EuroSDR project proposal

Medium Format Digital Cameras

Teil 1

Teil 2

Teil 3

Presented by

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Content

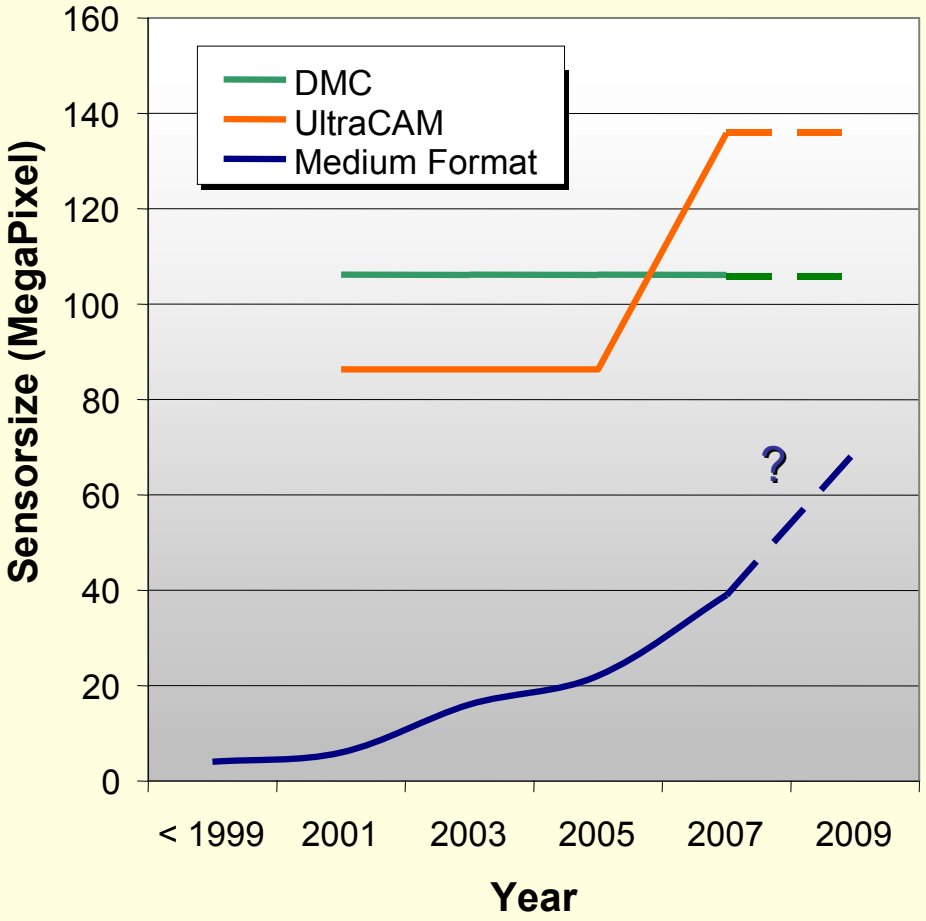
- Introduction
- Current status – why do we have to care for medium format cameras in photogrammetry ?
- Current trends with digital medium format cameras
- Objectives of the proposed EuroSDR project
- Timeline

Introduction – situation of digital frame cameras and medium format digital airborne imaging systems

- Digital airborne multi head frame cameras (e.g. DMC, ADS 40, UltraCam-D) are in use and replace the analogue cameras
- Additionally medium format digital systems are available for a large range of applications (unique ones and competitive ones to frame cameras)
- The photogrammetric potential of digital medium format cameras is similar to frame cameras
- Compared to frame cameras, medium format cameras are much cheaper

- The market for medium format cameras is strongly increasing, however the digital „low-cost“ systems differ greatly in terms of performance, reliability, accuracy, price

Footprint of digital frame cameras and medium format cameras

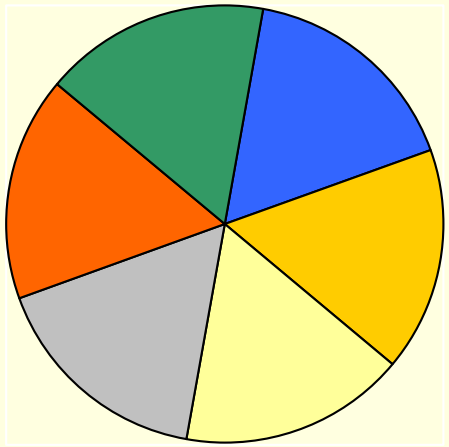


- The footprint of digital medium format cameras strongly increased in recent years
- The footprint of a single head medium format camera becomes more and more competitive
- Multi head solutions of 2 or more cameras are already competitive to digital frame cameras

Applications of Medium Resolution Digital Cameras

Strip Mapping
Linear-based mapping projects
Pipeline surveys
Hydro corridors
Transportation routes

Laserscanning & Camera
Mapping & Orthophotos
True Orthophotos
3D-City Models



GIS and Urban applications
Urban and regional planning
Urban Hot-Spot Monitoring
Orthophoto generation
3D-Models (Nadir + Oblique)

Agriculture and Forestry
Species identification
Timber value assessment
Disease control and monitoring
Precision Farming

Remote Sensing
Environmental research
Coastal zone monitoring
Color-Infrared imaging

Rapid Response Imaging
Rapid mobilization for disaster management
Time-dependent image acquisition
Homeland Security digital imaging

➡ **Application especially suited for medium format cameras**

Categorization of digital „low-cost“ medium format systems

Components \ System type	Low-end	Low- mid end	Mid end	Mid - high end	High end
Digital Video- / (Consumer camera < 12 MP	X	X			
High end digital SLR Camera, (12 bit, 16 MP) or better		X	X	X	
Industrial digital camera, (12 – 16 bit, 22 – 39 MP				x	X
GPS	X	x			
GPS / L1-DGPS		X	x		
RTK-GPS			X	X	X
Simple GPS- flight management systen	X	X			
Automatic image triggering system		X			
Flight management system with event marker			X	X	X
Stabilized platform					X
GPS-INS (x,y,z < 1 m, ω,φ,κ < 0.4°)				X	
GPS-INS (x,y,z < 0,1 m, ω,φ,κ < 0.01°)					X
Price [€]	<5.000	<25.000	<50.000	<100.000	>250.000

Results and products of digital low - high end systems

	Low-end	Low- mid end	Mid end	Mid - high end	High end
Products / Results	Vertical and Oblique Images (Pretty pictures)	AT and ortho photo generation	Direct geo referencing of blocks without autom. Tie points	Direct geo-referencing of block with autom. tie points / no or little GCP's	Direct geo-referencing of blocks, strips and single images without GCP
Processing Time 1 / 100 Orthophotos	N/A	1 h / 100 h	45 min / 75 h	15 min / 25 h	5 min / 8 h
System Price (€)	< 5.000	< 10.000	< 50.000	< 100.000	< 300.000

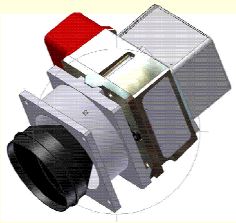
Characteristics of state of the art professional medium format digital cameras for airborne applications

- Single lens - single focal frame - single shutter
- Large image foot print (39 MP)
- Ruggerized metric design (fixed lenses) – fully calibrated systems
- Short exposure interval (2 – 3 sec.)
- Min. photogrammetric GSD* (5 – 8 cm/ pixel)
- Constant exposure delay / linked to flight management system
- Highly automated and reliable sensors (MTBF 50.000^{+} images)
- Suitable for use without a camera operator
- Compact systems suitable for small single engine aircraft
- RGB or CIR by changing camera filter (limitations in CIR)
- …

* At 60 % endlap, aircraft with 50 m/s, 2 – 3 s exposure interval, smear < 1 Pixel

High End Medium Format Digital Systems on the market

Rollei AIC



IGI DigiCAM

DiMAC

Leica RCD105

Applanix DSS 439

Current Trends for Digital Medium Cameras

- Rapid processing (online, in flight orthophoto generation), e.g. for disaster management, security applications etc.
- Multi camera head developments, which provide a similar coverage of a standard digital frame camera, but for a much lower price
- Forward motion compensation, not by time delayed integration (TDI) but mechanically
- Combination of oblique and vertical imagery acquisition

Flexible digital aerial surveys - PFIFF in action

Small aircraft
(Cessna 172)

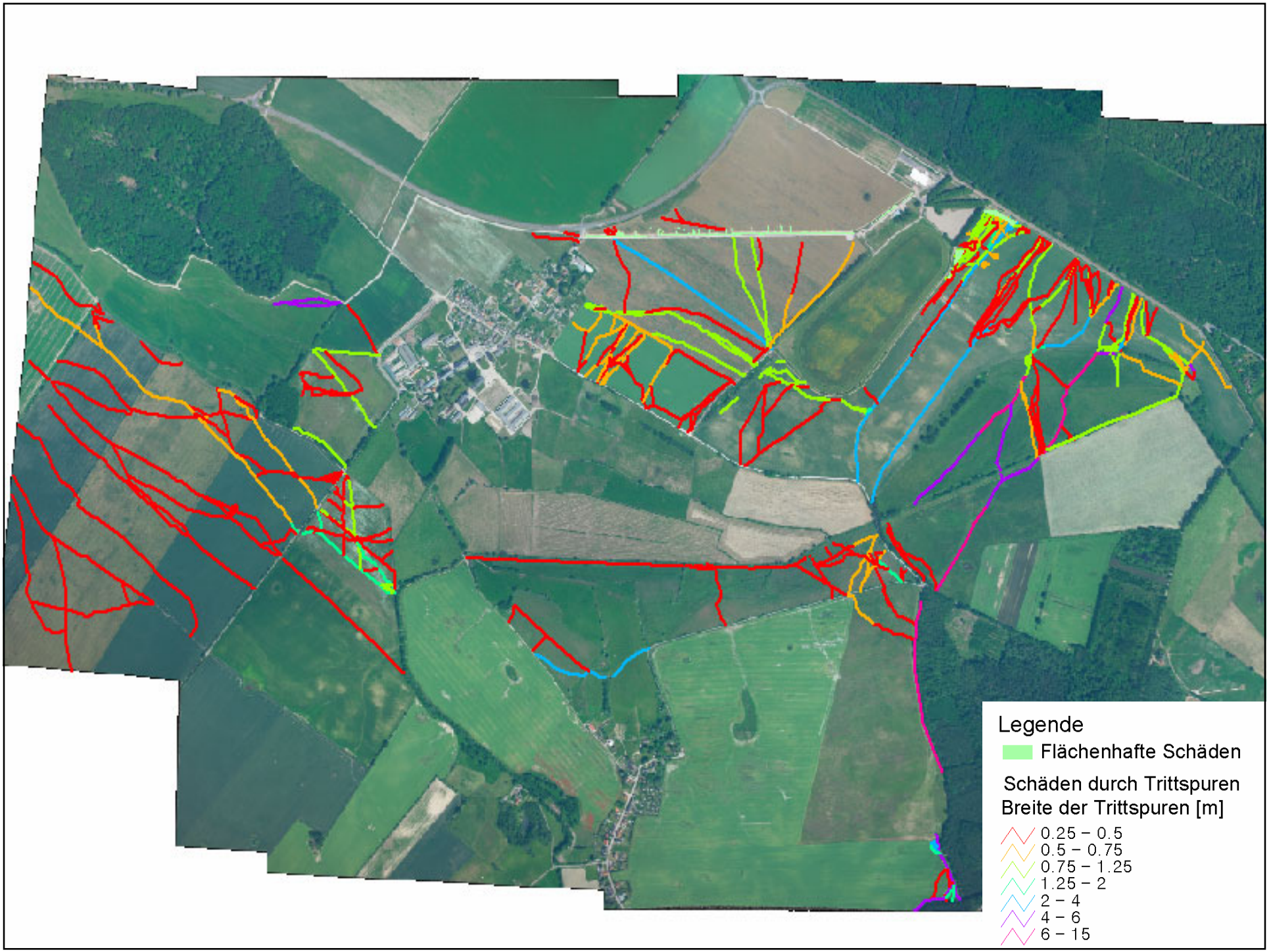
Navigator / Copilot

Operator

Ground hole

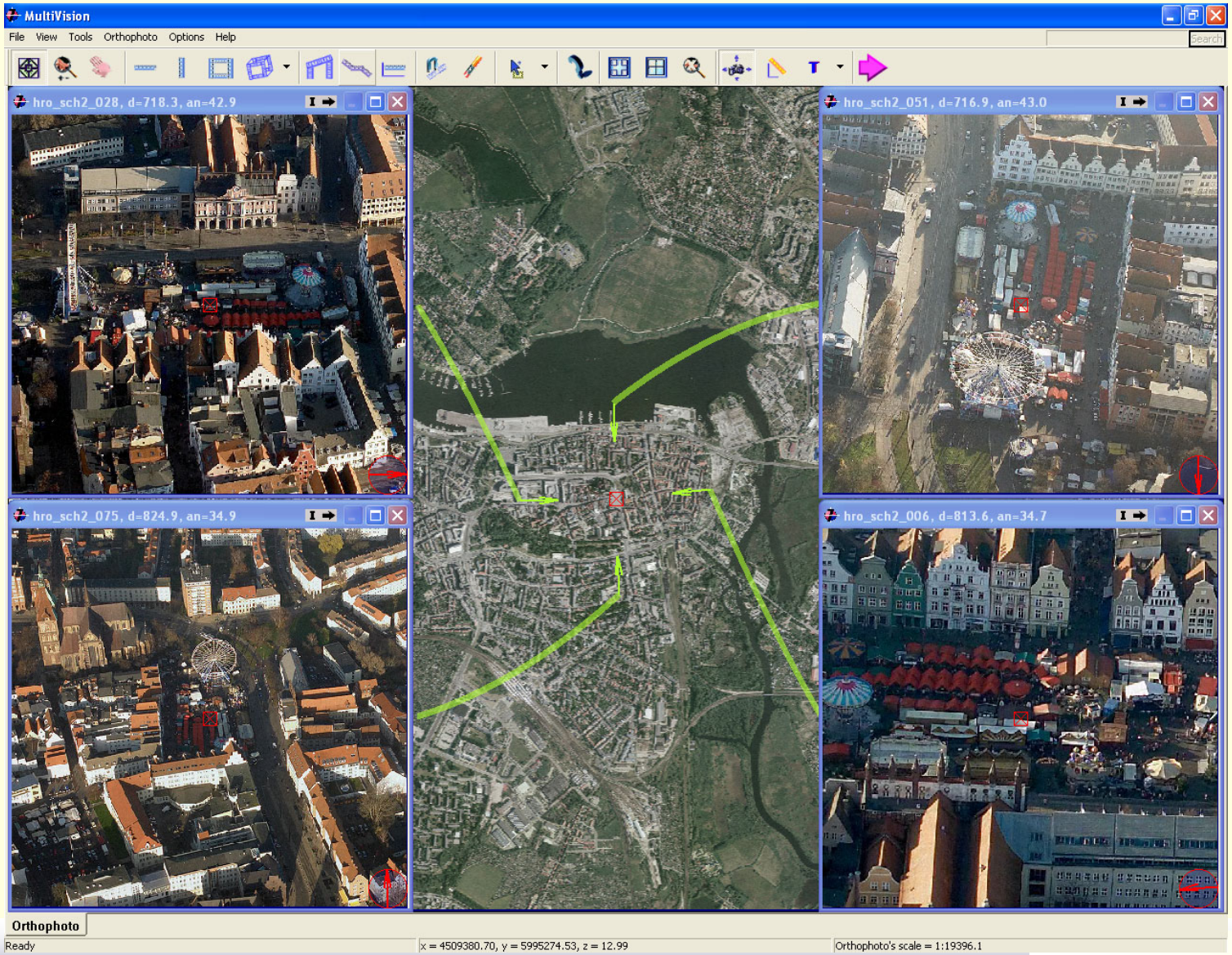
Aftermath of G8 – Summit

Survey: 11.06.2007
Altitude: ca. 2.200 m
GSD: 30 cm

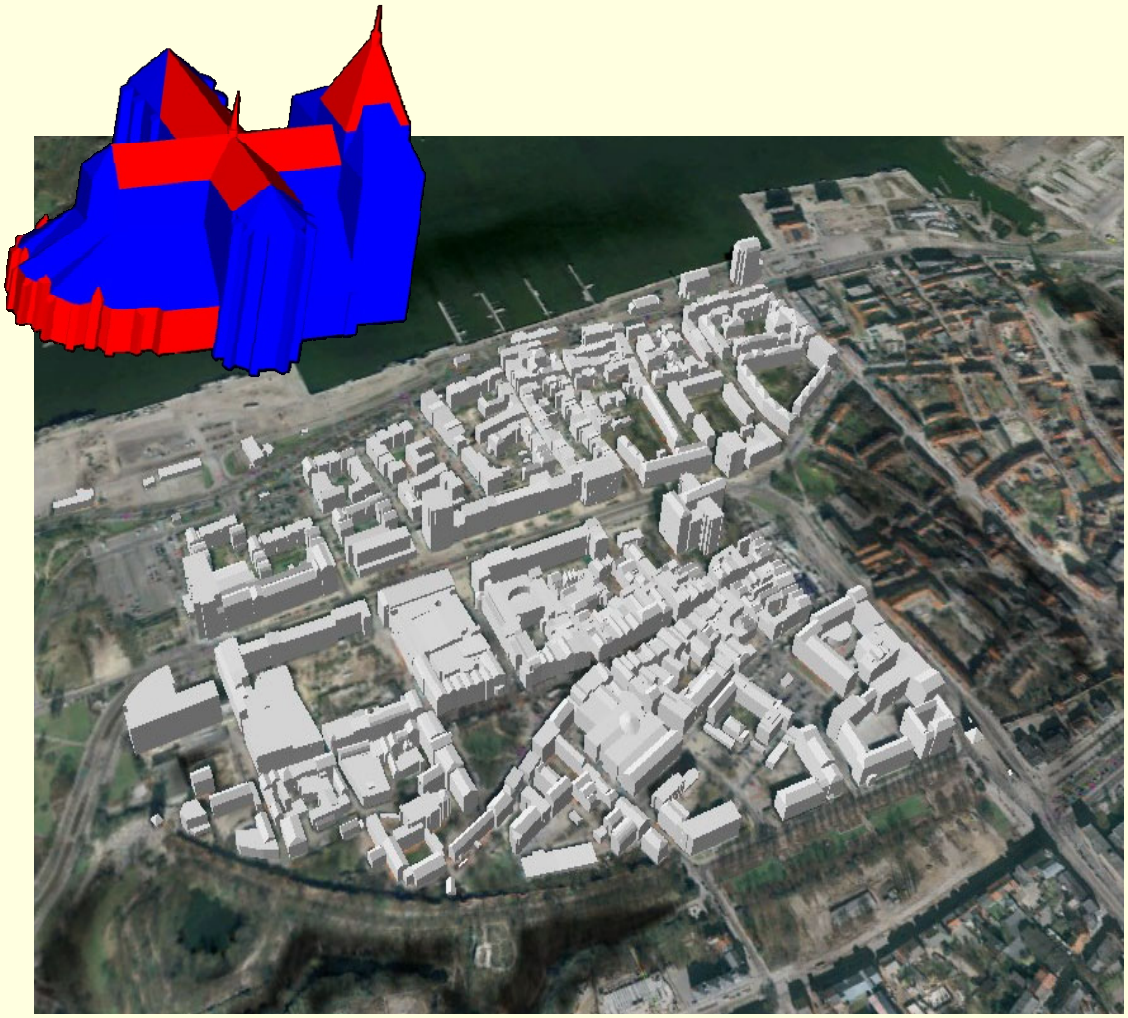

Legende
Flächenhafte Schäden
Schäden durch Trittspuren
Breite der Trittspuren [m]
0.25 – 0.5
0.5 – 0.75
0.75 – 1.25
1.25 – 2
2 – 4
4 – 6
6 – 15

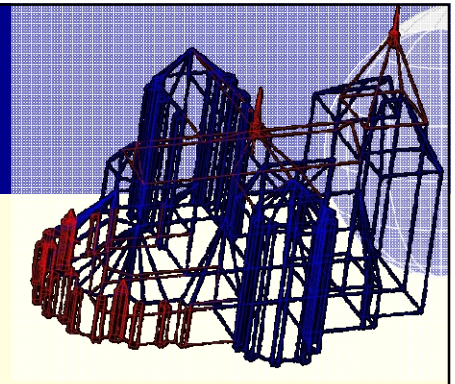
Sample of oblique image (foreground)

Multivision Main Screen



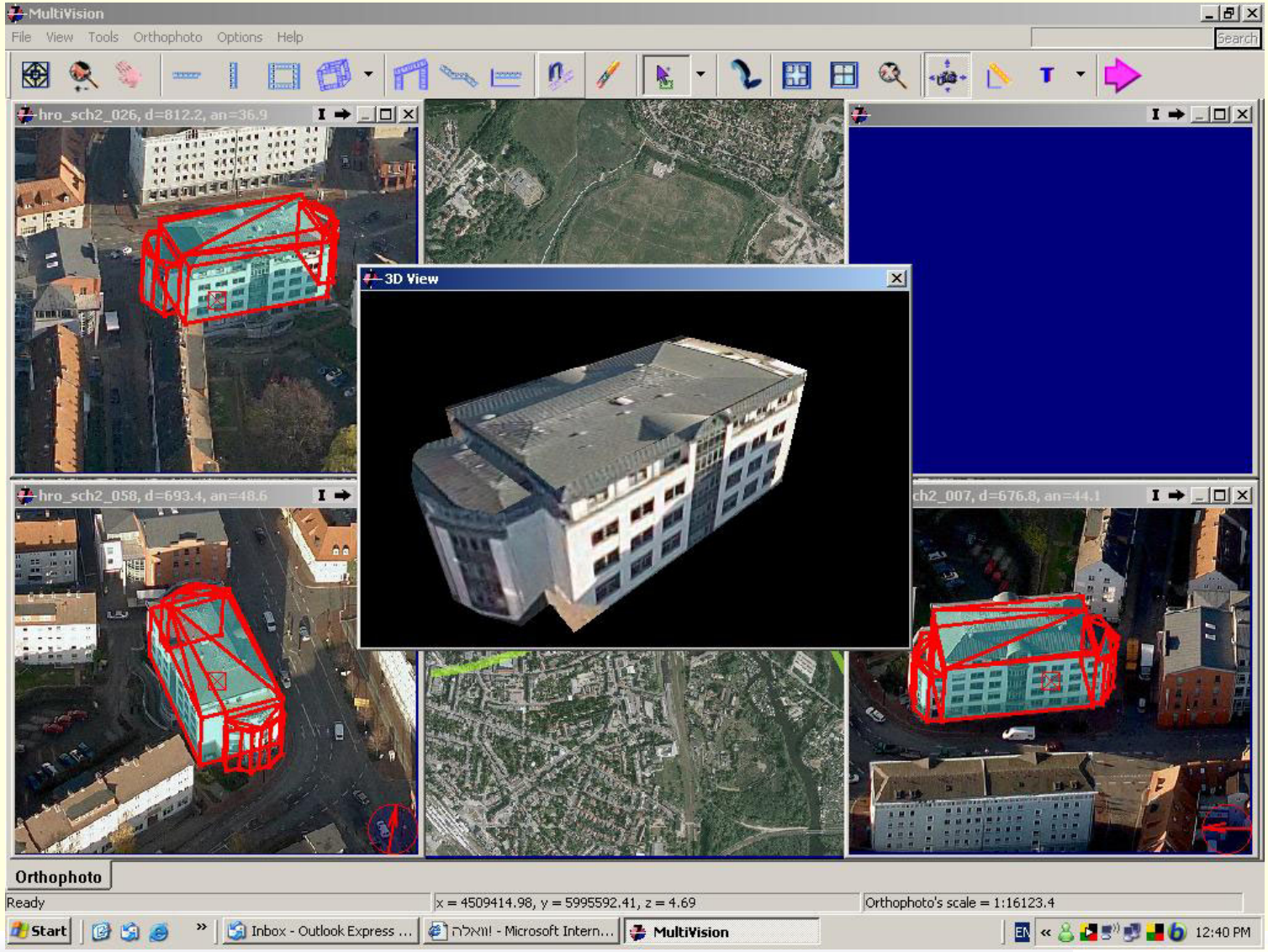
Rostock 3D-Model LOD 1 → LOD 2





- Semiautomatic 3D-buildings based on ALK
- Separation of „Multipart“ ALK-buildings
- Definition of roof type via building attribute
- CAD-construction of selected landmarks
- Texture generation of selected buildings with Multivision

Semiautomatic generation of building textures



Objective of Project

Phase 1:

- Collection of publicly available material on medium format digital camera systems to compile an extensive report describing the currently used practice and methods

Phase 2:

- Empirical testing of 4 – 6 professional camera systems with focus on the adoption of commonly accepted procedure(s) for camera calibration and testing, based on the experiences from the frame cameras (EuroDAC²)
- Radiometric tests in addition to the investigations in the EuroSDR project *Radiometric Aspects of Digital Photogrammetric Images*

Phase 1 – Objectives and documentation

- Documentation of high end medium format cameras / systems
- Geometric properties and calibration of medium format cameras
- Radiometric properties and radiometric workflow of medium format cameras
- Current trends and future developments
- Comparison of medium format cameras with digital frame cameras
- Application analysis – documentation of special application domains of medium format cameras and common markets with frame cameras
- …

Phase 2 – Questions and Objectives

- How good are the geometric and radiometric properties of the different camera suppliers ?
- Can we use the same test procedures and facilities for geometric certification of frame cameras (EuroDAC²) ?
  - If not, what has to be changed ?
- How do we treat medium format multi camera systems ?
  - Geometrically
  - Radiometrically

- Lab experiments for geometric and radiometric calibration
- Test flights and determination of different image quality parameters

Timetable

- Phase 1
  - Okt. 2007 – Jan. 2008
  - Report generation and distribution
- Phase 2
  - Feb. 2008 – Summer 2009
  - Development of general concept for practical work
  - 1 day meeting for practical test design in Spring 2008.
  - Experimental test investigations Summer 2008
  - Data analysis and documentation 2009
  - Final Report 115th EuroSDR Meeting