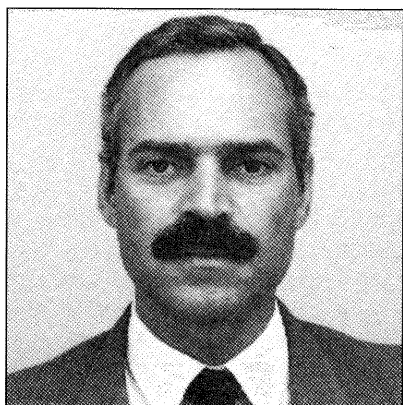


# Summary of the Scientific Program – Résumé du programme scientifique – Zusammenfassung des wissenschaftlichen Programms

## *Reports by Presidents on Technical Commission Activities 1988 - 1992*



### **COMMISSION I**

#### **Primary Data Acquisition**

by Marcio Nogueira Barbosa, President 1988-1992  
and José Luiz de Barros Aguirre, Secretary 1988-1992

#### **Introduction**

At the Kyoto Congress in 1988 the approved resolutions concerning Primary Data Acquisition addressed specific aspects on the planning of space missions, on cooperation with CEOS (the Committee on Earth Observation Satellites), on use of GPS (the Global Positioning Satellite System), on microwave systems and on the Specifications for Aerial Photography.

With these priorities in mind the incoming Commission President, in interaction with the Council, restructured the Commission in four Working Groups, one Intercommission Working Group and one Special Topic, with the Terms of Reference below.

#### **Working Group I/1: Optical Sensors for Remote Sensing**

- investigate geometric and radiometric characteristics of optical airborne and spaceborne photogrammetric sensors;
- investigate methods and procedures for photogrammetric sensor calibration;
- revise and update the contents of the "Recommended Procedures for Calibrating Photogrammetric Cameras and Related Optical Tests" document;
- identify and establish formal mechanisms for the continued maintenance of the Procedures, possibly in cooperation with other organizations.

#### **Working Group I/2: Digital Imaging Systems**

- investigate geometric and radiometric characteristics of digital airborne and spaceborne imaging sensors;
- investigate methods and procedures for airborne and spaceborne digital sensor calibration;

- define and recommend quality standards in close contact with existing organizations such as the Committee on Earth Observation Satellites (CEOS).

#### **Working Group I/3: Microwave Remote Sensing Systems**

- investigate the capabilities and potential applications of airborne and spaceborne microwave sensors in obtaining topographic and thematic information;
- study calibration procedures and quality standards for airborne and spaceborne microwave systems in close contact with existing organizations such as the Committee on Earth Observation Satellites (CEOS).

#### **Working Group I/4: Sensor Orientation and Navigation**

- study models, techniques and mechanisms, in particular those related with NAVSTAR-GPS, for navigation of airborne and spaceborne sensors;
- study models, techniques and mechanisms for orientation of airborne and spaceborne sensors.

#### **Intercommission Working Group I/IV: International Mapping and Remote Sensing Satellite System**

- gather information on examples of international cooperation concerning space sensors;
- gather information on results obtained or being obtained on new space sensors;
- gather information on future Remote Sensing missions at international level;
- establish and publish a newsletter with the gathered information for dissemination within ISPRS and the Remote Sensing Community in general.

#### **Special Topic: Future Remote Sensing Missions and Early Results of New Systems**

- gather information on examples of international cooperation concerning space sensors;
- gather information on results obtained or being obtained on new space sensors;
- gather information on future Remote Sensing missions at international level;
- establish and publish a newsletter with the gathered information for dissemination within ISPRS and the Remote Sensing Community in general.

#### **Commission Activities**

The work of the Commission was harmed to some extent by limitations and problems of different sorts faced by the President himself and most of the Working Groups. Four of the original Chairpersons had to be replaced due to changes in necessary support from their companies. The Gulf War forced the cancellation of an international workshop in 1991. And the 1989 nomination of the Commission President as Director General of his

organization (INPE), a second-rank government position in Brazil, imposed on him new and heavy responsibilities which in many occasions conflicted with his charges as Commission President. On the other hand, some tasks were facilitated, such as the organization of the 1990 mid-term Symposium in conjunction with the Brazilian Symposium on Remote Sensing, in Manaus.

The choice of Manaus, in the heart of the Amazon forest, was taken as an additional motivation for foreign participation, in a timeframe when international concern about preservation of the tropical forests was giving place to passionate arguments in several scientific circles. The joint event had an expressive international participation of 108 registrants from 24 countries, besides 392 from Brazil.

Forty-two presentations were given in the context of the ISPRS Commission I Mid-Term Symposium. It is remarkable that only two cancellations occurred from the accepted papers list. The Proceedings (*ISPRS Archives, Vol. 28, Part 1*) were published in softcover by INPE and distributed on site, including the 35 manuscripts that were submitted in time. A Supplement (*Vol. 28, Part 1a*) was published later, with five additional papers whose originals were provided after the pre-Symposium publication deadline.

Despite the difficulties, we believe Commission I's presence in the 1992 Congress was significantly improved with respect to 1988. Almost 90 presentations scheduled in the Final Program represent an increase of nearly 50% over the corresponding number in the previous Congress.

### **Working Group Activities**

#### *Working Group I/1*

The original Chairperson, Dr. Rolf-Peter Oesberg (Germany), was not active after his nomination due to professional involvements away from his quarters. He asked for resignation in late 1989 and was replaced by Dr. Hartmut Ziemann, then at the Royal Institute of Technology (KTH) in Sweden.

Dr. Ziemann's energy, although high, could not be fully utilized on behalf of the WG due to successive employment changes during the period. Nevertheless, he was able to become involved with CEOS, first on behalf of the German Space Agency (DARA) and thereafter on behalf of the Swedish National Space Board (SNSB).

The Recommended Procedures and the Specification for Aerial Photography have not been worked on. In the Chairman's judgment, the reason is primarily one of priority with people having the expertise to participate: this activity apparently does not have high enough a profile to find institutional support. Nothing has been done directly, but contacts have been established/attempted to several ISO (International Standards Organization) Technical Committees dealing with related matters. Dr. Ziemann, as a member of SPIE

(the International Society for Optical Engineering) is monitoring their standards committee through their regular publications, primarily OE reports (appearing monthly). No work has been done in regard to camera calibration problems, i.e., the attempt to have camera manufacturers and testing laboratories use test procedures leading to calibration certificates equivalent in content. Changes have apparently been made at the U. S. Geological Survey but those are only partly in line with recommendations coming from earlier activities of the WG. The Chairman recommends that if ISPRS desires to be active in standards and related activities, limited funds must be made available and a (reasonably permanent) representative chosen who can then participate in activities of relevance of ISO, of CEOS, of IEC (the International Electrical Commission), of CIE (the International Commission on Illumination) and others. This point was made in Dr. Ziemann's presentation in Manaus. Suggestions for changes to the Statutes and Bylaws concerning standards and related activities were submitted to the ISPRS President on October 1990. The standards situation is reviewed in the WG's Invited Paper for Washington. Additionally, the Chairman points out that this kind of activity should be of concern to the other technical commissions of ISPRS as well.

Dr. Ziemann had himself placed on the correspondence roster of Intercommission WG I/II and received their circular letters until August 1991, the last being a telex canceling a WG meeting scheduled for Moscow in October 1991. He attended the Dresden symposium of ISPRS Technical Commission II where two sessions had been planned for the WG, but paper cancellations reduced those to one session. The activities of this group were presumably very significantly affected by the political changes in Eastern Europe.

The Chairman has become involved with the CEOS WG on Calibration and Validation (Cal/Val) and participated in their last two meetings (August 1991 in Ottawa, Canada; April 1992 in Abingdon, UK). This group deals with calibration and validation of sensors observing the surface of Earth and the lower atmosphere. The group uses their own definitions for calibration (an engineering activity conducted primarily in a laboratory environment) and [geophysical] validation (any activity to convert instrument output to useful [geophysical] data) which the Chairman cannot agree with; they will most likely again be on the agenda of the forthcoming Cal/Val meeting to be held at INPE, Brazil in November 1992. ISPRS was denied observer status with CEOS on the ground that it is a professional rather than a scientific group; a reapplication is being considered. Cal/Val has an active subgroup dealing with the calibration of radar imaging systems and is in the process of forming other subgroups. A proposal for a subgroup evaluating optical and radar based terrain mapping (primarily elevation determination) is under discussion; Dr. Ziemann was asked and tentatively agreed to chair this group but finally had to decline because SNSB decided not to sponsor the group.

During the last Cal/Val meeting, some participants thought that the envisaged activity was outside the WG scope and should be taken up e.g. by ISPRS.

#### *Working Group I/2*

The original Chairman, Alex Merametdjian (France), had his organization partly absorbed by another company and, in his new situation, found great difficulty in obtaining support for travel and scientific activities, in particular those related to ISPRS. He was able to divulge and participate at the Commission Mid-Term Symposium but could not report any other achievements. His co-chair, Dr. Xuan JiaBin from China, could not attend the Symposium nor any of the Commission Board meetings. The President freed him from his WG duties shortly after the Symposium and nominated Dr. Décio Ceballos, from Brazil, as the new co-chair of the WG. A few weeks later, Mr. Merametdjian left his company and the Remote Sensing field, and asked for resignation from the chairmanship. Dr. Ceballos was then appointed as the WG only chairperson.

Dr. Ceballos initiated his activities by drawing up a mailing list based, among other sources, on the Kyoto list of Commission II authors. He was able to get feedback from approximately 50 persons worldwide. In addition, he established a WG with ten investigators from Brazil, USA, France, Germany, Finland and Canada. The WG held formal and informal meetings during the SPIE Conference in Orlando (April 1991) and the CEOS Cal/Val meeting in Ottawa (August 1991).

Preliminary topics for discussion were identified and a mail exchange was established with satisfactory results despite the slowness of the process. Fruitful interaction was obtained in the fields of combined (on-board/space/ground targets) calibration, the use of the Landsat historic database, quality standards and geometrical and radiometric characterization. A large number of comments and suggestions were provided by persons involved with present advanced sensors, future sensors, reflectance databases and test sites. A more detailed report can be obtained with the WG Chairman.

In particular, the Chairman calls the attention to the evolution in technology and variety of existing and coming sensors as a concern to be kept in mind when updating and maintaining the Specifications and Procedures published by ISPRS. A directory of existing reflectance databases and test sites should also be included.

#### *Working Group I/3*

Dr. John Curlander (JPL, USA), had already chaired the previous Working Group on microwave systems and accepted the President's invitation to continue with the activity. He contributed to and participated in the Mid-Term Symposium in Manaus and organized a workshop on his area of activity in Oberpfaffenhofen, Germany, in conjunction with a CEOS meeting. The workshop was a two-day meeting with approximately 20 presentations,

attended by nearly 40 representatives from all continents. A follow-on workshop is planned for the Fall of 1992 in Ottawa, Canada.

#### *Working Group I/4*

The Chairperson originally appointed, Dr. José Bittencourt de Andrade from the Federal University of Paraná in Brazil, established several mail contacts in Brazil and abroad and organized a WG with 10 specialists from Brazil, France, USA and Norway. He organized a Workshop in Curitiba, Brazil, in September 1989, in conjunction with a German-Brazilian Symposium on Cartography, where a panel discussion was held on the WG activities and plans.

However, considering the Chairman's difficulties in obtaining travel support, which did not allow him an effective participation in the Commission activities, the President in August 1990 thanked him for his efforts and accomplishments to the moment and released him from WG charges, nominating as substitute Dr. Denizar Blitzkow, from the University of São Paulo.

Dr. Blitzkow maintained the contacts initiated by his predecessor and added new ones at the 2nd International symposium on Precise Positioning with GPS, in Ottawa, Canada, where he participated in September 1990.

The Chairman organized an International Workshop on Sensor Orientation and Navigation in conjunction with the XV Brazilian Congress on Cartography, in São Paulo, in July 1991. Seven presentations were made with authors from Brazil, Canada and the U.S.

A report summarizing the evolution of sensor positioning with GPS and a bibliography on the field were prepared for the XVII ISPRS Congress by the Dr. Blitzkow and are available upon request.

#### *Intercommission Working Group I/IV*

To chair this WG the President invited Dr. Gottfried Konecny from the University of Hannover in Germany. He formed the WG with correspondents from Space agencies of various countries and from the United Nations Outer Space Affairs Division.

A first meeting with some of the participants was held during the ASPRS meeting in Colorado, in early 1990. A basic difficulty felt then was that space agencies were reluctant to discuss space programs which were not their own.

Anyway, contacts and invitations made at that event resulted in a most interesting set of presentations and ensuing discussions in the WG I/IV session at the mid-term Commission I Symposium in Manaus. These papers, besides their inclusion in the Archives, were published in a special volume by the Institute for Photogrammetry and Engineering Surveys of the University of Hannover, and

were distributed to international organizations and space agencies.

The next session of the WG was planned for Moscow in September 1991 during a symposium, but political events determined its cancellation. The next opportunity was during the ISY Conference in Munich, in April 1992, where another set of presentations were made and should be published as part of the Conference Proceedings. From the experiences of that meeting, the WG I/IV program for the XVII ISPRS Congress has been arranged.

In parallel with these activities, Dr. Konecny maintained contacts with other remote sensing satellite coordination groups such as CEOS and COPUOS (the Committee on Peaceful Uses of Outer Space), not only as WG I/IV Chair, but also as ISPRS First Vice President. At this last forum, the following points were made:

1. Present space efforts and remote sensing supplement each other in performance and operational capability, but much coordination effort is due.
2. Most efforts of space agencies are technology driven (top down) rather than demand driven (bottom up).
3. The commercialization move on space products has made it difficult for developing countries to satisfy their remote sensing requirements, which are the most critical.
4. The space product market is an imperfect one, and this makes the private sector reluctant to commercially invest on it.
5. Remote sensing efforts in general do not provide the required spatial resolution, stereo capability and coverage to meet the needs of environmental monitoring and sustained development on a regional or local level.
6. Remote sensing is not the only input required for providing environmental information, and should be combined with other data in a GIS context.

The Chairman presented the following concluding remarks concerning WG I/IV:

"ISPRS is a scientific body with no financial means to substantially influence, what Governments and space agencies decide. Therefore, ISPRS can only continue to make analyses of the current status and make suggestions widely known through means of publications with appropriate circulation. Whether a Working Group (like this) will be able to make significant impacts or not depends on close contacts with agencies who have the funding for space activities. . . . It would be more effective if ISPRS would strengthen representation in other coordinating bodies, especially in COPUOS, but also CEOS, if it is permitted to participate."

#### *Special Topic*

The President nominated Professor Placidino Machado Fagundes (SBC, Brazil) as Chair and Rapporteur of this Special Topic. Prof. Fagundes spent the first two years of his activities collecting data and information, not only

about the future remote sensing missions but also on current and past sensors.

The data and information so collected were the subject of a paper presented at the Mid-Term Symposium of Commission I in Manaus, along with other four papers related to the Topic.

Pursuing WG activities, the Chairman participated at the 24th International Symposium on Remote Sensing of the Environment (the ERIM Symposium) in Rio, in May 1991, and at the Euro-Latin American Space Days, also in Rio, in November, in the same year.

The WG was in the process of preparing an updated edition of the Manaus paper for presentation at the Washington Congress. However, the draft was ready to be printed when the Chairman received a pre-release copy of a 200-plus page book by Dr. Herbert J. Kramer, from DLR, Germany, which covers the present and future scenario of space missions, and is much richer in data and descriptive information. The book is planned for publication by the end of August 1992, and the author has authorized the Chairman to show his pre-release copy to the Congress participants and announce its publication. Dr. Kramer's address may be provided to those interested in acquiring the book.

#### **Concluding Remarks**

It was felt and discussed at ISPRS Council meetings with Commission Presidents that some overlap existed across the scopes of more than one Commission, while some areas which were of concern were not covered by the Terms of Reference of any Commission. A study was prepared on request from the Council, and, as a result of it and its discussion at the last meeting, new Terms of Reference were generated for each Commission. Commission I was renamed "Sensors and Platforms" and its revised Terms of Reference are:

1. Planning for terrestrial, aerial and space missions;
2. Design, construction, testing, installation and calibration of analog, digital and microwave sensors;
3. Design and performance of data reception, recording and preprocessing systems;
4. Quality standards and factors (environmental and other) affecting data quality;
5. Media (film, magnetic, optical, etc.) and techniques for recording sensor data and auxiliary data (time, position, attitude, etc.);
6. Preprocessing techniques to generate datasets suitable for analysis and measurements (radar image synthesis, multisensor integration, radiometric and geometric corrections, etc.).

No attempt was made at this stage to restructure the Working Groups of the Commission in face of the new Terms of Reference above, although it may be a necessary measure. We understand that the incoming President, in interaction with the new Council, should be the appropriate judge and conductor on this issue. We

understand, however, that the existing Terms of Reference of the present Working Groups, listed at the beginning of this report, are still mostly valid in content and should be one of the inputs to the restructuring process.



**COMMISSION II**  
***Systems for Data Processing and Analysis***  
*by Klaus Szangolies, President 1988-1992*

**Introduction**

During the period between the 16th Congress in Kyoto in 1988 and the 17th Congress in Washington-DC in 1992 Commission II of the International Society for Photogrammetry and Remote Sensing (ISPRS) had to deal with the subject "Systems for Data Processing and Analysis". Five Working Groups and two Inter-Commission Working Groups headed by leading scientists planned research projects, discussed results and set up programs for future developments.

Development over the last four years has been largely influenced by significant advances in the fields of electronic computer technology and space research.

The results achieved in these fields have brought a tremendous change in survey technology. There has been a marked trend to replacing opto-mechanical equipment by digital systems with computers and software as substantial components. This development has contributed to an essential merging of the fields of photogrammetry, remote sensing, cartography and geographic information systems (GIS), and their main activities, i.e. information gathering, information processing and result representation.

From September 8 to 12, 1990 Commission II held a symposium in Dresden, "Progress in Data Processing and Analysis", attended by 81 experts from 16 countries.

60 papers reported on the latest state of development and new development projects. The papers presented at this informative and successful meeting were published in Volume 28, Part 2, of the *International Archives of Photogrammetry and Remote Sensing, Progress in Data Processing and Analysis*, comprising 396 pages.

Within the framework of the 17th ISPRS Congress in 1992, 180 papers were submitted dealing with the subject of Commission II. In the most important subfields treated by the various Working Groups the following results have been achieved:

**1. Analytical Plotters (WG II/1)**

The development of analytical plotters, starting with the concept of the first analytical plotter of Helava in 1957, and leading to the mature serial instruments launched in 1988, is now finished. The development period of analytical photogrammetry (1960-1990) has been replaced by that of digital photogrammetry (from 1990), which is characterized by digital image processing and digital image correlation. This new technology is also called pixel photogrammetry, or softcopy photogrammetry. The analytical plotters used worldwide are being successively replaced by digital photogrammetric workstations (DPWS) or digital photogrammetry systems (DPS).

During the term 1988 to 1992 many exciting developments have been completed and tested. There has been a continuing trend to replacing the large, expensive optical, mechanical and electronic instruments by digital output and mass storage devices. Interfacing with geographic information systems (GIS) has become an important consideration.

A climax in development was the emergence of softcopy photogrammetric workstations that use digitized photographs to form stereomodels. Several of these instruments appeared on the market as PC-controlled workstations at very reasonable prices.

Under the direction of Morris L. McKenzie, USA, Chairman of the WG II/1, the documents already completed in 1988 were revised and updated. The documents comprise: a list of the analytical plotters offered in the market; test procedures for analytical plotters; standards and specifications.

**2. System for Analyzing Remotely Sensed Data (WG II/2)**

The Working Group arrived at the conclusion that remote sensing image analysis, digital photogrammetry, digital cartography and GIS use the same platforms. Where does remote sensing end and where do photogrammetry, computer vision, cartography and GIS start today?

The advances in technology demand stronger emphasis on the integration aspects of the systems. Quite a number of universities and educational institutions have already begun to redefine their scientific fields. Their geo(infor)matics programs see education, research and system development as a unified and integrative effort.

Working Group II/2 chaired by Prof. Dr. Manfred Ehlers, Vechta, draws the following conclusions from the most recent development:

- The advances in the development of computer hardware and software for GIS, image processing,

digital photogrammetry and digital cartography are leading to the development of integrated geoinformation processing systems.

- General-purpose high-resolution graphics workstations can be used for the analysis of remotely sensed data, computer vision, digital photogrammetry, digital cartography and GIS.
- The emergence of standards and the ever increasing computing speeds and storage and display capabilities of modern RISC-based CPUs is seen as a catalyst for the development of integrated geoinformatics workstations.

### **3. Systems for the Reception, Recording, Preprocessing, Archiving and Dissemination of Remotely Sensed Data (WG II/3)**

The activities of the Working Group were a link between satellite/sensor systems and data analysis/user systems.

The main tasks included:

- Continued data availability for the user's operational use
- Timely data delivery to allow timely analysis and decisions in case of short-lived phenomena such as catastrophes or agricultural processes

On account of his activities in connection with the development of the NASA Earth Observation System, Dr. Fred C. Billingsley, USA, Chairman of Working Group II/3, primarily dealt with the development of a pertinent data and information system (EOSDIS).

In addition to this, the following activities are worth mentioning:

- Development of the multisensor SAR processor for ESA.
- Elaboration of an international directory/catalog through CEOS (Committee on Earth Observing Satellites).
- Development of a CEOS system for the global procurement, storage and availability of data.
- Japan suggested the establishment of a global network for earth observation data.
- Data compression.
- Digital precision rectification.
- Geographic position allocation of image data.
- Integration of different kinds of data.

### **4. Systems and Instruments for the Processing of Microwave Data (WG II/4)**

This Working Group focussing on passive microwaves was chaired from 1990 to 1992 by Dr. Horst Weichelt, Potsdam. The Group could, unfortunately, only gain the cooperation of East European scientists.

The Working Group investigated a multisensor concept and the synergies between active and passive microwave procedures and infrared data acquisition.

According to current information, there is not great interest in using and further developing passive microwave techniques worldwide. On the other hand, the collection and evaluation of SAR data have further gained in importance after the successful launchings of ERS-1 and JERS-1.

### **5. Integrated Photogrammetric Systems (WG II/5)**

Fundamental to the integration of all photogrammetric office operations is the existence of a fully networked computing environment. Residing within this environment should be a full function-shared data base. The network should connect several types of computing nodes such as a PC, workstation or photogrammetric plotter.

Integrated photogrammetric systems are the result of the combination of technologies of photogrammetry, computer graphics and data base management for the purpose of serving photogrammetric production needs.

From 1988 to 1992 this Working Group chaired by Dr. Atef A. Elassal, USA, influenced development in this field substantially. A system model, called "Integrated Digital Photogrammetric Facility" (IDPF), was installed and tested at National Ocean Service (NOS) of the NOAA in Rockville, MD.

### **6. Acquisition and Use of Space Photographic Data for Mapping (IC WG I/II)**

Development during the last four years is characterized by:

- the improvement of the spatial information potential of space photographs by means of a wide image format and high resolution,
- the improvement of the spectral information potential by means of multispectral and spectrozonal operating modes,
- the increase of operability by the improvement of data distribution systems and data management.

Currently, the following satellite systems are available for taking space photographs:

- Resource F1/F2 automatic satellite systems with landing modules, and
- MIR space station, for automatic or hand-controlled operation. Photographic cameras used aboard these satellite systems are KFA 1000 and MK 4.

Headed by Dr. Vladimir V. Kiselyev, Russia, and Prof. Dr. Karl-Heinz Marek, Potsdam, this Inter-Commission Working Group suggests support for further development of space photography with the objective of increasing ground resolution to 3 m (current ground resolution is 5 to 8 m).

### **7. Digital Photogrammetric Systems (IC WG II/III)**

Digital photogrammetric workstations are well on their way to replacing analytical plotters in topographic mapping. Concerning their application on a production



level, the transition from analytical to digital photogrammetry will still take some time. Today digital photogrammetric workstations are accepted in practice for specific tasks with demonstrated cost efficiency, i.e. for orthophoto production, as a front end data acquisition system for GIS, and for revision tasks in a small production environment. The more powerful, expensive digital photogrammetric workstations are only used in environments where cost is of minor importance. Their wide acceptance must await the development of robust image processing and feature extraction algorithms.

The IC WG II/III with Prof. Dr. Heinrich Ebner, Munich, as Chairman has formulated the following proposals for the further improvement of digital photogrammetric systems:

- Development of open systems with greater portability of the software.
- Faster image display in stereo viewing.
- Interactive measurement of image coordinates with subpixel accuracy.
- Simultaneous use of more than two digital images.
- Use of data from different sensors.
- Continued development of algorithms for robust image processing and interpretation.
- Improved integration with GIS.
- Improved human interface.

The development of digital photogrammetric workstations started with experimental setups: Videomapper of the Quebec University (1988), and Context mapper of the Hannover University (1988).

Serial instruments that followed were: Kern DSP-1 (1988); Matra Traster T 10 N/MS 2i (1988); HAI 500 Automated Softcopy DTM Generator.

In 1991 the commercial offer of digital photogrammetric systems comprised already ten different types.

In addition, the following complex solutions were developed: MBB MOMS-02, for space photogrammetry; ETH-Zürich DPS-II, for close-range photogrammetry.

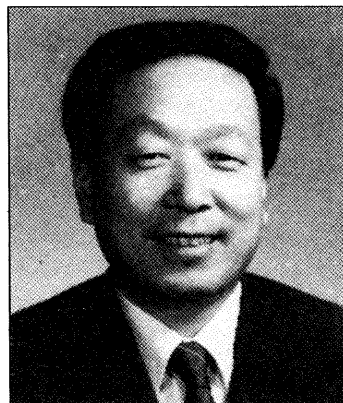
### Future Prospects

Considering the fast progress in the computer technology and space research and the changed demands of the users of surveying results, it is suggested that the future efforts of Commission II be focussed on the following:

- Design and development of digital systems for photogrammetry, remote sensing and GIS.
- Design and development of digital workstations with versatile data input and output. Basic data may be digital and photographic image data, graphical vector data in the form of maps, geodetic measurement values and GPS and GIS data. Data processing results may be rectified image data, screen displays, hardcopy printouts of raster or vector data, graphical plotter drawings, coordinate printouts and superimposed

representations of various results such as raster images with line maps, place names and numbers.

- Development of the system aspect for photogrammetry, remote sensing and GIS.
- Design and development of automated intelligent information processing systems.
- Development of systems and techniques for SAR data processing.
- Development of real-time mapping techniques.
- Standardization of digital systems for photogrammetry, remote sensing and GIS.



### COMMISSION III

#### *Mathematical Analysis of Data*

by Deren Li, President 1988-1992

and Jianya Gong, Secretary 1988-1992

#### 1. Introduction

Based on the definitions of Commissions III topics and the current needs for research, six resolutions were made during the Kyoto Congress for the period 1988-1992. The resolutions refer to:

- Geographic Information Theory
- Object Reconstruction and Location by Image Analysis
- Thematic Information Extraction from Digital Images
- Knowledge-Based Systems
- Design and Algorithmic Aspects of Digital Photogrammetric Systems
- Tutorials on Mathematical Aspects of Data Analysis.

In accordance with the above resolutions, four Commission III Working Groups, and two Inter-Commission Working Groups were established. The Working groups with their Chairmen and their corresponding terms of reference were the following.

*WG III/1: Geographic Information Theory* - Chairman Dr. Martien Molenaar (The Netherlands), Co-Chairman Dr. Richard Groot (Canada)

- a. Knowledge representation in GIS with emphasis on: data structures in relation to semantic aspects; data quality and data integrity; query spaces and user interfaces.

- b. Processing of data with emphasis on: transformation of raw data to topologically structured data; raster vector conversion; editing of databases.
- c. Models for interactive use of databases: geo-information-based CAD systems; geo-information-based environmental analysis.

*WG III/2: Object-Reconstruction and Location by Image Analysis* - Chairman Dr. Wolfgang Foerstner (Germany), Co-Chairman Dr. Robert M. Haralick (USA)

- a. Monocular image computer vision for object reconstruction object description and pose estimation.
- b. Multi-view and/or time varying images for object reconstruction, object description and pose estimation.
- c. Matching and tracking of 2- and 3-dimensional objects.
- d. Saliency of object and image features for object matching, tracking and description.

*WG III/3: Thematic Information Extraction from Digital Images* - Chairman Dr. Tony Schenk (USA), Co-Chairman Dr. Bernd-Siegfried Schulz (Germany)

- a. Research and development of methods for semi and fully automated image interpretation with the aim of topographic and thematic mapping.
- b. The use of existing information sources, and local and global image context in thematic information extraction.

*WG III/4: Knowledge-Based Systems* - Chairman Dr. N. J. Mulder (The Netherlands), Co-Chairman Dr. Tapani Sarjakoski (Finland)

- a. The role of knowledge in tasks related to photogrammetry, remote sensing, digital mapping, image interpretation and classification, and geo-information systems.
- b. Knowledge elicitation and learning.
- c. Knowledge representation, paradigms, applicability to various knowledge domains. Likelihood and accuracy.
- d. Man-machine interfaces, the roles of man and machine.
- e. State of the art in integrating knowledge-based control and selection software with e.g. procedure and function libraries. Inference engines.

*IC WG II/III: Design and Algorithmic Aspects of Digital Photogrammetric Systems* - Chairman Dr. Heinrich Ebner (Germany), Co-Chairman Dr. Ian Dowman (U.K.)

- a. Definition of functionality and performance of digital photogrammetric systems. Critical evaluation of systems existing so far. Proposals for development with the final goal that such systems are widely used in practice.
- b. Digital photogrammetric systems comprise hardware and software designed to derive photogrammetric products from digital imagery, using manual and automated techniques and algorithms for point determination, surface reconstruction, feature extraction and digital image transformation.
- c. The design aspects include system architecture and components, interfaces to data capture, data input and

geographic information systems and the human interface.

- d. The algorithmic aspects are related to real time and on line procedures, restitution modes, such as mono, stereo, multi-image, and parallel processing.

*IC WG III/VI: Tutorials on Mathematical Aspects of Data Analysis* - Chairman Dr. Luigi Mussio (Italy), Co-Chairman Th. Bouloucos (The Netherlands)

- a. Organization of related tutorials with different levels concerning elementary and advanced topics.
- b. Spread of knowledge of data analysis, organization of courses and production of lecturing materials and tutorial papers in co-operation with Commission VI.
- c. Investigation of standards and scientific fields in order to organize as many tutorials as possible by appropriate institutions.

## 2. Meetings, Conferences and Symposiums

Commission III has organized and participated in many formal meetings at which technical presentations were made by WG members. Individual WGs often hold informal meetings during other scheduled conferences and events. In addition, several joint Working Group colloquia and business meetings have been held. A summary of the activities at these meetings is as below:

*13 September 1989 - Joint Working Groups III/3 and II/III Meeting*

took place in Stuttgart. The meeting was attended by 38 participants. In the discussion it was pointed out that a digital system should have all features of analytical systems and more. In view of the rapid hardware changes, portable software was seen as the key factor for the success of any digital photogrammetric system.

*24-26 September 1989 - Joint Working Groups III/1, III/2, and III/4 Meeting*

was held in Wageningen, The Netherlands. After the Kyoto Congress of ISPRS in 1988 the chairmen of three working groups III/1, III/2 and III/4 decided that they should cooperate as closely as possible because of the overlap of their fields of interest. To define the tasks of the working groups these chairmen organized a combined workshop in September 1989, to which a limited number of people were invited. The participants were chosen from different backgrounds to discuss topics of common interest in the three areas of the working groups.

The workshops consisted of plenary sessions in which all the participants met and separate sessions for the individual working groups. During the plenary sessions the most important topics of common interest were identified. These were:

- spatial object modeling
- data structures for spatial object models
- handling uncertainty

It appeared that the approaches of WG III/1 and WG/III/2 towards these topics were quite different.



That is why the final task definitions have been made separately for these working groups. It was clear though that these WGs could learn from the experience of each other, so they should stay in close contact and preferably more common workshops should be organized.

*13-14 February 1990 - A joint workshop of IC WG II/III and WG V/3 - Image Analysis and Image Synthesis in Close Range Applications*

was held in London and organized by Dr. Ian Dowman, Dr. D. Fritsch and Dr. J. P. Muller. It was entitled "hardware and software for fast image data processing". The workshop was attended by 36 participants, mainly from the photogrammetric and the computer vision communities. In three sessions 12 invited papers were given.

*20-25 May 1990 - Commission III Symposium - Progress in Data Analysis*

was a week-long activity in Wuhan, China. A total of 145 participants from 24 countries and regions attended the symposium. 6 tutorial sessions and 9 technical sessions were organized, which dealt with:

- data structure, data models and object-oriented programming in GIS (lectured by M. Molenaar and Y. C. Lee);
- image processing and feature extraction, object location and image interpretation (lectured by W. Foerstner);
- point densification using aerial and space data;
- thematic information extraction from digital image;
- geographic information theory;
- the application of geographic information theory;
- object reconstruction and location by image analysis;
- knowledge based systems;
- digital terrain models; and
- new techniques and algorithms.

During the symposium, two business meetings were held; for WG III/2, III/3, III/4, and for WG III/1, IC WG II/III respectively. In addition, one business meeting on publication was held by Prof. K. Torlegård, ISPRS President. A board meeting of Commission III (President D. Li, Former Secretary Mrs. Lu Suqin, and M. Molenaar, W. Foerstner, T. Schenk, B. S. Schulz, N. J. Mulder, T. Sarjakoski, H. Ebner) was held on May 24, 1990. The main discussions were focused on further activities of WGs and preparation for Washington Congress. Congress Director L. Fritz was invited to explain his request to Commission III.

*1-3 October 1990 - The First International Workshop on Robust Computer Vision*

was held in Seattle, USA and organized by WG III/2 (Chairmen W. Foerstner and R. Haralick) together with the IEEE Computer Society. Proceedings including 27 papers were published. One day tutorials provided an introduction into workshop's topics (W. Foerstner: Quality Analysis, Robust Methods; R. M. Haralick: Robust Pose Estimation; D. Marton: Bias Robust Estimation).

*21-22 March 1991 - Workshop on "Design Issues of Softcopy Photogrammetric Workstation"*

was held in Boulder, Colorado. It was well organized by IC WG II/III together with Dr. F. Leberl, President of Vexcel Corporation, Boulder, USA, who attracted a total of 57 participants. The workshop was intended to give an overview of the North American development in DPWS. Accordingly, 12 out of the 13 invited papers were given by speakers from the US and Canada. Summaries of the workshop have been published in special issue *PE&RS*, January 1992.

*3-6 September 1991 - Conference on "Digital Photogrammetric System"*

was held at the Technical University Munich. It was organized by Prof. H. Ebner. The conference covered all aspects of the working group and was attended by 135 participants from 16 countries. 29 invited speakers presented their papers in 11 sessions. The first day was dedicated to tutorials. Reports of the conference have appeared in scientific journals. The main topics addressed were design and algorithmic aspects of digital photogrammetric systems, the vendor's and user's view of operational systems, and relations to GIS, remote sensing, computer graphics and machine vision. The proceedings have been published in book, Wichmann, Karlsruhe, Germany in 1991.

*5 September 1991 - Commission III Board Meeting*

was held in Technical University Munich and organized by Prof. Deren Li, President of Commission III. Most of WG chairmen of Commission III (I. Dowman, H. Ebner, W. Foerstner, M. Molenaar, T. Sarjakoski, T. Schenk) attended this meeting. The agenda included review of Commission III activities; preparation for the Washington Congress (procedures for selecting papers; invited papers and resolutions) and other issues.

*6-8 October 1991 - Working Group III/1 Meeting*

was held in Fredericton, Canada and organized by Prof. M. Molenaar and Dr. R. Groot.

*9-12 March 1992 - The Second International Workshop on "Robust Computer Vision" - Quality of Vision Algorithms*

was held in Bonn, Germany and organized by W. Foerstner, R. Haralick and B. Radig. It is a joint effort of WG III/2 and the working group 1.4 "Image Understanding" of the German Society of Computer Science. The first day was dedicated to tutorials lectured by above three organizers. Proceedings including 23 papers were published in a book, Wichmann, Karlsruhe, Germany in 1992.

*11-14 May 1992 - International Colloquium on Photogrammetry, Remote Sensing and GIS*

was held in Wuhan and organized by Commission III and National Laboratory for Information Engineering and Surveying, Mapping and Remote Sensing (LIESMARS), Wuhan Technical University of Surveying and Mapping. More than 60 participants from China, USA, Japan, Australia and other countries took part in the event. The proceedings have been published.

### ISPRS IC WG III/VI Tutorials:

Besides the tutorials during above symposium, colloquium, conference and workshops there were some tutorials organized by IC WG III/VI:

#### *1-2 June 1989 - Tutorial on Mathematical Aspects of Data Analysis*

was held at Pisa, Italy. This Tutorial produced good results: 22 participants, 10 of which were from abroad. The lectures were clear and interesting and the social events took place in a nice and friendly atmosphere. The proceedings were issued in September 1990.

#### *10-12 September 1990 - Tutorial on Mathematical Aspects of Data Analysis*

was held in Rhodes, Greece. The aim of the tutorial was to offer to all participants an overview of the modern trend in photogrammetry, particularly in GPS and photogrammetry, deformation monitoring, close-range and real-time photogrammetry.

#### *7 May 1991 - Tutorial on Mathematical Aspect of Data Analysis*

was held in Milan in honor of Prof. Mariano Cuniatti, on the occasion of his birthday. The number of participants of this tutorial was more than the double in the others.

### ISPRS WG III/3 Data Set

Working group III/3 made a data set for test. The data set has 1040 records, per 1120 byte, resolution: 25 m, rectification: Polynomials, applied on Ground Control Points

The data sets include:

- Landsat TM, 30 July 1984, 7 chan;
- Landsat TM, 17 Aug. 1987, L-band;
- Seasat SAR, 9 Oct. 1978, L-band;
- Soyuz KFA-1000 images, digital orthophoto;
- Digitized thematic map foils;
- DEM;
- Format description;
- Topographic map 1:50000 scale;
- CIR mosaic print.

The data set was distributed to 15 institutions (include IFAG), which were asked at the end of the period to report about their activities concerning the utilization of the data for the a.m. program. 6 answers returned, 3 institutions reported utilization in general, two of the a.m. three reported the usage of the data sets in the sense of the WG-program.

### 3. Significant Results of Commission III at Washington Congress

3.1 There were 17 technical sessions and one tutorial session related to Commission III at the Congress.

Technical sessions:

- TS-08 Geographic Information Theory  
(Chair: Dr. M. Molenaar) III
- TS-33 Application of Geographic Information Systems  
(Chair: Dr. R. A. Welch) IV/III/VII

- TS-39 Visualization of GIS Output  
(Chair: Dr. R. A. Welch) IV/III/VII
- TS-68 Digital Mapping and Geographic Information Systems (Chair: Dr. R. Shibasaki) IV/III
- TS-35 Object Reconstruction and Location by Image Analysis (Chair: Dr. W. Foerstner) III/V
- TS-38 Image Understanding in Photogrammetry & Remote Sensing (Chair: Dr. W. Foerstner) III/V
- TS-32 Image Analysis and Synthesis in On-Line Applications (Chair: Dr. D. Fritsch) V/II/III
- TS-01 Thematic Information Extraction from Digital Images (Chair Dr. T. Schenk) III/IV/VII
- TS-48 Simultaneous Interpretation of Different Digital Recordings (Chair: Dr. B-S. Schulz) III/VII
- TS-13 Computer Vision and Computer Graphics  
(Chair: Dr. B. P. Wrobel) III/V
- TS-41 Knowledge Based Systems  
(Chair: Dr. N. J. Mulder) III/VII
- TS-56 Knowledge Engineering, Application and Systems  
(Chair: Dr. T. Sarjakoski) III/VII
- TS-16 Design and Algorithmic Aspects of Digital Systems  
(Chair: Dr. H. Ebner) II/III
- TS-29 Algorithms and Software Concepts for Digital Photogrammetric Workstations  
(Chair: Dr. H. Ebner) II/III/V
- TS-49 Tomorrow's Digital Systems  
(Chair: I. Dowman) II/III/V
- TS-23 Progress in Photogrammetric Data Analysis: New Theories and Algorithms (Chair: D. Li) III
- TS-40 Computerized Teaching  
(Chair: A. Georgopoulos) VI/III/II

Tutorial Session:

- TS-3 Tutorial - "Modern Trend in Photogrammetry"  
Giovanna Togliatti Memorial Tutorial  
(Chair: Dr. L. Mussio) III/VI

Besides, there were 9 poster sessions at the Congress. These "oral presentations" with posters were very effective. The face to face discussion together with pictures and figures may be, in many cases, better than the 15-minute oral presentations at technical sessions.

The basic statistics for Comm. III at Washington Congress are:

- 236 Abstracts;
- 9 Technical Sessions with 46 papers;
- 9 Poster Sessions with 137 papers;
- 159 Papers (997 pages) to the Archives

### 3.2 Resolutions of Commission III

Five Resolutions were proposed from Technical Commission III to the General Assembly meeting. The are:

- Integrated Sensor Orientation and Modeling;
- Object Reconstruction from Digital Imagery;
- Image Understanding;
- Conceptual Aspects of GIS; and
- Tutorials.

The other two resolutions are related to other commissions:

- Digital Photogrammetric System (Comm. II/III);
- Image Sequence Analysis (Comm. V/III)

These resolutions emphasize on multiple sensors, system integration, full automation, fully digital (softcopy), high level image understanding, knowledge engineering, and total integration of photogrammetry, remote sensing with GIS. Instead of supplying map products our discipline will supply different digital and visual products as well as different kinds of living spatial information systems promptly, reliably and dynamically to Geo-Science, and Resource and Environment Science.

#### 4. Progress, Achievements and Trends

4.1 Photogrammetric point determination and precision mapping have reached high precision and high reliability with analytical methods, advanced adjustments, automatic point transfer, data snooping and robust blunder detection. Current GPS based aerotriangulation allows the determination of the camera and scanner position in space at the moment of exposure. The new camera positions can be connected to a GPS receiver. Camera positions can be obtained with cm accuracy and, as a result, ground control for aerial triangulation can be reduced to the very minimum of what is needed for datum definition. Its operational use for practical application depends on the use of robust GPS receiver, the solutions to the problems of ambiguity and lock-losing, and the increase of the available satellite signals. The use of crossing control flight strips, the INS data and the relative observations for conjunctive camera stations might be reliable.

4.2 Geographic information theory has been put forward and is still to be improved and completed. The research work emphasizes on spatial data structure and data model for the integration of attribute data, graphic data with RS data; raster, vector and hybrid data and their conversion in GIS; data quality, data integrity and multi-resolution models for interactive use of databases; knowledge representation in GIS and knowledge discovery from GIS as well as the standardization of GIS. An object-oriented, knowledge based, multi-resolution and integration GIS software package is expected.

4.3 Digital image matching for generation of DEM and digital orthophoto has made good progress by using multi-image object based approaches and hierarchical representations, e.g., image pyramids. Multi-point, geometry constrained relaxation image matching can be performed fully automatically only for small scale images or under special circumstances. More work is needed to robustify the algorithms and build a self-diagnosis system for quality control.

4.4 New concepts are being developed for digital image analysis and this leads to image interpretation and image understanding. Image understanding, while successful in

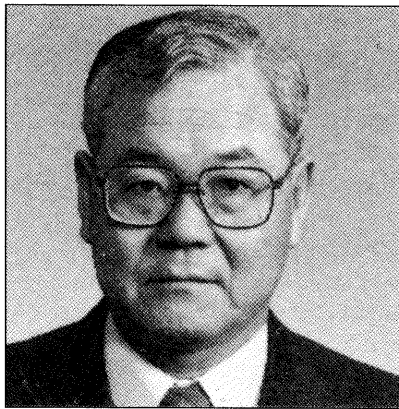
special applications, must be supported by a human operator in the foreseeable future. Exacting interactive tools are available on a research and development level. There is a need from the image understanding community for easy to-use photogrammetric "black boxes". Along these lines computer vision and digital photogrammetry are increasingly working together. Using low level and high level image analysis, geometric and thematic information extraction from photogrammetric and remotely sensed data will be faster, more reliable and more intelligent.

4.5 Digital photogrammetric systems are under investigation and well on their way to replace analytical plotters both for topographic mapping and for non-topographic applications. However, this transition from analytical to digital photogrammetry will take its time. Today DPWs are accepted for specific tasks with demonstrated cost efficiency, especially for orthoimage production, as front end data acquisition systems for GIS, and for revision tasks in a small production environment. The more powerful, expensive workstations are only being used in environments where cost is of minor importance. Their wider acceptance must await the development of robust image matching and feature extraction algorithms as well as the improvement of performance-price-ratio.

4.6 In the investigation of fundamentals of knowledge engineering, progress is made in the identification of the minimum cost of decision making as the general criterion. With equal cost for each evaluated hypothesis, the resulting optimal method is the maximum likelihood method. The use of fuzzy sets and certainty factors does not fulfill the minimum cost of error criterion. Multisource and incomplete data sets and the need for dynamic modelling lead to the requirements for a 3 dimensional GIS with class-likelihood vectors per (3-d) object. This allows the use of both forward and backward chaining inference mechanisms to be applied to the modelling of objects and processes. The general theory of modelling objects and processes leads to an integration of RS+GIS. Specific applications with specific constraints can be handled as specialization of the more general theory of modelling and decision making. Methods for minimum cost parameter estimation lead to an integration of methods in remote sensing, computer vision and photogrammetry.

4.7 Knowledge transfer and spread in rapidly changing theory and algorithms of our discipline have become a central issue for our society. Different levels of tutorials are needed to be organized, better to be free of charge, and to involve more professional practitioners.

In this information age which the whole world is facing, Photogrammetry and Remote Sensing is more and more integrated with GIS and becoming a significant part of information science, i.e., iconic informatics, or image information engineering science and technology. It has an unlimited life and a very brilliant future.



## COMMISSION IV

### *Cartographic and Data Base Applications of Photogrammetry and Remote Sensing*

by Takeshi Hirai, President 1988-1992

and Ryutaro Tateishi, Secretary 1988-1992

#### Introduction

The area of responsibility for the Technical Commission IV adopted at the Kyoto Congress is as follows:

- Photographic, analogue, and numerical mapping procedure.
- Compilation and revision of planimetric, topographic, thematic, and other types of maps.
- Digital terrain models, cartographic data base, and geographic information systems.
- Planetary mapping.

Based on this definition and the current need for research, seven working groups were established. The Working Groups (WGs) with their chairmen were the following:

#### *WG 1: Digital Mapping*

- Chairman Minoru Akiyama (Japan)

#### *WG 2: Mapping from Space*

- Chairman Alain Baudoin (France)

#### *WG 3: Map Revision*

- Chairman Paul R. T. Newby (UK)

#### *WG 4: Specification for Photogrammetric Procedure*

- Chairman Jon Kure (The Netherlands), Co-Chairman Mahamed Mostafa Radwan (The Netherlands)

#### *WG 5: Geographic Information Systems*

- Chairman Roy A. Welch (USA)

#### *WG 6: Extraterrestrial Mapping*

- Chairman Sherman Wu (USA)

#### *WG 7: Digital Elevation Model*

- Chairman Luiz Alberto Vieira-Dias (Brazil)

#### Activities of WGs

##### *WG IV/1: Digital Mapping*

Terms of reference of WG IV/1 were described as follows:

(1) methods of controlling the data quality in computer-aided mapping system; (2) automatic compilation of digital data obtained by computer-aided photogrammetry and field surveying; (3) data exchange specifications in computer-aided photogrammetric systems; (4) acquisition of digital data from existing maps.

Working Group IV/1 was established to study how to obtain digital cartographic data, how to compile them and how to produce analogue maps from them. Data acquisition techniques range from photogrammetric procedures, digital field surveying, analysis of digital imagery as well as digitization of existing maps. Major interests in this field are improvement of the man-machine interface, automatic recognition and interpretation of map symbols, practical methods to obtain three dimensional data, etc.

Data compilation techniques are composed of topological structuring, data transformation as contour/DEM and data exchange standards.

Analogue map production techniques include automatic generation of map symbols, automatic generalization and automatic scale conversion.

In order to activate research in this field it is essential to determine the current status of digital mapping activities in the world. In this regard, a world survey with questionnaires on the current situation of the preparation and standardization of digital mapping data was executed in 1990. The results of the questionnaires were given at the Tsukuba Symposium in 1990.

##### *WG IV/2: Mapping from Space*

A questionnaire was prepared and distributed to investigate the use of space images for mapping. The Working Group agreed to use the reference of CNIG (Conseil National de l'Information Géographique, France) on "Typology and Terminology of Image Maps" to describe the products derived from space imagery.

The questionnaire was sent to about 200 organizations which could be either a producer or a user of space maps. Among the 40 replies only 18 described maps derived from space. The 22 others did not produce or use these products. A total of 27 types of product were presented (some of them corresponding to several scales).

In summary the use of space imagery for mapping is in continuous progress, from an operational point of view (the quality and the quantity of space maps are increasing) and from a technological point of view (new instruments, new processing methods, and new products are developed).

##### *WG IV/3: Map Revision*

Working Group IV/3 has had a successful session from 1988 to 1992. Considerable technical advances, not all predictable in 1988, have been made during the period. Actual practice in mapping organizations evolved to the point that digital database update is a routine (though still developing) photogrammetric process in a few organizations including the Ordnance Survey of Great Britain. It is also now universally recognized as a vital future activity which must be included in the design of databases and information systems, and future

photogrammetric equipment. Moreover theoretical and practical advances in image processing have enabled progress towards the ultimate goals of automating both change detection and database update.

We believe that the Working Group has played a valuable role in the exchange of ideas and information about these advances. It made a substantial contribution to the Commission IV Symposium in Tsukuba with two technical sessions and many posters. Our working group on Updating Digital Data by Photogrammetric Methods, held jointly with the European Organization for Experimental Photogrammetric Research (OEEPE) Commission D at Christ Church, Oxford University, on 15-17 September, 1991 attracted some 70 participants from 20 countries and 25 papers were presented. These, together with introductory material by Co-Chairman C.N. Thompson and P.R.T. Newby, have been published by OEEPE.

Finally, the theme of Map Revision has come a long way since it described the process leading to new scratches on copper printing plates.

The developments which the Chairman of this WG expects his counterpart to be addressing in 1992-96 are now better described as "updating digital geographical databases by photogrammetric methods".

#### *WG IV/4: Standards for Photogrammetric Products*

Based on the Kyoto resolution IV/5 that guidance be drawn up in drafting specifications for the photogrammetric and remote sensing techniques used for the production of data for GIS's, WG IV/4 was set up, with the terms of reference to concentrate on: (1) specifications for photogrammetric point determination, with quality control; and (2) organizing courses and producing lecture material and tutorial papers for the spread of knowledge in this field.

The WG concentrated on data quality standards and not on data classification standards or data exchange standards, simply because the former is application-independent and is thereby suited for discussion within an international forum. Furthermore, the WG did not attempt to develop a "universal data quality standard", but produced "guidelines on the establishment and verification of data quality standards", in order to be of assistance to agencies, either involved in setting up standards themselves or involved in trying to interpret standards set up by someone else.

This latter objective, in particular, suited the second item in the TOR, concerning spread of knowledge in this field.

The approach followed by the WG first to identify the main production lines used in the digital collection of GIS data and to review all possible error sources (of the two main group of errors, locational or positional errors and attribute or classification errors) involved in the three

main phases within these production lines: data collection; data storage and processing; data presentation.

On the basis of these error sources, guidelines were drawn up on how to develop the data quality standards, which include the following elements: (a) data history, including data currency; (b) positional accuracy; and (c) data base completeness, in terms of the generalization percentage of the content requirements, the percentage of elements required actually available, and the correctness of the classification.

Now, although it was the intention to test these guidelines at a special ISPRS Workshop to be organized in East Africa in 1991, this idea had to be abandoned since neither Nairobi nor Dar es Salaam were able to hold such a workshop. The decision taken then was to prepare a set of extensive guidelines for the Washington Congress, which by themselves should be self-explanatory so as to minimize the effect of having them tested at a Workshop.

Over the last period, the WG activities include an informal meeting at the OEEPE Symposium on Data Quality in LISs held at Apeldoorn, The Netherlands from 4 to 6 September 1991.

In our attempt to produce an extensive set of guideline standards, the report to the Washington congress is a concise version that includes planimetric accuracy with a limited number of examples. Complete guideline standards will be available for users on request.

With regard to further research in this field, the WG confirmed its opinion that in the next Congress period, attention should be paid to the accuracy of processing and manipulating data within a GIS.

#### *WG IV/5: Geographic Information Systems*

The focus on the integration of geographic information systems (GIS) with remote sensing and photogrammetry began as an ISPRS Inter-Commission Working Group formed in 1985 at the suggestion of Dr. Gottfried Konecny. Its purpose was to consider the growing interest in merging photogrammetry, remote sensing and digital image processing with land and/or geographic information systems (LIS/GIS).

The terms of reference for this Working Group (IV/5) are as follows: (1) digital technologies for the integration of photogrammetric and remote sensing data with geographic information systems; (2) guidelines for GIS specifications; (3) the use of personal computers or engineering workstations for extracting and analyzing geographic information.

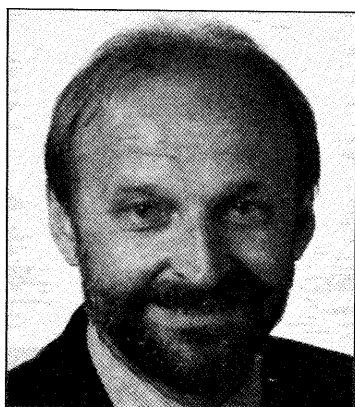
#### *WG IV/6: Extraterrestrial Mapping*

Working Group IV/6 was newly established by the ISPRS' 16th Congress in 1988 to provide international cooperation for the development of new techniques of data acquisition and processing, and methodology for

extraterrestrial mapping. The terms of reference of this Working Group are: (1) documentation of data sources, mapping techniques and products of previous and current activities in extraterrestrial mapping; (2) development of new techniques of data acquisition and processing for extraterrestrial mapping.

*WG IV/7: Digital Elevation Model*

Based on the resolution adopted at the Kyoto Congress, WG IV/7 was established to study digital elevation models in photogrammetry and remote sensing. The terms of reference of this Working Group are: (1) strategies for data acquisition and blunder detection; (2) integration of digital elevation models in geographic information; (3) role of digital elevation models in image understanding.



**COMMISSION V**  
**Close-Range Photogrammetry and Machine Vision**

*A. Grün, President 1988-1992*

**Mandate of Commission V**

With the recent advancements in microelectronics and semiconductor technology, photogrammetry in general has received a substantial push forward toward the fully digital domain. The development of new sensors, e.g. solid state cameras, and more powerful computer hardware has opened new technologies and fields of application. Hybrid and fully digital acquisition and processing systems have triggered much interest among photogrammetrists since the 15th ISPRS Congress in Rio de Janeiro, 1984.

During the past years Commission V has always been application-oriented. Papers of the type "Photogrammetric measurements of ..." have dominated the scene. A remarkable amount of photogrammetric projects relates to deformation measurements, dimensional industrial measurements, and architectural/archaeological applications. This clearly reflects the success story of classical close-range photogrammetry. Of more recent concern are robot vision, issues of image analysis and synthesis, CAD, etc. It can be noticed that new tools and technologies, like solid-state cameras, computer vision technology, CAD, computer graphics and artificial intelligence greatly

influence the scientific and practical issues of Commission V. Although we have to preserve and further develop the traditional and well established methods in our Commission work, we also have the responsibility to be open towards new perspectives, to respond to the new challenges. Machine vision, robot vision and medical imaging are promising and rapidly growing disciplines which already have a stronghold in a number of international scientific societies. Since Commission V must develop a strong interest in those disciplines, a close contact with these societies (e.g. ACM, IEEE, SME/MVA, SPIE, etc.) is mandatory.

The mandate of a Commission is defined by its terms of reference and resolutions. The ones adapted at the Kyoto Congress are concerned with the following issues.

*Terms of reference:* (1) close-range and micro-range photogrammetry; (2) recording and monitoring of objects in motion and under deformation; (3) optical and integrated close-range sensor systems; (4) digital systems and time-constrained solutions to monitor or control dynamic events.

*Resolutions:* (1) interfacing close-range photogrammetric systems with CAD/CAM; (2) scientific contacts with the Machine Vision community; (3) digital and real-time photogrammetric systems; (4) algorithmic and computational aspects of time-constrained vision systems; (5) promotion of photogrammetry in medicine, architecture, archaeology and engineering.

**Organization of Commission V**

*President:* Prof. Dr. Armin Grün

*Secretary:* Dipl. Ing. ETH Horst A. Beyer

*External Board Members:* Prof. Mario Fondelli (CIPA President), Prof. Dr. Thomas S. Huang (Chairman IEEE Comp. Soc., TC on Pattern Analysis and Machine Intelligence).

As a result of the Kyoto Congress the following facts and trends could be distinguished:

- Non-metric and semi-metric cameras are fully accepted. The analytical plotter allows for fast and accurate treatment of this type of imagery.
- In general analytical plotters have proved to be very useful for Commission V related work. The flexibility and accuracy of these instruments have contributed to make the photogrammetric approach more acceptable and economic in many applications.
- The self-calibration approach is occasionally refined by the use of block variant additional parameters.
- Statistical quality control methods, e.g. blunder detection by robust estimation, are being increasingly used.
- Interactive design and optimization of close-range networks seem to have stagnated. New tools provided by CAD and computer graphics are only rarely used.
- "Unconventional" sensors and systems, like X-ray, CT, SEM etc., continue to find some interest. However,



there is not a substantial and systematic approach visible within ISPRS with respect to these most interesting and promising technologies. The otherwise rapidly emerging area of medical imaging does not yet get the attention it should deserve.

- Solid-state cameras find widespread interest. Major issues are calibration, accuracy tests and applications.
- Hybrid and in particular all-digital systems with real-time capabilities are starting to make an impact. Aspects of automated processing and system design and performance are treated.

Considering the mandate of Commission V and the most urgent scientific issues to be dealt with the following Working Group structure with the respective Chairmen was implemented:

*WG V/1: Digital and Real-Time Close-Range Photogrammetric Systems*

- Chairmen Dr. Sabry F. El-Hakim (Canada) and Prof. Dr. Kam W. Wong (USA)

*WG V/2: Close-Range Imaging Systems. Calibration and Performance*

- Chairmen Prof. Dr. John G. Fryer (Australia) and Prof. Dr. Wilfried Wester-Ebbinghaus (FRG)

*WG V/3: Image Analysis and Image Synthesis in Close-Range Photogrammetry*

- Chairmen Dr. Dieter Fritsch (FRG) and Prof. Dr. Jan-Peter Muller (UK)

*WG V/4: Structural and Industrial Measurements with Consideration of CAD/CAM Aspects*

- Chairmen Dr. Clive S. Fraser (USA) and Prof. Dr. Heinz Rüther (South Africa)

*WG V/5: Photogrammetry in Architecture and Archaeology*

- Chairmen Ross W. A. Dallas (UK) and Dr. Landolf Mauelshagen (FRG; replaced Rune Larsson, April 1990)

*WG V/6: Biostereometrics and Medical Imaging*

- Chairmen Prof. Dr. Andreas Engel (Switzerland) and Prof. Dr. Peter Niederer (Switzerland)

*Associate Group: Robot Vision*

- Chairman Dr. Reimar Lenz (FRG)

### Major Results of Working Group Reports

The following conclusions can be drawn for the period of activity as indicated by the individual Working Group reports:

- The number of fully automated systems continues to increase, both in research and commercial environments.
- At the same time the variety of applications expands (including industrial gauging, biostereometrics, flow measurement, automobile crash testing, space exploration).
- Increased interactions with researchers from other disciplines can be observed. Mutual support at conferences and in publication media leads to improved synergy effects. In particular in the areas of camera calibration, statistical network and system analysis, and high accuracy measurement algorithms the work of the photogrammetric community finds

increasing recognition within the field of computer vision.

- While CCD-type cameras offer exciting possibilities for the present and the future it is appropriate to note that many new users of photogrammetry will continue to use small format film cameras. Therefore there is still fundamental research taking place with analog cameras in the areas of variation of lens distortion and the effect of film unflatness.
- Calibration procedures for "digital" cameras are still subject to scientific investigations and no standards have evolved yet.
- Substantial progress has been made in particular in high accuracy template and image matching. Also, visualization techniques are gaining ground. It is felt that intensive tests are required to compare different algorithmic approaches with each other and to analyze the effects of preprocessing algorithms (image enhancement, compression and minification) onto the geometric integrity of the frames.
- Specialized processor architectures are losing their importance in favor of powerful and more flexible host computer CPUs.
- With modern on-line measurement and processing capabilities structural and industrial applications are covering a widening range of topics, as for instance tooling, surface reconstruction, as-built computer modeling, robust calibration, deformation measurement, open-cast mining, on-line manufacturing and CAD/CAM applications.
- The field of architectural photogrammetry has expanded considerably in recent years, through a wider appreciation of the recording and processing techniques and due to important technological advancements, e.g. in CAD integration, low-cost system development, digital photogrammetry research and information systems integration.
- In biostereometrics and medical imaging a somewhat higher diversity of applications of photogrammetry can be observed. However, the rapidly developing field of 3D microscopic imaging (including nano-imaging) is still poorly represented.
- The response to the Associate Group "Robot Vision" has been moderate. Major current applications of photogrammetric techniques are seen in robot calibration, geometrical quality control and navigation of autonomous vehicles.

### The Washington Congress

Scientific-technical results of the Washington Congress.

More than 50 papers on "digital" sensors have been selected, compared to 30 papers referring to photographic cameras and 10 papers to hybrid sensors. While algorithm problems found a widespread interest (26 papers), CAD issues seem to be just emerging (10 papers). In terms of general assessment of the Congress' results it is obvious that digital photogrammetry is fully accepted. The transition of fully digital systems from having "potential" (as it has been expressed in the report of the President of

the previous Commission V: *Photogrammetry and Remote Sensing*, Vol. 44, No. 3, Nov. 1989, pp. 123-126) to being used in real-world applications has been achieved. Likewise the "integration of components" has given place to full system development and utilization. Commercial digital systems with increased task flexibility have been demonstrated. The classical field of biostereometrics is nowadays dominated by the almost exclusive use of digital sensors. Low-cost analytical systems, using semi-metric or non-metric photographic cameras in various formats, are gaining ground rapidly and contribute to the further popularization of photogrammetry, if equipped with a robust and easy-to-use user interface. Other major scientific issues of more recent concern relate to multi-camera and multi-sensor integration (in particular for outdoor applications), navigation problems employing heavily time-constrained solutions, visualization (e.g. digital orthoimage), expert-system technology for project design, and monument information systems.

Progress has been shown in calibration methodology (e.g. with lines, distances) and characterization of digital systems, in algorithmic issues of sequential and robust estimation and in the measurement of natural features and surfaces, as well as in object-oriented and CAD-guided measurements.

Current limits in data acquisition are overcome through the use of digital multispectral cameras, high-speed camera systems (both video and photographic), line scan sensors and zoom lenses. The well-known disadvantages of the stereo approach seem to be widely acknowledged and attention is focussing more on the multi-frame ( $\$ > \$2$ ) arrangements. The current accuracy status of these arrangements can be described (in a simplistic manner) as follows:

#### Large format

hybrid systems: 1:500,000 (signalized points)

#### Standard CCD fully

digital systems: 1:50,000 (signalized points)

1:25,000 (natural, well defined edges)

As always in Commission V, a great variety of different (sometimes "exotic") applications confirm the generic character of photogrammetry as a powerful non-contact measurement technique.

#### Resolutions for 1992-1996.

The following resolutions were approved by the General Assembly.

- Integrating New Technologies in Digital Measurement and Navigation Systems.
- Interfacing Close-Range Photogrammetric Systems with CAD/CAM.
- Algorithmic and Computational Aspects of Time-Constrained Vision Systems.
- Scientific Contacts with the Machine Vision Community and Promotion of Photogrammetric Methodology.

- Image Sequence Analysis.

#### Future Developments

Digital photogrammetry is now fully accepted and improved system performance offers new capabilities and will lead to novel applications. There is a need to interface CAD systems more closely with photogrammetric systems both in an a priori and an a posteriori mode. Likewise we will see spatial information systems playing a greater role, in particular as monument information systems (MIS). Low-cost, user-friendly analogue/analytical as well as digital systems will contribute to the further popularization of architectural photogrammetry. In industrial applications a more realistic, modest approach in system and methodology promotion is required, in order to avoid damage that could be caused by building exaggerated expectations on the user side.

We will experience a further integration of computer vision techniques, whereas robot vision is still a widely unexplored field for photogrammetrists and needs much more attention.

In general it is foreseen that the dynamics of (video-)data acquisition and related issues of image sequence analysis will play a much more significant role in the future. Thus, in order to further improve the performance of automated systems, a more thorough involvement in the field of algorithmic design will be required in research and development.

#### Conclusions and Outlook

Within the four-years period since the Kyoto Congress, Commission V has realized most of its goals as defined in Kyoto. The restructuring of the Working Groups was successfully completed and guarantees that the new relevant technologies and applications are represented adequately. Considering its particular mission, Commission V has taken over responsibilities (e.g. in CCD camera calibration, machine vision system design and performance analysis, algorithmic and hardware aspects of image analysis and image synthesis) which are also of concern to other Commissions. Relations to the relevant Working Groups have been established and have worked out well to the benefit of the scientific issues.

Close contacts have been established to other societies, in particular to FIG (Commission 6), IEEE Computer Society (Technical Committee on "Pattern Analysis and Machine Intelligence") and to SPIE (printing and distribution of Symposium and Conference Proceedings). As examples, the Workshop "Calibration and Orientation of Cameras in Computer Vision" has been organized on occasion of the Washington Congress, as a joint Commission V/IEEE PAMI effort, and SPIE is organizing a conference on "Videometrics" (15-20 November, 1992, Boston, USA), with the Commission V officials A. Grün, S. El-Hakim and K.W. Wong serving as Conference Chairman and Co-Chairmen.

Knowledge and technology transfer has been achieved by organizing and sponsoring several scientific-technical meetings and by offering several tutorials.

On the technological side we are looking at a promising future. Computer CPU performance is improving at a very rapid pace, computer peripherals (framegrabbers, storage devices, etc.) are improving in performance at reduced costs, the market of CCD-cameras and associated products is already huge, and the introduction of truly inexpensive larger format CCD chips is just around the corner. The consumer electronics industry continues to provide for a number of components which can as well be used for our measurement tasks, e.g. TV-cameras and still video cameras.

The true scientific challenge ahead lies in the advancement of algorithms for automated processing, the development of novel measurement procedures taking into full account the digital nature of the data and the integration of these aspects into operational systems. All in all we believe that Commission V provides for a solid organizational structure and a sound scientific-technological basis for our profession to further advance and to expand into new application areas. We expect further growth and expansion for the time after the Washington Congress.



## COMMISSION VI

### *Economic, Professional and Educational Aspects of Photogrammetry and Remote Sensing*

*Prof. J. Badekas, President 1988-1992*

*and Dr. A. Georgopoulos, Secretary 1988-1992*

#### Introduction

Commission VI has been charged with the responsibility for history, economics, education, technical cooperation, periodicals, bibliography, international exchange of information in photogrammetry, remote sensing, GIS and LIS. As these multiple and diverse subjects span the entire spectrum of activities of ISPRS, Commission VI serves not only the entire scientific and technical community in this field, but also plays an important role as the main link between our Society and other allied professional organizations. As far as it has been possible, therefore, the philosophy of the Commission over the past

period has been to establish a Working Group for each of its subject areas and define the tasks in such a way to cover part or all of the possible research areas, identified as those important problems needing solution during the four-year period.

#### Structure and Working Groups

Based on the 1988 Kyoto Congress resolutions, the program of the Commission's activities for the 1988-1992 period, which were subsequently approved by the Council at its first meeting in Zurich, has been assigned to the following seven Working Groups and two Inter-Commission Working Groups:

##### *WG VI/1: History*

- Chairman Dr. F. Doyle for Volume II, Co-Chairman Prof. Z. Sitek for Volume III.

##### *WG VI/2: Education, Training and Educational Standards for Photogrammetry and Land Information Systems*

- Chairman Prof. G. Ellis; Co-Chairmen: Dr. W. Jiwalai for Asia; Prof. S. Ghosh for Europe and N. America; Prof. O. Ayeni for Africa; Dr. G. Barnes for L.I.S.

##### *WG VI/3: Terminology - ISPRS Multilingual Dictionary*

- Chairman Dr. G. Lindig; Co-Chairmen Prof. Dr. H.P. Bahr (for Spanish and Portuguese) and Dr. Sievers.

##### *WG VI/4: Economics and Business Management*

- Chairman Dr. A.S. Walker (resigned).

##### *WG VI/5: Technical Cooperation*

- Chairman Mr. D. Burette, replaced by Mr. A. Fontanel.

##### *WG VI/6: Literature Retrieval System for Photogrammetry and Remote Sensing*

- Chairman Prof. J. Hothmer (passed away in early 1991).

##### *WG VI/7: Education, Training and Educational Standards for Remote Sensing and GIS*

- Chairman Prof. J. R. Jensen

##### *IC WG III/VI: Tutorial on Mathematical Aspects of Data Analysis*

- Chairman Prof. L. Mussio, Co-Chairman Dr. Th. Bouloucos.

##### *IC WG II/VI: Newsletter on Instrumentation for Teaching*

- Editor Dr. I.J. Dowman

The mandates of these Working Groups are the following.

*WG VI/1* is responsible for: (1) compilation and publication of Volume II of the History of Photogrammetry, related to Space Photogrammetry and Photointerpretation; (2) preparation of the material for Volume III.

*WG VI/2* is responsible for: (1) promotion of education and training for photogrammetry and LIS, taking into account the particular regional needs; (2) identification of educational standards for photogrammetry and LIS; (3) compilation of ideal syllabi and course layouts for undergraduate education on photogrammetry and LIS; (4) investigation of the possibilities for training personnel through the organization of appropriate workshops.

*WG VI/3* is responsible for: (1) updating the already compiled *Multilingual Dictionary* (MLD); (2)

urging the inclusion of other languages in the MLD; (3) investigation of the possibilities for the standardization of the terminology for photogrammetry, remote sensing, LIS and GIS.

*WG VI/4* is responsible for: (1) studying the economics and business management aspects of photogrammetry and remote sensing operations; (2) investigation and establishment of standards for economics and business management; (3) investigating the impact of 1992 on economics and business management matters of photogrammetry and remote sensing as far as the EEC member countries are concerned.

*WG VI/5* is responsible for: (1) encouragement and organization of the international exchange of information, documentation and research in photogrammetry and remote sensing; (2) urging governments, particularly in developing countries, to encourage the use of photogrammetry and remote sensing by establishing appropriate facilities; (3) standardizing the form of National Reports and suggest ways to best evaluate and exploit them; (4) establishing connections with international organizations (UN, EEC, ESA, World Bank, etc.) to urge the wider promotion and use of photogrammetry, remote sensing, LIS and GIS.

*WG VI/6* is responsible for: (1) an endeavor establishing a tailor-made database for an ISPRS information retrieval system, and prepare specifications and guidelines for access and use of the system; (2) accessing capabilities, efficiency, reliability and costs of available bibliographic information; (3) gathering information concerning already existing data bases related with ISPRS activities.

*WG VI/7* is responsible for: (1) promotion of education and training for remote sensing and GIS, taking into account the particular regional needs; (2) identification of educational standards for remote sensing and GIS; (3) compilation of ideal syllabi and course layouts for undergraduate education on remote sensing and GIS; (4) investigation of the possibilities for training personnel through the organization of appropriate workshops.

*IC WG III/VI* is responsible for: (1) spreading of knowledge of data analysis, organization of courses and production of lecturing materials and tutorial papers in co-operation with Commission III; (2) investigating the standards and the scientific fields in order to organize as many tutorials as possible by appropriate institutions.

*IC WG II/VI* has an obvious goal.

A quick comparison of these Working Groups and the structure of the Commission during the past periods reflect some drastic changes that have been attempted in order (a) to modernize the Commission's activities by the inclusion of GIS/LIS education and information retrieval systems, and (b) to attract as many prominent colleagues as possible to contribute to Commission VI.

### **Intercongress Activity**

For the past four-year period emphasis has been placed on:

- Education with the preparation of internationally accepted standards of education, and through promotion of high level education in surveying and mapping including remote sensing through cooperation with other sister organizations.
- Bibliography through investigations for the preparation of specifications for the information retrieval system ISPRS.
- Terminology through preparation for the publication and the expansion of the Multilingual Dictionary.
- Organization of international tutorials on photogrammetry, LIS, remote sensing and GIS by suitable institutions.
- Computer-assisted education or teaching (CAT). This subject has been selected for further investigation, as the rapid progress in computer technology might greatly contribute to the modernization of the various teaching methods.

Unfortunately, this period's presidency has again been confronted with the usual unsurmountable problems that every host to Commission VI has to fight. Namely the indifference of the various colleagues to contribute to its activities, as well as the vast diversity of the subjects to be covered.

All traditional activities of Commission VI, like education, multilingual dictionary, completion of the history and information retrieval have progressed adequately, although the Working Groups have been unable to set up and complete any major cooperative program. Very important is, however, the encouraging response with which our initiative in computer-assisted teaching has been received by our colleagues.

The most important activity of Commission VI during the period 1988-1992 was the Intercongress Symposium, which was held on Rhodes, Greece.

The Symposium took place in a well equipped and pleasant environment with 83 participants from 26 countries. 30 papers were presented, some of which of very high quality. These reports have covered almost all aspects of the activities of Commission VI and they were enlightened with lively discussions.

Three tutorials and one Training Seminar have been organized. The first three in co-operation with Commission III, through the relevant Working Group (*IC WG III/VI*) and the latter in co-operation with Working Group *V/5* on architectural and archaeological photogrammetry. In detail these tutorials and seminars were:

- Tutorial on Mathematical Aspects of Data Analysis, June 1989 in Pisa, Italy.
- Tutorial on Mathematical Aspects of Data Analysis, June 1990 on Rhodes, Greece.

- Tutorial on Mathematical Aspects of Data Analysis, June 1991 in Milan, Italy.
- Training Seminar on Architectural Photogrammetry, September 1990 in Athens, Greece.

Another very important initiative of Commission VI was the proposal and the preparation for the meeting of the presidents of the sister societies. This meeting has as its aim to plan the proper actions for better co-operation of the sister societies in the field of education. The meeting took place in August 1991 in Vienna and was very successful. The first result of this meeting were the Special Sessions of IUSM on education which were held during the 17th ISPRS Congress in Washington.

During this four-year term Commission VI and the whole of the international photogrammetry community has suffered from the sudden death of Prof. J. Hothmer, an active colleague for many years and former President of Commission VI.

For the rest of the 1988-1992 period the Commission has focused attention on developing countries where facilities are poor or non-existing in many cases. In the field of education, the major challenge has not only been the formulation of standard courses, the preparation of textbooks, lecture materials and teaching aids to meet individual demands, but also to outline new training courses to allow countries and organizations responsible for national development to master the new demands. More emphasis has been placed on technical cooperation to establish facilities, transfer and acquisition of the necessary technology.

#### **Concluding Remarks**

In conclusion, the pleasant and rewarding experience from our efforts to promote Commission VI affairs and from our cooperation with so many international colleagues should be stressed. We would also like to thank many individuals and especially the members of the ISPRS Council and other key persons, who have continuously supported the work of Commission VI.

### **COMMISSION VII**

#### ***Interpretation of Photographic and Remote Sensed Data***

*by Frank Hegyi, President 1988-1992*

#### **Introduction**

Four years ago in Kyoto, I had the honor of being nominated by my adopted country Canada, as candidate for the presidency of Commission VII. As a born Hungarian, who was educated in Scotland, lived in Guyana, South Africa, and emigrated to Canada as a Scottish immigrant, I felt comfortable with the proposal of working in a truly international environment. As an applications oriented Director in Government at that time, with responsibilities of implementing GIS and



remote sensing systems, I found the opportunity challenging especially in a society where academics and researchers appeared to dominate the leadership team.

I started the four-year team with enthusiasm and a secure government job! Then, in early 1990 I took the opportunity of making a major career change from Directory of B.C.'s Forest Inventory and Mapping Program to establish a private company with the focus on GIS and remote sensing applications to resource and environmental monitoring. I would like to acknowledge the support of my former employer, the B.C. Ministry of Forests, during the first two years of my term. Also, I would like to thank the Canada Center for Remote Sensing for their financial support during the past four years, as well as for providing a strong secretariat. I will always be grateful for the outstanding contribution of Dr. Bob Ryerson of CCRS as Secretary for Commission VII. Finally, I would like to thank my business partner, Ms. Penny Walker for strong support and cooperation in spending our Company's financial resources on the activities of Commission VII, and my daughter Jennifer for producing the Proceedings of the Mid-term Symposium.

#### **Activities**

Concerning the technical aspects of Commission VII, I am pleased to report a high level of activities through seven Working Groups and one Inter-Commission Working Group in cooperation with Technical Commission I. Each Working Group had a high degree of participation in the Mid-term Symposium, which was held in September 1990 in Victoria. The theme for the Symposium was Global and Environmental Monitoring, and was attended by over 400 participants. At that time we also hosted the ISPRS Council and the Technical Commission Presidents. All Working Group chairpersons participated in the organization of the Technical Sessions of the Congress. In total, Commission VII was responsible for fourteen Technical Sessions, six Special Sessions, one IUSM, and eight Poster Sessions. Furthermore, each Working Group organized special events during the 1st and 3rd year of our term. At this time I would like to mention the working groups.

*WG VII/1: Physical Measurements and Signatures in Remote Sensing*

Chairman Dr. Gérard Guyot (France)

was very active all four years, and as well, held a highly successful Colloquium in France in January 1991.

*WG VII/2: Spatial Information Extraction and Manipulation*

Chairperson Dr. Pam Sallaway (Canada)

organized a joint workshop with Commission II/2 in Germany.

*WG VII/3: Renewable Resources*

Chairman Dr. Randall Thomas (Denmark)

promoted the work of our Commission in Europe.

*WG VII/4: Non-Renewable Resources*

Chairman Dr. Tsehaie Woldai (Netherlands)

who stepped in at the Mid-term Symposium, made up for the slow start of this working group.

*WG VII/5: Water and Atmospheric Remote Sensing*

Chairman Dr. Klaus Ulbricht (Germany)

promoted the subject matter in South America and in the Baltic States.

*WG VII/6: Human Settlements*

Chairman Dr. Bruce Forster (Australia)

was active in Australia and the Asian countries.

*WG VII/7: Expert System Applications for Remote Sensing*

Chairman Dr. David Goodenough (Canada)

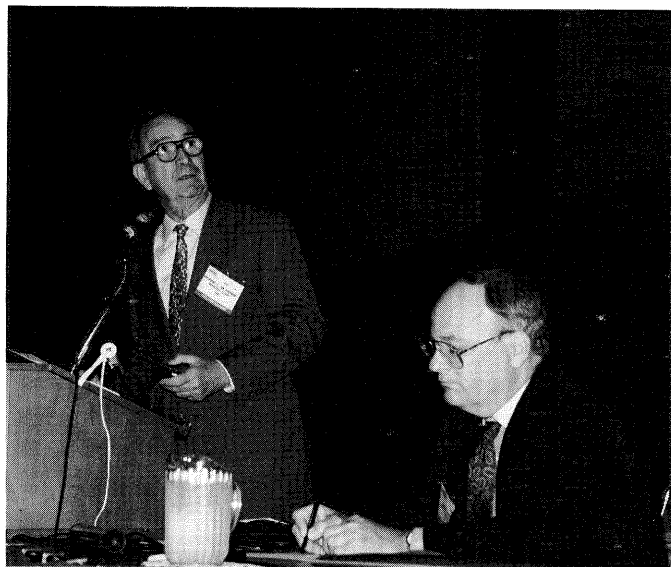
held a workshop on the subject matter, as well as was chairman of the Scientific Committee for the Mid-term Symposium.

We also submitted resolutions to promote the following:

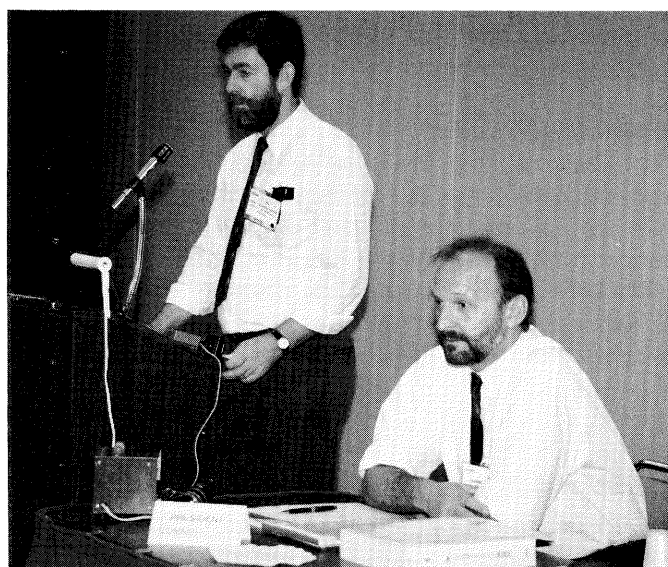
- The developing of specifications and requirements for remote sensing systems and GIS.
- The organization of a workshop on radar applications.
- The applications of airborne digital imagery to resource and environmental monitoring.
- The applications of integrated data.
- The applications of new sensor data and advanced technology.
- The transfer of technology to resource and environmental monitoring.

**Concluding Remarks**

I had the honor of working with an excellent team and we became good friends during the past four years. I thank you all for your strong support and outstanding team work. In addition, I would like to give special recognition to Dr. David Goodenough for his help in developing the technical program for the Mid-Symposium, and to Dr. Bob Ryerson, who did a tremendous amount of work as Secretary of the Commission. I thank you very sincerely.



WG II/1 Chair M. McKenzie and D. Andrews



WG V/2 Chair J. Fryer and  
Commission V President A. Gruen