

Stuttgart, Sept. 15<sup>th</sup>, 2003



***EuroSDR network Digital Camera Calibration  
Minutes of initial meeting at September 4<sup>th</sup>, 2003 in Stuttgart***

Dear colleagues,

EuroSDR formerly known as OEEPE has started an initiative to investigate the future of camera calibration. The initial planning meeting took place on Thursday, September 4<sup>th</sup>, 2003 at The Institute for Photogrammetry (ifp), University of Stuttgart.

The Steering Committee of EuroSDR has established a core network of key researchers in this field to initiate a research project inside EuroSDR with the goal to derive **the technical background for calibration procedures** for digital cameras based on scientific theory and empirical investigations. The goal is to invite producers of digital camera systems to participate at an early stage in the project to increase acceptance with them and the users of digital cameras.

The originally envisaged legal and organizational aspects for certification are put to the background for the time being.

EuroSDR Members of this core network are so far:

- Dr. Michael Cramer, Institute for Photogrammetry (ifp), University of Stuttgart, project leader EuroSDR (Network Digital Camera Calibration)
- Prof. Risto Kuittinen, Head of Finnish Geodetic Institute and President of EuroSDR
- Dr. Ismael Colomina, IdeG, President of Commission 1 of EuroSDR
- Dr. Hartmut Ziemann, University of Applied Sciences, Dessau, Project leader EuroSDR (Test of digital cameras)
- Prof. Dr. Eberhard Gülch, University of Applied Sciences, President of Commission 3 of EuroSDR

The following persons have participated in the initial meeting of the network and expressed their principal interest in co-operation and participation in such a project.

#	Participant	Organization	Sensor/topic
1	Christoph Dörstel	Z/I Imaging	DMC
2	Mostafa Madani	Z/I Imaging	DMC
3	Peter Fricker	Leica Geosystems GIS+Mapping	ADS 40
4	Stewart Walker	Leica Geosystems GIS+Mapping	ADS 40
5	Mohamed Mostafa	Applanix	DSS/Emerge
6	Ludger Hinsken		
7	Erwin Kruck	GIP Eng.	
8	Jurgen Everaerts	Vito	
9	Risto Kuittinen	Finish Geodetic Institute FGI	EuroSDR
10	Hartmut Ziemann	University of Applied Sciences Anhalt	EuroSDR
11	Eberhard Gülch	Stuttgart University of Applied Sciences	EuroSDR
12	Michael Cramer	ifp – University of Stuttgart	EuroSDR
13	Ralf Reulke	ifp – University of Stuttgart	
14	Norbert Haala	ifp – University of Stuttgart	

## Agenda

### *Status*

- What is the general status of digital camera calibration procedures?
- What do other organizations (ISO, ISPRS, ASPRS, CEOS, EUROGI, ...) do?
- How is calibration performed by the camera producers?

### *Concepts for calibration procedures*

- What is expected from digital camera calibration?
- Is the calibration restricted on the optic parts only or should additional sensors like GPS/inertial components being involved?
- Is there a need for laboratory and/or test field calibration?
- Does calibration include only the geometric part or should radiometry be covered also?
- Is there a realistic chance to design an accepted and practicable camera calibration strategy, which could be recommended for future digital cameras?
- What about stability, reliability, validity aspects of calibration parameters?

### *Experimental research*

- Should EuroSDR go into experimental testing of digital camera calibration? What are the project goals?
- If so, who is interested in participating such tests and who could provide the appropriate test facilities (laboratory equipment, test site) and human power?
- Will camera producers support such test campaigns providing their digital systems?
- Are there any general recommendations on test design and procedures?
- Which software modules are available for processing?

### *Miscellaneous*

## Minutes of meeting (compiled by E. Gülch)

E. Gülch presented EuroSDR and the background to this initiative.

M. Cramer presented the technical aspects of the agenda and a summary of open questions to users of digital cameras and customers of digital camera products (cf PPT presentation in enclosure).

The discussion concentrated on the following items:

- It is generally agreed on that there is a lack of knowledge about calibration procedures. This supports the proposed idea by M. Cramer to collect information on the current practice in a first phase of a project. It is, however, also recognized, that there is still the same need for validity of camera calibration reports as in classical cameras. It is a must for governmental contracts to have an official calibration report. There are varying requirements for repetition cycles as well.
- The comments by the camera producers indicate quite different procedures used so far, possibly also due to the great variety in concepts used at the moment.
- It is generally agreed on to look at complete systems and not only at single components (also in classical calibration combinations of modules are checked)
- It is also recognized that there are new components in the process, namely the software to process images, which needs to be considered.
- It is proposed to run the calibration in two steps: 1<sup>st</sup> a laboratory calibration by the producer followed by 2<sup>nd</sup> calibrations by users/certified sites etc probably using test field calibration procedures. Strategies for those test field calibrations need to be elaborated. The major goal is to decide on: "fit" for job or not.
- Each camera will most probably have (to a certain extent) an own procedure, and own software, which does not make the task easier.
- The manufacturers calibration (initial calibration) is documented in a report. There seems to be a need for new procedures or special equipment due to the multi-head (multi-lens) design of some of the systems. There are different procedures in use on the producers site which need to be investigated (goniometer, terrestrial test fields etc). They vary also from continent to content. Experiences from US, Canada, Australia, Germany, Switzerland were reported.
- There are certainly different procedures applied for self-calibration using testfields. Test field calibration would enable the user to certify the calibration in a time sequence proposed by the manufacturer. There seem to be recommendations by camera producers available on how often calibration has to be verified. Information on some existing test field (Vaihingen/Enz, FGI test field etc.) were given.
- With the NASA test field procedure (report by M. Mostafa) the final result of a process is checked (here digital ortho) instead of calibration parameters "only". The user gets access to some ground control to derive the product. The result is checked by ground control unknown to the user by the neutral authority.
- It is recognized, that there are geometrical, radiometrical and image quality aspects that need to be considered.
- The geometrical aspects seem to be easier solvable and could be addressed first. Radiometric aspects are heavily influenced by outside world conditions and are thus much more difficult to investigate.
- Resolution tests are part of most calibration procedures. The type of test plates needs to be investigated further.

- It seems unclear how radiometric features and image quality should be verified and what kind of facilities are needed for that. It is further unclear if there is a need for absolute radiometric calibration or if relative calibration is sufficient. It is recommended to check for existing Remote Sensing procedures, still the much higher spatial resolution in digital airborne systems might require adaptations or new solutions.
- Current calibration software seems to be mature enough to be applied by customers doing self-calibration in specified conditions, like e.g. to verify misalignment. A training plus documentation of the software will, however, be required. These aspects have certainly to be investigated further, but it seems possible to train users in this respect.
- Camera producers would want to see part of the calibration done outside governmental agencies, however certified by them due to the speed of development in new digital cameras and a potential delay of adapted procedures at agencies. The usage of well defined and certified self-calibration procedures using e.g. test fields could be a potential solution to increase flexibility.
- It is noted, that calibration procedures should be available for all types of airborne digital cameras, also those with less high accuracy requirements to ensure their applicability in (governmental) projects and to be consistent with accept standardization procedures.
- There is concern about repeatability due to different GPS/inertial performance over time compared to potentially stable camera geometry.
- Contacts and some information were provided about USGS and NASA calibration procedures. USGS has recently changed calibration report contents, which should be investigated.
- ISPRS seem to have stopped earlier initiatives, however, Commission I (Stan Morain) is organizing an ISPRS WG I/2 International Workshop on Radiometric & Geometric Calibration ([www.edudevweb.com/isprs/](http://www.edudevweb.com/isprs/)) in Gulfport Mississippi, USA December 3-5, 2003.
- The 3D Optical Measurement Technique conference in Zurich in 2003 will have a paper from Leica-Geosystems (U. Tempelmann) concerning details about the calibration procedure.
- H. Ziemann gave a short report on the goals of his EuroSDR project on performance of digital cameras in comparison with classical film cameras. It was recommended not to mix this project with the current project proposal on camera calibration mainly due to the different objectives, both relevant for users and camera producers.

## Plan for future actions

It was agreed on to send these minutes and the power point presentation to all participants and all other invited or named persons, which could not attend the meeting.

M. Cramer will together with I. Colomina and E. Gülch prepare a project proposal to the Science and Steering Committees of EuroSDR to be presented by M. Cramer on October 15, 2003 in Munich during the next Science Committee meeting of EuroSDR. The goal is to get acceptance for such a project by the Steering Committee of EuroSDR.

*Phase 1 of potential project: October 2003 – December 2003:*

If the project is accepted, the first phase can start. As a result of phase 1 it is expected to present a report on the currently used practice and methods in digital camera calibration. This report will be compiled by M. Cramer with the help of all participants. All are invited to participate in this research and to submit their (publicly available) experiences, which will be summarized in this report. Such a summary will help to create a common knowledge base for the formulation on future strategies and experimental work within this project. Additionally, this status report could be helpful for digital camera system users to gain their experience with digital camera calibration aspects. Further this report should list open problems which need to be solved. All participants welcome the idea that this report is open to producers, users and customers.

*Discussion and Decision on Phase 2:*

Based on the report in phase 1, general concepts of camera calibration should be discussed in the second topic preferably by email. It might be needed that participants meet for that purpose 1 day in spring 2004.

*Aspired Phase 2 (Summer 2004 – Summer 2005):*

The second phase should focus on the development of commonly accepted procedure(s) for camera calibration and testing, based on the experiences and advice of individual experts. It seems to be necessary to focus on some of the technical aspects in a sequential order, possibly starting with geometrical aspects and verification in a limited number of test flights by different camera producers and discussion on radiometric and image quality aspects. One aspect is the design for optimal calibration flight procedures to be tested then empirically. Another aspect is a collection of recommendations of producers on how customers should calibrate and do the processing. It requires a fine definition of goals which should NOT lead to direct comparisons of cameras, but to individual recommendations for each camera type. The road map for this phase should be fixed in the discussion in spring 2004 after analyzing the outcome of phase 1.

Yours sincerely,

Dr. Michael Cramer, Project leader, Network Digital Camera Calibration  
Dr. Ismael Colomina, President of Commission 1, EuroSDR  
Dr. Eberhard Gülch, President of Commission 3, EuroSDR

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**Enclosure:** PPT presentation by M. Cramer  
(EuroSDR\_overheads\_0409.pdf)