU)

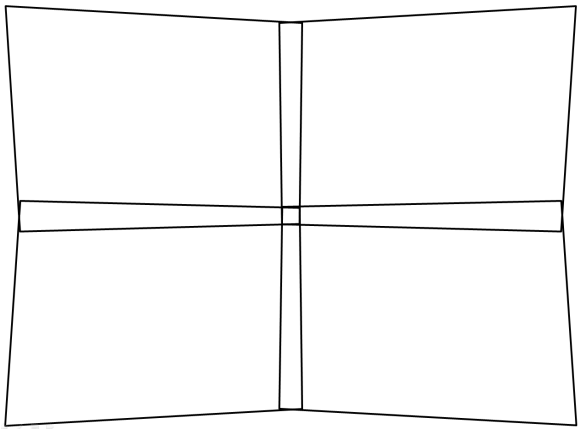
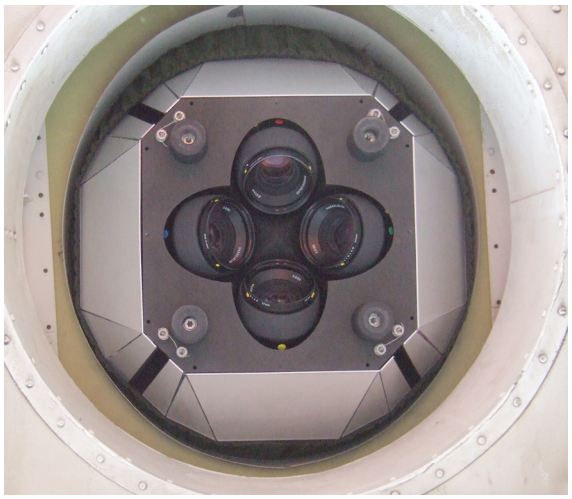


Figure 6: Left: *Quattro DigiCAM* Right: Footprint of a *Quattro DigiCAM* with 100mm focal length



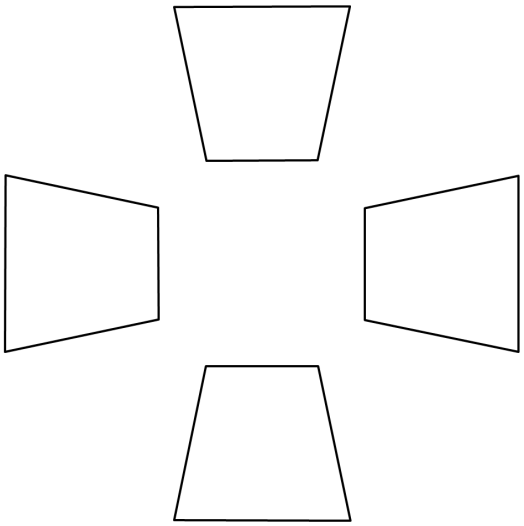


Figure 7: Left: *Quattro DigiCAM Oblique* Right: Footprint of a *Quattro DigiCAM Oblique* with 80mm focal length

Fig. 6 shows the nadir version, fig. 7 the oblique version of *Quattro DigiCAM* and its appropriate footprint with 100mm focal length.

> "The *Quattro DigiCAM* installation creates four near nadir images in a two by two pattern with small overlap. The images are taken synchronously and with the same camera settings. This results in four images that can be stitched together geometrically and radiometrically into one uniform large format image with the software *DigiMerge* that is provided together with the camera.
>
> In the *Quattro DigiCAM Oblique* configuration, the camera modules are mounted to point forward, back, left and right with an oblique angle of 45°. Because of the synchronization of the images, the same time stamp can be used to obtain the exterior orientation of the images from the integrated *AEROcontrol* GNSS/IMU system" [2, p. 4].

2.2. Conclusion

Quattro DigiCAM is a large format digital aerial camera which can be equipped with lenses with a range of different focal lengths and with CCD sensors with different resolutions. It is integrated to a turnkey solution with data storage, a graphical user interface together with flight guidance and sensor management (*CCNS*) and GNSS/IMU system (*AEROcontrol*). The *Quattro DigiCAM* design enables the stitching of four digital images to one large format virtual image; this composite image can be utilized in the same way as a photo from one camera position. With the *Quattro DigiCAM Oblique*, the simultaneous capturing of high quality oblique images in the four different directions is possible. Using small and lightweight Sensor Management Units the modification of a *Quattro DigiCAM* to the *Quattro DigiCAM Oblique* configuration can be accomplished within two hours [cf. 2, p. 7-8].

3. CCNS5 – ALL NEW FLIGHT MANAGEMENT SYSTEM

IGI, the first company to introduce a GPS based flight management system or **C**omputer **C**ontrolled **N**avigation **S**ystem for survey flights worldwide, is taking the next step and unveils a brand new, next generation *CCNS* system – version 5 [cf. 3, p. 2].

3.1. System configuration

The new *CCNS5* is smaller, lighter and richer in functionality and operability. *CCNS5* consists of one 6.5 inches display with a couple of control buttons (fig. 8). With an extra bright screen, resolution of 1024x768 pixels and 16 million colours the system is again state-of-the-art in flight management equipment. Available display information can be personalized in size and colour for different kind of users or scenarios. Map information is displayed in the background for easy orientation during flight.

3.2. Conclusion

CCNS5 – An all new mobile flight management system with a bright, sunlight readable display and fully customizable display information.

Figure 8: *CCNS5*

4. REFERENCES

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