

COMMISSION II - Systems for data processing, analysis and representation

1. State of Science and Technology of Commission Topics

Ian Dowman, President Commission II

The reports from the working groups which follow indicate the wide range of activities which are covered by Commission II, how they are interconnected and how fast the subject is moving forward. The traditional core subjects of 'instruments', now read digital workstations, and the automation of the techniques which are implemented, are covered by WGs II/6 and II/8 and the progress in automating processes is developing quickly in some areas, for example aerial triangulation, but more slowly in areas of feature extraction. The move to Windows NT will undoubtedly have a big influence on equipment during the next few years, and also encourage integration of data from image processing and GIS.

Three working groups are working in the area of system design and data interchange. WGII/7 reports good progress on developing standards for data transfer and the involvement of the manufacturers in this activity is encouraging. WGII/3, which has strong links with CEOS, is looking at tools for search, retrieval and distribution of data and the workshop in Boulder 'From Producer to User' is a good example of how this topic is progressing. WG II/5 is concerned with the design of processing systems, particularly involving the integration of data, and has made good progress on tackling this problem.

The use of SAR in systems for data integration is particularly important and WGII/4 is working to inform people on the use of SAR and how it can be complementary to data from optical sensors. The Working Group has noted the increasing importance of interferometric SAR and stereo SAR; the latter being a topic which has been of interest to a dedicated few for many years but is only now becoming of wider interest.

Working group II/1 notes the spread of interest in using positioning devices, GPS and INS for example, in both land based systems and air and space systems. In this area very similar technology and processing techniques are used across the whole spectrum from close range to satellite imaging. The use of new sensors such as laser profiling is increasing and is of interest to many of the working groups.

The output of the processing systems is frequently fed into digital mapping and GIS and the integration of data into a GIS is considered by WG II/2. Here again the use of a wide range of data to help in classifying features is important.

All of these activities will be brought together and discussed at the Symposium in July 1998 and the theme 'Data Integration: Systems and Techniques' will demonstrate new work in this area.

2. Accomplishments of Commission during 1997

During 1997 most of the visible work of the Commission has been concentrated on the working groups and a wide range of meetings are reported in the following sections. Many of

these have been held jointly with other working groups, within and without the Commission and good collaboration is reported with other organisations such as SPIE and CEOS, as well as with national groups. The involvement of manufacturers has also been significant.

Behind the scenes work has been going on to plan the prepare the Symposium and a meeting of working group officers was held during the Photogrammetric Week in Stuttgart. The Commission has also contributed to the general interaction between ISPRS and other international organisations such as COPUOS, especially in the area of data policy. Links have also been established with the Open GIS Consortium (OGC).

3. Working Group Activities During 1997

WORKING GROUP II/1 Real time mapping technologies

Chair: Dr Rongxing Li

Co-chair: Holger Schade

State of Science and Technology of Working Group Topics

Real-time mapping has had a steady progress since the Congress in Vienna in 1996, characterised by the following trends:

- The mobile mapping concept developed and implemented on land-based platforms has been expanded to airborne and satellite platforms. Typical examples are AIMS (Airborne Integrated Mapping System) developed at The Ohio State University Center for Mapping and the new generation of high-resolution satellite imagery. The former uses DGPS and INS to georeferenced airborne digital CCD images. Such a mapping system may greatly reduce or eventually eliminate ground control and aerial triangulation. The latter employs space GPS and star tracker to obtain the positions and attitudes of satellites. It will be of great interest of the WG to confirm the estimated mapping accuracies of the satellites in 1998.
- Intelligent processing of mobile mapping data becomes a research topic. Advanced techniques such as neural networks and snake models have been applied to automate measuring procedures and automatic object recognition from mobile mapping data. The unique advantages of the mobile mapping data, namely that the images have unknown exterior orientation parameters and the image sequences are along a known track, make the automation more efficient and robust. Multiple image based matching has found its application in the mobile mapping processing. Bayesian networks have been actively researched and promise great potential for feature extraction.
- More land-based systems are being developed. The accuracy and resolution of the sensors are increased. It is hoped that the costs of the system can be greatly reduced to a commercially acceptable level.

Accomplishments of the WG since Vienna Congress

Suggested and contributed to a mobile mapping session at GIS/LIS 97 including papers on land-based (TransMap), airborne (AIMS) and satellite (1m) topics.

A Mobile Mapping Workshop in Bangkok 1999 is being organised with the support from Prof. Shunji Murai.

A Web page of the WG is being constructed and will be completed by the end of the year.

Other news on WG activities or plans for the future.

Mobile mapping session(s) at Commission II Symposium in UK 1998

Although the WG is not officially sponsoring the Mobile Mapping Conference 1998 and Duane Brown Summer School in Geomatics 1998, both in Columbus, OH, mobile and real-time mapping are major issues of these two events. The WG will closely observe the scientific and technical trends discussed at the conferences.

WORKING GROUP II/2 Software and modelling aspects for integrated GIS

Chair: Dr Manfred Ehlers

Co-chair: Mark Gahegan

Accomplishments of WG During the Report Period:

The International Workshop on 'Dynamic and Multi-Dimensional GIS' 25 - 26 August 1997 in Hong Kong was sponsored jointly by four ISPRS Working Groups, with a broad range of topics. An agreement has been made to publish a book containing expanded versions of the best papers given at the Workshop. It will appear as 'Advanced Geographic Data Modelling (II) - ISPRS Workshop on Dynamic and Multi-Dimensional GIS'. Reviewing of papers for the book will begin shortly.

During the Workshop, a business meeting of the WG was held, where interest was expressed in the ideas of bench marking classifiers and of improving accuracy and uncertainty reporting in Integrated GIS (IGIS). It was noted that there is a great deal of overlap between the various groups. This was a cause for concern so it was agreed to keep closely in touch and to look for further opportunities to organise joint events. One problem is that the WGs present at the Hong Kong Workshop represented three different Commissions, so they cannot meet at Symposium events.

Proceedings for the International ISPRS WG II/2 Workshop on 'New Developments on Geographic Information Systems'. The proceedings were published in August 1997 by Environmental Research Institute Michigan (ERIM) International Inc. (ISBN 0-9603590-9-5, 223 pages). Editors are James B. Johnston, Manfred Ehlers, David R. Steiner and Mario A. Gomasca.

A first newsletter was sent out in April 1997, a second one will be submitted before the end of November 1998.

Working Group Plans

A Workshop is planned for January/February 1999 in Australia or September/October 1999 in Germany. Input is currently solicited from the WG members for their specific preferences of topics and location.

The WG will participate as a sponsor for the 10th International Geomatics Conference 'Spatial Data Infrastructures' (SDI'98), June 8 - 11, 1998 in Ottawa, Ontario. A business meeting of the WG will be held during this conference.

WORKING GROUP II/3 Spatial data handling technologies

Chair&: Henrik Osterlund

Co-chair: Dr Wyn Cudlip

State of science and technology in the WG area

Rapid development is currently ongoing on web based services using the Internet, for distributed search and retrieval and distribution of spatial data. Many new tools, mostly based on Java are being developed. New, fully commercial end to end providers are entering the EO market, providing very high resolution data at high processing levels via the Internet. They will meet the increasing demands of faster satellite data distribution. The lack of globally accepted standards and non-existing co-ordination in related fields leads to different metadata standards, protocols and incompatible services being developed. However, converging efforts are being undertaken.

Accomplishments of the WG in 1997

Participation in the RSS meeting "Systems and Techniques for Data Integration", 28/4, London, UK. Presentation "An integrated Approach to Agricultural Monitoring using Satellite Data and GIS" given.

Arranging the ISPRS Joint Workshop "From Producer to User", in co-operation with ISPRS WG I/2, 7-9/10, 1997, Boulder, CO., including WG business meeting 9/10 1997,

Future Plans

Participation and arranging sessions at the Midterm Symposium of ISPRS Commission II, Cambridge, UK, July 13-17, 1998.

Ad hoc WG business meetings in conjunction with other, international meetings.

Follow-up Joint Workshop with ISPRS WG I/2 in Stockholm Archipelago, Sweden ,August 1999.

WORKING GROUP II/4: Systems for processing SAR data

Chair&: Dr Douglas Corr

Co-chair: David Stanley

State of Science and Technology of Working Group Topics

Applications based on SAR interferometry (IFSAR) have grown at an astonishing rate over the past five years and are proving to be of outstanding benefit. These applications have been brought about using data from the ERS system. Recently however RADARSAT has also been shown to produce high quality interferometric data.

A key application of IFSAR is in the production of DEMs. The variable incidence angle capability of RADARSAT provides stereo data which can also be used for DEM production. There are now several commercial off-the-shelf software systems for IFSAR and Stereo SAR workstations: eg, VEXCEL, Atlantis Scientific, PCI. These system allow ortho correction and automated DEM extraction by IFSAR (ERS & RADARSAT) and stereo correlation (RADARSAT). It has been found that under good conditions IFSAR derived DEM's from RADARSAT fine beam data may approach DTED 3 (10 m posting) accuracy.

There are still difficulties however in automatic DEM extraction from SAR:

- Ground control points (GCP) can be difficult to locate accurately due to speckle and layover. This results in poor stereo models. The use of many GCP's is often not a practical solution, since the data is for areas with difficult access.
- Stereo correlation techniques are unable to resolve fine detail due to speckle, this means that DEM's of less than 100m postings (DTED 1) are difficult to achieve.
- The systems are very new and there is little expertise in understanding the quality of the DEM's produced, how different terrain types, ground cover types and atmospheric conditions effect the DEM's. Much work in evaluating the tools remains.

Commercial image processing software is now available for RADARSAT, ERS and JERS satellites. This allows researchers and production users to obtain lower cost signal data and then process it independently to enhance specific features. Reliance on the default parameters set by the Receiving Station/Data providers is no longer necessary. It is to be expected that this capability will stimulate further research into tuning parameters for specific applications, since the results can be immediately used by commercial applications, rather than being only a theoretical proposition. For example: tuning parameters to enhance target/point recognition, or processing products with a high number of looks to reduce speckle e.g. to improve stereo correlation for DEM extraction.

Finding widespread applications for SAR satellite imagery continues to be a problems. Applications such as DEM extraction, disaster monitoring low resolution mapping, and some geological work have been established, but these tend to use a relatively limited number of scenes. Ice monitoring is an exception, but it is only used at a limited number of sites. Applications, such as for agriculture, which require multiple scenes per year are not yet established. Further work needs to be done to establish

such applications, probably by using SAR imagery as one of many sources of data being fused together.

High resolution and multiple polarisation are features of planned future SAR systems. Improved resolution is to be offered by RADARSAT 2 with 6m resolution (possible launch in 2001) and NASA's LightSAR with <3m resolution (target launch in 1999). Fully polarimetric operation is envisaged for LightSAR. ESA's ENVISAT (launch in 1999), which has resolution similar to ERS, can be operated with in a dual polarisation mode.

As well as the benefits of high resolution in terms of greater geometric definition, the fusion of electro-optical and SAR data of comparable high resolution is also likely to be beneficial to remote sensing applications. Optical data with up to 1 m resolution will be available from 1998 onwards, from IKONOS-1 (launch in March 1998) and QUICKBIRD (launch in late 1998).

Tools will be necessary to facilitate the analysis of multipolarimetric data and the combination of SAR and optical data.

Accomplishments of Working Group During 1997

Introductory presentation of the working group were made at:

- Commission II 1 day meeting in London April 1997
- RSS97 SARSIG session in Reading September 1997

Future activities

Further activities are:

- Population of the WEB site with information on SAR. This is aimed at the new user. It will include information on SAR fundamentals and key issues; pointers to other useful sites, and information on working group activities.
- Working Group Meeting combined with WGII/5 in London on 28 April 1998.
- Participation in Commission II symposium in Cambridge in July 1998

WORKING GROUP II/5 Systems for integrated geoinformation production

Chair: Dr Charlotte Gurney

Co-chair: Dr Nick Veck

State of Science and Technology of Working Group Topics

The tasks for WGII/5 are:

- identification of the main processes involved in integrated geoinformation system production
- identification of the problems /issues involved

- formation of solutions - the WG will attempt to formulate guidelines for developers.

Current activities/discussions (prior to any workshops) have identified the following major issues/trends:

- Selection of flexible design methodologies

The problem is that traditional design methods (waterfall & even OO) assume well developed and stable user requirements. In reality, uncertain and evolving requirements have to be carefully developed in partnership with a user who may have no clear formulation of requirements. Use of OO methods can partially alleviate this, in that iterative prototyping is in-built, but it appears to be necessary to incorporate an even more flexible design approach which allows user requirements to remain ill-defined for longer periods. The use of structured methods for requirements capture, tracing and analysis is identified as very important in this respect.

- Incorporation of R&D

There are difficulties in moving academic research results into an operational environment in terms of adapting software to conform to more rigid industrial standards; this can often be more time-consuming than expected. Also, research results are often not sufficiently practical in terms of their operational requirements (too many unobtainable parameters; too much expert user knowledge required). Further, there may be uncertainty as to their effectiveness, so that a design is required in which there are operational alternatives to the more research-based components.

- Use of Commercial-off-the-shelf (COTS) vs customised software development

There is increasing use of COTS, bolting together tools with a minimum of customised code. This is a cheaper solution than developing a fully customised solution. However, it makes it difficult to add research (see above) and it can mean that tools can be wrongly applied in situations not intended by their original developers.

- Methods for testing and validation

There is a lack of time, data, and effective methodology. Often this aspect of a system will receive a low priority from developers. There is also an issue in separating the system (well understood by system engineers, but not necessarily by an end user) from the actual interpretation techniques (possibly well understood by the user, but less so by the systems engineers - see also the blind acceptance of COTS tools mentioned above).

- Delivery mechanisms

There is a recent surge in interest in Web based solutions which is likely to increase markedly with a corresponding focus on interactive visualisation and data retrieval.

Within Europe the stimulation provided by EC funding via the 4th Framework Pilot Projects and the Centre for Earth Observation (CEO) has led over the last few years to a focus on providing applications for specific customers using existing 'proven' technology. Many of the 'geoinformation systems' known to the Working Group have arisen from projects funded in this manner or by the equivalent national programmes.

News / plans

A Workshop is planned for April 28th in London in association with the IEE. A joint workshop is planned with WGII/4 (SAR Systems). The purpose of the workshop will be to expand and refine the identification of major issues and trends in integrated system development as discussed above. This theme will be further developed during the Cambridge conference in July. It is hoped that the final output will be a series of guidelines for systems developers which will assist them in avoiding the sort of problems encountered by previous developers.

A web page is being prepared on which details of planned events will be available. It is hoped to include a discussion forum so that views of a wider system development community can be obtained.

WORKING GROUP II/6 Integration of image understanding into cartographic systems

Chair: Dr David McKeown

Co-Chair Olivier Jamet

Accomplishments of Working Group During 1997

'Integrating Photogrammetric Techniques with Scene Analysis and Machine Vision III' at the SPIE Aerosense '97 Symposium, Orlando, Florida, April 21-25, 1997.

Future plans

Commission II Symposium, Cambridge UK, July 1997

European WG meeting, TBD (most likely France, Spring 1998)

Mail working group announcements to potential participants, and posting working group announcements to relevant news groups.

Working group homepage: <http://www.cs.cmu.edu/~MAPSLab/isprs.html>

Participate in Commission III Symposium, Ohio, 1998?

WORKING GROUP II/7 Practical and implementation issues in digital mapping

Chair: John Thorpe

Co-chair: José Colomer

State of Science and Technology of Working Group Topics

The use of digital aerial images has become a standard approach in mapping organisations. Today this occurs mainly with digital orthophotos that are used as background information for various vector-formatted geospatial data. In future it is very likely to happen that also central perspective images are increasingly used by the same group of users. A clear benefit over orthophotos is that also three dimensional data acquisition is possible.

A prerequisite for utilising central perspective images is that their orientation data can be transferred easily from manufacturer organisations and systems to the user organisations and systems. Today this is usually guaranteed only if the systems are used by a single vendor. Otherwise difficulties occur because there are no widely accepted standards for transferring orientation data, neither for the semantics or syntax of the relevant model and parameters.

To summarise: There is no commonly accepted standard for both the image raster data and the image meta data, i.e. orientation parameters.

Accomplishments of Working Group During 1997

The main objective of the WG in the year 1997 was to establish a forum for the exchange of ideas on practical and implementation issues in digital standard data transfer formats, especially image data transfer formats. Our goal was to bring manufacturers, researchers and users together, to determine and to discuss these issues. In order to establish this group we sent out an invitation letter, to which 39 people responded and agreed to be member of this WG. In addition to this a WWW-page has been established for means of information exchange. The WWW address is <http://anlt.com/isprs/main.html>

We had two WG meetings. The first one was held on April 9, 1997 in Seattle, USA during the annual ASPRS convention. The second was held on September 24, 1997 during the Photogrammetric Week in Stuttgart, Germany. In both meetings, most of the manufacturers and representatives from universities and users were present. The necessity and willingness to work on the standardisation of an image exchange format was clearly stated by the three big manufacturers Zeiss, Intergraph and LH Systems. As a first step Intergraph and Zeiss presented their ideas and developments regarding this topic. We also invited Mike Ruth, Manager Product Development with Spot Image Corp., who played a major role together with Niles Ritter (NASA) in developing GeoTiff. He gave a short presentation about GeoTiff and its future.

In the Stuttgart meeting it was decided that one approach is to develop a PHOTO-TIFF standard, which would mean that the raster data will be represented by this image format, with additional meta data stored as standard photogrammetric tags. Dr. Tapani Sarjakoski of the Finnish Geodetic Institute offered his help to work on a more theoretical conceptual approach to define this PHOTO-TIFF standard.

Working Group News

The next meeting will be held during the ISPRS II Symposium in Cambridge, where the WG will have a panel session, where an attempt to establish an agreement on future efforts.

Set up WWW site

Host a seminar in Colorado Springs, USA, Summer 1999

WORKING GROUP II/8 Digital systems for image analysis

Chair: Dr Christian Heipke

Co-chair: Dr Tapani Sarjakoski

State of Science and Technology

A large number of Digital Photogrammetric Systems (DPS) including input and output devices with different degrees of functionality, user friendliness, and automation potential is commercially available. Vendors of DPS include traditional photogrammetric, but increasingly also remote sensing and GIS companies.

A major trend can be observed to use Windows NT as operating system. Modules for automatic interior and relative orientation are operational and are in daily use in practice.

Automatic aerial triangulation was introduced into the commercial arena during the last 12 months and is promising large cost savings, while retaining the needed accuracy. Investigations are under way to analyse the performance of AAT.

Automatic DEM generation was accepted in practice some time ago, but interactive verification and editing is there to stay, especially in difficult terrain, and in large scales.

Digital orthoimages are being produced routinely on a daily basis, and there is a trend especially for large scale applications to use true orthoimages, i.e. to correct the displacement of man-made objects like houses and similar.

As of today semi-automatic extraction of GIS and CAD data is still mostly restricted to research and development. Implemented algorithms combine computer vision approaches with rigorous photogrammetric modelling. Some results indicate that future systems will be equipped with more powerful tools. The human computer interface is increasingly being seen as an important factor. In practice, GIS and CAD data are often still acquired from film imagery using analytical plotters. The term 'semi-automatic' is interpreted in at least two different ways: it is used to mean (1) post editing of automatically generated results, and (2) a close interrelationship between human operator and computer in the actual data acquisition phase. Clarification of the term is needed.

Photogrammetric and remote sensing imagery plays a significant role in spatial data base revision. As compared to map revision, there are many more attribute data to be

acquired. The research arena is starting to develop integrated updating concepts including various data sources and automation. The workflow in practice is still highly manual and the GIS data capture often occurs from paper plots showing the actual GIS objects, even though digital imagery might be used for acquiring the object geometry.

Relatively little attention is being paid to data compression and its effects for photogrammetric and remote sensing processing. It is estimated that this topic will receive more attention once digital cameras will become available.

Accomplishments of the WG in 1997

Participation in the SPIE International AeroSense Symposium, Conference on "Integrating Photogrammetric Techniques with Scene Analysis and Machine Vision III", in co-operation with ISPRS WG II/6, including a WG business meeting, Orlando, FL, USA, April 20-25, 1997.

Participation in the ISPRS Workshop "Theoretical and Practical Aspects of Surface Reconstruction and 3D Object Extraction", in co-operation with ISPRS WG III/2 and III/3, including WG business meeting, Haifa, Israel, September 9-11, 1997.

WG Business meeting during Photogrammetric Week, Stuttgart, Germany, September 24, 1997.

Publication of a theme issue "Automatic Image Orientation" in the ISPRS Journal for Photogrammetry and Remote Sensing, Vol. 52 No. 3, June 1997.

Test on "Performance of tie point extraction in automatic aerial triangulation" in co-operation with the OEEPE, progress report attached.

Establishment of a WWW site for the working group:
<http://www.photo.verm.tumuenchen.de/isprs/wgII8.html>

Mailing of 3 WG newsletters, predominantly by email.

WG news

Processing of OEEPE/ISPRS test "Performance of tie point extraction in automatic aerial triangulation".

Workshop on "Performance of tie point extraction in automatic aerial triangulation" together with OEEPE, in conjunction with the Commission. II Symposium, Cambridge, UK, July 13, 1998

Conference on digital photogrammetry in co-operation with ISPRS WG III/3 and possibly ISPRS WG III/4, Munich, Germany Fall 1999.