# LARGE FORMAT DIGITAL CAMERAS FOR AERIAL SURVEY OF GEOSPATIAL INFORMATION

by

Ralf W. Schroth



## First steps






## Overview



1. Introduction and Motivation
2. Evaluation
3. Configuration
4. Challenges of Digital Cameras
5. Examples



## Introduction



**HL is operating 10 analog metric cameras**
**Analog/digital work flow is well established**

**Driving factors for the investment in Large Format Digital Camera:**

- **Aerial survey market is technology driven**
- **High demand form clients**
- **Optimization of digital work flow**
- **Simultaneous multi-spectral information**



## Evaluation



1. **Decision Line Scanner / Frame Camera**
   **Market research**
   **Workflow internal / external**

2. **Technical Evaluation**
   **Technical evaluation study**
   **Compatibility to existing flight configuration**
   **Compatibility to existing internal workflow**

3. **RoI Analysis**
   **Investment plan**
   **Financing**
   **Economic aspects (analogue vs. digital)**



## Evaluation



**The evaluation ended in purchasing a Z/I Imaging DMC**

- **Sep 2005 signature of the contract**
- **Nov 2005 installation of processing system**
- **Dec 2005 delivery of the DMC and first test flight**
- **Jan 2006 training phase**
- **Feb 2006 start of production**

## Flight Department

Hansa Luftbild
German Air Surveys

1 Cessna 210

2 Cessna 402

1 Cessna 404

1 AC 680 V

1 AC 680



## Digital Camera

Hansa Luftbild
German Air Surveys



## Configuration

Hansa Luftbild
German Air Surveys






## Configuration

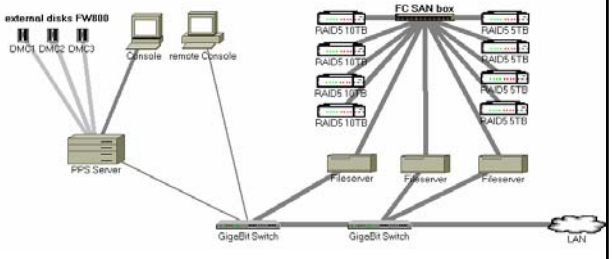
Hansa Luftbild
German Air Surveys



## Configuration

Hansa Luftbild
German Air Surveys

Configuration of a Processing- and Storage-Network for Postprocessing Pictures of a DMC






## Challenges

Hansa Luftbild
German Air Surveys

**Geometric Quality**

**Complete analysis of the geometric quality of digital large format cameras is not available.**

**Our experiences are out of the analysis of the aerial triangulation of UltraCam-D and DMC data (about 60.000 images):**

**In general the planimetric accuracy is good.**
**Small blocks (some hundred images) are good.**
**More tie points available than with analogue images.**

## Test Block Gent

Hansa Luftbild
German Air Surveys

**DMC flight spring 2006**

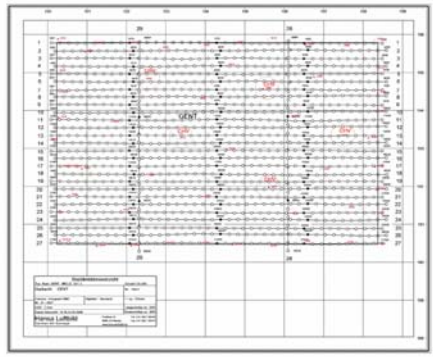
**Block size 5,5 km * 8,5 km**
**29 strips, 1.105 images, GSD = 7,2 cm (1:4.000)**
**Flying height Hg = 800 m**
**DGPS/INS**
**End lap: 60 %**
**Side lap: 80 %**
**53 GCPs**

**For statistical analysis 14 check points in the block center were used.**



## Test Block Gent

Hansa Luftbild
German Air Surveys





## Test Block Gent

Hansa Luftbild
German Air Surveys

**Aerial triangulations with MATCH-AT and PAT-B**

**With and without additional parameters for self-calibration (Grün approach)**

**Expected theoretical accuracies:**

**Sigma x = Sigma y = 2 cm**

**Sigma z = 4 cm (0,005 % of Hg)**



## Test Block Gent

Hansa Luftbild
German Air Surveys

| A priori standard deviations | x | y | Z |
|---|---|---|---|
| Ground control points | 0,030 [m] | 0,030 [m] | 0,030 [m] |
| Projection centers | 0,050 [m] | 0,050 [m] | 0,050 [m] |
| Image points | 0,002 [mm] | 0,002 [mm] | |



## Test Block Gent

Hansa Luftbild
German Air Surveys

| block type | # images | # strips | end lap [%] | side lap [%] | RMS without AP x [m] y [m] z [m] | RMS with AP x [m] y [m] z [m] |
|---|---|---|---|---|---|---|
| 1-fold | 364 | 10 | 60 | 20 | 0,019 0,031 0,109 | 0,019 0,034 0,064 |
| 2-fold | 442 | 12 | 60 | 40 | 0,038 0,020 0,107 | 0,031 0,016 0,050 |
| 3-fold | 598 | 16 | 60 | 60 | 0,018 0,034 0,118 | 0,019 0,034 0,048 |
| 4-fold | 1.105 | 29 | 60 | 80 | 0,024 0,030 0,593 | 0,020 0,034 0,030 |



## Challenges

Hansa Luftbild
German Air Surveys

**Geometric Quality**

**Problems with height accuracy in large blocks.**
**Systematic effects seem to be significant.**

**Practical solutions:**
- **Integration of additional parameters (workflow!)**
- **Use of DGPS/INS information**
- **High quality aerial triangulation**

➔ **Further scientific research necessary**

## Challenges

Hansa Luftbild
German Air Surveys

**Radiometric Effects:**

- Total reflection and saturation
- Smearing effects
- Influence of near infrared to pan
- NIR hot spot



## Examples (LGN 30 cm)

Hansa Luftbild
German Air Surveys



## Examples (10 cm)

Hansa Luftbild
German Air Surveys



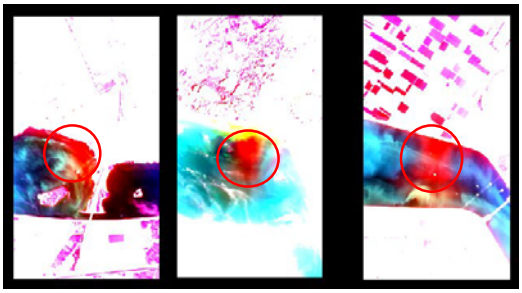
## Examples (7 cm)

Hansa Luftbild
German Air Surveys



## Examples (Microsoft NL)

Hansa Luftbild
German Air Surveys

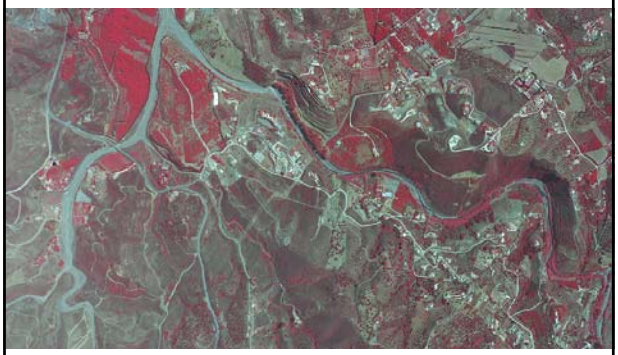


**Hot spot NIR (shown by linear stretching) can cause problems in automatic classification**



## Examples (25 cm)

Hansa Luftbild
German Air Surveys



## Examples (7 cm)

Hansa Luftbild
German Air Surveys



## Examples (Bucharest)

Hansa Luftbild
German Air Surveys



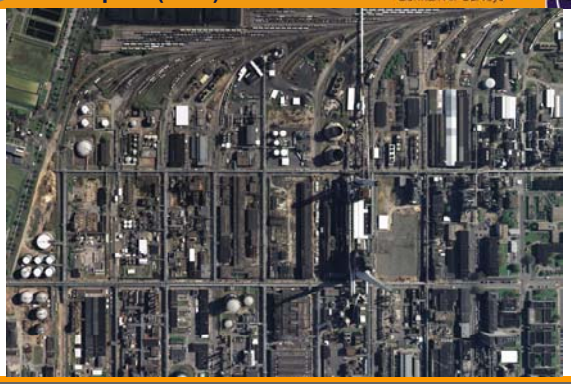
## Examples (Hamburg)

Hansa Luftbild
German Air Surveys



## Examples (Marl)

Hansa Luftbild
German Air Surveys





## Examples (Turin)

Hansa Luftbild
German Air Surveys



## Examples (Sardinia)

Hansa Luftbild
German Air Surveys

## Examples

Hansa Luftbild
German Air Surveys

Aalen 2006, GSD~6cm, Bild Nr. 000700071019,
Cabrio- Fahrer, versch. Zoomstufen



Hansa Luftbild
German Air Surveys


**Thank you for your attention**