



## *EuroSDR network*

### *Digital Camera Calibration*

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*104<sup>th</sup> EuroSDR Science and Steering Committee Meetings*  
*Copenhagen, Denmark, June 9 - 11, 2004*

[www.ifp.uni-stuttgart.d/euroedr/](http://www.ifp.uni-stuttgart.d/euroedr/)



## Objectives

### ▶ **PHASE 1**

Collection of publicly available material to compile an extensive report documenting currently used calibration practice and methods

- All network participants, i.e. camera producers and other experts contribute with their experiences
- Common knowledge base for the formulation on future strategies
- Helpful for system users to gain their experience with digital camera calibration
- Report is open to producers, users and customers

### ▶ **PHASE 2**

Development of commonly accepted procedure(s) for camera calibration and experimental testing

- Phase 2 design discussed on results of Phase 1
- Focus on some of the technical aspects in a sequential order, i.e. starting with geometrical aspects and verification followed by radiometry
- Empirical testing should *not* lead to direct comparisons of cameras, but to individual calibration recommendations for each digital camera design





# Road map



## Phase 1

Oct '03

Apr '04

Jul '04

## Phase 2

Jul '05

- Official project launch at October 17<sup>th</sup>, 2003
  - Start collecting publicly available material/experiences with recommendations of camera producers and other experts
- Compilation and distribution of report on currently used practice and methods of digital camera calibration
- Evaluation meeting of core network
- Presentation of results of Phase 1 at 104<sup>th</sup> EuroSDR meeting Denmark and ISPRS congress Turkey
- Experimental test and investigations
  - Final road map based on results of Phase 1, i.e.
    - testing and development of accepted procedures
    - design for optimal calibration flights
    - geometry, radiometry and image quality
    - stability and repeatability aspects
- Compilation of final report on results of empirical test



# Network members



#	Group	Representatives	#
1	Camera manufacturers	ADS, DIMAC, DMC, DSS, TLS, Ultracam	11
2	Software developers	Bingo, Bluh, Orima	3
3	Other companies	Vito, McDonaldDettwiller, OMC	3
4	Universities	ETH, OSU, Glasgow, Stuttgart, Rostock	13
5	NMAs	ICC, USGS, OrdSurv, IGN, FGI	6
			$\Sigma$
			36



## Phase 1 History (1/2)



- Sep 4, 2003
  - Initial planning meeting a PhoWo 03
- Oct 17, 2003
  - Project initialization at EuroSDR meetings in Munich
- Oct 28, 2003
  - WWW-Homepage project description and objectives
  - Email request for material including questionnaire (Deadline Dec 5, 2003)
  - Response by
    - Uni Rostock, ETH Zurich, Prof. Petrie, Vito
- Dec 4, 2003
  - Reminder email (specially for camera manufacturers)
  - Response by
    - ETH Zurich / Starlabo (TLS)
    - Kruck (Bingo), DIMAC (no deeper information)
- Dec 5, 2003
  - EuroSDR project presented by K. Jacobsen (Uni Hannover) at Gulfport international workshop on radiometric and geometric camera calibration



## Phase 1 History (2/2)



- Dec 15, 2003
  - Second reminder email
  - Response by
    - ZI (DMC), Leica (ADS) → lab calibration protocols
- Feb 6, 2004
  - Project status for EuroSDR Newsletter 2004.1
- Mar 23, 2004
  - Meeting at ifp (Cramer, Gülch, Hyyppä, Kuittinen)
- May 8, 2004
  - ISPRS paper „EuroSDR network on digital camera calibration“
- May 18, 2004
  - Email request for additional material for final report Phase 1 based on ISPRS paper (DSS, Ultracam, DIMAC, DMC, ADS)
- May 25, 2004
  - Core team meeting at ifp (Colomina, Cramer, Gülch, Kuittinen, Ziemann)



## Phase 1 Status

- ▶ Final report Phase 1
  - Based on ISPRS paper, already covers major findings of Phase 1
  - Extended with
    - outcome core team meeting in Stuttgart
    - discussions at EuroSDR Copenhagen meeting
    - personal correspondences with manufacturers at ISPRS congress
  - Distribution of final report before EuroSDR Madrid meeting, October 04
  
- ▶ Bibliography (online digital)
  - Relevant project publications should be made available digitally
    - literature research sometimes quite difficult
    - H. Ziemann has almost all relevant (analogue) papers available
  - Scanning ? Data base ? Copyright ? Support from EuroSDR secretariat ?
  
  - Generally, all EuroSDR literature could be provided at EuroSDR WWW site (could increase attractivity of WWW presentation)



## Phase 2 Planning

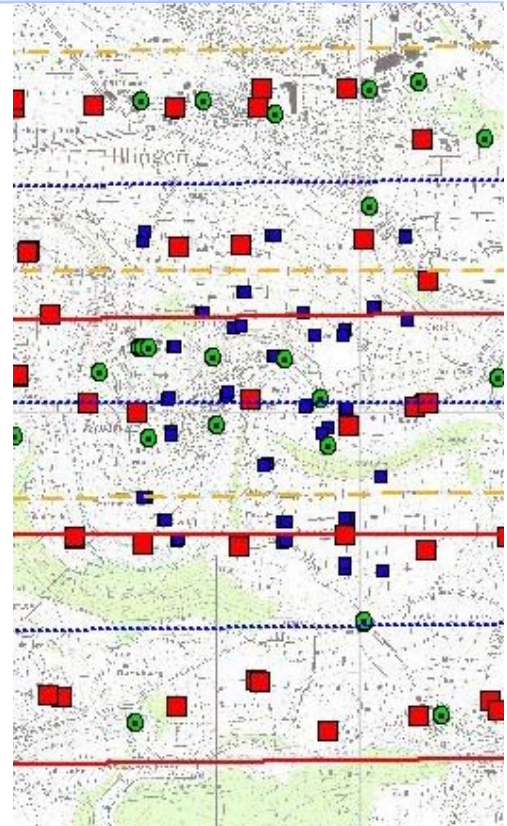
- Focus on following calibration and validation aspects
  - Does camera geometry work ?
  - Does camera radiometry work ?
  - Does camera colour work ?
  
- Further motivation camera manufacturers ?
  - Till now very few (new) material has been provided only
  - Email contact vs. personal contact at ISPRS
  - Calibration methodologies not yet finished at least for some of manufacturers
  - Meeting during Intergeo2004 could be valuable for final Phase 2 preparation
  - Camera users could address manufacturers as well
  
- NMAs participation ?
  - NMAs already using digital systems
  - Exchange of experiences between NMAs but (almost) no project participation





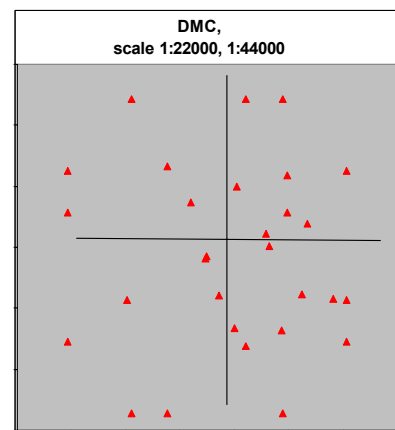
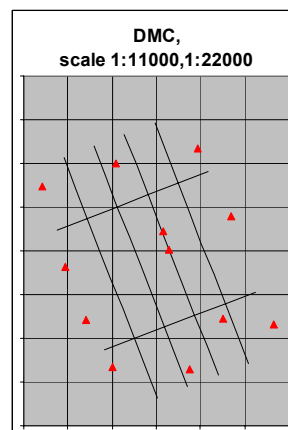
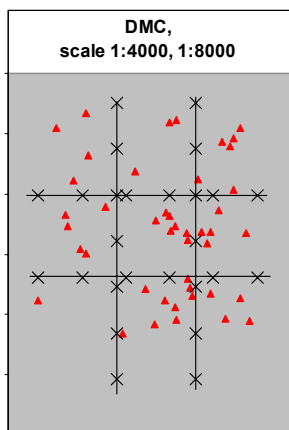
## Phase 2 Potential test flights

- FGI test flights in southern Finland
  - DMC (+ HRSC-AX), August 2004
- ifp tests Vaihingen/Enz Germany
  - ADS40, June 04
  - Test sponsored by Leica Geosystems
  - ▶ *Availability of data has to be confirmed !*
- H. Ziemann test flights Dessau Germany
  - DMC and LMK (parallel)
  - Flight sponsored by ILV-Wagner (so far)
  - ▶ *Availability of data has to be confirmed !*
- Other flight test, i.e.
  - Ordonance Survey flights ADS40, DMC ?
  - Other NMA flights ?



## Phase 2 FGI test flights Sjökulla

- FGI test range Sjökulla
  - DMC large scale 1/2
    - hg = 480 m  
p = q = 80%
    - hg = 960 m  
p = q = 80%
  - DMC medium scale 1
    - hg = 1320 m  
p = q = 60%
    - hg = 2640 m  
p = q = 80%
  - DMC medium scale 2
    - hg = 2640 m  
p = 60%
    - hg = 5280 m  
p = 60%

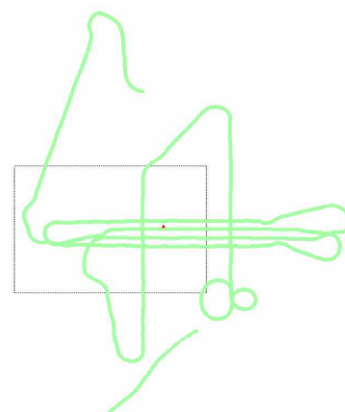
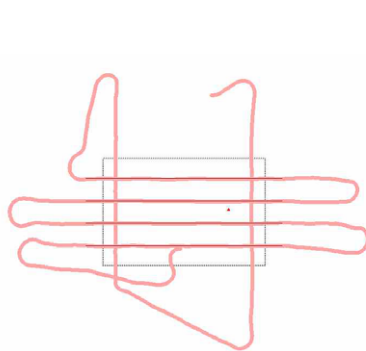
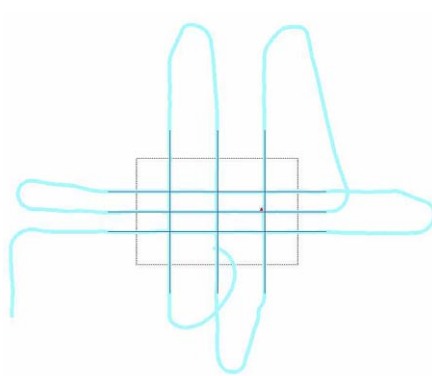


Preliminary flight pattern

## Phase 2 ifp ADS40 test flights Vaihingen/Enz

- ifp test range Vaihingen/Enz

- ADS-flight 1
  - hg = 2500 m
  - 3 east-west lines  
70% side lap
  - 3 north-south lines  
30% side lap
- ADS-flight 2
  - hg = 1500 m
  - 4 east-west lines  
40% side lap
  - 2 north-east lines
- ADS-flight 3
  - hg = 500 m
  - 4 east-west lines  
40% side lap
  - 2 north-east lines



## Phase 2 Test flights Dessau

- Test design Dessau (H. Ziemann)
  - all details available from [www.hziemann.de](http://www.hziemann.de)

camera	image format	c [mm]	m <sub>B</sub>	c×m <sub>B</sub> [m]	H [']	s <sub>Z</sub> = ± 0,15‰ ×c×m <sub>B</sub>	pixel size [μm]	GSD [cm]
ADS40	2 CCD-Lines à 12000	62.5	30769	1923	6309	± 29cm	6.5	20
ADS40	1 staggered CCD-Line 24001	62.5	30769	1923	6309	± 29cm	3.25	10
DMC	~14000×8000	120	14285	1714	5623	[± (0,04-)0,08‰] <sup>1</sup> = ± (7-)14 cm	12	17
RMK		153	10435	1597	5240	± 24 cm	14	15
UltraCam	11500×7500	100	23188	2319	7608	± 35 cm	9	21
UltraCam	11500×7500	75	23188	1739	5705	± 26 cm	9	21
UltraCam	11500×7500	125	23188	2899	9510	± 43 cm	9	21
DiMAC	3992×5312	6.5	50200	326	1070	± 5 cm	9	45
DSS	4096×4096	35	65104	2279	7477	± 34 cm	9	59
HRSC	CCD-lines à 12000	150	30769	4616	15144	± 69 cm	6.5	20
HRSC	CCD-lines à 12000	47	30769	1446	4744	± 22 cm	6.5	20
AIMS	4096×4096	50	65104	3257	10686	± 49 cm	15	98
AIMS	4096×4096	80	65104	5208	17087	± 78 cm	15	98
IGN	4096×4096	50	65104	3257	10686	± 49 cm	9	59
TLS (10200)	3 CCD-lines à 10200	65	33610	2185	7169	± 33 cm	7	24
TLS (14400)	3 CCD-lines à 14400	65	23810	1548	5079	± 23 cm	7	17





## Phase 2

### *Test flight data*

- Data distribution
  - Pan-chromatic data for geometric accuracy and geometric resolution tests
  - Full resolution vs. 8 bit resolution ?
  - Image coordinate measurements vs. image data ?
  - Special software modules at least for processing of line geometry
  
- Data policy
  - Data restricted to active members of projects only – a least for certain time period
  - Terms of conditions defined in contract

