EuroSDR

European Spatial Data Research

Annual Report 2015

www.eurosdr.net

About EuroSDR

EuroSDR is a pan-European organisation established by International Treaty, as OEEPE, in 1953 in Paris in accordance with a recommendation passed by the Council of the Organisation for European Economic Co-operation. The spatial data research interests of European Countries are represented through the membership in EuroSDR of national organisations from their production and research sectors.

The result is a network of delegates, from European Geographic Information organisations and research institutes, effectively and practically addressing Europe's spatial data research requirements.

Collaborative research projects address the acquisition, management and delivery of spatial data and services while international workshops and courses, in collaboration with related organisations, address key issues in a timely and focused manner.

Vision

EuroSDR is the recognised provider of research-based knowledge to a Europe where citizens can readily benefit from geographic information. Our mission is to develop and improve methods, systems and standards for the acquisition, processing, production, maintenance, management, visualization, and dissemination of geographic reference data in support of applications and service delivery.

Our Member States and their Prime Delegates (2015)

Austria	Michael Franzen	Bundesamt für Eich- und Vermessungswesen (BEV)
Belgium	Ingrid Vanden Berghe	Nationaal Geografisch Instituut
Croatia	Danko Markovinović	Državna geodetska uprava
Cyprus	Andreas Sokratous	Department of Lands and Surveys
Denmark	Thorben Hansen	Geodatastyrelsen
Finland	Juha Hyyppå	Geodeettinen Laitos
France	Bénédicte Bucher	Institut Géographique National
Germany	Hansjörg Kutterer	Bundesamt für Kartographie und Geodäsie
Ireland	Andy McGill	Ordnance Survey Ireland
Norway	Jon Arne Trollvik	Statens Kartverk
Poland	Piotr Woźniak	Glowny Geodeta Kraju
Slovenia	Dalibor Radovan	Geodetski Institut Slovenije
Spain	Antonio Arozarena	Instituto Geografico Nacional
Sweden	Mikael Lilje	Lantmäteriet
Switzerland	François Golay	Ecole polytechnique fédérale de Lausanne (EPFL)
The Netherlands	Jantien Stoter	Technical University of Delft and NL Kadaster
United Kingdom	Malcolm Havercroft	Ordnance Survey of Great Britain

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1. Message from the President Martin Salzmann

2015 was a year where many developments in research and development have really become manifest. Increasingly new concepts and technologies have transferred from the research phase to the development phase and sometimes even into the operational phase, without having matured to a level where this would have happened a number of years ago. Within EuroSDR we used to work on spatial data management with a linear view of the world. Starting from data acquisition via modelling, sensor integration and quality control we moved into spatial information which we made applicable for users' needs or issues. In our trade we now increasingly see that developments take place simultaneously. Information is at the core and it might well happen we work simultaneously on sensor optimization and information modelling for a certain problem. An example where you see this happen is the smart city (or rather the smart society) where everything may be related to or dependent on everything in the eye of the problem holder. This is reflected within EuroSDR as well. We have restructured our commission structure in a way that we support this way of working. When we depict our new commission structure graphically you will not see a chain any longer, but a network of interrelated themes. I am also very happy that outreach and knowledge development are now within the core commission structure of EuroSDR. Keeping track of all these developments makes continuing professional development pivotal. Not only for our members, but for all workers in the geospatial industry.

We started working along the lines of the new commission structure at our Board of Delegates meeting in Winchester. At the same meeting we have held our first review of our strategy. Basically the review showed that our delegates support and work along the lines of our strategy. The relation between agencies and academia was reconfirmed as the cornerstone of EuroSDR. At the same time members were aware that this requires continuous contributions by and collaboration between all members and outreach to private industry and young professionals.

In 2015 we witnessed the move towards information-centric approaches in both our board of delegates meetings in Tønsberg in Norway and Winchester in the UK. Our hosts (Statens Kartverk and Ordnance Survey) at those two meetings showed very clearly how they operate within an information society and how they face the challenges and base their strategies on this development. Users' demands seem to develop at such a speed, that it becomes a challenge by itself to maintain a reliable and versatile information infrastructure. This also happens at the level of research institutes, universities and private companies. In the presentations I was surprised to witness how new players have discovered the power of spatial information.

2015 was also the year where we have further worked together with our partners. We have strengthened our cooperation with Eurogeographics. We participated actively at their general assembly in Belgrade, giving a presentation and hosting a round table discussion. Furthermore we are looking how we can find common research and development issues with the so-called knowledge exchange networks of Eurogeographics. At the global and European policy level UN-GGIM is shaping itself. The UN sets its agenda on the basis of the recently established sustainable development goals. The UN has recognized that to achieve these goals the use of spatial data, statistics and reasoning is essential. UN-GGIM is looking for active participation of NMCA's and academic institutions. We will

actively follow these developments as an observer of UN-GGIM:Europe. I expect that in the coming years this will result in more interest in geospatial data management particularly on the political and policy level.

Cooperation was also at the basis of many workshops we organised; often in cooperation with other learned societies as ICA and ISPRS. The workshops of the past year have proved to be very successful, both at the level of knowledge exchange, but also in attracting many participants. We were also instrumental to support the future of the EuroCOW events.

A new element we have explored is crowd-funding. In general we are able to achieve results with low budgets. As funding at mapping agencies and academia is still difficult we have looked for alternatives. This especially holds for research projects and this year we have started our first research based on the contribution of a number of mapping agencies. Unfortunately the budgets cuts in our governments still make it difficult for some members to cover their membership fees or the actively participate.

As with all associations the real work done is by its delegates and members. I have – once again – witnessed that the projects and workshops are successful because of the work of our members. They organize the workshops, advance knowledge in working groups, participate in projects, publish results and teach about the beautiful theme of spatial data management.
We are fortunate to be supported by an excellent secretariat and executive team. Joep Crompvoets (our secretary general) and Anneke Heylen at our secretariat, André Streilein (vice president) and our commission chairs Fabio Remondino, Norbert Pfeifer, Jantien Stoter, Jon Arne Trollvik and Markéta Potůčková taking care of our research and development agenda.

I wish to thank them all for making EuroSDR an association making a difference and to be proud of!

2. Message from the Vice-President André Streilein

This year was an intense and prosperous year for EuroSDR. The organisation became noticeable through many practical achievements in an increasing heterogeneous and complex research environment.

At the 126th EuroSDR Board of Delegates Meetings in Tønsberg, Norway, the delegates decided on the overall commission structure, the commission naming and the commission chairs. And at the 127th EuroSDR Board of Delegates Meetings in Winchester, Great Britain, the delegates approved the **Rolling Research Plan 2015-2018**. The rolling research plan is developed to define the framework within which EuroSDR research, development and education is performed. Its main purpose is to properly structure the work for the coming years, while leaving enough flexibility to be able to react to unforeseen developments.

The improvements initiated by EuroSDR are achieved by common tests, workshops, cooperation with partner organisations, and the exchange of experiences with other organisations. The main research activities of EuroSDR in this year dealt with:

- rapid technical development (ICT, sensors, processes, VGI, RPAS, mobile devices, etc.),
- growing demand for up-to-date spatio-temporal, 3D, multi-scale data and services,
- increasing focus on data integration and quality issues and
- historical data and processes.

Many **projects** have been finalized and new project have been launched, often based on the open tackled questions from workshops or Board of Delegates Meeting. For example the project on Oblique Imagery, which is an organized benchmark in collaboration with ISPRS Scientific Initiative 'Benchmark for multiplatform photogrammetry'. The aims of this initiative are to foster research concerning automated and reliable co-registration of multiple platforms/perspective imagery, to have a (joint) orientation/calibration of multi-platform imagery (terrestrial, RPAS, airborne), and to perform/evaluate dense image matching methods. Since autumn 2013 National Mapping Agencies are working together on 3D issues in the EuroSDR 3D Special Interest Group (3D SIG). This group defines and coordinates the long-term 3D research agenda of EuroSDR based on experiences and developments of both research institutes and NMAs in the area of 3D, carries out research projects on topics of common interest and organizes a workshop series on relevant topics. Currently the EuroSDR 3D SIG works on the definition of a common vocabulary for 3D mapping of large areas (regions or countries) aligned to INSPIRE and CityGML. The project on Terrestrial Laser Scanning for Forestry Applications is a benchmark on obtaining parameters of vegetation (position, diameter and height of trees, etc.) from TLS data in forest plots. And the benchmark project "dense image matching" is a follow on of the first phase of the high density image matching project. It provides nadir and oblique images and different test participants shall provide their high density image matching results as digital surface model.

Many of the activities, exchange of ideas and opinions, generation of new ideas and projects are performed in **workshops**. It is typical for EuroSDR workshops that these take place as joint events together with other relevant scientific organizations. To mention just a few: The workshop on "oblique cameras and dense image matching" took place in Southampton from 19 until 20 October 2015 with than 90 participants (R&D, NMCAs and Companies) from 23 countries. Other examples are the

EUROSDR/AGILE/OGC/JRC/ELF workshop 'data modelling and model driven implementation of data distribution' 28 - 30 January 2015 (Danish Geodata Agency, Copenhagen, Denmark) and the ICA/EuroSDR Symposium: multi-scale production lines, 3-4 December 2015, in Amsterdam.

In terms of knowledge transfer EuroSDR is continuously active in documenting the outcome of their research results and workshop results in their publication series. In addition this knowledge is disseminated via the Educational Service **EduServ**. The 13th series of the Educational Service was running this year and consists of the following courses: 'Mapping using high-resolution satellite imagery' tutored by Daniela Poli (Terra Messflug GmbH, Austria), 'Change detection in High-Resolution land use/cover geodatabases' tutored by Clément Mallet, (IGN France), 'RPAS in land survey – theory and practice' tutored by Görres Grenzdörffer, (University of Rostock, Germany) and Michael Cramer (University of Stuttgart, Germany), 'International standards for geographic information', tutored by Wolfgang Kresse (University of Applied Sciences, Neubrandenburg, Germany). A total of 33 attendees actively participated in the e-learning part of the educational service. Their feedback was in very positive regarding the content, structure and course materials.

Figure 1: EuroSDR Rolling Research Plan

3. Interesting examples of real life practices at NMCAs based on results of existing applied research.

3.1. AUSTRIA: Landcover detection based on remote sensing data
Michael Franzen, BEV

A main task of NMCAs is to maintain information on land cover. This data are relevant for the revision of topographic and cartographic models, as well as the cadastre. One approach to obtain information on land cover is the use of remote sensing data, especially orthoimages. This is the strategy of BEV (Bundesamt für Eich- und Vermessungswesen, Federal Office of Metrology and Surveying).

BEV provides in cooperation with the ministry of agriculture and the federal provinces of Austria a set of digital aerial images and digital orthoimages with an update cycle of three years over the whole area of Austria (84.000km^2). Specification of this data set is a ground sampling distance of 20 centimetres and an overlap of 80% along track and 40% across track. Orthoimages containing not only the red, green, and blue channel, but also an infrared channel enable the separation of vegetation from other land cover types, based e.g. on the NDVI (normalized difference vegetation index). The second main input for classification of land cover is a digital surface model derived from the aerial images by dense image matching. Since surface model and orthoimages are derived from the same aerial images, both data sets are consistent to each other.

The workflow of determining land cover information starts with segmentation relating to radiometric information and segment shape indices (object based image analysys) of the orthoimages. The following classification uses radiometric information of the orthoimages on the one hand, on the other hand height information of a normalized surface model (derived from the digital surface model by image matching and the digital terrain model) is used. Post-processing (“cleanup steps”) leads to information on land cover related to on the LISA (Land Information System Austria) classification model (see figure 1).

In the starting phase of this project BEV concentrates on the production of a land cover layer focused on buildings and forest.

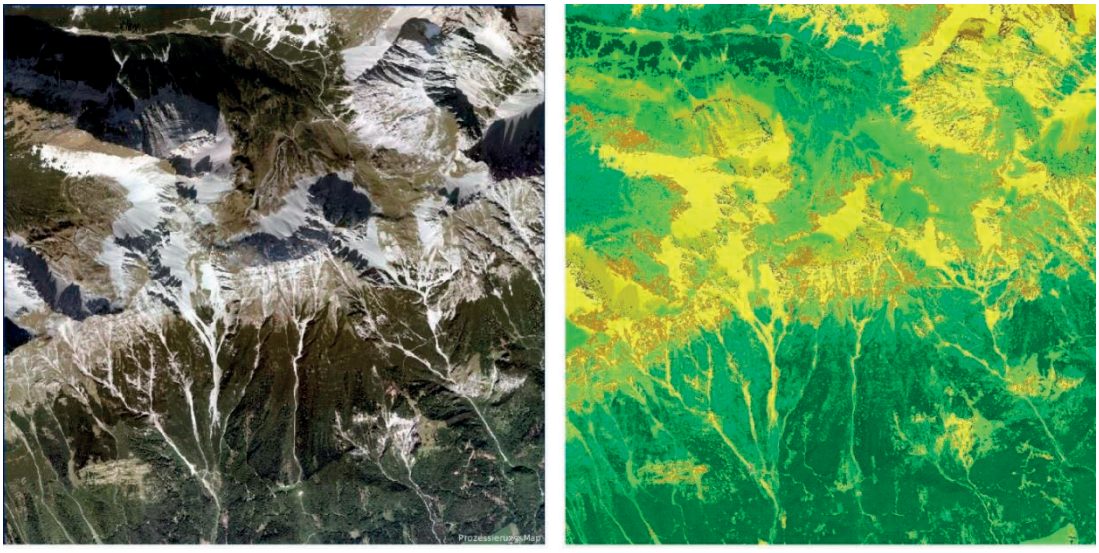


Figure 2: Land cover detection in an alpine region (focus on forest) – orthoimage and classification

3.2. Generalisation at NGI BELGIUM in 2015

Anne Féchir, Eric Bayers

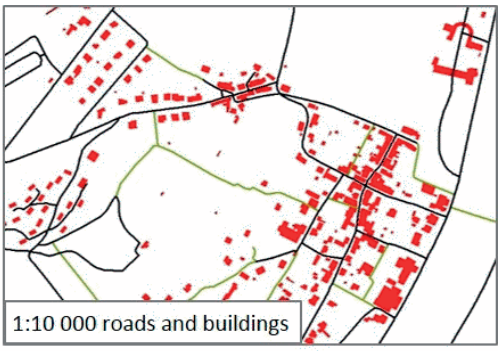
3.2.1. The context

In 2015, NGI-Belgium launched a new update cycle (2015-2020) for its 1:50 000 topographic maps and the production of a new series of 1:25 000 topographic maps.
Since its first edition (in 1994), the digital data of the 1:50 000 series are updated, at least partially, on the basis of the NGI's reference data, i.e. the 1:10 000 data.

3.2.2. Automatic generalisation

Since 2006, only the buildings and the transportation arteries are systematically updated in the reference data. In order to produce an entirely update 1:50 000 series, we had to look for other sources. The production process for the generalized data at the scales of 1:25 000 and 1:50 000 is not linear at all.

The updates of the buildings and the relevant transportation arteries for the 1:50 000 are traced interactively by comparing the generalised data with the reference data and applying the 1:50 000 selection criteria. Afterwards, they are propagated into the corresponding layers of the generalised data set. In 2009, the models of both scales have been redesigned to make them more coherent. This redesign makes the data propagation easier.



The built-up areas of the 1:50 000 are entirely recreated for each edition. The densely built-up areas of the 1:10 000 data are used for this operation. This generalisation is entirely automatic. We also use a generalisation process to simplify the reference data for the 1:25 000.

The roads, railroads and waterways we use for the 1:25 000 map are those of the 1:50 000. A specific generalisation process is used for the paths and the dirt roads, which are essential for the hikers who are the map's target group. The first part of this process is automatic, whereas in the second, interactive part the more complex cases are solved. By doing so, we obtain a network with a density which lies between the 1:10 000 and the 1:50 000.

The vegetation is first automatically generalised on the basis of the 1:10 000. Afterwards, it is updated (using orthophotographs) at the 1:25 000 scale and then generalised for the 1:50 000. The remaining themes, mainly the water surfaces but also objects like walls, tree lines or graveyards, are very slightly generalised, mostly in an interactive way.

3.2.3. Short term projects

Until now, the NGI has always preferred to use configurable tools for automatic generalisation (developed at the NGI or available in Radius Clarity).
In the future (from March 2016 on), the NGI plans to test also the generalisation solutions which are proposed in the ESRI suite (less configurable but more user-friendly), as well as the new solutions which are proposed in the 1Generalize suite (evolution of the Radius Clarity solutions).
Our aim is to enhance the speed and to diminish the cost of the production of generalised data, which meet the users' needs.

3.2.4. EuroSDR workshops

Anne Féchir and Peter Erauw, who both are in charge of the development of generalisation tools and the production of generalised data at the NGI, participate in the workshops which are organised by the EuroSDR commission 2 « Modelling and processing » about « Designing MRDB and multi-scale DCMs: Sharing experiences between mapping agencies and the outside world ». Participating in these workshops gives them the occasion to share their views on automatic generalisation with the experts from the other NMA's, which is always an interesting and rewarding experience.

3.3. FRANCE: IGN-COGIT

Simulating surface buildability to assess land prices based on 3D geodata and urban rules

Mickaël Brasebin

Since 2015, IGN COGIT laboratory collaborates with the Institute of urban planning of Paris region (IAUIdF, Institut d'Aménagement d'Urbanisme d'Île-de-France) in order to produce a buildability database on the region territory. The IAUIdF intends to use it to assess land prices which are correlated with what can be built on these lands. Buildability simulation necessarily refers to local urban regulation (PLU for Plan Locaux d'Urbanisme), elaborated by municipalities to define constraints that new buildings must respect, and to the existing topography and land use. For example, the PLU may limit the distance between a window and a new construction or the recoil to parcel boundaries.

In order to improve the buildability simulation, the PLU must be translated from textual format into a database of rules, which evaluation also requires reference data about the existing buildings, roads, windows, etc. During a former collaboration between IGN-COGIT, a municipality and a land planning cabinet, such a format was proposed to encode urban rules like constraints on morphology of new buildings, limitation of the maximal height or definition of a maximal authorized floor area ratio as 3D objects and tractable constraints (Brasebin et al, 2016).

Once rules are encoded, the assessment of buildability can be done visually by an expert on a small area, based on a proposed visualization of the rules together with the urban space. On a large area, automation is required. (Brasebin, 2014) designed a method to generate 3D buildings from PLU regulation encoded with the above format. The result of this work is released as the SimPLU3D open library (https://github.com/IGNF/simplu3D), that includes :

- A generic 3D model that allows the representation and the checking of PLU regulation ;
- A loader adapted to French datasets that describe mainly parcels, buildings and roads ;
- A building generator based on an optimization algorithm that proposes buildings composed by a set of parametric objects (for example, cuboids).

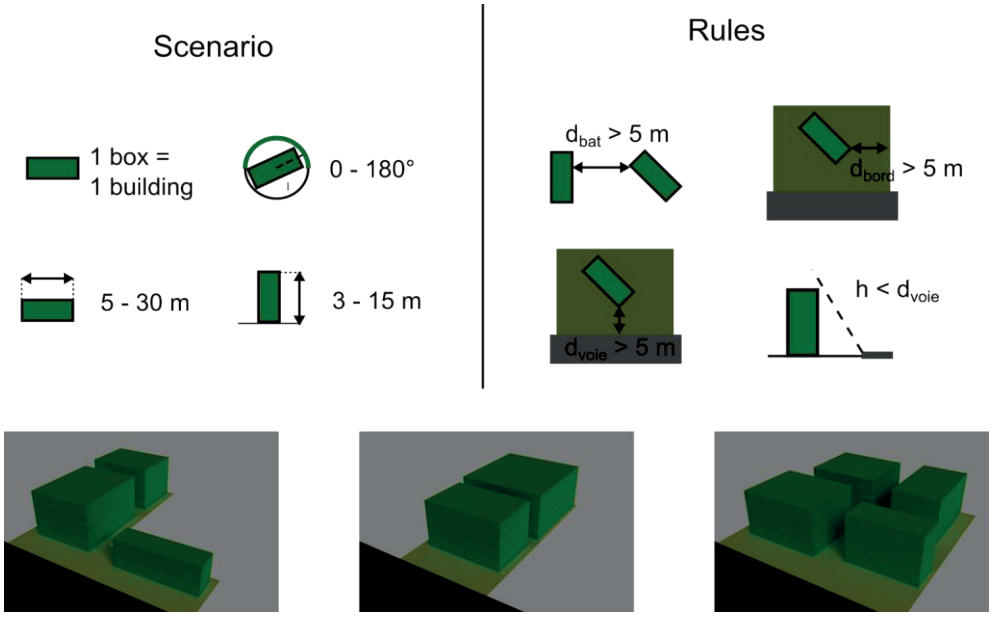


Figure 3: Several simulations with a same set of rules on different parcels.

This software was used to compare the floor surface of existing buildings to the floor surface that could have been achieved considering the actual regulation. The input data about the territory only where the road network and parcels. The simulations of possible buildings, compliant with the regulation

were processed on a set of 500 hundred parcels. The output was that it would have been possible to build denser in this area with the current regulation. More precisely, the simulator showed that the current regulation allows to add two floors to existing buildings on 210 parcels, This kind of information is interesting because it highlights zone where future land transactions may occur. In fact, when the difference is important for a given parcel, a promoter may be eager to buy this parcel in order to add new levels or to build new extensions or buildings.

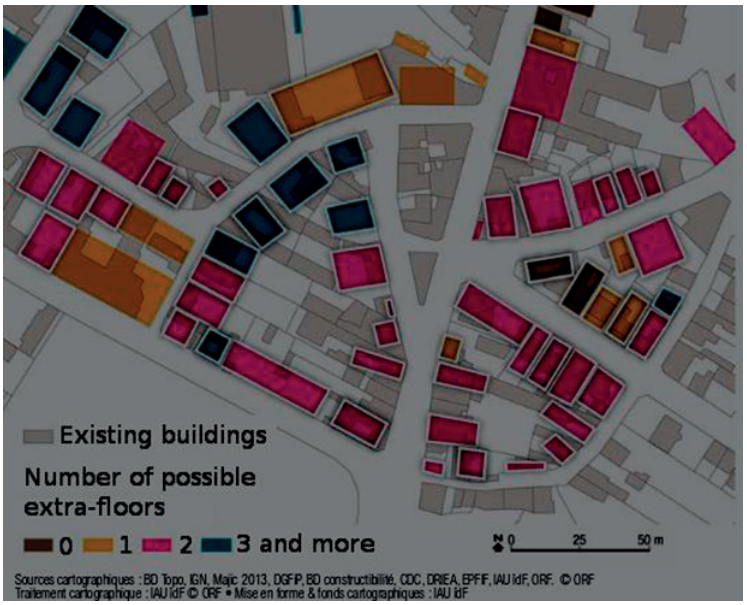


Figure 4: Example of map produced by IAUIdF (IAUIdF, 2015) with existing buildings in grey and simulated buildings colored according to possibilities of floors addition.

Future work will target the validation of the simulation by checking the quality of the buildable floor surfaces evaluation with land planner and to produce data about possible densification of Île-de-France.

Brasebin, M. (2014) Les données géographiques 3D pour simuler l'impact de la réglementation urbaine sur la morphologie du bâti. Ph.D. thesis, Université Paris-Est.

Brasebin, M., J. Perret, S. Mustière and C. Weber (2016) A Generic Model to Exploit Urban Regulation Knowledge, ISPRS International Journal of Geo-Information, vol. 5, n. 2, pp. 14, doi:10.3390/ijgi5020014

IAUIdF (2015) Note de conjoncture, de l'ORF , octobre 2015 - http://www.orf.asso.fr/uploads/attachements/orf_nc7_ok_lg.pdf

3.4. GERMANY, BAVARIA:
Agency for Digitisation, High-Speed Internet and Surveying (LDBV)
Dr. Klement Aringer, Martin Riemensperger

3.4.1. Production of a Digital Surface Model (DSM) at LDBV

Compared to previous experiences using image correlation the innovative computing method of dense image matching along with the improved image quality of digital aerial cameras resulted in a remarkable improvement of the derived digital surface models. Based on own investigation and software tests we decided to generate a Bavarian DSM using image correlation. This complements the existing LIDAR DTM and can be updated periodically in an inexpensive way with the images of the regular photo flights.

To gather experience for workflow details, we started a prototype production of an aerial image based DSM, whereby the matching process was performed with pyramid level 1 corresponding to 40cm GSD. The result was a DSM with a grid of 40 cm equal to 6.25 points per square meter. This resulted in five days of computing time for a project with 1,000 square kilometers and allowed faster adjustments of the production process to changes and improvements than it would have been the case on pyramid level 0 (20cm GSD).

Between February 2014 and May 2015 a state wide DSM was produced with images from the Bavarian photo flights 2012, 2013 and 2014. Test data were yielded to internal and selected external customers, who gave encouraging feedback, even though accuracy and homogeneity were varying because of the experimental status of this DSM. In 2015 the next step of DSM derivation started. To get a uniform density of the resulting point cloud and to minimize not visible areas in the image material the overlap parameters of the aerial flight were increased to 80% along and 50% across track. Matching with the full photo resolution of 20cm GSD improved the accuracy significantly. Because of the amount of data this (better) result is converted to a 40cm grid and stored into the database as before.

The extended computing time of now almost 20 days for 1,000 square kilometers makes high demands to the reliability of the used computer equipment (especially hard disc drives!). To achieve the throughput necessary, the number of powerful computers was increased from two to five by the end of 2015. The quality check of the results meanwhile is made according to a guideline based on own experiences and a bachelor thesis. In 2016 the image based DSM will be launched as official product of LDBV. The DSM is applied for the actualization of the DTM using a special procedure and for the production of current building models in LoD2. It will also be provided for various visualizations of geographical data particularly as the points enable clear examples when colored with the related aerial images. In the future additional products derived from the DSM are possible. First the True Orthophoto with 20cm GSD has to be mentioned. Change detection can be generated by the difference of two DSM epochs. And finally subtracting the DTM from the DSM produces the buildings and the entire landscape inventory on the flat map layer.

Figure 5: Digital Surface Model (DSM) at LDBV

4. Report by Secretary-General Joep Crompvoets

2015: The year that I was re-appointed for the second term as the Secretary-General. This means that Anneke Heylen and myself are already serving the secretariat of EuroSDR for four years. This report reviews the annual board of delegates meetings happening in the framework of EuroSDR in 2015, the activities related to our partner associations, and some logistics.

4.1. Meetings

The 126th EuroSDR Board of Delegates meetings took place in Tønsberg (Norway) from 20 until 22 May 2015. These meetings were hosted by the Statens Kartverket – the Norwegian National Mapping Authority (with Jon Arne Trollvik as the key host person) and were participated by 40 persons from 17 countries joined the events. These meetings started with an overview of excellent examples of GI research and professional activities in Norway. The highlights of the meeting were the two keynote presentations: 1) "Arctic SDI – An overview" by Knut Arne Gjertsen (Deputy Director General, Norwegian Mapping Authority) and 2) "European Location Framework" by Olaf Østensen. The European Location Framework (ELF) is a technical infrastructure which delivers authoritative, interoperable, cross-border geospatial reference data for analysing and understanding information connected to places and features. Both keynotes were followed by breakout sessions with the content of the keynotes as topic for discussion.The delegates approved the new commission structure of EuroSDR with chair persons; 1. Data acquisition (Fabio Remondino); 2. Modelling and processing (Jantien Stoter); 3. Updating and Integration (Norbert Pfeifer); 4. Information Usage (Jon Arne trollvik); Business Models and Operations (Joep Crompvoets; and Knowledge Transfer (Markéta Potůčková). The Norwegian host organised the great Viking Experience which was really a unique and unforgettable experience and several gorgeous diners were served. EuroSDR is very grateful to the Norwegian delegates for organizing such a well-organised event.

Figure 6: Group picture at the 126th Board of Delegates meeting, Tønsberg, Norway (21 May 2015)

Figure 7: The Viking Experience – Great, Wonderful and Fun

The 127th EuroSDR Board of Delegates meetings took place at the Winchester Science Centre and the Winchester Hotel from 21 until 23 October 2015. Both venues are located in Winchester (United Kingdom). These meetings were hosted by the Ordnance Survey Great Britain (with Malcolm Havercroft as the key host person) and participated by 38 persons from 18 countries. The meetings started with an overview of relevant innovations in the domain of Geographical Information achieved by Ordnance Survey Great Britain, academia, and industry in United Kingdom. The highlights of the meeting were the two keynote presentations: 1) "Pooling resources for remote sensing development in France – The THEIA Land Data and the GeoSUD project" by Pierre Maurel (IRSTEA – National Research Institute of Science and Technology for Environment and Agriculture) and 2) "EuroGeographics QKEN: Quality - Quality Matters?" by the Jonathan Holmes (Ordnance Survey Great Britain and chair of the EuroGeographics Knowledge Exchange Network on Quality). The two breakout sessions focused on a review of the EuroSDR Strategy that was approved at 124th Board of Delegates meetings in Apeldoorn (The Netherlands) as well as Data Quality.

Another important highlight for EuroSDR was the approval of the Rolling Research Plan 2015-2019. The delegates from United Kingdom organised a wonderful evening at the Winchester Science Centre and a very interesting 'tour' at Winchester City Museum. Moreover, a wonderful dinner was served at the Dinner Winchester Cathedral Visitor Centre. EuroSDR is very grateful to Ordnance Survey Great-Britain who hosted this excellent event.

Figure 8: Group picture at the 127th Board of Delegates meeting, Winchester, United Kingdom (22 October 2015)

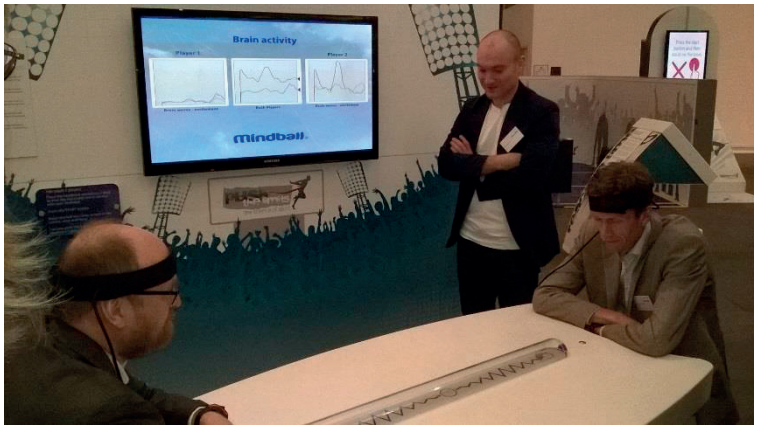


Figure 9: Some impressions of the evening at Winchester Science Centre (21 October 2015).

Many thanks to the hosts Ordnance Survey Great Britain and 1Spatial.

In preparation for these two Board of Delegates meetings the Executive Team met at the headquarters of Bundesamt für Eich- und Vermessungswesen (9-10 March 2015, Vienna, Austria) and Swisstopo, Flight service, Militärflugplatz (27-28 August 2015, Dübendorf, Switzerland).

4.2. Partnerships

In 2015, EuroSDR continued cooperating with its key partner associations (e.g. Association of GI-laboratories in Europe (AGILE), EuroGeographics, International Society for Photogrammetry and Remote Sensing (ISPRS), Open Geospatial Consortium (OGC), UVS-International).

Some examples showing our successful cooperations with our partner associations are the following:

- Organisation of EUROSDR/AGILE/OGC/JRC/ELF Workshop Data Modelling and Model-driven Implementation of Data Distribution (28-30 January 2015, Danish Geodata Agency, Copenhagen);
- Organisation of EuroSDR/ICA NMA-Generalisation workshop (Amsterdam, 3-4 December 2015);
- Contribution to the OGC/EuroSDR Interoperability experiment on 'Defining an validating data quality requirements of CityGML';
- EuroSDR Support for ISPRS workshop on High Resolution Imaging for geospatial Information (Munich, Germany, 25-27 March 2015);
- Presentation of an EuroSDR-keynote at the ISPRS Geospatial Week 2015 (La Grande Motte, France, 28 September – 2 October 2015).

A cooperation agreement between EuroSDR and EuroGeographics was signed (Brussels, 5 March 2015). A meeting with the chairs of EuroGeographics KEN's was organised during the Extraordinary Assembly in Leuven (5 May 2015) in order to strengthen the future cooperation between EuroSDR and EuroGeographics Knowledge Exchange Networks (KEN), to define the overlapping spheres of activities, and to set up a cooperation plan with concrete steps. It is the intention that a chair of a KEN gives a keynote at the EuroSDR BoD meetings – in this context Jonathan Holmes gave a keynote about

the content of KEN Quality at the 127th Board of Delegates meetings in Winchester. The president and the secretary-general participated to the General Assembly of EuroGeographics 2015 (Belgrade, Serbia, 4-6 October). The introduction to the EuroGeographics Roundtable on the Impact of new technology for NMCAs as part of the program of the General Assembly took place under the umbrella of EuroSDR.

Figure 10: Signing of the cooperation agreement between EuroSDR and EuroGeographics by EuroSDR-president Martin Salzmann and EuroGeographics president Ingrid Vanden Berghe (Brussels, 5 March 2015)

The EuroSDR president and myself attended the second meeting of United Nation initiative on Global Geospatial Information Management Europe (UN-GGIM Europe) in Belgrade, Serbia (7 October 2015).

4.3. Logistics

Regarding the associated logistics, the Secretariat was among others strongly involved in preparing the meetings, processing the meetings' minutes, decisions and actions, registering for EuroSDR events (e.g. workshops, EduServ), editing the annual report, financial accounting, auditing, sending e-newsletters, managing websites, etc.

On behalf of the Secretariat, I would like to express that we look forward to continue cooperating with our members, commission chairs, president, vice-president, representatives of our partner associations and those that are simply interested in the activities of EuroSDR in the (near) future.

5. Commission I: Data Acquisition
Fabio Remondino

In 2015 Commission I has been principally involved in the **oblique imagery** activity. Oblique aerial cameras and imagery are a rediscovered technology, regarded in the photogrammetric community as one of the major developments in the field and a great source of geo-information. Oblique airborne multi-camera systems are becoming a standard sensor technology across a growing geospatial market, as complementary to the traditional vertical views. Some NMCAs are critically observing the developments in this field or running internal tests. Therefore, following the outcomes of the 2014 **questionnaire**, the research activity focused on the processing of the testfield data. The testfield and benchmark activity was realized in collaboration with ISPRS, collecting also UAV imagery and terrestrial data (images, laser scanning point clouds and GCPs) to exploit the intrinsic advantages of each dataset, develop novel fusion methodologies and perform accuracy analyses. The activity was presented at the 2015 edition of the **Photogrammetric Week** in Stuttgart and a **scientific workshop** was organized in October in Southampton.

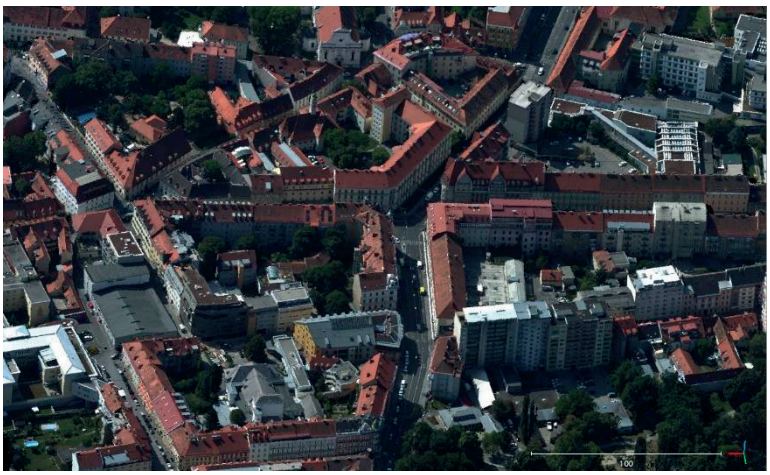


Figure 11: Oblique Imagery

Finally, Commission I lunched a new activity on “high-resolution satellite imagery for mapping purposes”. The idea is to collect (through delegates and stakeholders) some dataset(s) and evaluate mapping capabilities of high-resolution (<5m) satellite imagery in terms of mapping scale potential, potentialities of commercial software, accuracy potential, man-made feature identification and extraction, integration with aerial data and cost analyses.

Here you can find the references of some publications which are about the EuroSDR oblique activity and benchmarking:

- Gerke, M., Remondino, F., 2014: Oblique airborne photogrammetry: users' and vendors' views EuroSDR survey. GIM International, Vol. 28(12)
- Remondino, F., Gerke, M., 2015: Oblique Aerial Imagery – A Review. Proc. Week 2015, Dieter Fritsch (Ed.), pp. 75-83

5.1. Workshop in the picture: EuroSDR / ISPRS Joint Workshop on Oblique Cameras and Dense Image Matching

by Paul R. T. Newby, Fellow of ISPRS; Editor Emeritus, The Photogrammetric Record
Based on a shorter report published in The Photogrammetric Record, 30(152) (December 2015)

Well, that was interesting and fun! After all the years of "Remote Sensing and Photogrammetry", this was a real photogrammetric meeting, full of international experts whose main preoccupations still include accuracy, calibration, deformation, distortion, even earth curvature, and, above all, geometry! [This has only taken us from A to G … I could go on.]

The EuroSDR / ISPRS Joint Workshop on Oblique Cameras and Dense Image Matching took place at the Ordnance Survey (OS) Head Office in Southampton, United Kingdom, on 19th and 20th October 2015. Registrants, 95 in number, came from 23 countries, including a sprinkling from outside Europe, and seem to have been considerably more numerous than the organisers and sponsors expected! There was a reasonable balance between national mapping and cadastral agencies (NMCAs), academic R&D and private sector companies. The organisers included Fabio Remondino (President of ISPRS Technical Commission V and Chairman of EuroSDR Commission 1, Bruno Kessler Foundation (FBK), Trento, Italy), Norbert Haala (University of Stuttgart, Germany) and Markus Gerke (Co-chair, ISPRS WGIII/4, ITC / University of Twente, the Netherlands).

After a brief welcome by our host, David Holland (Ordnance Survey), Fabio Remondino introduced the meeting by thanking the sponsors, led by Leica Geosystems (Hexagon Group) and supported also by Aerowest, IGI, Microsoft UltraCam (Vexcel Imaging)), nFrames, Pix4D and Visionmap. Remondino's overview of the past ten years of change in our field set the scene: the improving quality of digital images, the development of oblique multi-camera systems and their acquisition by photogrammetric production organisations in the public and private sectors, innovation in dense image matching algorithms and ongoing changes in production flowlines at the NMCAs.

As leaders in R&D responding to these opportunities, ISPRS and EuroSDR have jointly set up two linked "benchmarks", on high density aerial image matching http://www.ifp.uni-stuttgart.de/ISPRS-EuroSDR/ImageMatching/index.html and on multi-platform photogrammetry http://www2.isprs.org/commissions/comm1/icwg15b/benchmark_main.html. These two projects provided the overarching theme for the Workshop. The visual aids used for most of the presentations can be found on the EuroSDR website: http://www.eurosdr.net/workshops/eurosdrisprs-workshop-oblique-cameras-and-dense-image-matching.

Remondino went on to chair **Session 1**, *Benchmarks, oblique sensors and workflows.* Markus Gerke presented preliminary results of the multi-platform photogrammetry benchmark, beginning with a reminder (from Boston, USA, 1860) that oblique airborne photography is not in itself new, but that exploiting it in the 21st century requires a difficult change of mindset after a century of predominantly vertical (now apparently known as "nadir") imagery. It is clear that multiple oblique views, now typically using a "Maltese Cross" or "penta" (five-image) configuration, mitigate the problem of occlusion and can improve height accuracy, especially if far greater overlap (up to 80% both along and across track) can be afforded. The potentially better intersection geometry is yet to be fully exploited and tie point matching between different viewing directions is proving more difficult than expected. A comment from the floor emphasised the difficulty of handling the complex and currently poorly understood distortion effects, including atmospheric effects, compared with the well understood radial and symmetrical case of nadir imagery. Norbert Haala then introduced the benchmark on high density aerial image matching.

This is about geometry! The ultimate focus will be on complex urban environments although the first of the three experimental datasets issued for the benchmark covers a semi-rural area; the third goes all the way, over a dense urban area of Zurich and including oblique imagery. The digital surface model (DSM) product is expected to give way to the point cloud, although comments from the floor disputed this. Recognising the excessive weight of data in any useful point cloud, the potential end product may be a filtered and "meshed" version, perhaps to become known as a digital image model (DIM). [The linguistic purists' battle against the use of "mesh" = German *Masche* instead of the once-preferred but longer English "triangular irregular network" (TIN) seems to have been lost, on the evidence of this meeting, and I am bound to admit that "mesh" now serves a useful purpose.] Mathias Motz and Rene Rothe (Leica Geosystems) then brought the practical perspective to oblique sensors, workflows and information with a masterly and highly informative sales pitch centred on the RCD30 Penta Oblique camera system with five 80 Mpixel CCD camera heads and the HxMap (pronounced "hexmap") production workflow software suite.

Session 2, *Advancements in data acquisition and processing* was chaired by Haala and repeatedly emphasised current progress in the resolution and ground sample distance (GSD) of digital imagery and in the automation of its processing. Konrad Wenzel (nFrames, Stuttgart) led with "Flight planning for city acquisition at high resolution". [We editorial pedants risk losing this battle of words, but in a subsequent conversation I learned that Wenzel is actually very interested in the developing terminology of our discipline and moreover has no wish to acquire cities, only customers and prestige for his young company.] To achieve his aims, his quest is for best practice, balancing quality and productivity: efficient **data** acquisition involves minimising the number of flight lines while providing adequate overlaps for the individual cityscape; efficient processing requires automation with a minimum of manual editing. These points were repeated often throughout the meeting but will not be repeated for successive speakers. Yuri Raizman (VisionMap, Tel Aviv, Israel) introduced his company's "A3 Edge for oblique and dense DSM – practical case study" including the LightSpeed processing suite and example models from Chile and France. Michael Gruber (Vexcel Imaging/Microsoft UltraCam, Graz, Austria) presented "UltraCam Osprey – nadir meets oblique". He emphasised that software is the key technology which enables today's exploitation of the over-100-year-old principles usually attributed to Scheimpflug (one might add: "following Carpentier's British patent of 1901"). He stressed numerous practical considerations from colour balancing, de-hazing and water masking across multiple images, through to the handling of earth curvature, all with the ultimate aim of true 3D (including the space under bridges and arches) rather than conventional 2.5D modelling.

Session 3, *NMCA experiences*, chaired by Francesco Nex (ITC/Twente) brought the first day to a close. Host David Holland presented "Ordnance Survey's experience in creating dense point clouds and 3D building models from oblique imagery". Experiments have been performed using the test area of Bournemouth in order to examine the considerations affecting the possible introduction of such products: what formats do users need; is oblique aerial or even terrestrial imagery really relevant; can data from multiple systems and sensors be economically integrated; can multiple uses (two examples: change detection and specialised information such as street furniture) be drawn from the same raw data or any intermediate or final products; can processes be sufficiently automated to render the products economic? If this point is reached (and without multiple uses and sufficient automation, OS experience to date is negative) how are such products to be stored, managed and filtered for a range of users? This was an enlightening presentation but it is clear that the goal of fully 3D geographical data is still some way from practical, cost-effective, realisation. Dare one introduce the "Holy Grail" metaphor to surveying and mapping yet again, or would that guarantee only a quest without end?

Very similar considerations affect Ordnance Survey Ireland (OSi): Andy McGill's presentation "LOD2 from vertical and oblique imagery" again emphasised cost-effectiveness, and therefore automation, in support of the objective of moving from 2.5D to 3D while updating the existing topographic database and eliminating historic legacy issues of accuracy in urban areas of Ireland. Here, in the face of the fickle Irish weather which is all part of the special environment in which OSi must operate, Dundalk provided the test bed thanks to good conditions on the day the chosen system was available. I would add that it remains to be seen whether the Level of Detail (LODx) model hierarchy, a recent borrowing from computer graphics, will stand the test of time in the context of the resolution, style and content of geographical information, or whether some more directly relevant measure will be devised to replace the traditional and perfectly understood **scale** of maps and vertical aerial photographs.

A pleasant social evening ensued, in the impressive if slightly faded ambience of the Grand Café, originally the splendid ballroom of Southampton's South Western Hotel, where doubtless many of the first-class passengers on the *Titanic* spent their last night on shore in 1912. Little was made of this interesting history by our generous hosts for the evening, Leica Geosystems: perhaps too many negative modern metaphors spring from that ill-fated voyage, but Southampton has learnt to live with its history and prizes its heritage.

As a Hampshire local I returned safely home for the night, and immediately briefed Mrs Newby, who knows a thing or two about oblique aerial photography among other matters, regarding my day. Quick as a flash she asked "so is that the same as the old Trimetrogon?" and "do they fire the cameras simultaneously?" I had to reply "yes, but now there can be up to five cameras" and "funny, nobody mentioned that all day, but I guess they must try to". This exchange provided me with a helpful opening to the discussion in **Session 4** next morning, *Advancements in data processing (I)*, chaired by Markus Gerke, in which the first speaker, Lisa Chen (Pix4D, Lausanne, Switzerland) spoke on "An oblique-imagery case analysis of Pix4Dmapper densification result" and **did** mention the need for synchronised exposures as well as rigorous calibration of camera rigs. She challenged our assumptions about flight planning by showing a "multiple circular" flight consisting of a tight series of equal and overlapping circles over downtown Nashville, USA. Pix4D is a software company concerned chiefly (though not exclusively) with surveys using UAVs and digital cameras, each of a wide range of sizes. Chen gave considerable detail on the processes involved in the dense image matching, editing and quality management. In discussion, Mrs Newby's sensible question provoked an interesting range of assertions and detailed responses from the floor, ranging from "exposures must be simultaneous" to "software can take care of any amount of time difference" to "lack of synchronicity greatly weakens the bundle adjustment solution". [For those too young to recall the Trimetrogon three-camera rig (vertical and sideways-looking, extending to the horizon), this was a military reconnaissance tool which was eventually used for the first mapping of vast areas of desert and polar regions. The view to the horizon assisted orientation but rendered the more distant part of the scene otherwise unusable; nevertheless in areas with good visibility and minimal population or detail, the number of flight lines required for preliminary mapping was greatly reduced compared with pure vertical photography.]

Mathias Rothermel (nFrames, Stuttgart) then presented "Oblique image processing in SURE: first experiments and results". He gave a lot of frank detail about stereomatching and "surface meshing" and the challenges involved in making use of multiple images to produce acceptable views of building façades. He became my clear winner for the most entertaining new piece of jargon of the meeting (perhaps of the year to date): "loopy belief propagation". Regrettably I cannot tell you what this means (unless it is simply what we used to call an iterative adjustment process), but I have no doubt that he could. Hans Joachim Benfer (Aerowest, Dortmund, Germany) spoke on "True orthophotos and dense point clouds from multi-perspective aerial imaging – opportunities and challenges in practice", from the perspective of a private company in the real world trying to develop modern products which will

actually earn money by finding, attracting and retaining clients. His splendidly detailed and lucid presentation covered the handling of images from the firm's IGI Quattro and Penta DigiCAMs to produce, inter alia, true orthophotos (with roofs placed in correct geometrical relationship to building footprints) and RGB point clouds, both of these being merely by-products of dense image matching. He pointed out that most potential customers do not yet have the software even to allow them to view, never mind manipulate, the amount of data in dense point clouds, and emphasised the age-old need to educate clients in what they can, and cannot, expect to achieve with the products. The disciplines of delivering, storing, backing up and eventually updating the volumes of information now entailed in 3D GIS have yet to be worked out. Automation will eventually reduce the price, speed up processing, render update more practical … and further increase data volume.

Session 5, *Advancements in data processing (II)*, was chaired by David Holland. Jens Kremer (IGI, Kreuztal, North-Rhine Westphalia, Germany) led with "Dense image matching with Penta DigiCAM images – experiences and options". He remarked that his presentation would not chiefly concern data processing but the whole flowline from mission planning through their modular sensor management system to the hardware of aerial sensor systems and mobile mapping solutions. The first of these items becomes far more complex and important where one is aiming to secure the correct overlaps between multiple nadir and oblique images. The camera systems sound impressive and are soon to employ large-format CMOS rather than CCD sensors in order to secure more rapid exposure repetition rates. IGI's eventual data processing module, IGI Match, is powered by nFrames's SURE. He pointed out practical aspects such as the conundrum of how to display five images in sensible orientation; it is not yet clear what clients want, but certainly standardisation is required! Chris Longworth (Blom UK (the former Simmons, then Blom, Aerofilms), Cheddar, UK) spoke on "Experiences with techniques for 3D modelling from oblique imagery in Blom". As former Pictometry franchisees still active in oblique imagery developments and production for city modelling, the company has gained extensive experience, especially in providing multiple levels of detail for navigation purposes. Isabella Toschi (FBK, Trento) then presented "Experiences with oblique datasets: AT, dense matching and building modelling". By using multi-camera bundle block adjustment, she demonstrated the behaviour of different oblique imaging platforms in real-world conditions, including the influence of the additional, oblique cameras on image block generation, dense image matching and 3D building model construction.

The final (and longest) session (6)*, R&D and experiences* was chaired by Andy McGill and seemed to become increasingly highly technical and difficult for this reporter to follow. Wojciech Ostrowski (Warsaw University of Technology, Poland) introduced "Quality assessment for dense image matching on oblique images – experience in Poland". Seven Polish cities have been surveyed using IGI Penta DigiCAMs in conjunction with laser scanning, leading to valuable experience of the possibilities and challenges of oblique imagery. Mozhdeh Shahbazi (Sherbrooke, Quebec, Canada) spoke on "From sparse matching based on evolutionary search to dense matching based on intrinsic curves – preliminary results", with the aim of developing UAV-based high resolution imaging and mapping flowlines using photogrammetry and computer vision to generate 3D point clouds for open-pit mining applications. Karlheinz Gutjahr (Joanneum Research, Graz, Austria) continued with the admirably short title of "3D mapping with RSG", the Graz remote sensing software package developed progressively since the 1980s to cover many different kinds of imagery right through to radar interferometry. Now tackling dense image matching using the benchmark datasets, he acknowledged the need for severe "thinning" to deal with the information overload resulting from point clouds derived from oblique images. Finally, Willi Karel (TU Wien, Austria) presented "Analysis of oblique image datasets with OrientAL". As another true photogrammetrist taking part in the image orientation benchmark, his preoccupation with the elimination of blunders and outliers enters new territory with the excessive numbers of tie points generated by multi-image datasets; the mixture of nadir and

oblique images means that “tiepoint decimation” is by no means straightforward nor easy to automate.

Fabio Remondino brought the successful meeting to a close by proposing continuing ongoing collaboration in the run-up to the next two relevant meetings, EuroCOW which will be held in Lausanne for the first time (February 2016) and the ISPRS Congress in Prague (July 2016). The tradition of EuroSDR / ISPRS joint meetings is clearly alive and well, as is the Ordnance Survey’s support for them, which incidentally enables participation by a significant number of OS staff, who would clearly not have this opportunity to attend meetings elsewhere in Europe in such numbers. I became quite nostalgic for the corresponding event, on Updating Digital Data by Photogrammetric Methods, which I was privileged to organise at Christ Church, Oxford University in September 1991.

Figure 12: Group picture of the workshop

6. Commission II: Modeling and Processing
Jantien Stoter

6.1. EuroSDR 3D SIG

Since autumn 2013 the National Mapping Agencies of EuroSDR are working together on 3D issues in the EuroSDR 3D Special Interest Group (3D SIG). The aim of this group is to define and coordinate the long-term 3D research agenda of EuroSDR based on experiences and developments of both research institutes and NMAs in the area of 3D, to carry out research projects on topics of common interest and to organise a workshop series on relevant topics.

In 2015 the members of EuroSDR 3DSIG had two meetings: at Ordnance Survey Ireland, Dublin (spring) and at Lantmateriet, Sweden (autumn). During these meetings we worked on common guidelines to represent map objects in existing 2D databases at NMAs (Transport, Buildings, Water, DTM/elevation, Vegetation and Structures) in 3D. The objectives of these guidelines are to be able to build on each other's developments and to articulate 3D mapping needs to industry, academia and standardisation organisations like OGC and INSPIRE.

Also in 2015, the EuroSDR 3D SIG launched a project to identify "the economic value of 3D data for National Mapping Agencies (NMAs)" as a follow up of the pre-study carried out by University College London. The project is unique because it is funded through "crowd-funding" by eleven National Mapping Agencies (NMAs) and EuroSDR as 12th partner. The results of the project will give the participating NMAs understanding in the business case of 3D data: in what applications does a 3D approach give added value?; what are the required 3D data for these applications"; and, what are the costs and benefits to collect and maintain these 3D data nationwide?

6.2. 3D and OGC

The OGC Interoperability Experiment (QIE) on defining and validating data quality requirements of CityGML data is a joint initiative of OGC, SIG3D and EuroSDR 3D SIG.

The aim of the experiments is to formally define data quality requirements for a general CityGML data specification, to provide recommended implementation guidance for 3D data, and to provide a suite of essential quality checking tools to carry out quality assurance on CityGML data. This is accomplished by evaluating the quality of existing CityGML data as well as of CityGML sample data sets that have been specifically developed for this experiment with different quality checking tools. The experiment started in September 2014 and is expected to finish in spring 2016.

To further support the collaboration and exchange of experiences and knowledge on 3D with OGC, the EuroSDR chair of this commission (Jantien) accepted the role of vice-chair of the OGC 3D Information Management Domain Working Group (3DIM DWG). The 3DIM Domain Working Group is facilitating the definition and development of interface and encoding standards that enable software to develop solutions that allow infrastructure owners, builders, emergency responders, community planners, and the traveling public to better manage and navigate complex built environment via the use of 3D geo-information.

6.3. Data Modelling and Model Driven Implementation of Data Distribution

NMCAs and other spatial data infrastructure (SDI) content providers are facing increasing demand for making well-documented data in known data models available as standardised web-services. National e-government initiatives require spatial data to be modelled seamlessly with non-spatial data; INSPIRE puts requirements on GML application schemas and web-service standards; and the European Location Framework (ELF) project brings the national SDIs together in a pan-European context.
Data modelling as such is a mature discipline, but how best to handle a number of specific modelling issues for geo-data is challenging. In addition although the potential benefits of automating implementation of the data distribution environment are obvious and automated generation of GML application schemas based on UML data models is widely used (e.g. in INSPIRE context), many considerations need to be taken into account when making the data models, and automatically generating database schemas. Web-services based on UML data models add even another level of complexity.

To discuss these issues with experts a workshop has been organised in January 2015 at the Danish Geodata Agency, Copenhagen, Denmark together with relevant partners (i.e. OGC. ELF, AGILE and JRC). The aim was to further identify challenges for data modelling and model driven implementation of data distribution in order to encourage development of best practise recommendations.
The workshop filled a need for such detailing: 26 presentations were submitted and with 54 participants the workshop was fully booked. The workshop outcomes and materials are available via the EuroSDR website.

Figure 13: Group picture of Data modelling and model driven implementation of data distribution.

6.4. GENERALISATION

On December 3 and 4 more than 60 people from 18 National Mapping Agencies (NMAS) gathered at the Kadaster in Amsterdam to exchange experiences on automated generalisation plays in their production line of multi-scale maps. The workshop was organised by EuroSDR and the commission on generalisation and multi-representation of the International Cartographic Association (ICA). In 2013 a similar workshop was organised on this topic. Compared to 2013 significant developments have been made. Automated generalisation is now implemented by most NMAs. And NMAs consider multi-scale information as a crucial part of the information society in which we live. Therefore up-to-date multi-scale information produced by NMAs should be easily available to everyone.

During the workshop, the participants also discussed the future development of multi-scale map products. Noteworthy were the conclusions that “object identifiers” for derived maps are not always necessary (instead complete maps are derived again when needed) and that pre-defined map scales are becoming less important as zoom in and out levels of digital visualisation are getting more important. Moreover, the criteria for “maps that are good enough” are no longer driven by cartography only. Instead up-to-dateness is an important criteria as well. This is made possible by automated generalised maps which may not yield a perfect cartographic result. At the end of the workshop people could study in detail each others multi-scale maps (analogue and digital).

Presentations and abstracts are available via the website of the ICA commission on automated generalisation and multi-representation.

Figure 14: Group picture of the generalization workshop

7. Commission III: Updating and integration
Norbert Pfeifer

Commission 3 concentrates on what has been a key objective of NMCAs ever since, namely the updating of geospatial information, often based on change detection. The production environments are no more standard data flows using one type of sensor only, i.e. the aerial photogrammetric camera, but rather a multitude of sources, including now LiDAR, volunteered geographic information, geodata from terrestrial mobile platforms, and satellite imagery. Therefore, the integration of different data streams is essential and in the ToR of Commission III.

Nation-wide handling of geo-data is an ongoing task within most European national mapping agencies. As the status of mapping and requirements on mapping are different among EuroSDR's NMCA, it is an ongoing challenge to find suitable interfaces for projects of cooperation. This ensures learning from each other's experiences. The ongoing initiatives in Commission 3 – Updating and Integration – are centered on understanding how acquired geo-data can be used efficiently and effectively in applications. In the year 2015 the topics of workshops and projects were specifically: exploitation of airborne Lidar data, of Satellite data, and of terrestrial lidar data in the context of tree measurements/inventories.

Updating of databases from Lidar data is one point of common interest, and a workshop was set up in 2015 and held in January 2016 at Kartverket (Norway). The workshop reports are available online[1], and not reported extensively here (reporting period is 2015, the workshop was lead by Jon-Arne Trollvik).

The "**Preparing for Sentinel-2 data**" are an ongoing activity, exemplified by a workshop 2014 and a workshop in 2016. Sentinel-2 (S2) commenced operation successfully around August 2015 and has delivered data since then (see Figure). S2 has 4 bands (blue, green, red, nIR) at 10m GSD and 6 bands at 20m resolution (red edge bands and bands for snow/ice analysis). There are another 2 bands at 60m resolution for atmospheric processing. Archiving of S2 data is not yet solved at European or national level (in most countries). National mirror sites of the rolling archive were established in some European countries in 2015 and this will continue in 2016.

[1] http://www.eurosdr.net/workshops/eurosdr-workshop-nationwide-generation-height-data-airborne-laser-scanning-and-other

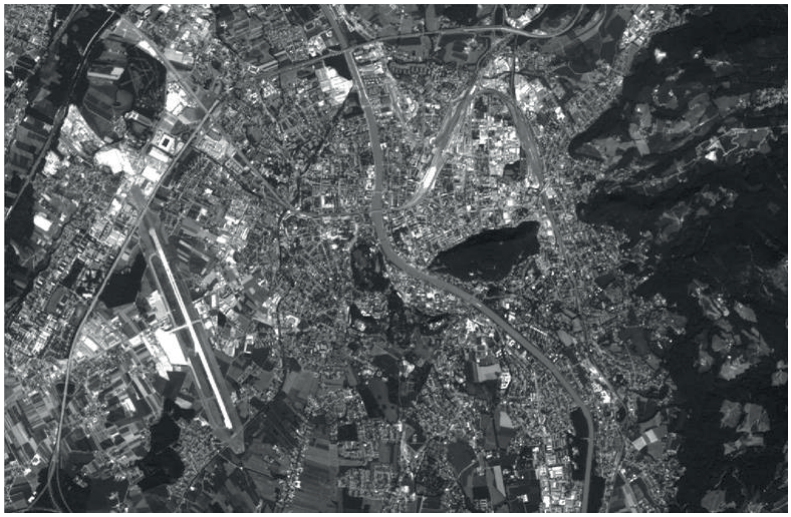


Figure 15: Image of Salzburg (Austria), acquired by Sentinel-2 on 13.8.2015, red band (central wavelength 665nm) with 10m GSD.

The international benchmark study of the **application of terrestrial laser scanning (TLS) in forestry** applications was launched in 2014. The main objective of this benchmarking project is to understand the recent developments of TLS methodologies in plot inventories by evaluating the quality, accuracy, and feasibility of the automatic and semi-automatic tree extraction methods based on TLS data. The specific sub-objectives include to study the accuracy and feasibility of various methods in the same test site; to study the effect of the plot characteristics on individual tree extraction; and to assess the difference between results from single- and multi-scan data collection approaches. Results and parameters to compare are the position of individual trees, diameter at the breast height, stem curve and tree height, as well as the Digital Terrain Model of the forest plot.

This benchmarking is targeting national mapping agencies, companies, universities and research organizations, which developed their own processing methods or modified existing methods. Meanwhile, the project is also open for techniques still in the research phase. The project was advertised actively to potential participants, reached through research networks, during conferences and via the project webpage. For example, the project was presented in the Silvilaser 2015 conference (La Grande Motte, France) and was also reported in an issue of GIMInternational as a feature article.

So far, 24 international partners expressed their interests in joining this benchmarking study. Among them, 15 partners have submitted their results, from Asia, Europe and North America. The project is now in the evaluation phase. With standardized data and evaluation method, the extraction of DTM, tree positions, DBH and stem curve are evaluated.

The comparison results obtained so far show there are clear variances between methods and data collection approaches. The chart (see Figure) shows the averaged RMSEs of DTMs from all the participants in each test plot. The results from single- and multi-scan data are marked in red and blue, respectively.

As expected, the single-scan results are clearly less accurate than that from the multi-scan data. Clear variances are also noticeable between forest plots under different forest conditions, as well as

between study partners. When building a DTM from the multi-scan TLS, the participant results gave a mean RMSE at 12.7 cm, the minimum at 6.5 cm and the maximum value of 28.9 cm; for the single-scan, they are 32.3 cm, 8.5 cm and 101.3 cm, respectively. As for the best performing participant, the mean RMSE of the DTM is 7.5 cm, the minimum is 4.5 cm and the maximum is 13.0 cm when using the multi-scan data; for the single-scan data, they are 21.3 cm, 7.9 cm and 52.8 cm respectively.

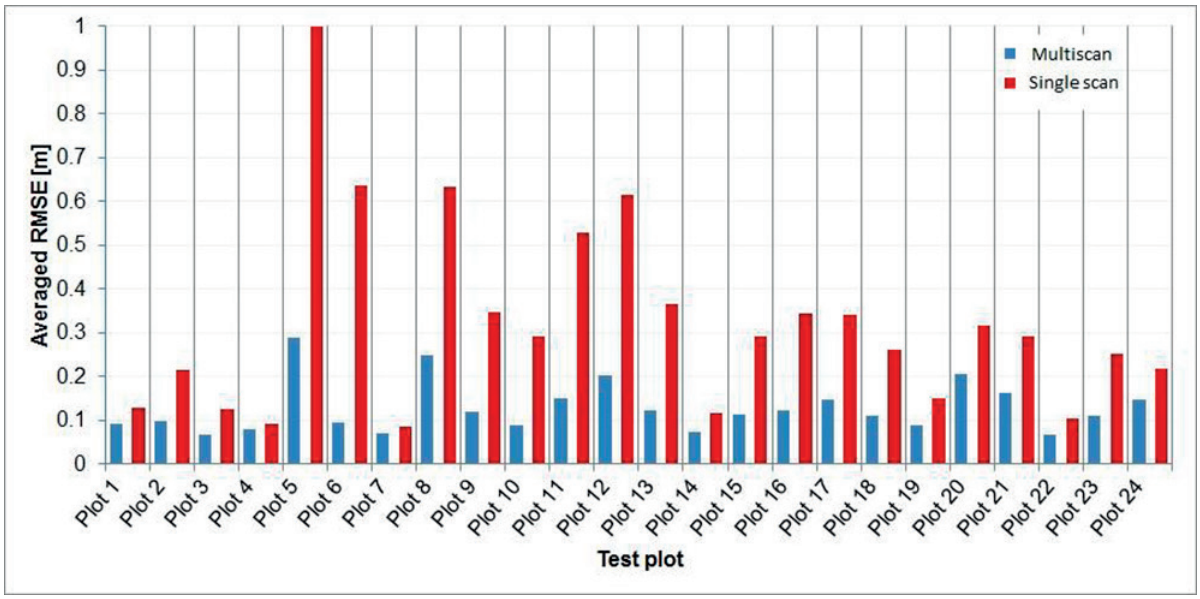


Figure 16: The averaged RMSEs of DTMs from all the participants in each test plot.

The superiority of multi scan results can be expected, when comparing the single and the multi scan data at a site (see Figure). However, the project will give a possibility to balance the gain in accuracy against the additional field time.

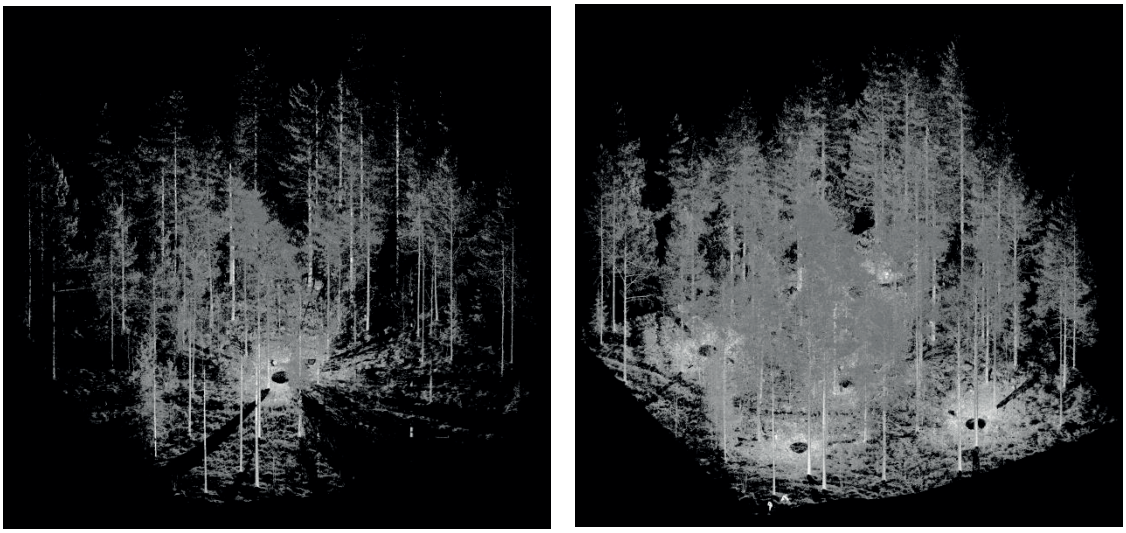


Figure 17: A forest plot in the single- and multi-scan terrestrial laser scanning mode.

8. Commission IV: Information Usage
Jon Arne Trollvik

The mission of Commission IV is to explore, demonstrate and contribute to further increase in access to authorized geodata, and contribute to improve the mechanisms for dissemination of geodata from database to end user. The Commission IV also cover to investigate, evaluate and document developments in the technologies for data integration, service-level interoperability and delivery of all forms of geoinformation, data and services.

8.1. Location frameworks on the Web and for the Web

Following EuroSDR position paper on Linked data, an EuroSDR Linked Data seminar was organized by the Dutch Kadaster and IGN France in Paris in April 2015. The goal was to get more insight in the potential contributions and potential new needs brought by these new technologies to the domain of geo-referencing in the largest sense, i.e. location framework on the Web and for the Web.

April 9th was a joined session with the annual event of the French Datalift association, which promotes the technology of linked data (http://datalift.org/?page_id=153). Conferences were in French and addressed topics like: provenance metadata, access management, licensing issues, cataloguing vocabularies, the need for a proper vocabulary to publish geographical reference data and publish explicit connections of thematic content with this referential, the publication of statistical data on the web of data, the fostering of innovation in e-administration by connecting actors together.

April 10th was a working session with fifteen participants; some with a professional career in geodata research, from Slovenia, Netherlands, France and Switzerland and others with a professional career in authoritative data research and innovation from French Statistical Institute, National Library, Geological Survey, Water management information system. Five presentations were given by participants to present their experience in the definition of URI (Uniform Resource Identifiers) for different kinds of resources, elaborating new vocabularies and publishing data. Then break up sessions were dedicated to identifying important issues that could be technical or organizational like:

- which geostandards should be in scope, especially wrt Uniform Resource Identifiers, the connexion with INSPIRE;
- to combine old and new technology; is there in reality a step to a new era;
- to access the economic benefits brought by INSPIRE;
- to manage time and space, to deal with versioning;
- to present to people (graphical and textual solutions);
- how should this become more user-driven.

Another conclusion shared by non EuroSDR participants was that there is a need to connect different European initiatives related to authoritative data with a location, and linked data.

A more detailed report as well as presentations can be downloaded from the EuroSDR website. (www.eurosdr.net)

Based on these outputs and on the exchanges with EuroSDR delegates during the following board meeting, the decision was made to adopt a perspective centered on the problems to be solved rather than on the technology. IGN France and Dutch Kadaster framed a new event aiming at reaching a common ground between people with different backgrounds in location framework on the web, practically Linked data believers and people attached to GI science unsolved issues. It will be organized in Amersfoort and Amsterdam in February 2016, jointly with the meeting of the Spatial Data on the Web working group of W3C and OGC.

Figure 18: Picture of the EuroSDR Linked Data seminar

9. Commission V: Business models and operation
Joep Crompvoets

As the chair of new Commission 5 'Business Models and Operation', it is my pleasure to contribute to the EuroSDR annual reports series. This commission was established at the 126th Board of Delegates Meeting in Tønsberg (Norway, 2022). It appears that the research topic on business modelling becomes more relevant for NMCA's (see e.g. the second version of the trend report of the United Nations Committee of Experts on Global Geospatial Information Management, 2015). This does not mean that this topic was fully ignored in the past (see for example EuroSDR projects on INSPIRE, Crowdsourcing and mapping, and Preservation of the geographic information production processes).

The main objective of this Commission 5 is to contribute to the development and implementation of business models describing the rationale of how NMCA's can create, deliver, and capture value, in economic, legal, social, governance, cultural or other contexts. Being aware of this objective, this commission aims to run projects and workshops on topics such as: Business modelling for spatial data infrastructure, Geographic information valuing, Geospatial brokering, Governance modelling for geographic information management (incl. structures, Roles, Task allocations), spatial data infrastructure concepts and implementations, and Open data business models.

Since its foundation, Commission 5 has already co-organised a workshop 'Exploring the economic value of 3D geographic information' (Amsterdam, 7-8 December 2015) together with Commission 2 'Modelling and Processing'. In addition, a workshop entitled 'Tutorial on Cost Benefit Analysis in the context of Geospatial Information' (Paris, 9 March 2016) was prepared together with OECD, NASA and USGS. At the EuroGeographics General Assembly 2015, a discussion paper on NMCAs' adaptations to alternative sources' was presented (Crompvoets et al., 2015). Other initiatives refer to the relaunch of the second phase of the 'Crowdsourcing and National Mapping' project, and to launch of a project on 'Coastal spatial data infrastructures' to seamlessly integrate marine and terrestrial data. Finally, the feasibility of a project focusing on 'Business models for open data of NMCA data' was explored to systematically review relevant business models and identify the implications for applying these business models. As you see this commission is full of ambition, which hopefully will be realised in the near future.

Crompvoets, J., Masser, I., Streilein, A., and Lovell, D., 2015. How should NMCAs adapt to alternative sources for NMCA data? EuroGeographics General Assembly 2015. Belgrade, 4-6 October 2015. Supporting paper, 8 pgs.

United Nations Committee of Experts on Global Geospatial Information Management, 2015, Future Trends in geospatial information management: the five to ten year vision – Second Edition, August 2015.

10. Commission VI: Knowledge transfer
Markéta Potrîckova

The activities of the commission aim at providing education services to support the transfer of knowledge from EuroSDR research projects to NMCAs, academia and industry and to fulfil specific NMCAs demands for knowledge update. Collecting and disseminating methodologies, developed tools and other research outcomes in the form of EuroSDR's official publications and via EuroSDR's homepage are an integral part of commission's work. In general terms the commission also contributes to development of curricula in GI.

In 2015, the Educational Service (EduServ) continued with its 13th series. It offered four two-week e-learning courses on the following topics:

- **Mapping using high-resolution satellite imagery**
  Daniela Poli, Terra Messflug GmbH, Austria,
- **Change detection in High-Resolution land use/cover geodatabases**
  Clément Mallet, IGN, France,
- **RPAS in land survey – theory and practice**
  Görres Grenzdörffer, University of Rostock, Michael Cramer, University of Stuttgart, Germany,
- **International standards for geographic information**
  Wolfgang Kresse, University of Applied Sciences, Neubrandenburg, Germany.

The pre-course seminar was held at the premises of the Federal Office of Metrology and Surveying (BEV) in Vienna, Austria, from 9th to 10th March 2015 and it was organized by Michael Franzen, the head of the BEV's Surveying Service Division. 24 participants attended this event where they could listen to introductory lectures of each course and have discussions with fellow students and teachers. The e-learning part of the educational service was actively followed by 33 attendees; most of them took part in two courses. In order to encourage the participation of PhD students and professionals with a limited support from their organizations, four grants fully covering the fee and travel expenses up to 500 EUR/person were offered. From 14 applications the members of the EduServ advisory board selected three PhD students who, after successful completion of the courses they subscribed to, received the scholarships. Looking to 2016, the topics for the 14th series of Eduserv were finalized in summer 2015 and it opened for registration in Ocotober 2015.

Figure 17: Group photo from the EduServ pre-course seminar in Vienna on 9th March 2015

In addition to EduServ, an intensive one week residential 5 ECTS course in gravity and height for national mapping and geodetic surveying was run in February 2015. It was organized as a collaborative activity of Dublin Institute of Technology (DIT), that also hosted the event, and EuroSDR, Dublin Institute for Advanced Studies, Geodesy Department, Lantmäteriet, Sweden, Land & Property Services, Northern Ireland and Ordnance Survey Ireland. The course was attended by 24 participants from 7 countries. Based on positive feedback, it is intended to continue with similar activities in future.

Figure 19: Group picture from the course in 'Gravity and height for national mapping and geodetic surveying'.

11. Workskops

- EuroGeographics/ELF/ESRI/EuroSDR/ICA/ISO/OGC International workshop on creating a framework for spatial data an map quality (20-21 January 2015, Valetta, Malta)
- EuroSDR/AGILE/OGC/JRC/ELF Workshop “data modelling and model driven implementation of data distribution (28-30 January 2015, Copenhagen, Denmark)
- Contribution to ISPRS Resolution Imaging for geospatial Information (Munich, 25-27 March 2015)
- Workshop “NMCA’S getting actively involved in linked data!”, working session IGN (10 April 2015, Paris, France)
- ISPRS Geospatial Week (29 September – 2 October 2016)
- EuroSDR/ISPRS Workshop on ‘Oblique Cameras and Dense Image Matching” (19-20 October 2015, Southampton, UK)
- Workshop: 1st ICA European Symposium on Cartography (10-12 November 2015, Vienna, Austria)
- 2nd Call for Papers UDMV 2015 (23 November 2015)
- EuroSDR/ICA NMA-generalisation workshop (3-4 December 2015, Amsterdam, The Netherlands)
- Identifying the Economic Value of 3D (Amsterdam, 7-8 December 2015)

12. Publications

65 Joep Crompvoets; André Streilein; Ian Masser: How should NMCAs adapt to alternative sources for NMCA data? 2016

64 Emilio Domenech; Clément Mallet: Change Detection in High-Resolution Land Use/Land Cover Geodatabases (at Object Level). Volker Walter: A survey on state of the art of 3D Geographical Information Systems. Norbert Haala: Dense Image Matching Final Report. Peter Mooney; Jeremy Morley: Crowdsourcing in National Mapping. 2014, 172 pages

63 Fritsch, D.; Pfeifer, N.; Franzen, M. (eds.): 2nd High Density Image Matching for DSM Computation Workshop. 2013, CD.

62 Honkavaara, E.; Markelin, L.; Arbiol, R.; Martínez, L.: Radiometric Aspects of Digital Photogrammetric Images. Kaartinen, H.; Hyyppä, J.; Kukko, A.; Lehtomäki, M.; Jaakkola, A.; Vosselman, G.; Oude Elberink, S.; Rutzinger, M.; Pu, S.; Vaaja, M.: Mobile Mapping - Road Environment Mapping using Mobile Laser Scanning. 2013, 95 pages.

61 Fritsch, D.; Pfeifer, N.; Franzen, M. (eds.): High Density Image Matching for DSM Computation Workshop. 2012, CD.

60 Höhle, J.; Potuckova M.: Assessment of the Qualityof Digital Terrain Models. 2011, 85 pages.

All publications can be downloaded from the EuroSDR website www.eurosdr.net

EuroSDR secretariat
KU Leuven Public Governance Institute
Parkstraat 45 bus 3609
3000 Leuven
Belgium

www.eurosdr.net