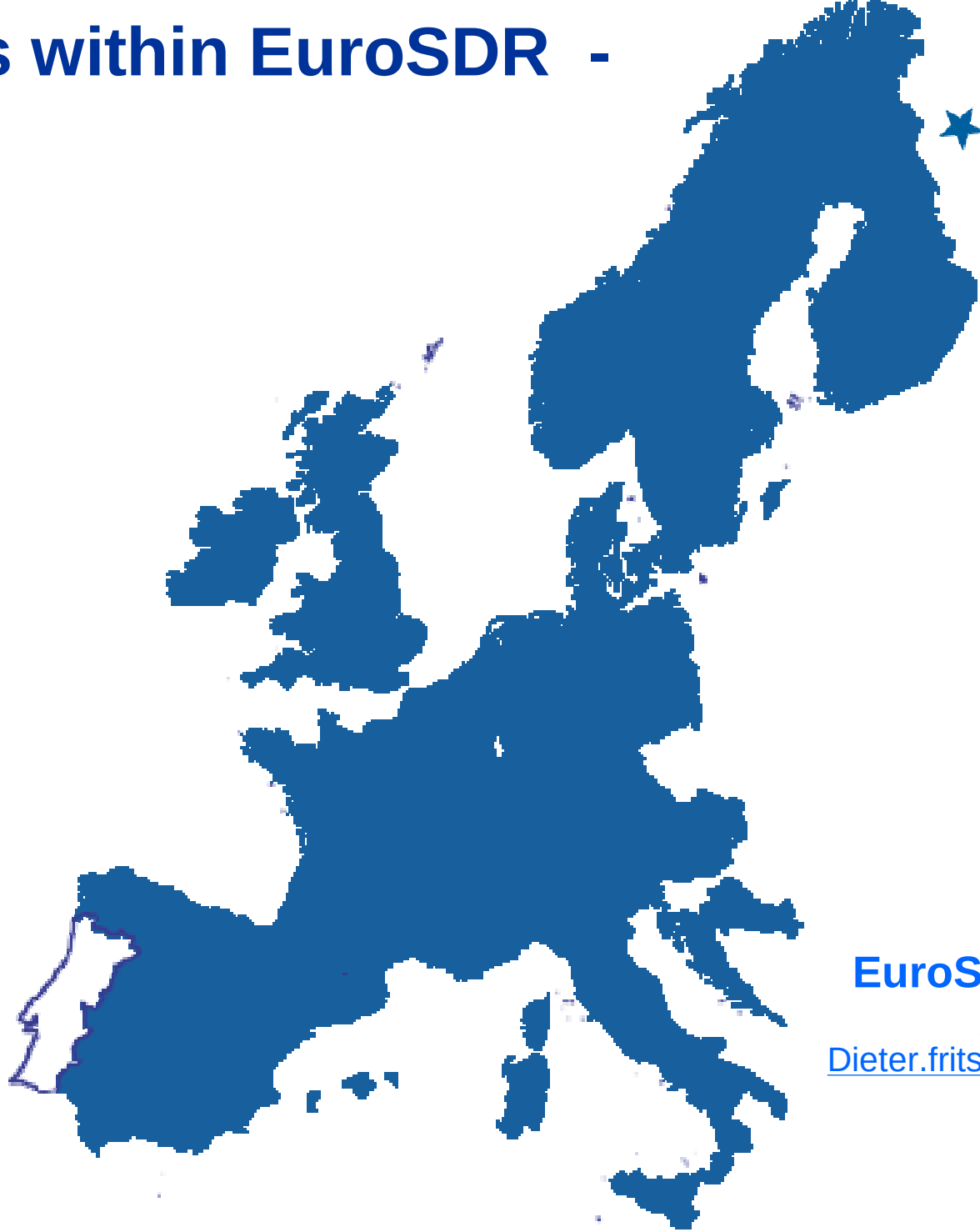
Benchmarks within EuroSDR - A Review



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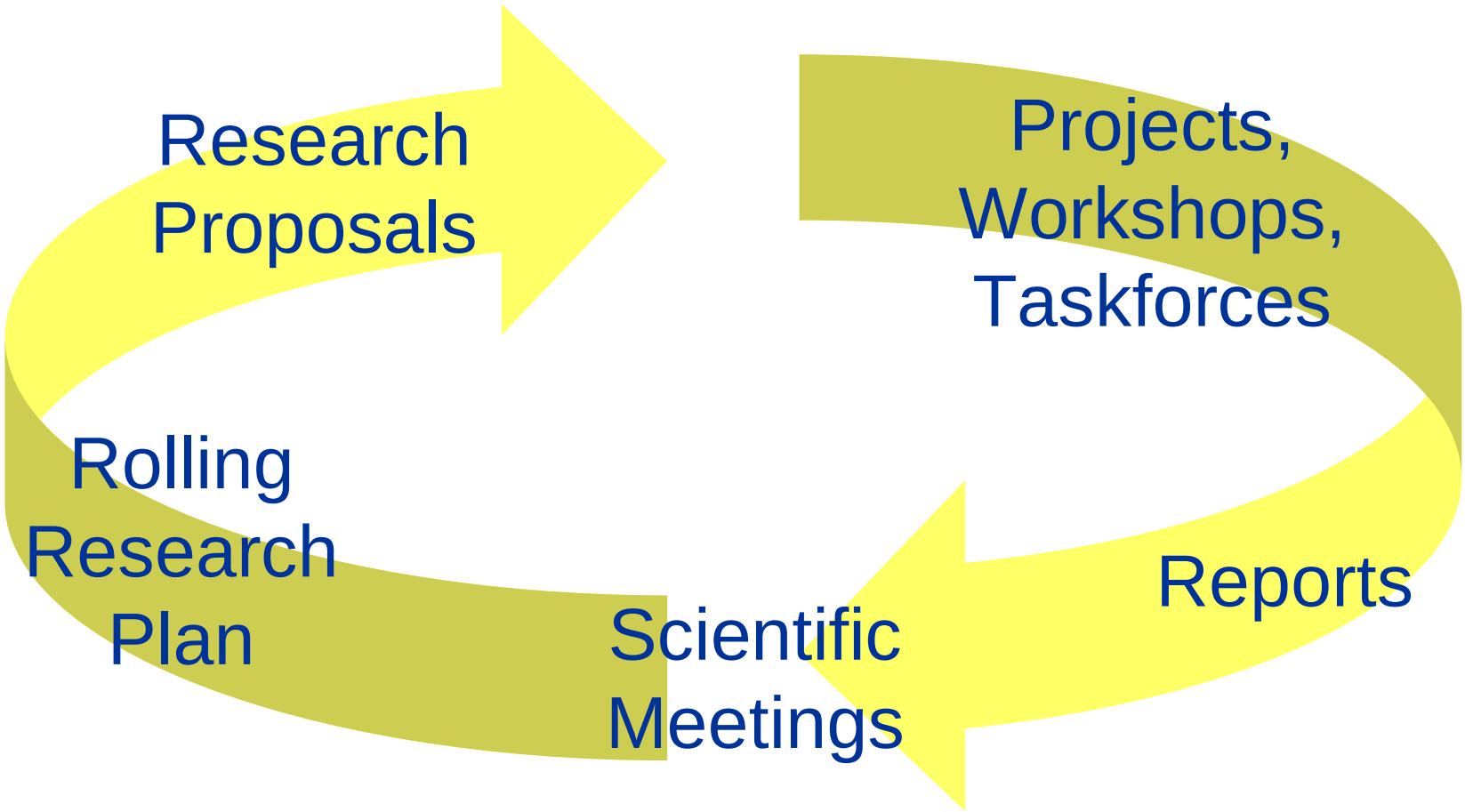
1. EuroSDR is unique

- **National Mapping & Cadastral Organisations** are members of EuroSDR

- But **so are Research Institutes**
  - Delegates from production and research **working together**


EuroSDR
NMCAs
+
Research Organisations

2. Research and Dissemination Cycle



Official Publications and EduServ Courses

2. The EuroSDR Network Idea

- Form a network of GI experts within EuroSDR
- Build and maintain alliances with neighbouring organisations in GI research, development and practice
  - EuroGeographics
  - ISPRS, ICA, FIG, AGILE
  - INSPIRE
  - JRC, OGC Europe, ISO TC 211, CEN TC 287
  - HW/SW Vendors (most recently)

3. EuroSDR Benchmarks – A Review

Benefits:

- Very important for EuroSDR members
- Strengthens the cooperation of NMCAs, academia and vendors
- Helps academia to learn about the problems of NMCAs and to provide technology transfer
- Helps vendors to learn about the performance of their products

3. EuroSDR Benchmarks – A Review

Benefits:

- 1st benchmark “Image Matching Algorithms (1996-2000)”
- 1st benchmark “2D Generalization Algorithms (2004-2008)”
- 1st benchmark “Unregistered Building Detection (2005-2009)”
- 1st benchmark “Geometric Calibration of Digital Airborne Camera Systems (2005-2009)”
- 1st benchmark “Mobile Laser Scanning Systems (2006-2011)”

- **2nd benchmark “Image Matching Algorithms (2009 till now)”**

3. Wrap-up of the 119th EuroSDR Science Committee Meeting, Udine

(Chairman: Dieter Fritsch, Vice-President EuroSDR)

10. New Project Idea VALID (Orhan Altan)

- EuroSDR should deliver 2p for booklet JBGIS/UN for internationalo visibility

-Approve costs of EUR 750

11. New Project AGILE/EuroSDR PTB Phase 3 (Lars Bernhard)

-Continue with project idea

-Results of AGILE WS April 24th, 2012 will be interesting

-Recommendation for budget EUR 2500

-Final Kick-off at Dublin Meeting

12. Midterm Review DTM Benchmarking Project (Marc Pierrot-Deseigilly)

-Redirect the project, organize a Workshop in Spring 2012, maybe in Stuttgart, bring in people of univ., vendors, NMCAs,

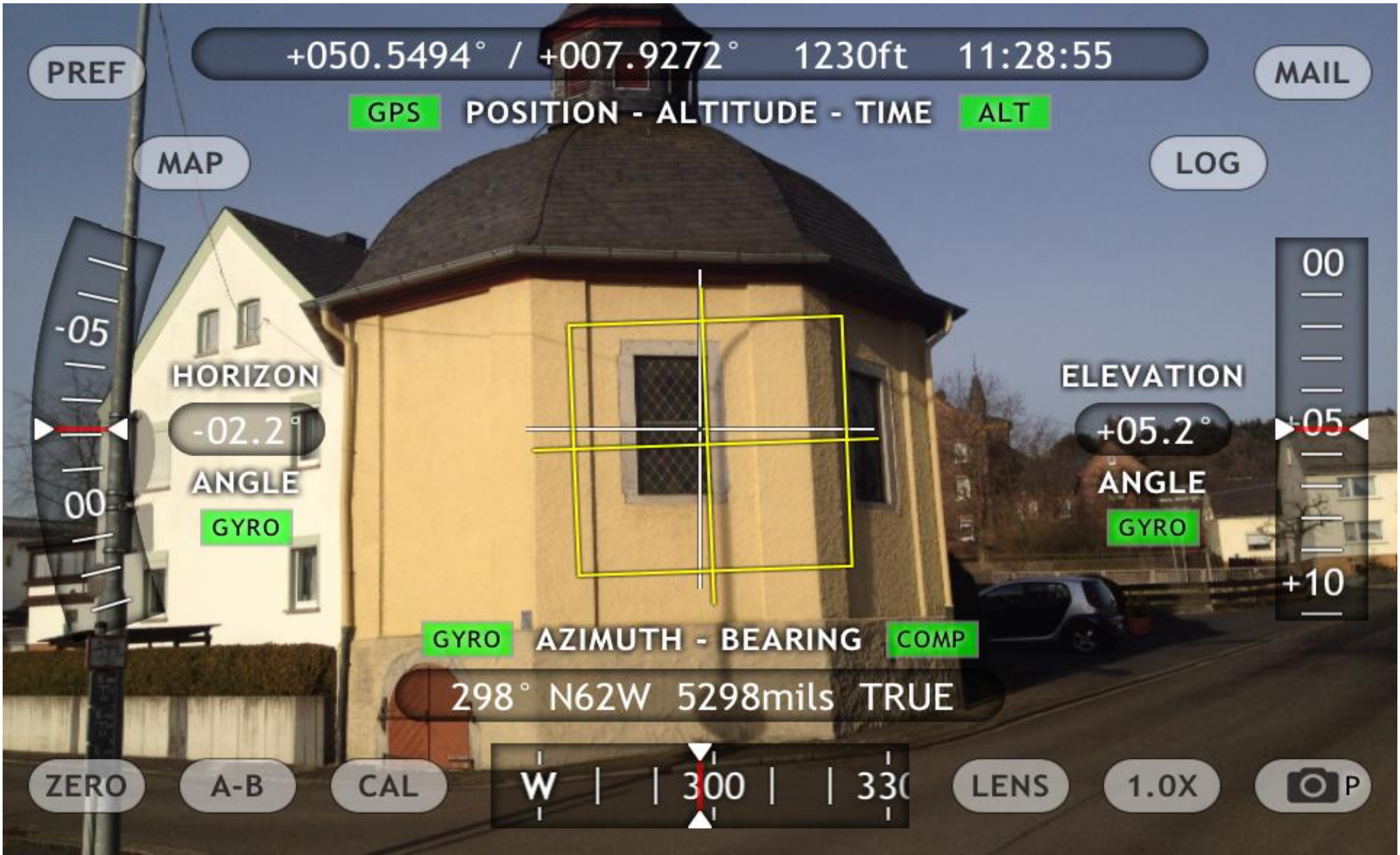
-Report and Decision in Dublin, 05/2012

3. All About EuroSDR Research Rolling Research Plan 11-14

(Relations with „Benchmarking Image Matching“ in bold)

- 1: Sensor systems
- **2: Geometric data collection issues**
- 3: Radiometric data processing
- **4: Vector data revision, DTM update**
- 5: Towards 3D topographic information systems
- 6: Process modelling and interfaces, CC
- **7: Core spatial databases**
- **8: Standards and open software, archives**
- 9: Ontologies and data integration
- 10: Model generalisation, MRDB
- 11: Cartographic generalisation, 2D and in future 3D
- **12: Geospatial data infrastructures, services**
- **13: Geoinformation quality**

4. All About EuroSDR – The EuroSDR App Store



4. All About EuroSDR – The EuroSDR App Store

- **European dimension of Technology Transfer using Open Source SW**
- Establishment of state-of-the-art application store (Example: Apple's App Store)
  - EuroSDR projects run 2 years only
  - EuroSDR projects use or create SW
  - Deliver the SW to the EuroSDR App Store
  - All members (NMAs, universities) can "play" with the SW for 1y, permanent feedback
- **This approach keeps EuroSDR projects alive in providing technology transfer and its SW may be in use for a much longer than the 2y project term!!!**

5. Benchmarking Image Matching #1 Objectives (1996)

OEEPE test

- to study the accuracy, quality and production performance of various methods resp. commercially available DTM computer programs runnig on digital photogrammetric workstations as functions of various parameters, e.g. pixel size, terrain type, point density and grid size
- to compare the performance of different methods and programs amongst themselves; against conventional analytical DTM generation and against in situ measurements
- to recommend that automated DTM generation is practically applicable, is more accurate and more economic than conventional measurements
- to study the weakness of expected performance caused by vegetation cover, building areas and by rough terrain

/fritsch/1996/oeepe/oeepe

5. Benchmarking Image Matching #1 (1996) Vendors involved (operational software packages)

- inpho
- Intergraph
- ism
- i^2s
- PCI International
- ERDAS
- ZEISS
- VIRTUOZO
- LH Systems
- MATRA

/fritsch/1996/oeepe/oeepe

5. Benchmarking Image Matching #1
3 Day Workshop at Stuttgart University

EuroSDR

24th - 26th June 1998

programme

1st day: results of operational software packages

2nd day: results of university software

3rd day: laser scanning and automatic DTM generation using images

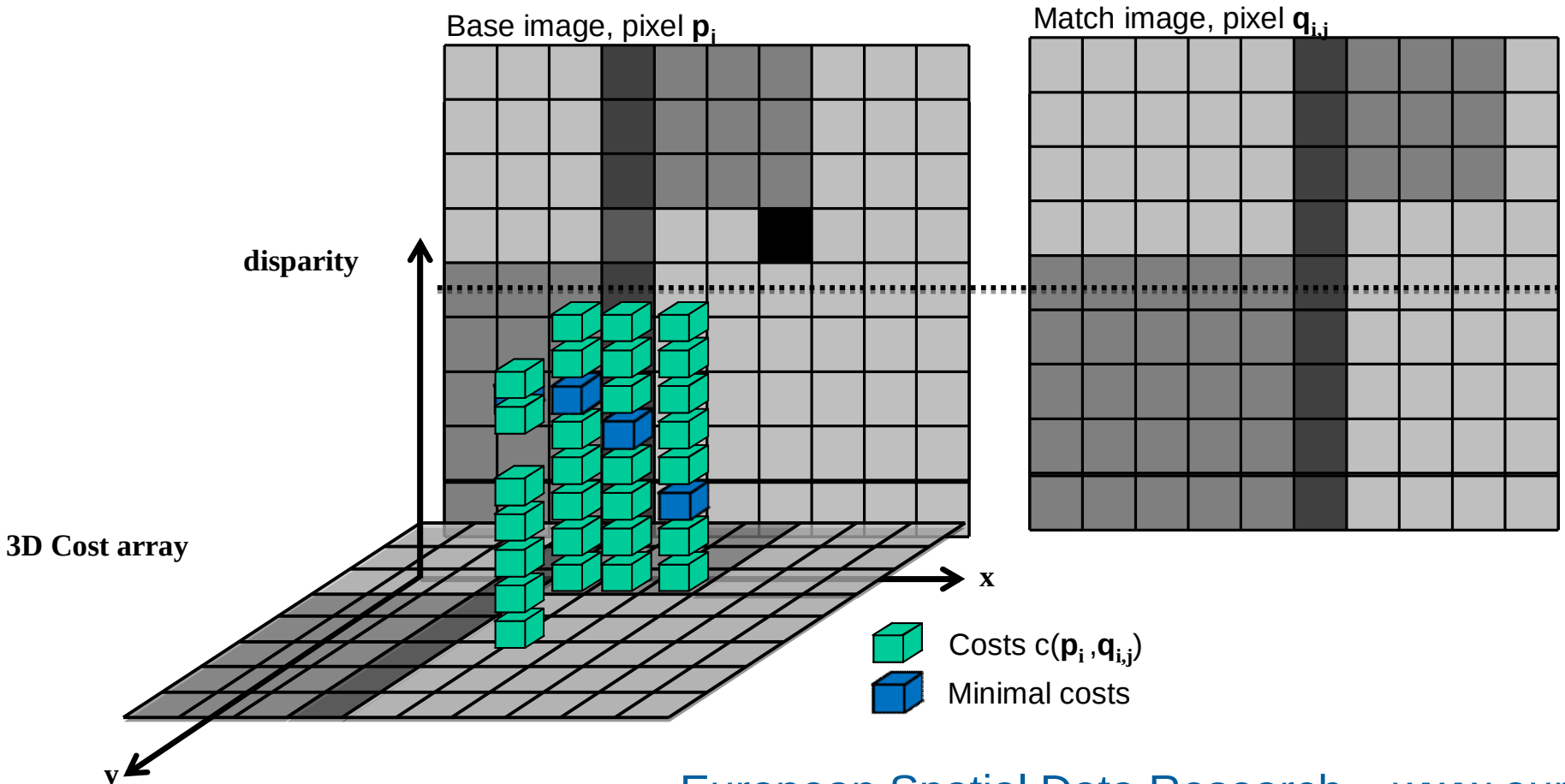
International Reception Center, Stuttgart University

/fritsch/1996/oeepe/oeepe

5. Benchmarking Image Matching #2 (2009)
Dense Matching – Cost-Based Approach

EuroSDR

– Pixelwise matching cost
  - Determine matching cost for each possible pixel correspondence (each disparity for each pixel)
  - Minimum cost represents desired disparity



5. Benchmarking Image Matching #2 (2009)
More about Semi Global Matching

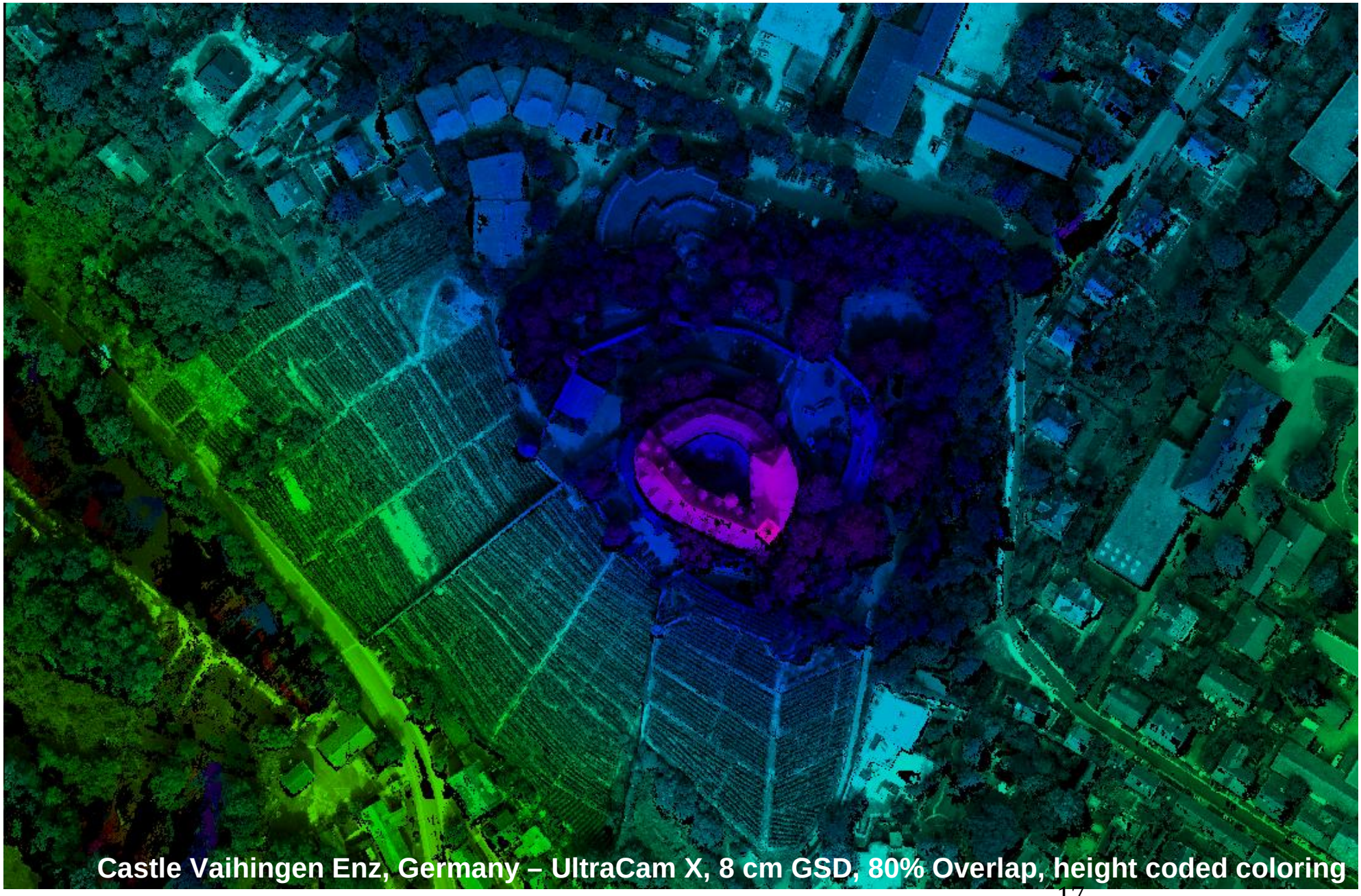
- Introduction of smoothness constraint
  - Global approach: neighboring disparities are taken into account
    - Introduction of cost penalties for disparity jumps
    - Approximation by cost aggregation on linear paths **è** fast

è Semi Global Matching is well suited for small baselines

- Noise reduction using high similarity between images
  - Good for highly overlapping aerial imagery
  - Good for small size stereo camera configurations

è good for our application

5. Benchmarking Image Matching #2
SGM - ifp Results Vaihingen/Enz



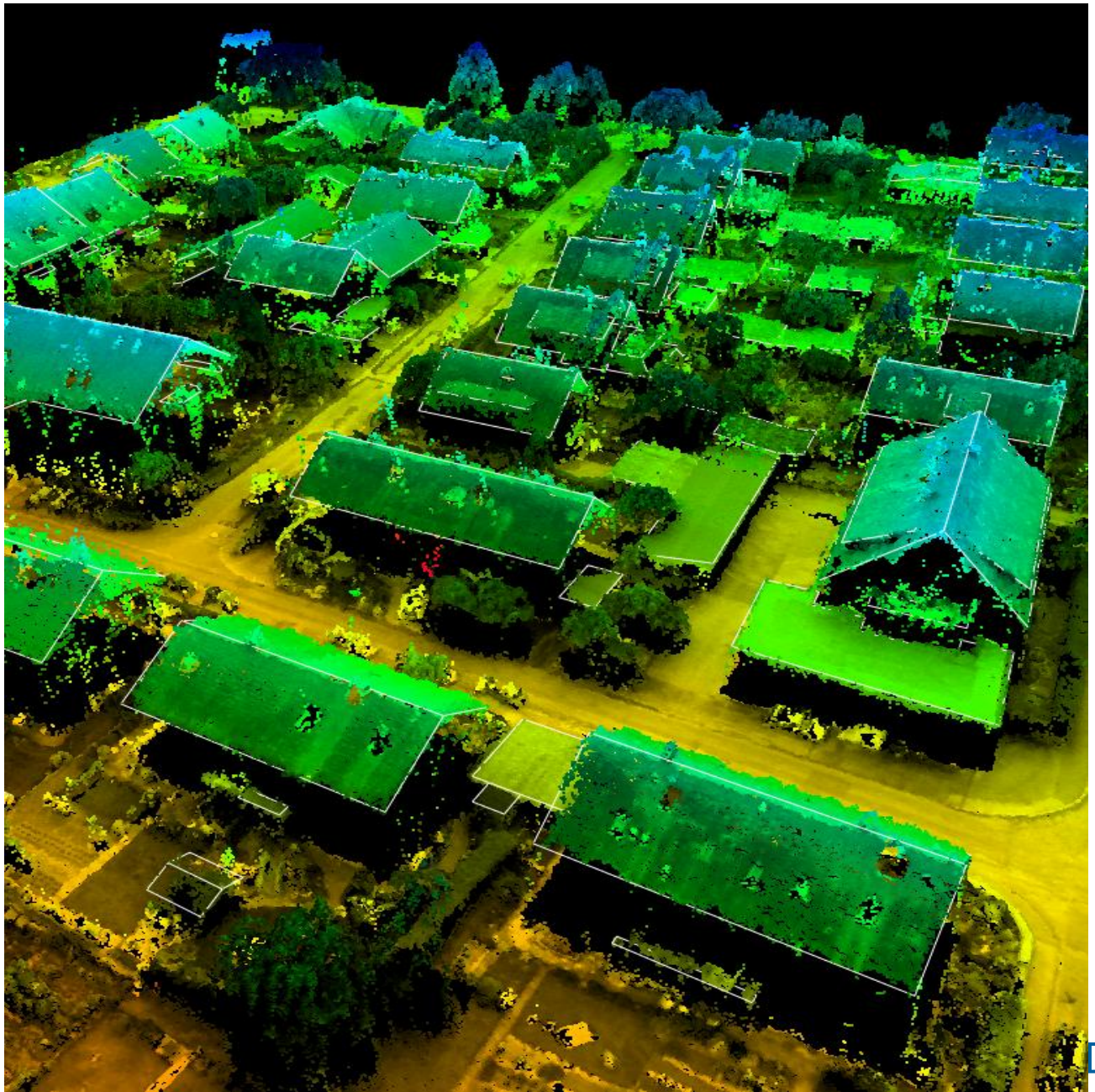
Castle Vaihingen Enz, Germany – UltraCam X, 8 cm GSD, 80% Overlap, height coded coloring

5. Benchmarking Image Matching #2
SGM – ifp Results Vaihingen/Enz
Pointcloud Evaluation

Method	Sensor	B/H	H/f	σ_δ [cm]	σ_d [px]	Pts/m^2	f_δ [-30,30][cm]
LiDAR	ALS 50			1.5		11.9	
SGM	DMC	0.292	7010.0	4.1	0.14	138.5	
SGM	UltraCam	0.129	11663.9	9.7	0.15	139.9	
SGM	UltraCam	0.257	11663.9	5.4	0.16	135.7	

- base-height ratio beneficial for relative accuracy
- Good illumination for the DMC dataset leads to better texture and thus improves the matching accuracy
- Highest accuracy in height direction for ALS 50 LiDAR dataset
- SGM enables high point density
- Multi baseline matching is expected to improve the accuracy and reliability of the pointcloud

5. Benchmarking Image Matching #2
SGM: ifp Results Vaihingen/Enz, Video Graz



Residental Area

Vaihingen Enz, Germany
UltraCam X, 8 cm
GSD, 80% Overlap
White: roof borders from stereoplotting
height coded coloring

6. Conclusions

- Photogrammetric Week 2011: Image matching has reached new horizons - Semi Global Matching is like a booster!
- Image matching has become more important than ever before, will lead to „All-in-one photogrammetry“
- NMCAs have to know quite fast how to integrate SGM and to restructure their GI data processing pipelines
  - For money saving reasons
  - To improve update cycles for DTMs, 3D City models, true orthos, etc.
  - To select fairly the use of airborne laser scanning
  - To develop new business

Questions:

- What have been the problems with the current IM benchmark?
- Are NMCAs really interested in new developments of image matching?
- How should we proceed with this benchmark?
- Recommendations to the EuroSDR delegates for the Dublin Meeting?

6. Conclusions

- Interested in other EuroSDR activities?
- Please register now for the 2012 series of **elearning courses offered by EuroSDR from March 2012**.
- The courses:
- **Terrestrial Reference Frames: application to the realisation of the European Reference System (ETRS89)**
- *Hosted by: Ecole Nationale des Sciences Géographiques, Paris*.
- **3D data in Urban Environments**
- *Hosted by: IGN France*
- **Open Standards & Open Source WebMapping**
- *Hosted by: ITC University of Twente, Netherlands*
- **Radiometric performance of Digital Photogrammetric Cameras and Laser Scanners**
- *Hosted by: Finnish Geodetic Institute and TU Vienna*

EuroSDR: A pan-European Network For Spatial Data Research

You are kindly invited to contribute!

Thank you very much for your attention!