Power Line Mapping: Data Acquisition with a Specialized Multi-Sensor Platform

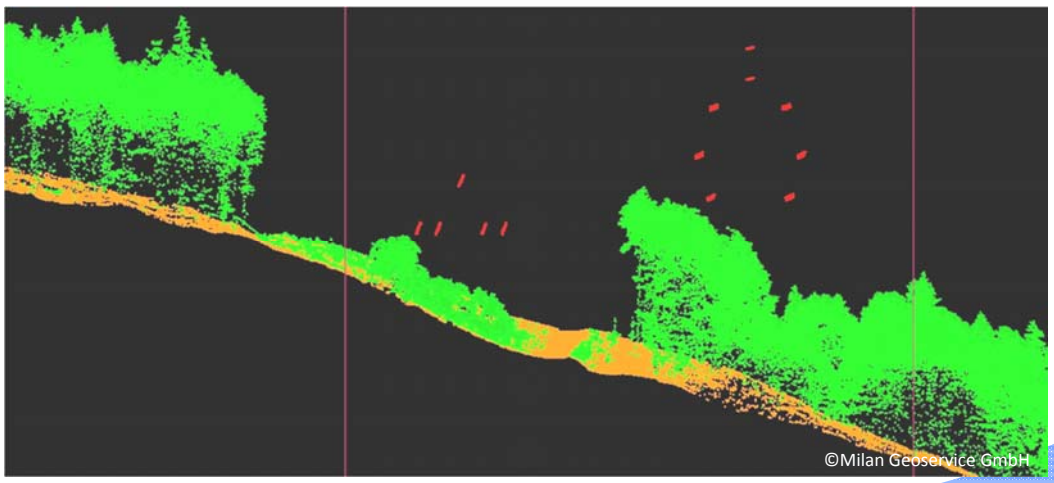
Jens Kremer, Stuttgart, 7.9.2011

53rd Photogrammetric Week

Power Line Mapping

LiDAR:

- Direct measurement of the wire shapes
- Direct measurement the distance to proximate vegetation etc.
- Powerful tools to distinguish vegetation from other features



Power Line Mapping

www.igi-systems.com

Photos:

- Interpretation / visual inspection
- Photogrammetry

Power Line Mapping

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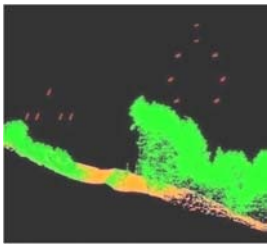
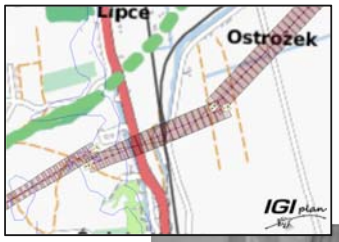
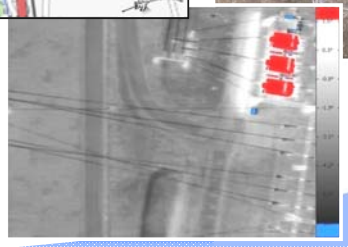


… what else?

- Efficiency / Performance
- Flexibility /Modularity
- Additional Products





Power Line Mapping

www.igi-systems.com

IGIs Modular LiDAR Mapping Systems:

LITEMAPPER® RAILMAPPER® STREETMAPPER®

Standard *LiteMapper*

LiteMapper Multi Sensor Platform

Power Line Mapping

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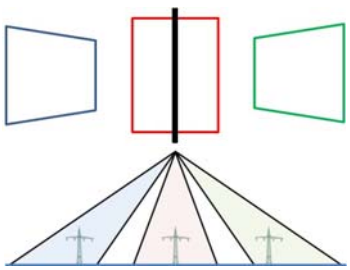
General Remarks

System Description

- Navigation, Flight Guidance
- GNSS/IMU
- LiDAR
- Cameras
- Add. Sensors



Example Project MGGP Aero

Mission Planning and Navigation

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Standard power line missions:

- Visual navigation
- Important: true LiDAR height
- Mission Planning with *IGIplan*

Complex power lines, underground pipelines, area mapping etc:

- *CCNS5* & *IGIplan*

AEROcontrol

www.igi-systems.com

IMU-IIe

Weight	2.2 kg
Data rate	400Hz
Gyro drift	0.03°/h

System accuracy

Position:	< 0.05m
Velocity:	0.005m/s
Roll/Pitch:	0.003°
Heading:	0.007°

AEROcontrol

www.igi-systems.com

***AERROcontrol* options and features**

- SMU integrated
- Multiple sensor support
- GPS & GLONASS
- DIA (Direct Inertial Aiding)
- OmniSTAR HP
- *TERRAcontrol* option

LiDAR

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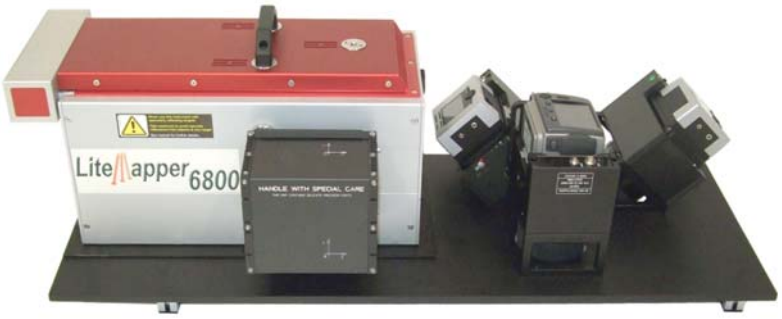
Laser Scanner

- Full wave form
- Max. range 3000m
- Eff. measurement rate 266.000 meas/sec



DigiCAM

50 or 60 Mpixel

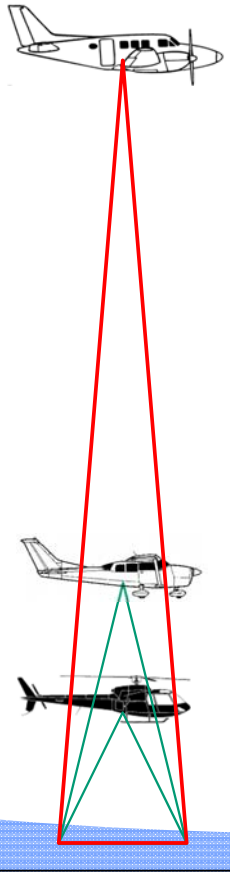
6µm pixel pitch

1.6s repetition time

Lenses: 28mm to 300mm

Option: 1.2s @ 40 Mpixel

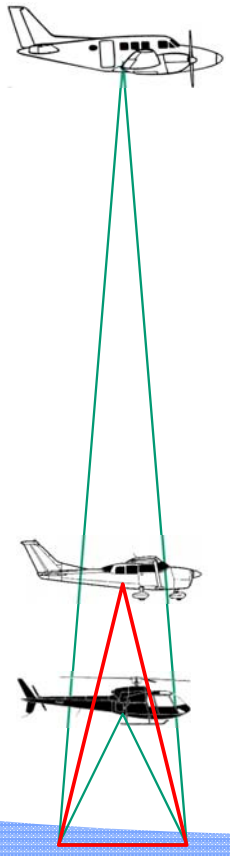
DigiCAM



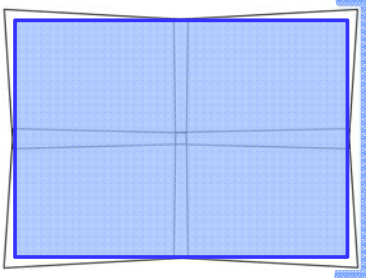
DigiCAM with 300mm lens

GSD = 8cm @ 4000m altitude

DigiCAM

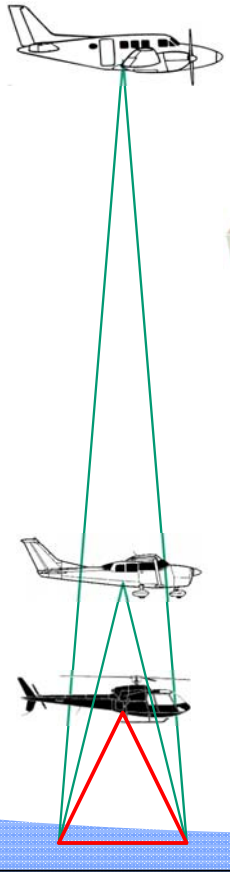


Quattro-DigiCAM with 100mm lens



GSD = 5cm @ 830m altitude

DigiCAM



DigiCAM with 50mm lens in a *LiteMapper*

GSD = 5 cm @ 420m altitude

FOV adapted to the scanner FOV

DigiCAM

DigiCAM with 28mm lens in an *UAV*

GSD = 2 cm @ 93m altitude

DigiCAM

User Interface: 8.5“ or 15“ Touchscreen

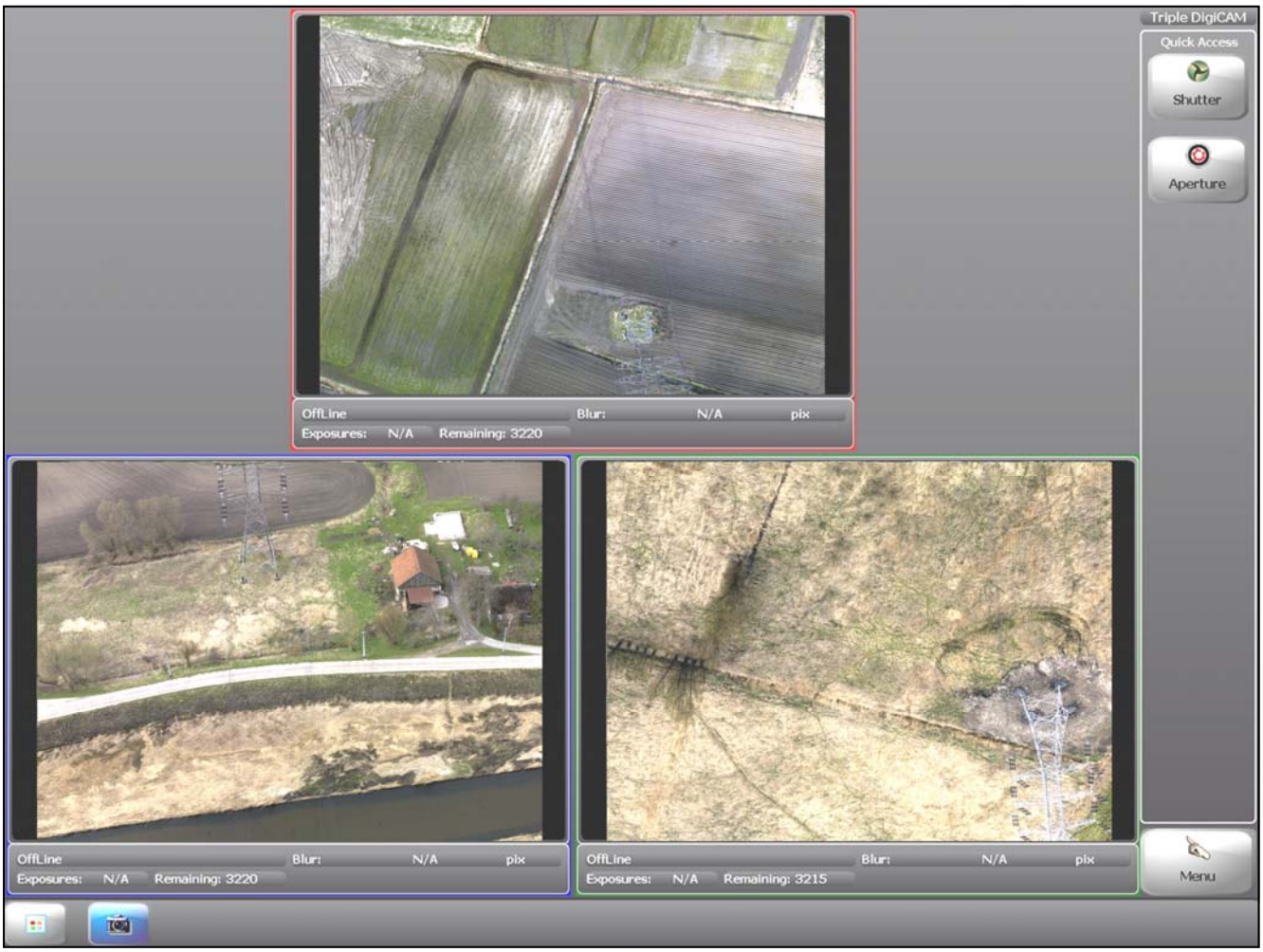
Storage Capacity (SSD): 500 GB / 5800 Images (60 Mpix, 16bit)

SMUs - Sensor Managemet Units

www.igi-systems.com

Operation of multiple sensors with SMUs

- scalable
- direct interconnection
- operation via one user interface



Quattro DigiCAM

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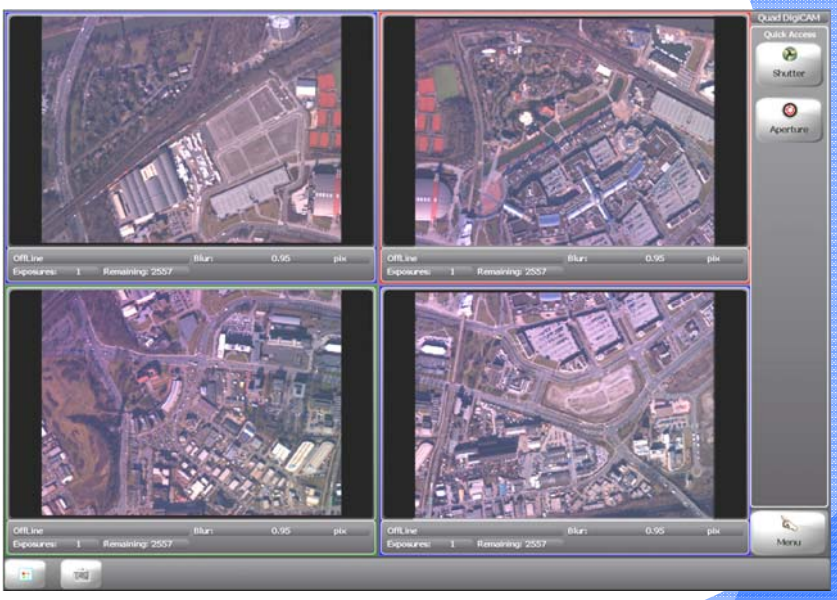

Camera Orientation and Mission Planning

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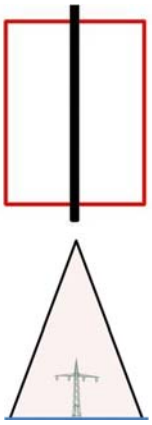
Flying height: 150m

Speed: 50kn



LiDAR swath: 170m

Focal length: 50mm

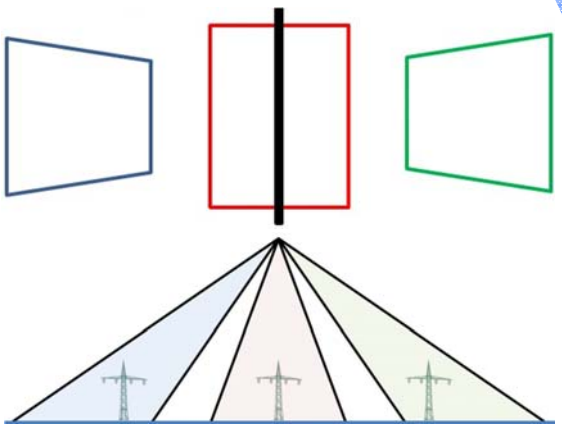
Image width (nadir): 150m

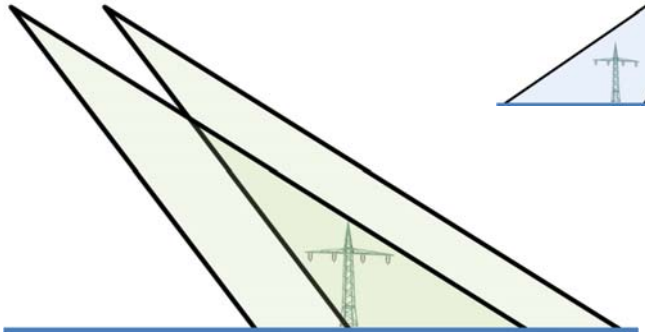
Overlap: > 60%

Camera Orientation and Mission Planning

Oblique angle: ±45°

Focal length: 100mm

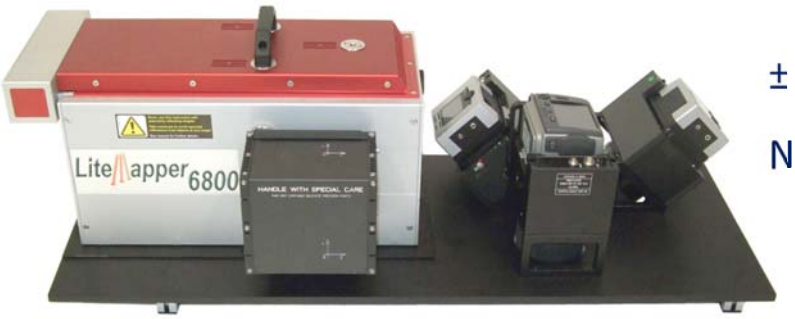




One oblique image with the complete pole @ 50kn and 150m altitude

True LiDAR altitude display for guidance!

Camera Orientation and Mission Planning



± 45° *DigiCAM* 100mm

Nadir *DigiCAM* 50mm

Additional Sensors

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For example

- Optical cameras with other properties or orientations
- *DigiTHERM* thermal cameras
- Hyperspectral sensors
- Video cameras …

Additional Sensors

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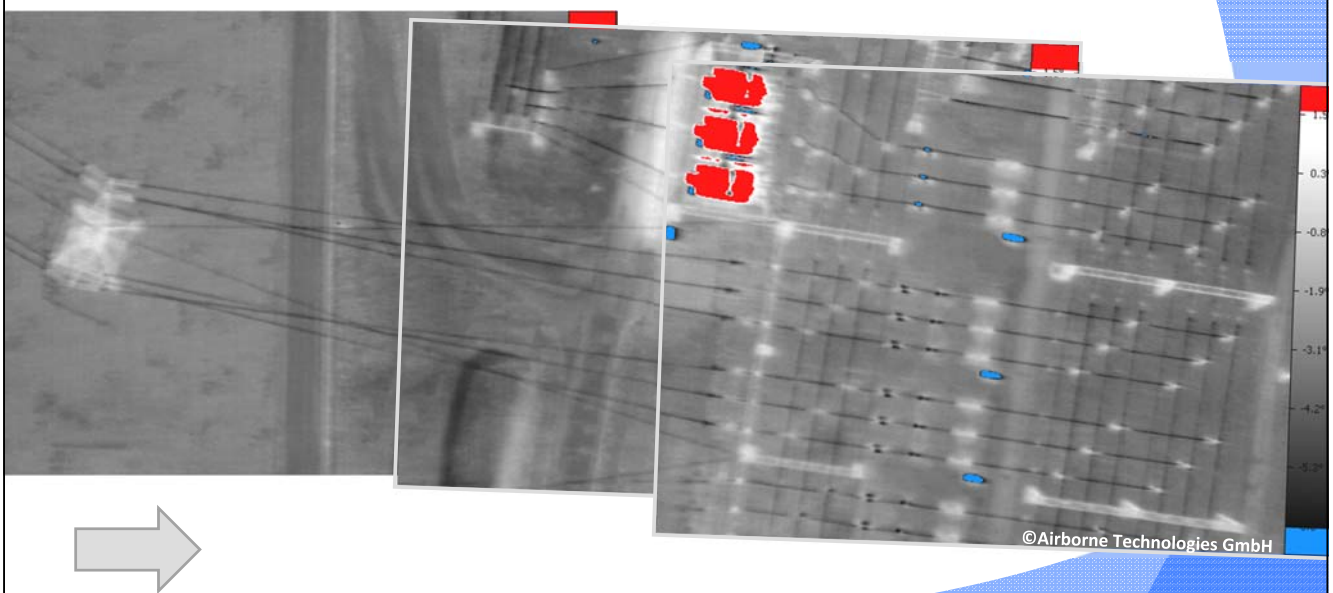
***DigiTHERM* power line images**



Installation and Certification

Installation and Certification

Camera equipment and *AEROcontrol* is qualified under the

- **EUROCAE ED-14E: ENVIRONMENTAL QUALIFICATION FORM (RTCA DO-160E, Environmental Conditions and Test Procedures for Airborne Equipment)**

For the installation of the *LiteMapper* Multi Sensor Platform in different configurations in an AS350 helicopter an EASA

- **STC (Supplement Type Certificate)**

exists. This document includes

- **Aircraft Flight Manual Approval**
- **Change Note**
- **Flight Manual Supplement**
- **Installation Instruction.**

Project Example

Operator: mggp aero , Poland

Task: Capturing 8800km of power line for the operator of the high power transmission system in Poland

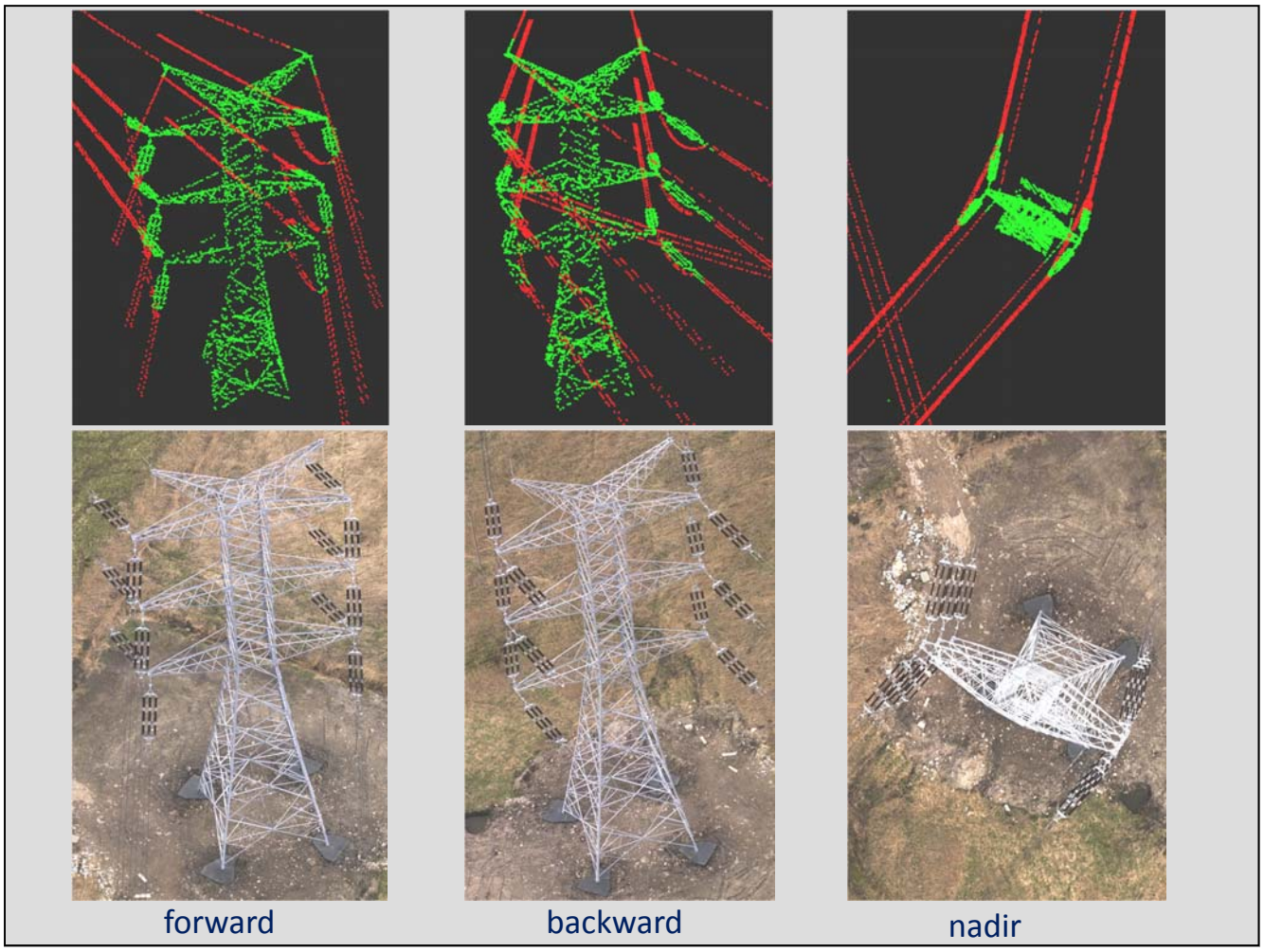
Mission Time: Two flying seasons
(June & August 2010 and June & August 2011)

Project Example

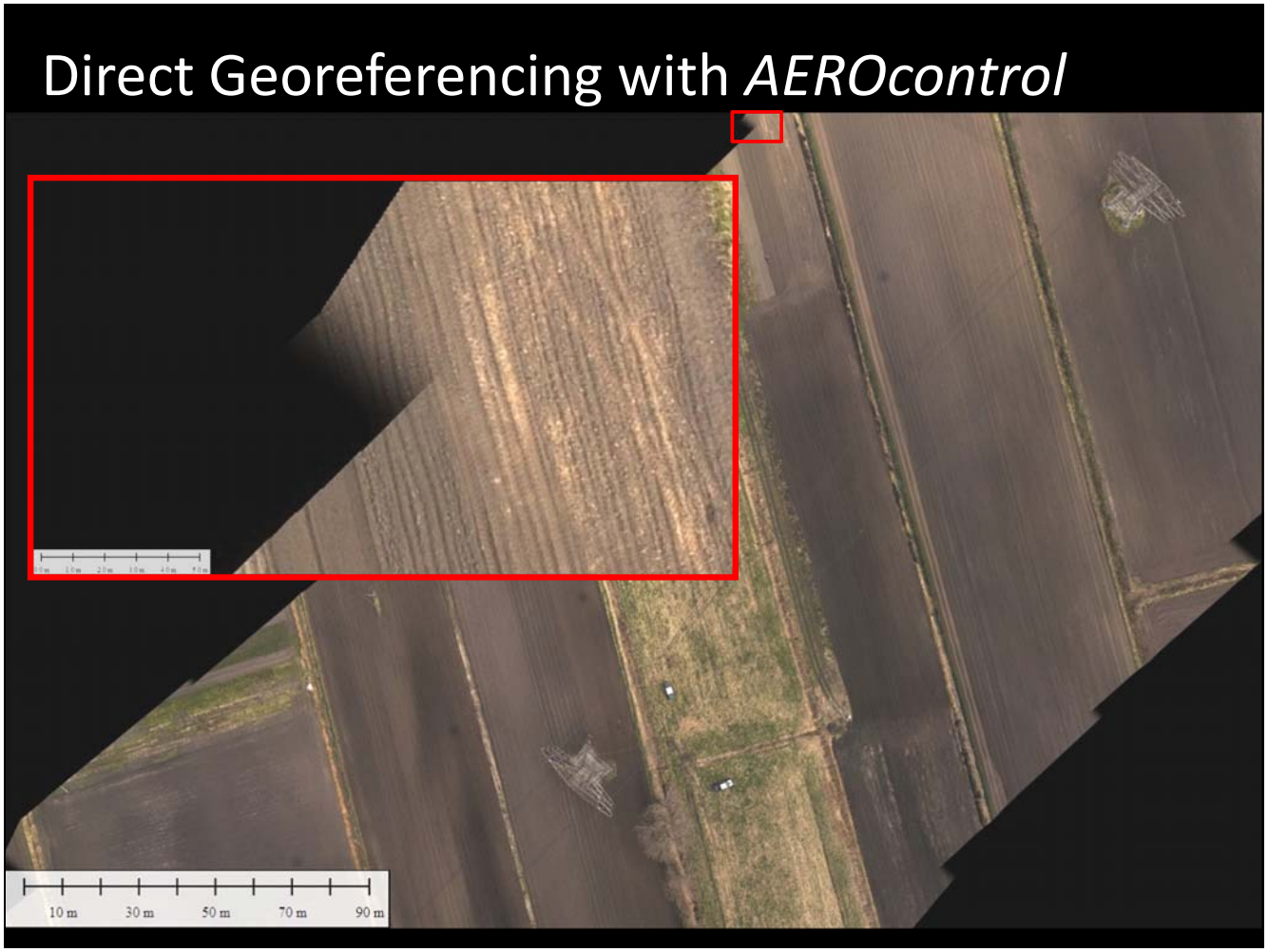
Products to be delivered:

- The classified LiDAR point cloud (power line, poles, ground, vegetation …)
- The digitized power lines
- Shape files with the pole positions
- Oblique images of the poles (forward)
- Oblique images of the poles (backward)
- An orthophoto mosaic of an 80m wide corridor around the line

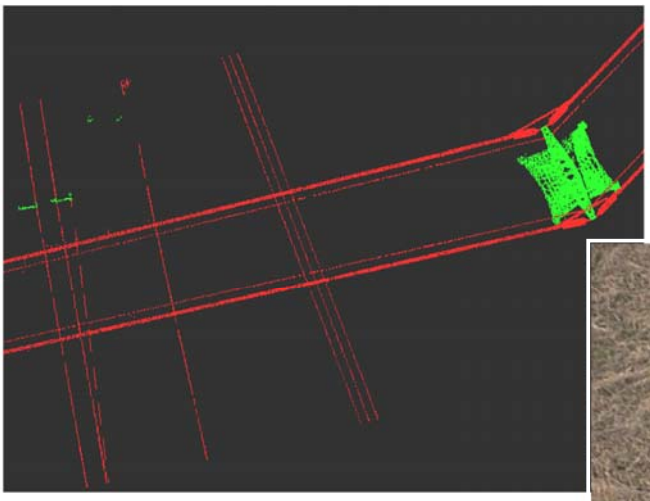
All products have to be delivered within 20 days after data collection.



Direct Georeferencing with *AEROcontrol*



Project Example



Project Example

Project Example

Project status (early summer 2011):

- Three quarters of the data were delivered successfully
- The last quarter is currently flown and processed

Conclusion I

The combination of LiDAR with aerial cameras is a **successful method** for inspection and mapping of power lines.

Optimal integration of the core components

- Scanner
- GNSS/IMU and
- Camera(s)

with modules like data storage, user interface, mission planning and navigation tools are **essential for an efficient and successful operation**.

The **integration of additional sensors** and functions, like

- Oblique cameras
- Video cameras
- Thermal sensors

to a modular survey system **allow a flexible reaction** to new trends and requirements.

Conclusion II

The MGGP Aero project example illustrates the **high efficiency** of a *LiteMapper* Multi Sensor Platform.

As much as nearly 9000km of power line, resulting in about half a million images is captured within two flying seasons (30-40 days) with a single system.