# 1995 Annual Report - Technical Commission II "SYSTEMS FOR DATA PROCESSING, ANALYSIS AND PRESENTATION"

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## TERMS OF REFERENCE

- Design and development of integrated systems for measurement, processing, analysis, representation, and storage of photogrammetric, remote sensing and GIS data
- Study and evaluation of system integration aspects for photogrammetry, remote sensing and GIS data processing
- Analysis of systems and their components for automated, semi-automated and manual digital processing systems
- Development of systems and technologies for radar data processing
- Study of real-time mapping technologies
- Standardization of digital systems for photogrammetry, remote sensing and GIS

## STATE OF SCIENCE AND TECHNOLOGY OF COMMISSION II TOPICS

A review of the systems aspects for the processing of geographic data reveals that progress in this area continues to be driven by advances in technology. Advances continue to originate from all of the fields of photogrammetry, remote sensing, surveying, and mapping. Acceptance of geographic information systems (GIS) as a unifying technology continues to challenge the "separation of disciplines". Consequently, the shift toward integrated systems for processing of geoinform-ation is driven by advances in hardware, software and networking.

Trends towards developing integrated systems capable of performing multiple tasks continues to be strong. Although these systems can operate as a stand alone workstations, the networking of many of them in a heterogeneous environment is becoming a reality. Future advances in systems for data processing, analysis, representation and communication will be measured by the degree of integration. Since the power of the new workstations can be realized only if they can communicate with multiple databases, the development of a spatial information infrastructure for interoperability becomes paramount.

Technological advances in integrated systems may be measured in terms of advances in the related technologies of GIS, satellite remote sensing, photogrammetry, GPS, and information technology (multimedia, visualization, database management systems and networking). More emphasis is being placed on digital photogrammetry, image processing, integrated systems, and real-time mapping systems. In the transition from analytical to digital photogrammetry, traditional photogrammetric instruments are becoming obsolete. Over the past several years, photogrammetric knowledge has gone into software instead of hardware. There is a growing need for end-to-end systems, and these are increasingly being assembled with standard off-the-shelf components in order to facilitate software portability across different hardware platforms.

## ACCOMPLISHMENTS OF COMMISSION II DURING 1995

- *Commission II Symposium Proceedings*

  Proceedings of the Commission II 1994 Symposium in Ottawa, Ontario, Canada are available through RICS Books in the United Kingdom.

- *Preparation of Papers for International Symposium on GIS Development*

  Dr. Mosaad Allam, President of Commission II, prepared two invited papers for an "International Symposium on GIS Development" held in Beijing, China during 12-16 November 1995. One paper addressed Data Sharing and Networking, whereas the other addressed Data Revision and Update.

- *ISPRS Journal*

  Commission II continued activities with the **ISPRS Journal of Photogrammetry and Remote Sensing** . In responding to requests from the Editor, Commission II reviewed several papers for publication in 1995.

- *XVIII ISPRS Congress Tutorials*

  Commission II has organized and will present two full day Tutorials at the July 1996 ISPRS Vienna Congress. The tutorials are: (1) "Integration and Orientation of Sensor Systems" co-sponsored by WG II/1, and (2) "Technologies for Handling Very Large Volumes of Spatial Data" lead by WG II/3.

- *ISPRS Joint Meeting of Council and Technical Commission Presidents*

  Commission II participated in the ISPRS Joint Meeting of Council and Technical Commission Presidents held in Vienna, Austria from 6-9 June 1995.

## COMMISSION II NEWS

- *Technical Session and Activities for 1996 - XVIII ISPRS Congress in Vienna*

Commission II was allocated 11 technical sessions, four poster sessions, one joint session with Commissions I/II/III at the 1996 Vienna Congress. It has eagerly worked to collect paper abstracts and invited papers for this activity. Preparations continue with the review of abstracts and development of a technical program.

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## WORKING GROUP ACTIVITIES DURING 1995

- **WG II/1 - "Real Time Mapping Technologies"**

*by Chairman:Dr. Kurt Novak (USA)*
*Co-Chairman:Michael Hahn (Germany)*
*Secretary:Holger Schade (Germany)*
*WG Members: 80*

**State of Science and Technology of WG II/1 Topics**

Real-time mapping gained tremendous interest over the past year. Developments of mobile mapping systems were initiated both in the US and in Europe. In the US there are now at least 5 companies offering mobile mapping services to customers. Real-time mapping technologies developed at major research institutions,such as the University of Calgary and the Ohio State University, were licensed to private companies for commercial use. In Europe there are a number of efforts to design vehicle based mapping systems.

Probably the most significant improvement over the past year was the operational implementation of a number of airborne real-time mapping systems. They integrate GPS/INS with laser scanners and video cameras for mapping of utility corridors. This is a significant step towards the full automation of aerial mapping.

The major objective of real time mapping systems development is the fast collection of digital data for GIS. In the case of airborne systems, research is concentrated on supplementing aerial cameras with GPS, INS, and laser scanners to automate DEM extraction and sensor orientation. There is a clear sign that digital photogrammetry by itself (using stereo image matching and feature extraction) cannot solve the data extraction problem. Additional sensors are needed to create accurate geographic data more efficiently. Beside the installation of GPS in the aircraft for absolute positioning of the exposure station (which is considered operational), inertial systems (INS) are being added for determining the absolute scanner positions (e.g. laser scanning) for automatically generating surface models and even for identifying objects. This technology will also improve the capabilities of automatic feature extraction from aerial photographs.

Terrestrial systems typically integrate even more different sensors than airborne systems: GPS, INS, digital and analog video cameras, voice recording devices, radar, imaging lasers, etc. The major applications of terrestrial systems are the mapping of inventories along linear features, such as highways

or railroads. Collection of geo-coded videos has become an important activity to create multi-media GIS. Videos are no longer stored in analog form, but rather are compressed on CD-ROM. They can be linked to geographic databases and serve as important decision making tools, saving the user expensive trips to the field. Precise positioning of objects with terrestrial systems, e.g. with a stereo vision system, is almost possible in real-time. Accuracies better than 30 cm can be achieved. We also found that a number of large contracts have been made in this field, which is an encouraging signal of the maturity of real time mapping technology.

The most important research activities concentrate on the tight integration of GPS and INS sensors. The positioning sensors are the enabling technology for real-time mapping. Improvements of this component will allow positioning with centimeter accuracies in the near future.

On the imaging side we believe that active sensors, such as imaging lasers are the future of real time mapping. These devices create both depth and gray value images instantaneously. This means that each pixel of the digital image has a distance associated with it. Stereo measurements may become obsolete once laser cameras are available. Furthermore, active sensors do not need any light; so they can be used in tunnels or during variable lighting conditions of the day, and they are not affected by shadows. They can be used in terrestrial systems as well as from aircraft.

**Accomplishments of WG II/1 During 1995**

In 1995 WG II/1 participated in a number of conferences and workshops relevant to its focus of interest. A listing of these activities is:

- o 3-6 April 1995 - Stuttgart, Germany
  WG II/1 members participated in the "3rd International Workshop on High Precision Navigation." Kurt Novak presented a paper on "Integrated Sensor Systems for Terrestrial Photogrammetry," Michael Hahn was on the organizing committee.
- o 24-26 May 1995 - Columbus, Ohio, USA
  At the "Mobile Mapping Symposium" WG II/1 members presented papers on mobile mapping; Kurt Novak organized a session on Imaging Systems.
- o 4-8 September 1995 - Barcelona, Spain
  WG II/1 co-sponsored the "Integrated Sensor Orientation Workshop"; Kurt Novak and Holger Schade organized sessions on "Real-time Mapping Technologies" and "Kinematic Survey Systems."
- o 8-10 November 1995 - Stuttgart, Germany
  WG II/1 organized three sessions at the Joint Workshop of Commissions I, II, III on "Real-time Mapping" and "Navigation."

**WG II/1 News**

WG II/1 will concentrate on preparations for the 1996 ISPRS Congress in Vienna, and organize at least two sessions.

WG II/1 will play a major role in the tutorial on "Integration and Orientation of Sensor Systems", which will be presented at the ISPRS Congress.

WG II/1 will continue with the development of a report/bulletin on world-wide real-time mapping activities.

- **WG II/2 - "Hardware and Software Aspects of GIS"**

*by Chairman:Dr. Manfred Ehlers (Germany)*
*Co-Chairman:Nickolas L. Faust (USA)*
*Secretary:David Steiner (Germany)*
*Members: 68*

**State of Science and Technology of WG II/2 Topics**

On the hardware side, we see a continuation of last years' trend, especially in the areas of increasing processing power, decreasing costs, and miniaturization. With the introduction of new 32-bit operating systems, PC's challenge workstations in performance. Laptops with GIS software and integrated GPS can be taken to the field. A fax/modem connection makes a mobile on-line GIS workstation. As usual, however, the real revolutions appear on the software side. Low-cost and easy-to-use visualization software with intuitive interfaces, such as ArcView, allow the use and distribution of geographic information to a much wider audience.

The introduction of Windows-NT and Windows 95 with the commitment to transport their software to these operating systems by all major GIS software developers will be a great step in the direction of an affordable GIS for everybody. The rapid growth of the World Wide Web (WWW) as a friendly, easy-to-navigate user interface to the Internet has begun to change our way of thinking about information and its availability.

Last, but not least, the impact that the Open Geodata Interoperability Specification (OGIS) Project will have on the development of GIS is a potential revolution to the GIS market. The goal of the OGIS Project is to promote the development of interoperability standards for the distributed processing of heterogeneous geospatial data. The Open GIS Consortium consists of representatives of government organizations, universities and major GIS developers. Given the tremendous amounts of geospatial data now available and recent dramatic developments in geospatial data generation, there is a great need to focus on techniques for accessing heterogeneous databases in real time across local and wide area networks. The OGIS defines an approach to such access by means of a distributed object-oriented software architecture.

**Accomplishments of WG II/2 During 1995**

Proceedings of the ISPRS Working Group II/2 "International Workshop on Requirements for Integrated Geographic Information Systems" held in New Orleans, USA during 2-3 February 1994 were published.

A WG II/2 Business Meeting was held during the "9th International Symposium on Computer Science for Environmental Protection," 27-29 September 1995 in Berlin, Germany.

**WG II/2 News**

Preparations are currently under way for an "International Workshop on New Developments in Geographic Information Systems." This workshop will be held 6-8 March 1996 in Milan, Italy.

- **WG II/3 - "Technologies for Handling Large Volumes of Spatial Data"**

  *by Chairman:Dr. Ekow Otoo (Canada)*
  *Co-Chairman:Terry Fisher (Canada)*
  *Secretary:Cherian Chaly (Canada)*
  *Members: 16*

  **State of Science and Technology of WG II/3 Topics**

  Technology to handle very large volumes of spatial data is now perceived as one of the major significant initiatives of most national governments. It is being recognized that Geographic Information Systems and Remotely Sensed Data will play a vital role in social evolution.

  A number of countries have initiated programs to establish a National Spatial Database Management Infrastructure with the purpose of:

  - providing some degree of standardization in spatial data formats;
  - defining the base information content of the metadata for spatial databases; and
  - defining the core information content for spatial database repositories and clearinghouses.

  These initiatives are intended to promote a high degree of shareability, useability and to facilitate the dissemination of information on the existence of national databases.

  The activities of WG II/3 took this recognition and a number of national initiatives into consideration in conducting it activities. Primarily, WG II/3 activities have concentrated on studies, research and programs that support the general principles of the setup and use of spatial database repositories. Towards this end, the WG held meetings, discussion sessions and invited papers on:

  - Data models that promote interoperability between heterogenous technologies of Geographic Information Systems;
  - Large capacity storage systems (e.g., RAID, digital tapes, etc.) technology for on-line storage and archiving of large volume spatial databases;
  - Limitations of current database technology and models of transaction processing systems to support large spatial databases;

- o The advantages and disadvantages of parallel computing in processing very large volume databases; and
- o Techniques for modelling time, events and for incorporating event processing in spatial databases.

An item which was of some concern but has been left open is the issue of integrating data of different levels of precision and accuracy.

**Accomplishments of Working Group II/3 During 1995**

The WG held a meeting of some members in Vancouver, Canada during the IRIS/PRECARC Annual Conference in June 1995. The WG corresponded primarily via E-mail and reading the WG II/3 bulletin at the WG WWW site.

**Working Group II/3 News**

The working group plans to hold a Business Meeting during the upcoming Canadian Conference on Geomatics in 1996 in Ottawa, Canada.

The group plans to hold a one day working session during the 1996 ACM SIGMOD Conference in Montreal, Canada.

A site for reading about the activities of the WG II/3 and other papers relevant to the WG has been set up at the Geographic Information and Services Division of Geomatics Canada. The URL address is: http://gis10.gisd.nrcan.gc.ca.

A bound publication of paper contributions to WG II/3 is being arranged. We hope this will be completed before the ISPRS Congress in Vienna. Papers on technology for the handling of large volumes of spatial data are being solicited. Further information is available at the WG web site.

- **WG II/4 - "Systems for the Processing of Radar Data"**

  *by Chairman:Dr. Robert O'Neil (Canada)*
  *Co-Chairman:Dr. Hiroshi Kimura (Japan)*
  *Secretary:Marc D'Iorio (Canada)*
  *Members: 55*

  **State of Science and Technology of WG II/4 Topics**

  There have been significant developments in several areas, as follows:

  - o A number of SAR processing systems are available commercially at lower cost than ever before. These make SAR processing directly accessible to new portions of the user community and lead the way to more application specific use of the SAR data;
  - o SAR interferometry has become a very exciting and promising research topic with numerous potential applications being investigated. Most common applications are related to the precise measurement of elevation differences over land;

- Other applications being investigated are velocity measurements and ocean features. These potential applications have stimulated a great deal of research into the better characterization of the SAR data, the response of SAR to various target classes, and novel processing techniques for manipulating, correcting and visualizing interferometric data sets;
- The ERS-1/ERS-2 Tandem Mission is providing very important interferometric SAR data sets. The archive of these data be an important source of global land elevation information;
- RADARSAT was launched on 4 November 1995 and the first imagery was released on 14 December 1995. RADARSAT is the first satellite carrying a SAR that has been designed to deliver imagery for routine operational requirements.

**Accomplishments of WG II/4 During 1995**

Few activities have been initiated since the sessions at the Commission II mid-term Symposium held in June 1994 at Ottawa, Canada and the WG meeting organized at that time.

**General Comments**

As a general comment it has been difficult to detect/generate much enthusiasm related to the theme of this WG because the reporting of the technology and early applications are very closely associated with the IEEE and IGARSS conferences.

- **WG II/5 - "Integrated Production Systems"**

*by Chairman:Dr. Atef Elassal (USA)*
*Secretary:Dr. Roop C. Malhotra (USA)*
*Members: 18*

**State of Science and Technology of WG II/5 Topics**

The scope of the WG-II/5 is confined to photogram-metric based Integrated Production Systems (IPS) with data acquisition functionalities. The functionalities of IPS as recognized are:

- Spatial data collection, editing, and storage
- Building topology for GIS applications
- Data transfer
- Integration of data sets (vector/raster, from different sensors)
- User interfaces to GIS.

IPS integrates various processes of spatial data acquisition, such as: triangulation, compilation, and transformations. Data analysis functions are relegated to GIS. The linkage between an IPS and GIS is considered essential in the IPS development.

*IPS User's Guide*

Due to a wide range of existing IPS's, from very simple to highly sophisticated systems, the WG II/5 has planned to compile an IPS User's Guide with the following features:

- o  description of INPUT data to the IPS
- o  description of data flow or processes in IPS
- o  description of functionalities of IPS
- o  definition of accuracy of the data set

This User's Guide will assist in establishing optimum IPS's for users in need of guidance.

Inputs to this IPS User's Guide have been solicited from the WG membership, who in turn are getting in touch with individuals involved in the development and use of an IPS.

**Accomplishments of WG II/5 During 1995**

Correspondence with the WG membership and the Chair continued regarding the affairs of the WG. No particular date for a formal WG II/5 meeting in 1995 was agreed upon by the membership. However, periodic informal meetings between members residing in the local Washington D.C. metropolitan area were held. Dr. George Lee of U.S. Geological Survey, Menlo Park, California, was able to participate actively in the WG affairs.

On the bright note, Dr. Elassal has agreed to continue as the WG II/5 Chairperson upon retirement from United States Federal Government.

Several responses for the IPS User's Guide have been received and will be included in the Guide. This is an on-going WG II/5 project.

Invited papers for presentation during the XVIII ISPRS Congress were solicited. Three invited papers were forwarded to Commission II for inclusion in the technical program. The Commission has also received directly other papers for inclusion in the WG technical sessions at the Congress.

**General Comments**

The downsizing of the government and budgetary constraints has impacted Society activities adversely in the United States. In spite of this, essential matters are being addressed. It is hoped that some of these members will be able to travel to attend the XVIII ISPRS Congress in July 1996.

- **Commission II Special Project WG - "Upgrading Photogrammetric Instruments"**

*by Chairman:Dr. Klaus Szangolies (Germany)*
*Members: 13*

**State of Science and Technology of Commission II Special Project WG Topics**

Several thousand conventional analog plotters and analytical stereoplotters are currently used in practice. We have to consider how to further proceed with them. It is necessary to distinguish between the modernization of existing equipment; e.g. by the exchange of obsolete computers and software for new ones; or the replacement of mechanically connected drawing tables by electronically controlled plotters; and the supple-mentation of existing equipment, e.g. the extension of the viewing system of stereoplotters by superimposition or higher viewing magnification.

There are company representatives advancing the opinion that in 1996, when the next ISPRS Congress will be held, the upgrading of the conventional instruments will no longer be necessary and will be of academic significance only. They believe digital photogrammetry will have fully replaced traditional photogrammetry at this time.

This opinion seems unrealistic. What can be expected is that the transition to digital photogrammetry will besteadily continued in map production and in the generation of GIS data banks. It will, however, still take ten years or more until it is completed. And during this time we need functioning optical-mechanical and analytical instruments as well as techniques for mapping.

**Accomplishments of Commission II Special Project WG During 1995**

Three WG Meetings were held in Germany during 1995:

- o   in Dresden, Technical University, on 30 January;
- o   in Cologne, during GEOTECHNICA, on 5 May;
- o   in Dortmund, during Deutscher Geodatentag, on 24 August.

**General Comments**

All members of the Special Project WG and all interested photogrammetrists are invited to participate in the ISPRS Congress in 1996 in Vienna with a paper related to the subject.

- **Inter-Commission WG II/III - "Digital Photogrammetric Systems"**

*by Chairman:Prof. Ian Dowman (U.K.)*
*Co-Chairman:Dr. David McKeown (USA)*
*Secretary:Zubbi Nwosu (Switzerland)*
*Members: 220*

**State of Science and Technology of Inter-Commission WG II/III Topics**

Digital photogrammetric systems continue to develop at a rapid rate. Several new systems have been announced during the past year and in particular the Zeiss PHODIS is now installed and operating in a number of centres. A major development in software is for digital aerial triangulation and both Zeiss and Leica now have this software ready. Photogrammetric software is also becoming more widespread within image processing systems and ERDAS have extended their range to include Softcopy Mapper.

A significant meeting for presenting digital systems was the "Photogrammetric Week" in Stuttgart in September 1995 and although this meeting focused on Zeiss products, it also contained papers looking at general software developments.

There is increased interest in the integration of photogrammetric systems with semi-automated andautomated computer vision systems, particularly for cartographic feature extraction. Of interest is the trend toward the incorporation of rigorous photogrammetric modeling within computer vision algorithms. There are active efforts to demonstrate and evaluate the utility of these techniques within several national mapping agencies, particularly IGN in France and USGS in the USA. One merging application area for digital photogrammetric workstations is the construction of large-scale databases for distributed visual simulation.

**Accomplishments of Inter-Commission WG II/III During 1995**

- 27-29 March 1995 - Kuala Lumpur, Malaysia
  "Seminar of Integrating Remote Sensing and GIS Data." Co-organizer with the Technical University of Malaysia. Published proceedings.
- 19-25 April 1995 - Orlando, USA
  Co-organizer with SPIE Conference on "Integrating Photogrammetric Techniques with Scene Analysis and Machine Vision II." Published proceedings: **SPIE Volume Number 2486** , 27 papers, 300 pp.
- 30 August-1 September - Stockholm, Sweden
  Joint Workshop with ISPRS WG's III/2 and III/3 on "The Role of Models in Scene Analysis," in seven sessions, each with two invited speakers and a discussion moderator.

Two newsletters have been produced and circulated to the members of the IC WG II/III.

A business meeting was held at the SPIE meeting in Orlando and a questionnaire has been circulated to determine the interests of members of the working group with a view to planning a program for 1996-2000 term.

KENNERT TORLEGARD