18. Summary of Technical Commissions
Sommaire des Sessions Techniques
Summarish der Technischen Sitzungen

Commission I—Primary Data Acquisition

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1. Introduction

The content of the Rio resolutions for Commission I differed only slightly from those which were adopted at the 1980 Hamburg Congress. This meant, that the tasks of Commission I had only slightly to be changed in regards to the previous 4-year period, since the recognized scientific problems needed further investigation. This was the reason why the working groups of the 1980—84 period were retained with minor modifications.
Only one additional working group was founded for the 1984—88 period; this working group covered the field of microwave sensors to stress the increasing importance of these sensor types.

Commission I participated also in an intercommission working group with Commission II on 'Acquisition and Use of Space Photographic Data', which was recommended by Council.

The established seven working groups (WG) are listed below:

WG 1 - Image Data Quality of Aerial and Satellite Sensor Systems
Chairman: R. Welch (USA)
WG 2 - Camera Calibration and the Effect of Environment
Co-Chairmen: H. Ziemann (FRG)
C. Norton (USA)
WG 3 - Sensor Orientation and Navigation
Chairman: R. Brossier (France)
WG 4 - Acquisition of Optical Remote Sensor Data from Spacecraft
Chairman: G. Brachet (France)
WG 5 - Acquisition and Processing of Aerial Photography
Chairman: R. Lorenz (The Netherlands)
WG 6 - Acquisition of Microwave Remote Sensor Data
Chairman: J. Curlander (USA)
WG I/II - Acquisition and Use of Space Photographic Data
Chairman: K. Szangolies (GDR)

2. Meetings, Symposium, Congress

The presentations during the Congress were prepared during the preceding four years by several 'regional' workshops and colloquia, which were organized in agreement with Commission I or which were directly initiated by Commission I.
The following meetings were held in the period 1984—88:

- Metric Camera Workshop, Oberpfaffenhofen, FRG
  11—13 February, 1985
  First results from images taken by the Metric Camera aboard Space Shuttle Flight STS 9 in December 1983 were presented. This international workshop was attended by over 80 participants from 11 countries. Proceedings are available from ESA-Estec, Postbus 299, 2200 AG Nordwijk, The Netherlands, Ref. No. ESA SP 209

- Camera Calibration Workshop, Bonn, FRG
  21—22 February, 1985
  This workshop on 'the practical application of camera calibration in photogrammetry' was held at Bonn University. About 80 participants from 10 countries attended the meeting. The proceedings were published under the title 'Kamerakalibrierung in der photogrammetrischen Praxis' in the DGK series B, No. 275.

- Workshop on the recommended procedures for calibrating photogrammetric cameras and relted optical tests, Stockholm, Sweden
  18 June 1985
  On an invitation by Prof. Torlegard ten photogrammetrists from six countries concerned with testing of aerial cameras met to discuss the revision of the 'Recommended Procedures ...'.

- Radar Altimetry Workshop, Stuttgart, FRG
  9—10 July, 1987
  This workshop on 'Scientific and Technical Aspects for an Experiment to Determine Global Topography' was held at Stuttgart University on an invitation by Prof. Ph. Hartl. The presentations and discussions of participants from several European countries and the USA dealt with potential applications of radar altimeter data for various earth science disciplines and with technical aspects of instrument design.

- Colloquium on 'Use of Photographic Data for Mapping of the Earth Surface', Leipzig, GDR 4—6 September, 1987.
  This colloquium was organized by the chairman of intercommission WG I/II Prof. K. Szangolies. More than 60 participants from East and West accepted the invitation to this international meeting. For many participants from western countries this meeting was the first opportunity to look at stereoscopic colour space images of approx. 5 m ground resolution, which were taken with the KFA-1000 camera of the USSR. Proceedings entitled 'Use of Space Photographic Data for Mapping' were published by 'Kammer der Technik, Wissenschaftlich-Technische Gesellschaft für Geodäsie, Photogrammetrie und Kartographie'.

More details on the above mentioned meetings can be found in the Commission I-bulletins, which were published 8 times as supplement to Bildmessung und Luftbildwesen (BuL), the official publication of the German Society for Photogrammetry and Remote Sensing.

One of the main inter-congress activities was of course the mid term Symposium, which was held at Stuttgart, FRG, 1—5 September 1986. The symposium's title 'Progress in Imaging Sensors' was selected to reflect the rapid advances, that have been made in the field of sensor technology over the last few years. Over 180 participants from 25 countries attended the meeting. A very detailed report on the Symposium was published by R. Brewer in Photogrammetric Engineering and Remote Sensing, Vol. 54, No. 1. The proceedings of the symposium were published under the title 'Progress in Imaging Sensors' by ESA in a softcover book designated 'International Archives of Photogrammetry and Remote Sensing', Volume 26, Part 1. They comprise 82 papers on 644 pages and are available from:
ESA-ESTEC, Postbus 299, 2200 AG Nordwijk, The Netherlands, Ref. No. 252.
For the Kyoto Congress 34 papers were accepted for oral presentation and 10 as poster papers. 7 of these were invited papers. The papers were assigned to 5 topics and were presented in 6 Technical Sessions. Two sessions were devoted to Space Sensors (10 papers) and dealt mainly with the SPOT system, CCD-Three-Line Stereo Cameras and the Japanese Earth Observation Satellite MOS-1.
The title and content of the other sessions were:

- Camera Development (6 papers): Solid State Digital Cameras and Forward Motion Compensation
- Aerial Survey (6 papers): GPS — investigations
- Specification and Calibration (5 papers): Discussion of Calibration Methods and Specifications for Aerial Photography.
- Microwave Systems (7 papers): Proposed or planned airborne and spaceborne SAR-systems.

Commission I was also involved in two joint sessions with Commission II on Space Photography and a joint session with Commissions II and VII on Microwave Systems.

3. Research Activities and Trends

3.1 IMAGE QUALITY

- OTF-based image quality criteria are not yet generally applied and accepted for Aerial Cameras.
  However, MTF-based criteria were used for first investigations on the improvement of image quality by the use of forward motion compensation in combination with high resolution films.
- The geometric and radiometric quality of SPOT images was tested and the results showed, that they exceeded pre-launch specifications.
- The use of optoelectronic imaging systems for different photogrammetric applications (spaceborne scanners, close range systems, digitizing of photographs etc.) have rapidly advanced in recent years.
  Uniform image quality criteria for these systems are still lacking and their definition needs further investigation. Also, the comparison of resolution of photographic and optoelectronic imaging systems needs further considerations.
- Multisensor image products were generated to improve the interpretability of remote sensed data. Examples of combinations of SIR-B and Thematic Mapper data were shown.
- The relationships between spatial resolution of satellite image data and map information requirements were investigated.

3.2 CAMERA CALIBRATION

- Offical contacts have been established between ISPRS WG-I/2 and ISO TC 42 (Photography) to relate the revision of 'Recommended Procedure...' to ISO standards. Contact was also initiated to ISO TC 172 (Optical Instruments) but not brought to conclusion.

  To OTF measurements, a special section on aerial camera lenses might be incorporated in ISO standard 9336 (OTF application).
- As optoelectronic cameras become more and more important in photogrammetry the definition of calibration standards and procedures for this type of cameras becomes an increasingly more urgent matter. The development of uniform testing and quality standards for digital solid state cameras with regard to spatial, spectral and radiometric resolution were discussed at the Congress.
- Tests have been carried out related to the design of a long focal length camera incorporating an focal length adjustment to adapt for temperature and pressure changes.
- The activities in the field of camera calibration were rather detrimentally affected by the disbandment of the Photogrammetric Research Section at the National Research Council of Canada.

3.3 SENSOR ORIENTATION AND NAVIGATION

- Various Global Positioning-System (GPS) receivers have been tested by several organizations for navigation and aerotriangultion purposes. GPS-coordinates of the camera position during exposure were compared to those obtained by aerotrian-

gulation:
the RMS-error is bellow 0.10 m. with further corrections this error can be reduced to ±0.05 m, which is of the same order as the aerotriangulation residuals themselves.
The investigations have also shown that ground control preparation could be drastically reduced for medium scale mapping.
- The development of other navigation systems are directed to be complementary to GPS. This is in particular true for INS, for which manufacturers are developing GPS hybridized versions. The aim is not only to enhance position up-dating but also to improve heading and attitude information by better knowledge of correction factors.

3.4 OPTICAL SPACE SENSORS

- The most important event in the last four years was the deployment of the French SPOT-satellite in February 1986. Other highlights were the Flight of the Large Format Camera (LFC) in October 1984 and the launches of the Japanese Marine Observation Satellite (MOS-1) in February 1987 and of the Indian Remote Sensing Satellite (IRS-1) in March 1988. Investigations on sensor performances of SPOT-1 and MOS-1 were presented. Unfortunately no or only few data of MOS-1 and IRS-1 were presented at the Congress. It was felt that Commission I should encourage early publication and dissimination of results from new sensors.
- Sensors for the following space missions were reviewed during the Stuttgart Symposium, at the Congress and at other Remote Sensing Conference:
  - MEOSS (FRG and India), July 1988
  - SPOT-2 (France, Belgium, Sweden), 1989
  - LANDSAT-6 (USA), 1991
  - Metric Camera on ATLAS-1 (FRG, USA), 1990
  - MOMS-02 (FRG), 1991
  - ERS-1 (Japan), 1991/92
  - SPOT-3, SPOT-4, SPOT-5 (France, Belgium, Sweden), 1990—95
- New developments in the field of optical space sensors concerned the following topics:
  - Imaging spectrometers (AIS, USA; MODIS, USA; MEIS, Canada; ROSIS, FRG)
  - Stereo imaging instruments (SPOT, France; MEOSS, FRG; MOMS-02, FRG)
  - wide field viewing instruments for global vegetation and ocean monitoring (LANDSAT, USA; SPOT, France)
- It was recommend in working group discussions that more efforts should be directed to modelling of future space sensors and to inter-calibration of different imaging sensors.

3.5 SPACE PHOTOGRAPHY

- Metric Camera (FRG), Large Format Camera (USA) and MKF-6 (GDR) photographs have been widely used for topographic mapping purposes. It was shown that these photographs can contribute to mapping at scales 1:100,000 and sometimes also at larger scales.
- In 1987 space images of the KFA-1000 Camera (USSR) with approx. 5 m ground resolution appeared on the market. These images can be purchased from Sojuskarta, Moscow, USSR. Investigations on the mapping capability of these images have been started in various countries and first results were presented. It appears that the space missions of the USSR are at the moment the only source for continuous delivery of space photographs of the earth.

3.6 AERIAL PHOTOGRAPHY

- To test the practicability of the 'Specifications for Vertical Aerial Photography', which were adopted at the Rio Congress, a questionnaire was sent to a selected group of organisations and commercial companies in order to ask them for comments. The conclusions from these questionnaires were presented in two papers during the Congress.
- High resolution but low speed films have been tested and used more extensively in practical aerial survey flights than before. This is due to the fact that aerial cameras with forward motion compensation are now available at various aerial survey companies. It was shown that with this means the resolution of aerial photographs can be increased to approx. 50 lp/mm.

3.7 MICROWAVE SYSTEMS

- New imaging radar system designs for future space missions such as ERS-1 Synthetic Apertur Radar (ESA), SIR-C (USA) and X-SAR (FRG, Italy) for Space Shuttle Flights, were reviewed and techniques for calibration and verification of these instruments were discussed.
- New concepts for microwave altimeter systems for determination of terrain height were studied.
- Definitions of standards for calibration and image quality of synthetic apertur radar systems are still to be worked out.
- Interferometric techniques were discussed for stereoscopic imaging.

4. Recommendation for the 1988—92 period

Discussions during the Stuttgart symposium and at the Kyoto Congress led to the following recommendations for the next period:
- Continuation of revision of the Recommended Procedures for Calibrating Photogrammetric Cameras based on ISO standards
- Further investigation of optical digital imaging systems for photogrammetric applications with special emphasis on calibration and quality standards.
- Further investigation of imaging radar systems for mapping purposes with special emphasis on calibration and data quality standards.
- Investigation of the capabilities and possible applications of scanning radar altimetry and interferometric radar systems for obtaining DTM on a global scale.
- Investigation of satellite navigation techniques, in particular GPS, for acquisition of reference data to reduce the ground

control efforts.
- Concentration on the modelling of future space sensors to investigate the influence of various parameters (spatial, spectral, radiometric resolution etc.) on their capability for different mapping and remote sensing applications.
- Continuation of intercommission studies on space photographic systems and their application for mapping purposes.
- Monitor the activities of the Earth Observation Polar Platform Program 'Mission to Planet Earth' and study its effect on the photogrammetric and remote sensing community.
- Most of the recent new sensor developments were stimulated by space agencies in various countries and they will continue to create new ideas for sensor concepts. It is therefore important for ISPRS to take a more active role in the planning process for future sensors and remote sensing space programs.

5. Resolutions

Resolutions initiated by Commission I and passed by the General Assembly covered the following:
(1) The need to take actions to get involved in planning of future remote sensing space programs and missions, in particular the Polar Platform Missions.
(2) The need to investigate spatial, spectral, radiometric and temporal resolution of digital optical space sensors as related to specific remote sensing and mapping tasks.
(3) The need to continue investigations on satellite-based navigation control techniques (in particular NAVSTAR-GPS) to determine and prove all the parameters of exterior sensor orientation to be of significantly higher accuracy.
(4) The need for further studies of the capabilities and potential applications of spaceborne microwave radar systems, such as synthetic aperture radars, radar altimeters, radiometers and scatterometers for obtaining topographical and thematic information on a global scale.
(5) The need to adapt a formalized approach to the maintenance of Rec. Proc. and Specs. and to extend the period of use for the revised Spec. for Aerial Photography for another four year period.

ISPRS COMMISSION I
PRIMARY DATA ACQUISITION
WORKING GROUP 1
Image Quality

Session T19-Space Sensors I
Monday, July 4, 1988, 09:00—10:30
Co-Chairmen : Ph. Hartl (F.R. Germany)
R. Welch (U.S.A.)

1. R. Welch (U.S.A.) — Recent Advances in the Quality of Remotely Sensed Imagery (Invited Paper)

Three topics were addressed in detail: 1) the impact of forward image motion compensation (FIMC) devices on the quality of aerial photography; 2) the relationships between measures of spatial resolution for Landsat and SPOT digital image data and map information requirements; and 3) the possibilities for improving the quality of Shuttle Imaging Radar (SIR-B) images by merging them with Landsat Thematic Mapper (TM) images. The use of digital image data with mapping software packages operational on personal computers was also examined.

2. G. Brachet (France) — Eighteen Months of Operation and 750,000 Images of the Earth Surface (Invited Paper)

More than 750,000 scenes have been archived at Toulouse, France; Kiruna, Sweden; Prince Albert, Saskatchewan and Reston, Virginia. The majority of data are released in CCT format, processed to level 1B. Approximately 54 percent of the purchase requests are for multispectral (20 m) data, whereas 46 percent are for the higher resolution panchromatic (10 m) data.

3. G. Begni and P. Henry (France) — The SPOT-1 Image Quality: Two Years of Experience.

The quality of SPOT-1 image data exceeds pre-launch specifications, includingl those for localization, length distortion, multispectral registration, multitemporal registration, and stereo heighting accuracy. Improved radiometric corrections have been implemented.

4. M. Leroy, M. Arnaud and J. Dupaire (France) — The Present Status of the SPOT New Generation Project Presented by P. Henry

The launch schedule was discussed for SPOT-2 (1989), SPOT-3 (1990), SPOT-4 (1993) and SPOT-5 (1995 or later). Beginning with Spot-4, a short wavelength infrared band will be included and on-board registration of the 10 m and 20 m data will be implemented.

5. P.S. Chavez, Jr. (U.S.A.) — Use of a Variable Gain Setting on SPOT

Images from experiments conducted for a test site in Hawaii were used to demonstrate the improvements in SPOT image quality realized by modifications in gain and spatial filtering. Techniques for the enhancement of low contrast detail were outlined.

ISPRS COMMISSION I
PRIMARY DATA ACQUISITION
WORKING GROUP 2

Camera Calibration and the Effect of Environment

Session T22 — Camera Developments
Monday, 7th July, 1988, 11:00—12:30
Chairman: H. Ziemann, (F.R Germany)

C.L. Norton, L.C. Peck (U.S.A.) — Invited Paper — Part BII: 222-231 — Electro-Optical Sensors Specification and Standards
I. Kamiya (Japan) — Presented Paper — Part BI: 64—72 — A Practical Method of Remotely Sensed Digital Image's Resolving Power
H.-P. Bähr (F.R. Germany) — Presented Paper — Part B9: 61—74 — Measure for Geometric Resolution of Digital Cameras
G. Vosselman, W. Föstner (F.R. Germany) — Presented Paper — Part BI: 148—157 — The Precision of a Digital Camera
U. Zeth, N. Dietz, (presented by W. Marckardt) — (G.D.R.) — Presented Paper — Part BI: 163—172 — Test Technique for Checking the Forward Motion Compensation Device in the LMK Aerial Survey Camera System
J. Hakkarainen, M. Schroeder (Finland, F.R. Germany) — Presented Paper — Part BII: 169—184 — The Effect of Forward Motion Compensation on Resolving Power of Aerial Photographs

CL Norton reviewed briefly ISPRS efforts in standard development for photogrammetric cameras, presented the results of a CCD image quality simulation study and reviewed answers received to a questionaire mail-out; the questionaire presented seven questions, all related to the development of specifications or standards addressing the image quality of electro-optical sensors.
Kamiya presented test results for the determination of edge spread functions (and modultion transfer functions derived there from) of the Japanese MOS-1 satellite and the Japanese MESSR, a multi-spectral scanning radiometer. These results were obtained using an edge not exactly perpendicular to the flight direction but rotated on purpose by several degrees.
Bähr presented a review of image quality measures and recent results for several methods applicable to images recorded with solid state cameras; the results were in good agreement and also showed that MTF for such images is, within a certain range, independent of pixel size.
Förstner reported on the design and use of a testfield for the close-range calibration of CCD cameras. The testfield consisted of a number of cells each containing 16 targets of different sizes and shapes. The pointing used several image processing procedures and resulted in image coordinate accuracies in the order of 0.02 pixel sizes.
Marckwardt gave a short summary on the LMK camera and its forward motion compensation feature and then described a recently developed forward motion simulator developed in Jena and used to test the operation of the LMK FMC.
Schroeder presented the results of FMC tests flown with a RMK 15/23 camera at a scale 1:10,000 using different film types. Results from a RMK 30/23 camera and from a RMK 8,5/23 camera without FMC will follow.
Several papers relted to the topic of the session were presented in the Poster Sessions; these were
D.I. Havelock, *H. Ziemann*: Optimal Position Estimation in Digital Image Meteorology; Part BI: 139—147
R.A. Neville, R.P. Gauthier, I.W. Schwarz, *S.M. Till*: Calibration of the MEIS multispectral Imager; Part B9: 75—79

ISRPS COMMISSION I
PRIMARY DATA ACQUISITION
WORKING GROUP 3

Sensor Orientation and Navigation

Session T25 — Aerial Survey
Monday, July 4, 1988, 13:30—15:00
Co-chairmen: R. Brossier (France)
M. Schroeder (F.R. Germany)

1. R. Brossier, C. Million, A. Reynes (France) — Photogrammetric Applications of SERCEL GPS TR5S-B Receiver at Institut Geographique National — France (Invited Paper)

IGN-F has realized in 1986 and 1987 two test campaigns with a GPS TR5S-B receiver built by SERCEL company. The aim of these operations was the evaluation of the contribution of this material, not only for navigation but mainly for photogrammetric purposes.
A first aspect of the paper concerns a description of the on-board system. Then results are presented when using two levels of accuracy for GPS data and testing differential measurements with a stationary receiver. Aerial Triangulation computations take into account GPS data and several hypothesis are considered, concerning use of ground control points. It is shown that it is possible to eliminate all ground control points for medium scale surveys, excluded are points at the center of the block for tying up to the geodetic network.
A last aspect concerns use of GPS data in lowered configuration with complementary data such as aircraft attitude given by a pressure sensor.

2. E. Cortes, F.J. Heimes (The Netherlands) — A Comparative Study of Dynamic Positioning by GPS (Paper presented by R. Lorenz, The Netherlands)

The purpose of this study was to compare the positions of the camera exposure stations determined by the GPS-Navstar during the survey flight mission with the corresponding position determined by accurate aerial triangulation.
For the experimental test a survey flight mission was carried out at a test area which has a dense and accurate ground control network. The Zeiss RMK-A 15/23 camera was equipped with a pulse generator for recording the time of exposures. The camera and the five channel GPS receiver (TR5S-B) were interfaced with a portable computer. The GPS raw data obtained by a single receiver were processed in a combined pseudo-range-phase mode.

3. E. Dorrer, C. Schwiertz (F. R. Germany) — Experimental GPS-Supported Aerial Triangulation

The paper discusses first results of a research project aimed at GPS-supported aerotriangulation without ground control. By concentrating on differential kinematic GPS positioning techniques, a survey of problems currently encoutered in photogrammetric applications is given. During flight tests in the summer of 1987 an area targetted with some 700 control points was phtographed in 1:6000 with an RMK 15/23 aerial camera modified for capturing the center point of the exposure time signal, together with on-board GPS carrier phase measurements. Due to overall unfavourable conditions a considerable amount of GPS data was bad. Hence direct comparison of the camera positions obtained from block triangulation with computed GPS antenna positions showed discrepancies not reflecting the expected high accuracy. The experiments are to be continued.

4. F.L.J.H. Corten (The Netherlands) — High Accuracy X, Y, Z Positioning in Flight

A new Computer Controlled Navigation System (CCNS) is described as an automated precision navigation and flight management system. CCNS can be interfaced with many navigation means such as GPS, LORAN-C, DME, INS; it is capable of determining X Y Z position and attitude with high accuracy at the instant of exposure.
New methods of combined adjustmentl make it possible to use these high accuracy in-flight positioning data as a means of replacing the cost and the time-consuming establishment of ground control by the use of aerocontrol.

5. J. Lindenberger (F.R. Germany) — Modelling Orientation Parameters of Sensor Platforms

The paper introduces autoregressive integrated (ARI) stochastic processes for modelling the dynamic characteristics of the exterior orientation parameters of a sensor platform. The ARI-model, in combination with a variance component estimation enables the entire functional and stochastical description of the orientation parameters. The main advantages of this model are the easy handling, the low number of necessary ARI process parameters and the dispensation of any a priori information concerning the stochastical model.

6. L. Ottoson (Sweden) — Aerial Photography from Very High Altitude in Sweden.

The Swedish national air photography programme has for a long time applied the standard flying altitudes of 4600 m and 9200 m, with 15 cm focal length lenss, in order to have the scales of 1:30,000 or 1:60,000 respectively. However it appeared in the early 1980's that aerial photography at a smaller scale would be useful for some applications. Thus a test programme was started for evaluation of superwide angle photography at an altitude of 13,200 m for obtaining the negative scale of 1:150,000.
This paper gives a summary of the experiences gained from the test programe. Examples of the use of this kind of photo material in different applications is given.

ISPRS COMMISSION I
PRIMARY DATA ACQUISITION
WORKING GROUP 4

Optical Remote Sensor Data from Spacecraft

Session T42 — Space Sensors II
Friday, 8th July, 09:00—10:30
Chairman: G. Brachet (France)

1. F. Lanzl (F.R.G.) — The Three-Line Stereo Camera MEOSS and its Application in Space

Presentation of the Germany-provided Monocular Electro-Optical Scanner (MEOSS) which will fly aboard the Indian SROSS-II satellite; due to be launched in July 1988. Three line scan stereo system of moderate resolution (70 m) operating in one spectral band (570 to 720 nm). Discussion of attitude-control system's impact on the image geometry and mathematical modelling of the system to evaluate potential planimetric and height determination accuracy.

2. F. Ackermann et al. (F.R.G.) — MOMS-02, A sensor for Combined Steroscopic and Multispectral Earth Observation.

Presentation of the MOMS-02 experiment, an improved version of MOMS-01 which flew aboard the NASA Shuttle in 1982 and 1984, to fly on SPACELAB-D2 mission now planned for late 1991. MOMS-02 includes a 'photogrammetric' mission

in addition of its multispectral capability, with a 5 m pixel size CCD based sensor in the panchromatic range (520 to 760 nm) covering 35 km swadth width and two CCD sensors fore and aft, 28 degrees from vertical with 10 m pixel size. Data recording will be taken in various, mutually exclusive modes, the final choice depending on the type of on-board recorder which will be selected. Height determination of 5 m accuracy is expected.

3. H. Ebner, F. Müller (F.R.G.) — Studies on Object Reconstruction from Space Imaging Using Three-Line Scanner Imagery.

Presentation of mathematical modelling of object reconstruction from three-line scanner imagery such as MEOSS and MOMS-02 instruments presented earlier. Study of the effects of attitude and/or position errors on the final planimetric and vertical accuracy. Theoretical model which could be improved by taking into account a more realistic modelling of the spacecraft motion (orbital and orientation).

4. H. Wakabayashi et al. (Japan) — Outline of MOS-I Verification Program (MVP)

Presentation of the very well structured performance verification program for the Japanese MOS-I satellite sensors (launched in February 1987).
Preliminary results presented for radiometric resolution and geometric accuracy of data from the MESSR, VTIR and MSR sensors, confirming that specifications were easily met. Unfortunately, some important performance parameters such as band to band registration, MTF, reltive distortion, etc., were not presented. Hopefully these will be discussed further in the future MVP-dedicated symposia, with participation of non-Japanese investigators.

5. H. Koshiishi, K. Homma (Japan) — A Conception Study of Optical Earth Observation from Geosynchronous Orbit.

Presentation of a proposed technical design for a large Schmidt telescope in a geosynchronous orbit capable of imaging the Nippon islands with a 50 meters ground resolution. Concept based on a circular scanning system where the Nippon islands are imaged within a quarter of a circular sector. Discussion of the diffraction-limited maximum resolution and size of the telescope: 1 m aperture, 5 m focal length.
An original concept, which would have attracted more interest if it had included a discussion of the mission objectives of this ambitious technical approach.

ISPRS COMMISSION I
PRIMARY DFTA ACQUISITION
WORKING GROUP 5

"ACQUISITION AND PROCESSING OF AERIAL PHOTOGRAPHY"

Chairman R.W.Loreng

General specification for Black and White Aerial Photography for Mapping, Mosaicing and General Interpretatios.

CONTENT

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FOREWORD

This Specification is intended for general use world-wide as model contract for vertical aerial photography. It refers to the recommendations for camera calibration of the ISPRS and to the appropriate standards of the International Standard Organization (ISO),
The Specification is designed to satisfy the usual need of users requiring vertical aerial photography for photogrammetric mapping, photomosaicing and general interpretation. The standards set can be achieved in normal operational flying at reasonable cost.
Users with particular requirements may insert additional clauses or leave out clauses or may change whatever they consider as appropriate.
It is advisable that users discuss operational implications of the special requirements with the producer of aerial photography before preparing the annex.
Colour photography, photography for high quality orthophotomapping or for particular interpretation purposes may require separate appendices.
Users are invited to send comments on this specification to the President of Commission I who will pas it on to the Working Group dealing with specifications.

Comments should then be made available befor or at least at the Symposium in 1986, where they migth be considered, discussed and, if appropriate, inserted.

The second edition of the ISPRS specification for vertical aerial photography should then be available at the congress in Kyoto 1988.

As early as 1928 (Berlin, Lacmann) Specifications for the International Society were prepared. This, however, did not become an ISP standard. After the war several specifications have been prepared at various places but none of them as been adopted by the ISP. The first edition of this specification has been prepared based on the initiative of members of the British Air Survey Association (BASA) and the International Institute for Aerospace Survey and Earth Sciences (ITC) in The Netherlands (1976).
The Royal Institute of Chartered Surveyors (RICS) of United Kingdom has presented a first edition at the congress of the ISP in Hamburg 1980. An updated version was intensively discussed at the symposium of Commission I in Canberra, 1982 with the intention that Working Group 5 should present a first edition of the ISPRS specification in Rio 1984 for acceptance.
Canada has always been very active in the field of specification for aerial survey. Contributions from the National Research Conucil (NRC) in Canada, the Mapping Branch of the Energy, Mines and Resources Ministry in Canada and from mapping authorities and survey organizations in Australia, Germany and some other member countries have been inserted to a large extend.
An updated version of the RICS (second edition 1983) was then the basis for a workshop on specitications at the ITC in December 1983, to which all national correspondents of Commission I had been invited. The draft of the ISPRS spehification was prepared thereafter and send to the national correspondents for further comments to be made before April 1984, leading to the specification, first edition, of the ISPRS presented at the congress in 1984.
Expecting intenrsive discussion of those who had not yet a chance to comment it was intended to have the first edition of the specification edited after the congress and to get it printed in the proceedings. Indeed, various intensive discussions have cleared the way how to interprete the specification and have even lead to better statements in some cases which are inserted in this first edition. The dissemination of this fype of documents is not yet cleared.

For the period 1984-88 it was intended to let the specification be used during this period of four years and to collect comments. At the symposium in Stuttgart 1986 there was announced that the dissemination of this kind of information by the ISPRS seems to be a problem as there is no real instrument foreseen for this.
A questionnair on comparing the RICS and the ISPRS specification was sent by the UK national correspondent of Commission I to all national correspondents (summer 1987) with relative weak reply. The chairman of 1/5 has sent a questionnair to a selected group of companies, institutions and governmental organisations with a rather weak reply as well. After these activities the conclusion can be drawn that only a few members are really interested in the specification and its content. The reason might be that it is rather late seen the history of the ISP and the trend towards other technologies. One shall conclude that the specification should habe been rather early permanent part of the ISP activities at congresses.
Working Group 1/5 therefore proposes, that this modified version of the specification shall be adopted by the congress for the next period of four years, 1988-92, and that in this period - like in the period before - proposals shall be forwarded for changes and inprovements addressed to the president of the commission I who shall pass these on to the working group 1/5 which shall be kept active at least for the next period 1988-92.

ISPRS COMMISSION I
PRIMARY DATA ACQUISITION
WORKING GROUP 6

Microwave Remote Sensor Data

Session T56 — Microwave Systems
Saturday, July 9, 1988
13:30—15:00
Co-chairmen: J. Curlander (USA)
Ph. Hartl (F.R Germany)

This session consisted of seven papers primarily dedicated to proposed or planned microwave sensors:
J. Curlander (USA), Invited Paper
The Shuttle Imaging Radar (SIR-C): New Techniques in SAR Data Acquisition
Ch. Elachi (USA), *Ph. Hartl* (FR Germany)
TARRI — Terrain and Rain Radar Imager
S.N. Madsen, E.L. Christensen and N. Skou (Denmark)
KRAS — A Danish High Resolution Airborne SAR
S.R.J. Axelsson (Sweden)
Scanning Beam Radar Altimetry for Land Surface Monitoring
S.D. Wall (USA), presented by Johnson
Scientific Objectives of the Magellan Mission to Venus
Ph. Hartl, *H.M. Braun* (FR Germany)
A Bistatic Parasitical Radar (BIPAR)
G. Konecny, *W. Schuhr* (FR Germany)
Reliability of Radar Image Data

The first paper described the NASA imaging radar program (airborne and spaceborne) which is developing multifrequency/multipolarization synthetic aperture radar. Other papers on SAR included a high resolution airborne system being developed by Denmark and a description of the Magellan system, a SAR designed to map Venus. A novel design for a parasitical bistatic radar using existing communication satellites with an airborne receiver was also presented. Two papers on advanced altimeters for land terrain height mapping were presented with one featuring the characteristic of also monitoring rain rate. Finally a paper discussing the historic variation in reliability of radar data for mapping.
Prof. Hartl the outgoing Commission I president closed the session.

ACTIVITIES AND TRENDS OF PHOTOGRAMMETRIC AND REMOTE SENSING SYSTEMS FOR DATA PROCESSING AND ANALYSIS 1984—88 COMMISSION II REPORT

Lawrence W. Fritz

During the past 4 years, many major technological advancements have taken place that will significantly affect the future directions of our photogrammetric and remote sensing profession. ISPRS Commission II, responsible for "Instrumentation for Data Reduction and Analysis," has been privileged to recognize, acknowledge, research, develop, and report on these advancements. The change has been so dramatic that Commission II's name and areas of responsibility (Terms of Reference) have been reevaluated and major changes in both have been recommended for ratification by the XVI ISPRS General Assembly in Kyoto, Japan, July 1988.

Commission II — Instrumentation for Data Reduction and Analysis

It was recognized by the 1980—84 President of Commission II, Dr. Zarko Jaksic, and his Commission members that the term "Instrumentation" had become less descriptive of the tools that photogrammetic and remote sensing scientists use in the Profession. Instead "Systems" has become the predominant term that characterizes their tools. As a result, an adjustment to the new Commission II Terms of Reference replaces the term, instrumentation' with the term 'systems' to recognize that modern analysis systems include software and hardware and transcend the traditional meaning of 'instrument.' Similarly the term 'data reduction' has given way to 'data processing.' Thus it is now proposed that Commission II hereafter be titled "Systems for Data Processing and Analysis."

Commission II — Terms of Reference

The current terms of reference of Commission II are as follows:
Commission II — Instrumentation for Data Reduction and Analysis

- Design and construction of instruments for reduction, mensuration, analysis, and display of photographic and other remote sensor data.
- Calibration, accuracy and precision, and performance of data reduction and analysis instruments.
- Physiological factors in instrument design and operations.

At the March 1987 Annual Meeting of Commission II Officers a new set of Terms of reference for Commission II were refined to reflect modern technology and issues. The redefinition of Commission II areas of responsibility are proposed as follows:

Commission II — Systems for Data Processing and Analysis

- Design and development of systems for measurement, processing, analysis, presentation and storage of photogrammetric and remotely sensed data.
- Integrated information systems for georeferenced and other data bases.
- Design and performance of automated and intelligent data and information processing systems for correlation, measurement, compilation and interpretation.
- Evaluation, testing, calibration and performance of data processing and analysis systems.
- Standards for testing of systems for data exchange.
- Biotechnological factors in system design and operations.

Notable differences in this modernization of the terms to which Commission II activities are referenced include: 1) the emphasis on systems; 2) the recognition of digital imagery as well as analog imagery (film); 3) addition of systems for storage and data bases; 4) acknowledgment of automated and knowledge based systems (intelligent system); e) an emphasis on standards, especially for systems designed to transfer data between sensor, data base and processing systems; and f) change from physiological to biotechnological[1] factors.

Working Group Activities and Technology Trends

For the 1984—88 period, Commission II was organized into six Working Groups (WGs), sponsored the activities of the Intercommission I/II Working Group (IC WG), and promoted and financed the publication of the "Instruments for Teaching" Newsletter. All WGs were formed in accordance with six resolutions passed by the XV ISPRS General Assembly at Rio de Janeiro, Brazil, on June 28, 1984. (ISPRS Archives, 1984.) In late 1984 and early 1985, the WGs were formed and Terms of Reference for each were developed.

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[1]Biotechnology is the study of the relationship between human beings and machines, especially in terms of physiological, physchological, and technological requirements. (Random House, 1974.)

Membership of Commission II Working Groups is broad-based and consists of representatives from manufacturers, research laboratories, universities, government and private production organizations. WG Chairmen are selected by the Commission President based on their proven accomplishments and leadership related to the domain of the WG and to ensure an international perspective is maintained. When appropriate, WG Co-chairmen are selected on a wide geographical basis to facilitate communications between WG members of different continents. Similarly, WG members are solicited on an international basis. The following is a synopsis for the 1984—88 period of each WG's Terms of Reference and other relevant information regarding its activities and future trends of its technology.

Working Group II/1 "Analytical Instruments"

Chairman: Morris L. McKenzie, U.S. Geological Survey (retired), U.S.A.
Secretary: Chester C Slama, NOAA/National Ocean Service (retired), U.S.A.
28 Members

WG II/1 has been responsible for activities related to all analytical photogrammetric instruments and is developing testing procedures, standardized programs, and data exchange for analytical stereoplotters. Primary goals, which were achieved, were to produce: 1) a manual containing an updated ISPRS Analytical Stereoplotter Evaluation Guide; 2) an assemblage of testing procedures; 3) guidelines for standardizing input, output, and computer programs; and 4) a reference manual listing analytical photogrammetric instrument manufacturers. (See Fig. 1.)

Trends identified in analytical instruments include the predomination of analytical stereoplotter systems (ASP's) for aerotriangulation, feature extraction and digital vector output; superimposition in stereo and/or color; on-line automated functions for registration, point setting and calibration; large format stages for multimodelling and large format sensors (LFC, KFA-1000, etc.); and open architecture software design.

Working Group II/2 "Photogrammetric Digital Image Processing Systems"

Chairman: Dr. Zarko Jaksic, National Research Council of Canada, Canada
Secretary: David Havelock, National Research Council of Canada, Canada
30 Members

WG II/2 was established to address intelligent information compilation systems, metric digital imagery processing, and design principles and performance characteristics of photogrammetric digital imaging processing systems. Objectives were to review, discuss, and report on digital processing systems with emphasis on concepts, definitions of types, functions and structures; design principles, characteristics and optimal configurations; evaluation criteria, performance parameters, and testingk procedures.

Trends noted in this growing field of technology include the development of digital stereoimage processing stations for precision real-time metrology and for semi-automated feature extraction; faster processing on more powerful on-line 32 bit microprocessor; on-line automatic correlation with spatial filtering; real-time quality control systems for industrial metrology; and virtual n-stage comparators.

Working Group II/3 "Systems for Analysis of Remotely Sensed Data"

Chairman: Dr. W. Murray Strome, Perceptron Computing Inc., Canada
Co-chairman: Frederick C. Billingsley, Jet Propulsion Laboratory, U.S.A.
30 Members

WG II/3 has been emphasizing digital analysis and optical imaging processing. The WG's aim is to advance standardization for digital data interchange as well as of hardware, and analysis of software interfaces. In addition, the WG has addressed the rapid advances being made in commercially available optical recording technology. Five primary topics were addressed including; systems, media-conversion devices, computer graphics applied to image processing, special devices, and interfaces.

Trends have been toward more powerful computers utilizing super- and concurrent-computer architectures with bus capabilities of greater than 40 megabytes per second; associative memory; distributed image processing; optical storage technologies (CD-ROM, 5.25 inch WORM); integration and synthesis of data sources — both image and vector data; and development of standards for raster/vector conversions, data description, and for formats for transmission, transfer and archiving.

Working Group II/4 "Systems for Reception, Recording, Preprocessing, Archiving, and Dissemination of Remotely Sensed Data"

Chairman: Russell Koffler, NOAA/National Environmental Satellite Data and Information Service, USA
Secretary: Mr. Michael Matson, NOAA/National Environmental Satellite Data and Information Service, USA
10 Members

WG II/4 has concentrated on three areas: preprocessing, storage, and dissemination of data; the assessment of available instrumentation and technological trends; and the identification of priority areas where the need for special research activities is expected. The WG is also addressing compatibility of products and standards of international remote sensing programs.

Trends identified by WG II/4 include the use of array processors for preprocessing to remove radiometric and geometric distortions; use of optical disk for recording and archiving; development of Artificial Intelligence/Expert Systems to merge and synthesize data from multiple sensor systems; and development of new strategies for handling large volumes of data, i.e., hundreds of gigabytes daily per reception site.

Working Group II/5 "Systems and Instrumentation for Synthetic Aperture Radar Processing"

Chairman: Dr. Andrew Goldfinger, Applied Physics Laboratory, U.S.A.
Co-chairman: Dr. Jean Pierre Guignard, European Space Agency, the Netherlands
58 Members

WG II/5 has been promoting the development of systems and instrumentation for Synthetic Aperture Radar (SAR) preprocessing and information extraction. Five primary topic areas have been addressed: 1) SAR preprocessing; 2) SAR image processing, and information extraction, including radargrammetry; 3) calibration and validation; 4) precision product development and dissemination; and 5) integration with other sensors. The WG also decided to prepare a tutorial book on SAR to help bridge the gap between the microwave and optical remote sensing communities by exposing a larger audience to SAR technology and applications.

Trends identified in SAR technology include the development of multifrequency, multipolarization SAR imagers; the use of phased array antennas with solid state amplifiers; the use of supercomputer systems with pipelining and parallelism architectures to perform signal processing at 300—400 megaflops per second; more use of radargrammetry and stereoradar extraction on analytical stereoplotters; and the development of radar image simulators to prepare for future SAR missions.

Working Group II/6 "Integrated Photogrammetric Systems"

Chairman: Dr. Branko Makarovic, International Institute for Aerial Survey and Earth Sciences, The Netherlands
Co-chairman: Dr. Mossad Allam, Department of Energy, Mines and Resources, Canada
32 Members

WG II/6 was a new WG formed to promote research and development in the areas of integrated information systems with emphasis on photogrammetric collection and conditioning of geographic based information. Three subgroups were formed on concepts and models, design and development, and existing systems. Six primary topical areas have been addressed: photogrammetric concepts and system models; design and development; existing integrated systems; performance and reliability studies; evaluation; and impact on organizational and technological environment.

Trends in this field include the development of versatile processing stations for multisensor inputs, e.g. combined capability for mono and stereoplotting, orthophoto and editing; integration of photogrammetric instruments into digital mapping systems; development of digital image analysis systems with embedded software; and the use of open architectural designs to permit ready capture of benefits from new technological advancements.

Intercommission I/II Working Group — "Acquisition and Use of Space Photographic Data"

Chairman: Dr. Klaus Szangolies, Scientific Technical Society for Geodesy, Photogrammetry, and Cartography, German Dem. Rep.

IC WG I/II has concentrated its activity on optical-photographic cameras for space and on instruments and techniques for restitution and evaluation of space photography. The WG has been addressing new and existing space cameras; films; and processing equipment; investigating space camera technical parameters; estimating useful information content and volume of various sensors systems; potentials for international test field; and trends for future developments.

Trends observed in this activity include the development and testing of new high resolution metric space cameras (Metric Camera, Large Format Camera, Soviet KFA-1000 Camera) that can offer potential of 1:50,000 worldwide mapping; development of higher resolution films; and the development of systems designed to synthesize topographic and thematic products from a variety of imaging sensors, e.g., multispectral, metric, microwave, etc.

ISPRS Commissions II and VI Newsletter — "Instrumentation for Teaching"

Editor: Dr. Ian Dowman, University College London, United Kingdom

This newsletter activity has been established to address the unique needs of the teaching profession in photogrammetry and remote sensing. These needs include the awareness and hands-on experience of students to modern technology at a minimal cost. Not all universities can afford to own and maintain the sophistication of image processing and photomeasurement systems available. The availability of low cost instrument systems permit the basic principles to be demonstrated and taught. The Newsletter surveys and reports on worldwide developments and availability of instrument systems from manufacturers on surplus from major organizations. (See Fig. 1.) it is published at a minimum of one issue per year and is distributed worldwide with Commission II financing and under joint sponsorship of Commission VI.

Meetings and Conferences

Commission II has organized and participated in many formal meetings at which technical presentations were delivered by WG members. Individual WGs often hold informal meetings during other scheduled conferences and events. In addition, a formal Commission II Officers Meeting has been held annually at which all WG Chairman, Co-chairs and Secretaries participate in discussions on Commission II directions and objectives. A summary of the activities at these meetings follows:

13 March 1985 — *Commission II Officers Business Meeting*
held in Washington, D.C., USA, during the annual ASPRS convention for review WG terms of references, WG membership, and conduct of Commission II business.

14-16 January 1985 — *Joint Working Groups II/2, II/2 and II/6 Colloquium and Business Meeting*
convened in Rockville, Maryland, USA, and sponsored by NOAA/National Ocean Service. The meeting was highlighted by the delivery of nine technical presentations and a tour of the photogrammetric facilities at the National Ocean Service.

17 March 1986 — *Commission II Officers Business Meeting*
held in Washington, D.C., USA, during the annual ASPRS convention with reports on WG activities and final coordination and preparation of for the Commission II mid-Congress Symposium.

26-30 May 1986 Commission II Symposium — *Photogrammetric and Remote Sensing Systems for Data Processing and Analysis*
was a week-long activity in Baltimore, Maryland, USA, that began with WG business meetings. A total of 80 formal presentations were made to an audience of 150 registered attendees. A modest commercial exhibition of instruments and systems was conducted by 12 companies and agencies from Tuesday through Thursday. Social activities included an outstanding reception in the National Aquarium, a dinner cruise and an organ recital. At the opening

reception, Past President Commission II, Dr. Z. Jaksic, was presented the Key to the City of Baltimore, and Prof. G. Togliatti represented ISPRS Council in receiving the Proclamation of "ISPRS Week" by the City of Baltimore. A program for accompanying persons was also prepared. In total, 190 individuals participated as attendees, exhibitors, and committee members. The technical program by each of the seven WGs was preceded by a tutorial on the WG's technical domain. The 90-minute sessions included five to six technical papers which, in retrospect, severely limited technical discussions. The two Manufacturers' Forums, for photogrammetry and remote sensing instrumentation respectively, were quite satisfactory. The joint panel discussions were successful and generated significant audience participation. The week concluded with Friday afternoon WG business meetings to prepare for future activities. The proceedings were published (627 pp.) and are available from ASPRS. (See Fig. 2.)

31 March 1987 — *Commission II Officers Business Meeting*
held in Baltimore, Maryland, USA, during the annual ASPRS Convention. Reviewed deliberations from ISPRS Council meetings with Commission Presidents at Edinburgh, Scotland; reviewed WG activities; completed revision of Commission II Terms of Reference; and made initial plans for Kyoto Congress.

31 March-1 April 1987 — *Joint WG II/3 and II/4 Technical Sessions*
conducted under auspices of ASPRS/ACSM Auto/Carto convention was organized by R. Koffler, Chairman WG II/4 and M. Strome, Chairman WG II/3. Highlighted by 10 technical presentations on topics of artificial intelligence and expert systems for remote sensing systems and standards for processing remotely sensed data, the sessions concluded with a joint WG II/3 and II/4 business meeting.

2-4 June 1987 — *Intercommission Conference on Fast Processing of Photogrammetric Data*
held at Interlaken, Switzerland, and sponsored by the Institute of Geodesy and Photogrammetry, ETH Zurich. This three Commission conference was jointly organized by Prof. Dr. A. Gruen and WG's II/2, III/2, and V/6 and was highlighted by 31 technical presentations and one panel discussion. The proceedings are published (437 pp.) and are available from ETH. (See Fig. 2.)

9-12 June 1987 — *Systems and Instrumentation for Synthetic Aperture Radar Processing*
conducted by WG II/5 at Ecole Nationale Superieure Des Techniques Industrielles et Des Mines D'Ales (ENSIMA) was organized by Dr. J.P. Guignard, Co-chairman of WG II/5 and was highlighted by seven invited technical presentations and discussions focussed on SAR product simulation, SAR precision processing and SAR geocoding. The Ales Meeting concluded with discussion of the proposed SAR tutorial book and WG business.

4-6 September 1987 — *International Scientific Colloquium — Use of Space Photographic Data for mapping of the Earth Surface*
was held in Leipzig, German Democratic Republic, and organized by Prof. Dr. K. Szangolies, Chairman of Intercommission WG I/II. This "Space Photography" meeting was sponsored by WTG GPK of the Chamber of Technology, German Dem. Rep., with the assistance of Kombinat VEB Carl Zeiss JENA and was highlighted by over 30 technical presentations and the Zeiss Jena exhibition at the Leipzig Fair. The proceedings were published (226 pp.) and are available from Chamber of Technology WTG GPK. (See Fig. 2.)

21-23 September 1987 — *Joint Colloquium of Working Groups II/1, II/2, and II/6*
was held at University College London, United Kingdom, and organized by Dr. Ian Dowman. The meeting was highlighted by 19 technical presentations and a visit to the photogrammetric and remote sensing laboratories at University College London. A business meeting was held to coordinate WG activities for the Kyoto Congress.

2-6 November 1987 — *International Conference and Workshop on Analytical Instrumentation*
was held in Phoenix, Arizona, USA, and sponsored by WG II/1 and ASPRS. Deborah Johnson, member of WG II/1, was Director aof this conference. It was highlighted by eight tutorials by noted experts, 24 technical presentations, a panel discussion and hands-on workshops by eight manufacturers. The proceedings were published (447 pp.) and are available from ASPRS. (See Fig. 2.)

2 December 1987 — *Joint Working group II/3, II/4, and II/5 Officers Business Meeting*
was conducted in Beltsville, Maryland, USA, to review WG activities and to coordinate WG activities for the Kyoto Congress.

15 March 1988 — *Commission II Officers Business Meeting*
held in St. Louis, Missouri, USA, during the annual ASPRS convention for final review of the technical and business program for the XVI Congress. Draft resolutions and future directions for the Commission II were discussed.

Commission II — Future Work

The future of Commission II has been discussed by its current officers and is expressed in a series of draft resolutions prepared for discussion and acceptance at the 1988 XVI ISPRS Congress in Kyoto. A summary of some of the recommendations contained in draft resolutions are as follows:

- That WG II/1 on "Analytical Instruments" be continued for the 1988—92 term to address expansion of the reports on standardization and testing and to survey the users and ——

Acknowledgements

Commission II activities have flourished during the 1984—88 period. Although some goals and objectives, such as the tutorial book on Synthetic Aperture Radar, were not completed as originally planned, the overall contributions by the WG Officers and members were significant. As summarized above, many contributions in the form of evaluation and testing manuals, manufacturer guides, survey questionnaires and reports, conference proceedings, technical symposia, informal meetings and colloquia, individual WG newsletters and the newsletter "Instrumentation for Teaching" have been successfully prepared. I sincerely appreciate the contributions of those many individuals and organizations responsible for these successes.

References

International Archives of Photogrammetry and Remote Sensing, ISPRS Rio de Janeiro, 1984, published by the Committee of the XVth International Congress of Photogrammetry and Remote Sensing, 87—89.
The Random House Dictionary of the English Language, The Unabridged Edition, 1974.

ISPRS COMMISSION II
Introduction of New Instruments
Commission II Manufacturer's Forum

Session MF1
Friday July 1, 13:30—15:15
Chairman: Lawarence W. Fritz

Panel Members:
Werner Marckwardt, Carl Zeiss Jena
Marco Nardini, Galileo Siscam S.P.A.
Kohei Yoshida, Kimoto and Co., Ltd.
Bill Reed, Eastman Kodak Co.
David Hawkins, MacDonald-Detwiler
Haruo Takeuchi, Pasco Corp.
Ashoki Sujanani, Intergraph Corp.
Peter Norris, EOSAT Co.

Session MF2
15:30—17:00

Asia Air Survey
Cambridge Instruments
Carl Zeiss
Kern
Kokusai Kogyo
Uchida Yoko
Wild
Nihon Computer Graphic
Sumisho Electronics

W. Marckwardt- Instrument developments of the 80's involve microcomputer control systems with emphasis on developing instrument systems for aerial photography and multispectral photo analysis as well as for analytical evaluations. Developments since the last ISPRS congress include:
MTU 5300/P magnetic tape unit with a parallel interface for Zeiss Jena instruments,
Dicometer stereocomparator,
ZIF 2 digital interface,
LMK 1000 aerial camera,
NCU navigation control,
FEAG 400 for scanning and writing data,
DZT 912 digital plotting table,
Kartaflex M for interpretation and map revision.

M. Nardini- Galileo Siscam is designing a semiautomatic stereoplotter and is also developing an image acquisition and management system. The "Terrestrial Information systems section is building a Universal Cartographic System to manage data and make both general and special-purpose maps. Gallileo is also addressing instrumentation for data bases, architectural and archeological work, and for industrial applications. The Digicart 40 System is an analytical steroplotter, integrated with a cartographic information system.

K. Yoshida- Instruments developed by Kimoto include the Kimograph plotter, available in both a flat bed and drum-type model. Kimoto also produces drafting films, coated films, and paper bases for electrostatic drafting and high-speed scribing, inking, and general drafting.

B. Reed- Kodak has a new image computing environment that performs measurements of images as well as storage and hard-copy production. Traditional equipment include the MESA film-handling work station, Niagara printer, BEACON enlarger, and the DEKTOMATIC 65 paper processor.

D. Hawkins- Among the many airborne and space-data application systems developed by MacDonald-Detwiler are:
Image Mapping Systems for Quick-response mapping, resource management, and land-use planning,
systems for acquiring, correcting, analyzing, and displaying both optical and scanning imagery, whatever the source,
Meterological Data Analysis and Distribution Systems,
high-resolution, high-speed laser imaging systems for manufacturing electronics, graphics reproduction, and remote-sensing industries,
flight operations management and air-traffic control systems,
Space-Qualified Systems

H. Takeuchi- Paso started as a surveying company, expanded into photogrammetry, and is now deeply involved in Geographics Information Systems, applying the latest technologies in developing several powerful information and mapping systems. Among them are:
PADRAS (Pasco Archaeological Drawing System) performs the photography, surveying, and delineation of archeological sites, and it is a mobile system built into a special microbus.
IRISYS was developed to support road surface condition maintenance and management projects. It uses laser technology to gather road surface conditions.
Many systems for data retrieval, storage, processing, and manipulation.

A. Sujanani- The Intergraph Corporation's TIGRIS is workstation software comprising four components: a mapper, an analyst, and imager, and a modeler.
The mapper is for gathering data from a variety of sources such as digitizing tablets, CRT displays, and digital scanners.
The analyst topologically structures queries and reports.
The imager is a full-function, interactive, multispectral image processing and analysis system.
The modeler provides topologically structured terrain analyses.

P. Norris- EOSAT operates the Landsat remote sensing satellites and delivers up-to-date data for mapping and planning. It

has a network of 14 receiving stations scattered around the globe with plans to expand this number. EOSAT is committed to the continuance of the development of new products and services.

ISPRS COMMISSION II
Analytical Instruments

Session T11
Sunday, 3rd July, 9—10:30
Chairman: Morris McKenzie

1. "Developments in Analytical Instrumentation", G. Petrie (United Kingdom)
   The paper discussed the trends in instrumentation since 1980 and gave details of the equipment available. The main trends evident are:
   1. Analogue machines are now virtually nonexistent in the marketplace.
   2. There has been limited development and availability in comparators.
   3. Rapid development of relatively inexpensive image space plotters and analytical plotters of low to medium accuracy.
   4. The classical high accuracy analytical plotters from the main manufacturers continue to be produced in fair numbers.
   5. The introduction of very expensive and very sophisticated instruments which feature graphics work stations integrated in their design.
   6. The development and use of correlators and analytical controlled orthophoto printers has been surprisingly limited.

2. "Progressive Sampling-A New Realization of a Method for Interactive Data Collection for Digital Elevation Models on Analytical Plotter", H. Mann (Austria)

   The paper develops the idea of progressive sampling which was first proposed by Makarovic in the 1970's using an initial coarse mesh intensified after looking at second order differences. The new system uses a triangular mesh whose initial size is determined by factors such as the base height ratio, and the boundary of the area can be delineated by a four point quadrilateral.

   The triangular mesh can include break lines and points can be picked on selected features so that the mesh can more accurately model the terrain than would be possible with a rectangular mesh.

   The program is implemented on a BC-2 plotter, and results of the new system were given to illustrate the increased accuracy from a reduction of sampled points.

3. "Handling of Panoramic and Extreme High Oblique Photographs in Analytical Plotters"., K. Jacobsen (Germany)

   The main problems with these types of photography is that there may be no perspective geometry, and there are special random and systematic errors.

   With the extreme high oblique photographs it is not possible to carry out the orientation in a normal manner; however, a solution is possible using a special bundle solution using additional parameters. The projection of the panoramic photo to a target plane gives a perspective image. Examples were given of the processing showing the effects of adding additional parameters. For handling on an analytical plotter the results of the bundle solution are loaded together with a correction grid.

4. "Stability Testing of Analytical Plotters"., A. Laiho and E. Kilpela (Finland)

   Tests were carried out on six Analytical plotters with measurements being every half hour with a system which gave a mean pointing error of 1.5 microns. Attention was paid to various factors such as measuring order and direction, time dependency, whether the control panel was on or off, heating effects etc.

   There were some instabilities in all instruments measured, ranging from 2—5 μm to 2—10 μm in a single day. The biggest changes occurred in the first hour.

   Better temperature control improves stability, and there was no apparent major systematic pattern in the instabilities. Plotters with linear encoding devices tended to be more stable than those with spindle encoders. Random large shifts of up to 100 μm were sometimes recorded.

   Comment from a representative of the University of Hanover "They have observed similar results, and found that the origin shift with the Zeiss Planicomp in XL and XR were reverse. The DSR-11 was more stable, but sometimes threw up large errors. For guaranteed results they now observe all points for block adjustment twice, the second pass being made in the reverse order to the first" .

   Comment form Dr. Hobbie from Zeiss. "They have carried out similar tests and have found smaller residuals particularly in the later Zeiss instruments. He recommended that analytical instruments should be used in an environment with very good temperature control" .

5. "On line aspects of Stereophotogrammetric processing of SPOT images"., V. Kratky (Canada)

The paper first gave a quick summary of the problems in analyzing SPOT data, including those associated with push broom sampling, and the dynamic effects of sattelite images. The discussion then continued with the computational work load in the real time loop for analytical plotters if the complete modelling of these effects are to be performed. Solutions to reduce this problem were proposed with formulas and techniques being discussed. Stereovision aspects were then considered, particularly when one image was from a vertical scan, and the next from an oblique scan.

Comment from Igor Doran of FRG Germany, that they use a biquadratic approach to the polynomials.

Comment from Grabmier of the ITC that in their experience with SPOT images there was no physical problem in stereo vision even if there was one vertical and one oblique image. Dr. Kratky disagreed with this point of view, and time constraints did not permit further discussion in this session.

ISPRS COMMISSION II
Photogrammetric Digital Image Processing Systems

Session T14
Sunday, 3rd July 11:00—12:30
Chairman: Zarko Jaksic (Canada)

1. Z. Jaksic (Canada) gave a short review of the working group activities.

2. "On System Concepts for Digital Automation"., U.V. Helava, U.S.A. Because of the absence of Helava the paper was presented by Z. Jaksic.

   The paper deals with four main topics: It starts with an evaluation of the merit of digital photogrammetry, coming to the conclusion that it is well performed for automation. Tasks like interior, relative, absolute orientation and digital orthophoto production are easy to be done. While DTM generation can only be done for small scales because of problems with bare earth DTM, there are more severe problems with feature extraction. Here a semi-automatic solution is possible. The current status of digital systems is that most systems for mapping applications are black box systems with the hindrances of the lack of cameras which will be overcome, and the problem of feature extraction. Especially industrial applications are promising, e.g., real time operations and quality control. The last statement was that success for sure will come and that software will play a dominating role.

3. "Digital Stereophotogrammetry — Experience with an Experimental System"., G. Koenig, W. Nickel, J. Storl,, FR Germany

   Referring to the concept presented in Rio '84 the main structure of the now experimental Digital Stereophotogrammetric System (DSS) is shown. As a test area an aerial photograph of the Brechev-Spitye was scanned (25 um). Fiducial mark matching, relative and absolute orientation and 3-D processing with plausibility checks are performed. Difficulties arise in shady parts of the photos and times for resampling and correlation of 9 h and 25 h are mentioned. Future developments as a RISC computer as a host, parallel processing architecture, parallel transfer disks and a stereocopic display are listed.

4. "The design and implementation of a Digital Photogrammetric Stereo-Workstation"., P. Lohmann, G. Picht, K. Jacobsen, L. Skog, FR Germany

   The system is based on a commercially available image processing system, the GOP 3000. A drawing shows the whole system with a SUN3 computer connected via a VME-Bus to the other components as a minimum configuration. Stereo viewing is possible by two displays. The system further includes measurement and orientation programs and software for DTM generation, DTM editing and contour line generating.

5. "A Digital Reseau-Scanning Comparator System"., T. Luhmann FR Germany

   A digital mono-comparator system with a CCD camera for the digitizing of small image patches is presented. For each position the sensor orientation is found by automatic reseau cross detection and following numerical transformation. Finally the application of the system to a test area and a measurement of a car is demonstrated.

ISPRS COMMISSION II
Integrated Photogrammetric Systems

Session T17
July 3rd, 13:30—15:00
Chairman: Branko Makarovic, The Netherlands

Six papers were presented during the session, but no discussions could take place because of shortage of time.

1. "Context and Integration of Photogrammetric Production Lines". B. Makarovic, (The Netherlands).

   Makarovic stresses the need of optimization of the photogrammetric production lines in the context of GIS/LIS. He emphasizes optimal integration of the components for this goal.

2. "The effects of Digital Photogrammetry on Existing Photogrammetric Concepts, Procedures and Systems". T. Schenk, (USA).

   Digital photogrammetry, which evolved through analytical from analog offers considerable automation potentials. Schenk lists the present automation capabilities and emphasizes the need for cooperation with the cognitive sciences and artificial iantelligence to come to a much higher degree of automation eventually.

3. "Factors Influencing the Design of Modern Photogrammetric Systems". A.A. Elassal, (USA).

   Modern photogrammetric systems are integrated systems. The supporting technologies are database management, computer graphics, analytical stereoplotters and networking. Major design issues are photogrammetric process integrity and a sound interface architecture. Elassal stresses the importance of well integrated processes such, that the hardware components are easily replaceable.

4. "The Role of Integrated Photogrammetric systems in Geographic Information Systems Technology". M.M. Allam, (Canada).

   Allam stresses the importance of integration of data capture and editing systems into GIS. This must comprise compatibility of vector based digitization data and raster based results from digital image processing systems.

5. "A Digital Image Mapping System". G. Konecy, P. Lohman and L. Skog, (F.R. Germany).

   Skog briefly introduces the "Context Mapper" , a digital image processing system for photogrammetry, cartography and remote sensing. It's photogrammetric components allow orthophoto productions, mono-plotting and stereo-plotting from digital images.

6. "A Digital Three Line Stereo Scanner System". O. Hofmann, (F.R. Germany).

   Hofmann describes a planned digital mapping system using the triple push broom scanner of MBB, which has a forward, a vertical and a backward looking sensor array. Besides the immediate stereo capability the system allows easy determination of the orientation parameters and therefore is preferable to single array push broom scanning for mapping.

ISPRS COMMISSION II
Photogrammetric Systems for Data Processing and Analysis

Session T30
July 6, 1:30
Chairman: Lawrence W. Fritz

Panel Members:
Gordon Petrie, University of Glassgow, U.K.
Zarko Jaksic, National Research Council of Canada, Canada
Ian J. Dowman, University College London, U.K.
Klaus Szangolies, Technical University, Dresden
Sabry El-Hakim, National Research Council of Canada, Canada
Branko Makarovic, ITC, The Netherlands
Armin Gruen, Institute of Geodesy and Photogrammetry, Switzerland

L. Fritz-Four Commission II working groups are represented on the panel, Working Groups II/1, II/2, II/6, and I/II. In addition, Dr. Dowman is representing the newsletter "Instrumentation in Teaching." (Fritz introduced the panel members and outlined plans for the program.)

G. Petrie-Analytical Systems

In analytical systems development, comparators are disappearing, being replaced by analytical mono- and stereoplotters. The trend is toward image-space plotting instruments and lower-cost instruments in general. Instruments of these types are especially popular in environmental mapping. The question is how long will is be before the new trend takes off, or "where do we go from here?"

Z. Jaksic-Photogrammetric Digital Image processing Systems

Development of digital image processing systems depends on the unification of measuring, image manipulation, and interpretation techniques. The end objective is full automation, put present technology in digital photogrammetry do not allow attaining this objective. Therefore, developments are directed along two categories of systems; interactive systems with human intervention and real time systems for close-range applications without human intervention. Since the last congress, good progress has been made in both categories in spite of technical limitations. Artificial intelligence is important to further developments toward realtime, fully automated systems, and it is based on the concept that thinking and computing are the same. This concept might or might not be correct.

I. Dowman-User Friendly Systems

It would take all time allotted here to define user friendly systems. They not only guide operators through procedures, but they allow addition, deletion, and editing of data, plus letting the operator know what is going on within the system. They include features such as voice recognition, automatic error detection, touch control, and online graphics. Future developments will be directed toward perfecting these features so as to reduce the role of the operator, thereby making life easier and the operator happy.

K. Szangolies-Systems for Space Photography

Rather than divide restitution for surveying and mapping into geodesy, photogrammetry, and photography, it is best divided into data acquisition, processing, storage, and transportation. Space photography is one kind of data acquisition, and restitution of space photos is not much different from restitution of aerial photos. For data processing, space photos can be used directly or digitized with a scanner and then used.

Systems for space photos can be divided into four groups:

- computer-controlled video systems for digitized photos,
- Computer-aided systems for restitution with instruments such as analytical stereoplotters.
- optical rectifiers,
- automated interpreters.

Many of these instruments under development for conventional aerial photos can be used for space photos.

S. El-Hakim-Systems for Industrial Applications

Over the past 30 years, there has been significant development of photogrammetric systems, but industry has been slow to take advantage of these developments. For realtime applications, developments are needed in computers, camera, and plotters, but in general, the future is now. Existing systems are adequate for today's applications.

B. Makarovic-Integrated Systems

What and why to integrate need to be addressed as well as the problems involved. As to what should be integrated, the system should be an integral part of the external environment, fully compatible with its broader context. The main items involved are the system functions, the resources, the data, the interactive and automatic capabilities, quality control, and the production lines. Strongly interrelated structures are essential in system integration and also of concern are data, procedures, algorithms, and hardware.

Answering the question as to why integrate, the objectives reflect the needs, which emerge from such factors as advances in information technology. Needs can be categorized as general and specific. General needs concern data bases, standardization, and transition to more detailed data, automated components, faster responses, and wide-area communication. Specific needs concern capability to handle new types of data, greater efficiency, improved quality, networking, and balancing of interactive and automatic operations.

Some of the problems involved are knowledge about impact on the environment and internal system of the facility; standardization of data, software, and hardware; and the impact on personnel.

A. Gruen-Performance of Digital Systems

Prof. Gruen expresses disagreement with several points that had been made in a paper by Mr. U. Helava. These disagreements sparked lively discussions at the end of the panel presentations. Prof. Gruen stresses that we should be careful with names lest we repeat some of the pitfalls encountered in designating the analytical and digital plotters and other instruments.

Operator interventions and displays are needed under the present state-of-the-art. Digital efficiency has not yet matched analog efficiency except in offline modes.

ISPRS COMMISSION II
Systems for Analysis of Remotely Sensed Data

Session T31
Thursday, July 7, 9:00—10:3032
Chairman: David Goodenough (Canada)

1. "A proposed Standard Test Procedure for Conversion between Raster and Vector Data", J.M. Piwowar and E.F. LeDrew (Canada).

2. "Associative Memory for Pattern Recognition-An Implementation", J.B. Escada, Jr. (Brazil).

3. "Automatic Generation of Image Ground Control Features from a Digital Map Database", A. Stevens, A.C. Morris, T. J. Ibbs, M.J. Jackson, J.P. Muller (United Kingdom).

4. "Development of a Man-Machine Interactive System to Detect Land Use Changes by Using Remote Sensing Data", R. Matsuoka, H. Hasegawa, I. Ikeshima (Japan).

5. "Landsat TM Image Recognition by use of Power Spectrum Analysis", Q. Liu, J. Xu, Y. He (China).

ISPRS COMMISSION II
National Programs for Handling Large Volumes of Satellite Data

Session T34
July 7, 11:00—12:30
Chairman: Mr. Jack A. Koeppen

1. Working Group Review (J. Koeppen, U.S.A.)
   Working group focus-systems, volume of data, organization and dissemination of data.

2. "Technical Conditions for Large Volume Data Handling on Future Earth Observation Ground System"., T. Tanaka, S. Miida, Y. Suzuki, K. Ayabe, K. Arai and H. Sato (Japan). Presented by Mr. Nobuyoshi.
   Future ground handling system of NASDA. New systems (e.g. ADEOS) will have large volume data streams. Technical solution: large capacity systems, high speed systems, high density systems. New recording media to help solve data problems of future; optical disk, optical tape. Technology must be standardized.

3. "National Program for Handling Large Volumels of Satellite Data"., B.L. Deekshatulu (India).

   Overview of India National Remote Sensing Agency (NRSA), which processes Landsat, SPOT, IRS, and meteorological satellite data. Demand for satellite data has increased. Users also demand higher quality. Multimillion dollar program ($5M) is underway to upgrade processing facilities and archival at NRSA. Recommendations for improvements:
   High speed I/O flexible system to handle all types of data
   Reduce archival to manageable size
   Past archive must be screened. Future archival datamust be screened. Only useful scenes saved
   An integrated information management system must be setup to handle archiving.

4. "Some Methods for Standardization Enhancement and Handling of Satellite Data in China RSGS", Y. Gu A.Y. Dai (China).

   Overview of organizational structure of remote sensing program in China.
   Remote Sensing Satellite Ground Station in China can provide digital and analog scenes at various scales, enhancement, and formats.
   There is a lack of a precise film recorder, powerful hardware and software, and photolab equipment.
   Landsat enhancements and multispectral enhancements are being standardized for users.
   Showed several standardized enhancements of Landsat scenes of large Chinese fires in 1987.

5. "The Brazilian Experience in Handline 15 years of Remote Sensing Satellite Data", M.N. Barbosa and S. De P. Pereira (Brazil).

   1970's — experience with Landsat data.
   Also involved with Data Collection Platforms.
   Now defining a space mission for remote sensing satellites in the 1990's.
   Use of digital products has increased while photo products use has decreased.
   Daeveloping image analysis systems.
   Applications: natural resources, cartography, geographics information systems, land planning, irrigation.
   Activities 1985 on: Complete Landsat-SPOT ground station, GIS development, Data distribution network, Training center.

6. "ESA's Activities and Plans for Remote Sensing Data Systems". L. Fusco (Italy)., for L. Marelli.
   Overview of ESA EARTHNET program:
   Handled; Landsat, SEASAT, HCCM, NIMBUS 7, Metric Camera, NOAA, MOS.
   Future: ERS-1, Landsat-6, Radarsat, J-ERS 1, ADEOS, Polar Platform.
   Trends: Missions moving from experimental to operational. Moving from single instruments platforms to multi-instrument platforms. Regional coverage to global coverage. Qualitative analysis to quantitative analysis.
   Decentralize network of satellite acquisition sites is recommended to support specific users. Realtime support to users.
   Centralized satellite acquisition sites are need for primary satellite interface.
   Archiving problem. Data must be screened. New storage media are required. Archive all low bit rate data. Selectively archive high bit rate data.
   Effective user interfaces must be maintained. Trend is toward centralized, global, multimission user catalogues.

ISPRS COMMISSION II
System and Instrumentation for Synthetic Aperture Radar Processing

Session T37
July 7, 11:00—12:30
Chairman: Andy Goldfinger

1. "The Magellan Radar Mission to Venus" (Invited Paper)., W.T.K. Johnson (JPL-U.S.A.).

   Venus is an enigmatic planet due to its perpetual cloud cover. The Magellan mission (previously known as VOIR) will be launched by the Space Shuttle in 1989 and will carry a synthetic aperture radar. The goal is to map the entire planet. The radar system is rather unusual since the orbit will be highly elliptical and also since the radar will be operated in an open loop mode. This will require parameters such as prf and look angle to be commanded up to three days in advanced. The radar will operate in a burst mode and the rapidly changing geometry will complicate the mapping task. The first questioner asked what portion of the planet would be mapped. The speaker answered that the entire planet is the goal. T. Wolff of ESA asked whether a redundant coding scheme would be used for the primary data. The speaker answered that the raw data would not be encoded, only the header data would be. The final question concerned system resolution. The basic resolution will be 80 m in slant range which becomes 110 meters on the ground, corresponding to about 250 meter line pair resolution in range.

2. "ERS-1 SAR Processing with CESAR", (E.A. Herland, (NORE-Norway).

   Norway is interested in the use of SAR for monitoring its extensive coastal zone. The ERS-1 SAR will be used as a test bed. To accomplish rapid processing, the CESAT distributed processing system will bel used. The system has at its core

cylindrical configurations of bitserial processors called MALU's (multiple programmed arithmetic logic units). The arrays can function as MIMD architectures. Although the overall topology is cylindrical, processor interconnections can be programmed. The overall system performance is 120 to 320 Mflops, allowing a 100 km by 100 km scene to be processed in less than 8 minutes. The chairman asked about the overall architecture and the speaker answered that some parts were SIMD and others MIMD. Mr. Hoogeboom (Netherlands) asked about some market availability of CESAR. Mr. Herland replied that since NORE is a research institution, it does not do marketing, but that CESAR will be marketed through a private manufacturer.

3. "Performance Evaluation of ERS-1 SAR Fast Delivery Processor", J.P. Guignard (speaker-ESTEC-Netherlands), and P. Hassan (MDA-Canada).

   ESTEC has contracted with MDA to produce a fast delivery SAR processor for ERS-1. The processor was designed using a ST-100 Array processor with a VAX 11/730 host, but it will be ported to a VAX 6000 with two ST-50 array processors for operational use. A large battery of tests have been applied to the processor to qualify it. Simulated point and sinusoidal images along with re-conditioned SEASAT data have been used. All specifications, including resolution, integrated side lobe ratio, radiometric linearity and geometric fidelity have been met. The processor can produce a 100 km by 100 km image in 27.3 minutes, or a 5 km by 5 km wave mode image in 26 seconds. Mr. Hoogeboom asked for further description of the ST-100 array processor. Mr. Curlander (JPL) asked if any plans existed for product dissemination. Mr Guignard replied that no plans exist at present. Mr. Goldfinger asked about the effort involved in rehosting the software onto the new configuration. Mr. Guignard said that he officially expected it to be a minor job but realistically expected a more sizable effort.

4. Real Time SAR Processing Techniques, R. Schotter (Dornier-F.R.G.).

   Mr. Schotter defined real time to be processing at the speed at which the antenna moves; 7 km/sec for ERS-1. To accomplish this about 287 Mflops of throughput are required for a 1000 pixel wide image (i.e. 25 km swath at 25 m resolution, or 100 km swath at 100 m resolution.) Dornier has built a prototype processor that achieves real time processing. It employs a pipeline architecture built of standard hardware modules. For example, the FFT modules can perform 4096 point FFT's at 600 Hz.
   The first question concerned the system dynamic range. The speaker replied that the 16 bit range was sufficient. In response to a question from Mr. Hoogeboom, Mr. Schotter stated that swath selection is accomplished in the range compression module. Mr. Guignard expressed his concern over prf ambiguities, and this concern was shared by the speaker who felt that the problem could be handled by the present system when the signal was sufficiently strong.

ISPRS COMMISSION I/II
Space Photography

Session T38
July 7, 13:30—15:00
Chairman: A.A. Drazhnyukk (USSR)

1. Earth Space Sensing for the Interest of the Development of the Economy. Dr. Yu. P. Kienko (USSR).
2. Large Format Camera. Three years after, Achievements, Criticism and Remarks. Parof. J. Togliatti (Italy).
3. The Information Potential of Space Photographs, Dr. K.H. Marek (G.D.R.)
4. Reflight of the Metric Camera on the Atlas-1 Mission, Mr. M. Schroeder (F.R.G.).
5. High Resolution Sovient Space Photograhs for Topographics Mapping, Prof. R. Kaczynski (Poland).
6. Geometric Potential of Space Images, Dr. K. Jacobsen (F.R.G.).

No resolutions were adopted. The chairman in his speech underlined the usefullness of Space Imagries.

ISPRS COMMISSION II
Radar/Microwave Remote Sensing Systems

Session T45
July 8, 11:00—12:30
Chairman: Jeanne Pierre Guignard

1. "Experiences in Implementing an Expert System Supported Man-Machine-Interface for the Intelligent SAR Processor"., W. Noack, A. Popella and R. Konjack (F.R. Germany).

   The purpose of the expert system includes configuration, supervision, quality control and software maintenance of the SAR processor. It will be an operational system, and should include models of the earth, orbits, platforms and sensors. Currently a prototype for the configuration module has been successfully implemented.
   In expert systems there are two possible ways of development, in the first one many rules are written, and the system itself is also considered as the documentation. The second approach is to start from the beginning with a well documented approach. Both the paper and the discussion confirmed the second method as being the best, although heavier.

2. "Mapping Accuracy Using Side-Looking Radar Images on the Analytical Stereoplotter"., S.S.C. Wu, F.J. Schafer and A. Howington-Kraus (U.S.A.).

The extraction of altitudes from radar stereo pairs requires adaption of the software that was developed for cameras. The radar measure distances, whereas a camera measures angles.
Examples shown from Seasat SAR and SAR 580 data. Improvements can be obtained by applying a better mathematical model for the sensor position. The paper was not very specific on the limitations due to the speckle in SAR images.

3. "Design Assessment of a High Precision SAR Processor Employing the Transputer Based Meiko Computing Surface"., J.J.W. Wilson (United Kingdom).

   The objective is to obtain a 100 x 100 km ERS-1 high precision processed SAR image in 20 minutes. The image consists of 8 overlapping looks and is calculated in the frequency domain.
   The paper shows how the objective can be met by the use of a computing configuration which contains 10 T 800 transputers. The paper presented an interesting approach, but is not yet substantiated in terms of costs, software development, etc. It is therefore not yet possible to compare it with other approaches.

4. "Data Processing and Calibration of SAR data in Japan", K. Maeda and H. Sato (Japan).

   The paper discusses the processing and calibration of SAR data in Japan. The results and experiences from earlier campaigns (SAR 580 and SIR-B) are used in defining processing-and calibration schemes for the JERS-1, SAR, to be launched in February 1992. A transputer with built-in delay is considered for calibration.

5. "Towards a Polarimetaric C-band aircraft SAR in the Netherlands"., P. Hoogeboom (The Netherlands).

   An Aircraft SAR is being developed in The Netherlands for experimental purpose. In the first phase a small testbed is developed, with limited capabilities. It will fly in 1990. The second phase (not approved yet) undertakes the construction of a polarimetric SAR, based on the experience gained with the testbed and more generally on the radar remote sensing research program conducted in The Netherlands.
   The present status indicates that so far preliminary studies were undertaken, but now the budget is confirmed and the design and development starts.

ISPRS COMMISSION II/III/IV
Fast Processing of Photogrammetric Data

Session T51
July 9, 10:30
Chairman: Zarko Jaksic.

1. "Digital Photogrammetric Processing Systems-Current Status and Prospects" (Invited Paper), A. Gruen, Switzerland.

   The paper reviewed the current status of digital processing systems, focussing on systems with primarily photogrammetric functions. The author outlines the potential of a Digital Station, its characteristics and its performance, the design considerations and gave an overview of its components. He concluded that such systems are today preoperational but not so far ahead in time.

2. "Limiting Factors of Real-Time Image Metrology" (Invited Paper), S.T. El-Hakim (Canada).

   A real-time photogrammetric system has been developed and applied for computerized manufacturing, quality control and robot guidance. Description of the application and evaluation of the performance are reported. The evaluation is based on the degree of the success of the feature extraction process and the watching technique as well as the achieved accuracy of the measurements.

3. "Future Oriented Scenarios for Close-Range Photogrammetric Instrumentation"., H. Hoggren (Finland).

   The paper noted that today several alternative paths in developing the close-range photogrammetric instrumentation exist and posed the question whether these paths converge to an ideal endpoint. The author used the Fields Anomaly Relaxation method to derive a set of scenarios describing the alternative courses of future development for close-range photogrammetric instrumentation.

4. "Graphics Workstation for Integrated Data Collection, Simultion and Analysis", J.P. Muller (U.K.), V. Paramananda (U.K.), S. Richards, (U.K.).

   The paper outline the objectives and key components of developing a wide range of photogrammetric application on a Sun workstation. The integration of such systems into a multi-vendor computing environment, multiple data type display, humancomputer interface and the WIMP paradigm developed at UCL were described. Applications for SPOT, digitized aerial photographs and industrial photogrammetric images were demonstrated.

   Discussion:

   Q. Beyer: What is the tine for reducing the number of bits per image? What is your opinion about the different window environments.
   A. Muller: To reduce a 512^2 image 1 min is needed on the Sun and with the transputer 1 sec. NEWS is preferred because it allows merging of different type of data (images, fonts, etc), but the X11 seems to be more widely accepted.

5. Experiments on Target Location and Image Matching, J.C. Trinder (Australia).

   The paper described investigations on digital pointing to circular targets revealing the influence of image quality, pixel size in the image, quantization levels and noise on the precision of pointing. Asymmetry of the target profile reveals significant systematic errors. Under ideal circumstances, the precision of pointing can approach 0.01 pixel.

   Discussion:

   Q. Foerstner: Did you work with real data because we had problems in precisely locating small targets?

   A. Trinder: Yes, but the targets we used were rather large, about 15 pixels.

   Q. Wong: You said that the accuracy is proportional to the target size. Did you derive a mathematical function for this relationship?

   A. Trinder: No, for sizes between 50 and 800 μm the change is small, but for smaller targets the accuracy drops considerably.

ISPRS COMMISSION II
Emerging Technology for Handling Large Volumes of Satellite Data

Session T54
July 9, 11:00—12:30
Chairman: Fred C. Billingsley

1. "Optical Storage for Remote Sensing Technology", J. Iisaka (Canada).

   Presented their experience in the use of CDROM and WORM technology. CCRS began their program when CDROM had no standard. Also, MS DOS was limited to 32 megabyte storage. Therefore they developed a system for CDROM consisting of 7 volumes per disk at 32 Mbytes per volume. Their technology matured and a standard was developed. The advantage of this technology was given as; low drive cost, relatively low mastering cost, cheap distribution. Duplication is easy but takes too much time.

   A program using WORM technology has been in place for one year. Each WORM disk carrier 1800 Mbytes and juke boxes exist that can handle up to 10 Gbyte. However, there is no ANSI standard/other standard for WORM. Standards could come this year. CCRS uses WORM for two applications: Storage of Data on PC's, VAX input.

   Using a WORM drive as a streaming leader rather than a CCT has given CCRS a new capability in actual memory use. However, there is need for an industry wide standard to make these operational. Question: L. Fusco, ESA; Which manufacturer have you tried? Answer: The program is only one year old. During that time we have used ESL and ISR products only.

2. "Local Area Networks & Data Networks for the Advanced Earth Observation Satellite (ADEOS) System", K. Arai (Japan), Speaker, N. Fujimoto, (Japan).

   Adeos is a follow-on to MOSI, MOS2, and EOS. OCTS — Ocean Current and Temperature Sensor. AVNIR — Advanced Very Near Infrared Radiometer.

   Studies prior to launch of EOS are now underway.

   Their objective is to respond to real time requests via direct transmission to local user station for distribution by LAN. This is to be done for: (1) Quick Look Imagery & (2) Catalogs via WAN's and LAN's (Telephone, etc.)
   Conclusion: (1) This system is still in its conceptual design phase, (2) They hope to downlink data for users worldwide on real time or near real time.

3. "On-Line Data Services of NOAA AVHRR Images through Value Added Networks", S. Saitoh, Y. Hashimoto, M. Koga, and M. Shimizu (Japan)

   Non real time users of this data are provided with floppies. They want to use a value added network which will be: Timely and fast/low cost/on-line data source/service a large user network.
   Data from receiving site to data processing site goes via optical fiber over the 30 km route at 768 kbs. They perform standard corrections (Radiometry and Geometry.), then hold the data for transmission to users one week after acquisition. Users are equipped with modems for NEC PC 9801 and IBM 5550 PC. Data rate of 2400 mps used.
   Five types of images are generated:
   - Dotted Pattern Images
   - Isothermal (Contour) Images
   - Pseudo color (Color Coded) Images
   - False Color Images
   - Thermal Images

Two types of geometry are used:
- Broad oceans covered by 6 areas
  1200 km x 1200 km FOV
  1.1 Km IFOV
- Land & Coastal Zones
  600 km x 600 Km FOV
  1.1 Km IFOV

Users work with menu driven software on PC's.

4. "Concurrent Architecture and High Data Rate Data Processing", M. Lee (U.S.A.).

   A new class of images exist. The imaging spectrometers have had a progression from AIS/AVIRIS/SISX/HIRIS. HIRIS, to be on the polar orbiter in 1995, will be used to (for instance) identify minerals from space. It will have 192 spectral channels with 30M IFOV.

   The resulting high rate data processing requires fast computational power, large data storage, and fast data access simultaneously. In order to meet these challenges, computer technology has evolved toward a concurrent architecture where multiple processing elements are integrated for parallel execution of data. The processors may communicate through a shared memory system or may communicate directly to neighboring processors via a hardwired connection resembling a topology or a ring, a grid, or a hypercube. The performance characteristics of a system depend on the processor connection topology, memory organization, and data storage capacity of a system.

5. "Expert Systems for Image Processing; Past, Present, and Future Trends"., Bill Clark (U.S.A.)

   Past systems for image processing have not used expert systems. Similarly very little expert systems work has been devoted solely to image processing. For example at the last congress there were no papers dealing with expert system. This congress has five papers (oral presentations in this area). We note today an intersection in the two disciplines. However, the common areas have only a small degree of overlap. Present and future systems should attempt both a local and a global integration of these disciplines.
   Locally we need to use these (i.e., better expert) systems to improve production capabilities and improve the analysis of remotely sensed data. Significant upgrades are needed here.
   Globally we can now cross-compare multiple satellite systems through mathematical transformation of one data set to another. This has been done for MSS/TM/AVHRR/SPOT and others. In the fugure (1990's) it is predicted that up to fifty Earth pointing satellites will exist. An expert systems approach to the merger of data from this complex of sensors to extract the most information can be used and should be developed for future users of the data.

ISPRS COMMISSION II
Image Processing for Teaching

Session T57
July 9, 13:30—15:00
Chairman: Ian Dowman, (United Kingdom)

The chairman opened the session by outlining the special requirements of image processing for teaching.
Three levels of instrumentation are required: a basic level of teaching requires a multi terminal system which is interactive and inexpensive; a second level for project work, which involves applications and development, requires a programmable system with a full range of standard algorithms; the third level is an advanced image processing system.
The chairman reminds the audience of the newsletter for Instrumentation for Teaching which has the aim of exchanging information and ideas on that subject.

1. "An Image Processing System Which you can Make"., T. Liao, W. Hao, S. Chang and M. Wu (China Taipai).
   An image processing system based on an IBM/PC AT compatible computer was described. This system has been developed for teaching and research at the Chung Hsing University. Using a monochrome monitor, and EGA monitor and a color ink-jet printer, a maximum of sixteen colors can be displayed. Many PC-based statistical packages, such as SPSS, SAS, MINITAB are used in the package which can perform image enhancement, classification, fast Fourier transform, principal component analysis, factor analysis, discriminant analysis and texture analysis. In answer to a question concerning the language used, Wu recommended C as being most suitable.

2. "Digital Mapping System for Educational Purposes", J. Besenicar and A. Tuladhar (The Netherlands).
   A digital mapping system designed at ITC and used to help students understand the operational aspects of digital mapping was discussed. The role of this system in the revised and specialist courses now on offer at ITC was described, showing how this system helped to achieve the different aims of these courses.

3. "Use of Personal Computer for Image Parocessing in Education", T. Oshima, S. Tanaka and T. Sugimura (Japan)

   The historical development of personal computers in Japan and their present application to image processing were discussed and classified. The software and hardware requirements are outlined and the use of these systems by students was described. The trends for the future were explored, including the use of optical disk.
   Oshima confirmed that the use of PCs for DTM, GIS and WS work in conjunction with image processing was the subject of experimentation.

4. "A Distributed Information Processing System", D. Zhu, W. Ni, Z. Ye and Y. Wang (China).

   The distributed information processing system developed at the Research Institute of Surveying and Mapping, National Bureau of Surveying and Mapping, Peoples Republic of China was described. The Apollo Token ring is the basis of this system, with the Apollo operating system at level 1, with three other levels available, details of which were given. The hardware configuration was also described.

Commission I/II Space Photography

T-38 Session July 7, 1988 13:30—15:10
Chairman: A.A. Drazhnyuk (USSR)

There were 6 reports:
1) - Earth Space Sensingl for the Interests of the Development of the Economy. Dr. Yu. P. Kienko (USSR)
2) - Large Format Camera. Three years after, Achievements, Criticism and Remarks. Prof. J. Togliatti (Italy)
3) - The Information Potential of Space Photographs, Dr. K.-H. Marek (G.D.R.)
4) - Reflight of the Metric Camera on the Atlas-1 Mission, Mr. M. Schroeder (F.R.G.)
5) - High Resolution Soviet Space Photographs for Topographic Mapping, Prof. R. Kaczynski (Poland)
6) - Geometaric Potential of Space Images, Dr. K. Jacobsen (F.R.G.)

The hall was full, 150 participants.

Questions:
1) - 10; 2) - 6; 3) - 5; 4) - 0; 5) - 5; 6) - 6.

No resolutions were adopted. The Chairman in his speech underlined the usefullness of Space Imageries.
Chairman : A.A. Drazhnyuk

Commission I/II Space Photography

Session T-48, July 8, 1988, 13:30—15:00
Chairman: Prof. K. SZANGOLIES (G.D.R.)
Participants: 100

Lecturers Report:
1. K. Szangolies/G.D.R.: Report of the IC WG Space Photograhy
2. I. Dowman/GB: Invited Paper: The Restitution of Metric Photography taken from Space
3. K. Buchroithner/Austria: Spaceborne Stereo Photography for Mapping of High Mountain Terrain
4. J. Kraemer/G.D.R.: Map Production and Revision with Satellite Photographs Taken with MKF-6 Camera and by the Cameras KATE-140, -200 and KFA-1000
5. A. Drazhnyuk/U.S.S.R.: Cosmic Mapping of Antarctika
6. A. Elmhorst/W. Mueller/F.R.G.: Generation of DTMs with Space Photographs

Discussions: 6 Questions and answers

ISPRS Commission I/II/VII Radar/Microwave Remote Sensing Systems

Session T-45
prepared by: Peter Hoogeboom
Friday, July 8, 11:00—12:30
Chairman: J.P. Guignard

1. *W. Noack*, A. Popella and R. Konjack (F.R. Germany) — Experiences in Implementing an Expert System Supported Man-Machine-Interface for the Intelligent SAR Processor.

   The purpose of the expert system includes configuration, supervision, quality control and software maintenance of the SAR processor. It will be an operational system, and should include models of the earth, orbits, platforms and sensors. Currently a prototype for the configuration module has been successfully implemented.
   In expert systems there are two possible ways of development, in the first one many rules are written, and the system itself is also considered as the documentation. The second approach is to start from the beginning with a well documented approach. Both the paper and the discussion confirmed the second method as being the best, although heavier.

2. *S.S.C. Wu*, F.J. Schafer and A. Howington-Kraus (U.S.A.) — Mapping Accuracy Using Side-Looking Radar Images on the Analytical Stereoplotter.

   The extraction of altitudes from radar stereo pairs requires adaption of the software that was developed for cameras. The

radar measures distances, whereas a camera measures angles.
Examples were shown from Seasat SAR and SAR 580 data.
Improvements can be obtained by applying better mathematical models for the sensor position.
The paper was not very specific on the limitations due to the speckle in SAR images.

3. *J.J.W. Wilson* (United Kingdom) — Design Assessment of a High Precision SAR Processor Employing the Transputer Based Meiko Computing Surface.

   The objective is to obtain a 100 x 100 km ERS-1 high precision processed SAR image in 20 minutes. The image consists of 8 overlapping looks and is calculated in the frequency domain.
   The paper shows how the objective can be met by the use of a computing configuration which contains 10 T 800 transputers.
   The paper presented an interesting approach, but is not yet substantiated in terms of costs, software development, etc. It is therefore not yet possible to compare it with other approaches.

4. *K. Maeda and H. Sato* (Japan) — Data Processing and Calibration of SAR data in Japan.

   Paper presented by H. Wakabayashi (Japan)
   The paper discusses the processing and calibration of SAR data in Japan. The results and experiences from earlier compaigns (SAR 580 and SIR-B) are used in defining processing- and calibration schemes for the JERS-1, SAR, to be launched in February 1992. A taransponder with built-in delay is considered for calibration.

5. *P. Hoogeboom* (The Netherlands) — Towards a Polarimetric C-band Aircraft SAR in The Netherlands.

   An aircraft SAR is being developed in The Netherlands for experimental purpose. In the first phase a small restbed is developed, with limited capabilities. It will fly in 1990. The second phase (not approved yet) undertakes the construction of a polarimetric SAR, based on the experience gained with the testbed and more general on the radar remote sensing research program conducted in The Netherlands.
   The present status indicates that sofar preliminary studies were undertaken, but now the budget is confirmed and the design and development starts.

Commission III — Mathematical Analysis of Data

EINARI KILPELÄ[1] *and AINO SAVOLAINEN*[2]
[1]*President and* [2]*Secretary Commission III*

1.1 Research activities in 1984—1988

Based on the definitions of the Commission III area and the current needs for research five resolutions were made in the Rio Congress for the period 1984—1988. The resolutions refer to
- stochastic behavior of photographs,
- on-line photogrammetric triangulation,
- digital terrain models,
- combined point determination, and
- image analysis and pattern recognition.

In accordance with the above resolutions, four Commission III Working Groups, and in addition an intercommission Working Group between Commission III and Commission IV, were established. The Working Groups with their chairmen were the following:

WG 1: Accuracy Aspects of Combined Point Determination
Chairmen: H. Ebner (FR Germany) and M. Molenaar (The Netherlands)

WG 2: On-line Photogrammetric Triangulation
Chairmen: A.A. Elassal (U.S.A.) and A. Gruen (Switzerland)

WG 3: Digital Terrain Models
Chairmen: O. Jacobi (Denmark) and K. Kubik (Australia)

WG 4: Mathematical Aspects of Image Analysis and Pattern Recognition
Chairmen: W. Förstner (FR Germany) and E.M. Mikhail (U.S.A.)

WG III/IV: Digital Technology for the Integration of Photogrammetric a Remote Sensing Data with Land/Geographic Information Systems
Chairman: Dr. R. Welch (U.S.A.)

The detailed comprehensive commission report on the activities in 1984—1988 was published in the International Archives of Photogrammetry and Remote Sensing Vol. 27 Part 3B (Commission III), p. 367—376, in Kyoto. It includes e.g. the following chapters: Terms of Reference of WGs, Joint Activities of Commission III, and Working Group activities 1984—1988. In the latter chapter each Working Group reports on the development in the area of its responsibility. The joint activities of the Commission naturally comprised an intercongress symposium, workshops, seminars, Commission Board meetings etc. In addition to these a Tutorial on "Statistical Concepts for Quality Control" was organized just before the Symposium. The first tutorial of ISPRS was very favorably received.

1.2 Commission III Program in the Kyoto Congress

In the Kyoto Congress Commission III had 8 Technical Sessions, 2 Technical Sessions for WG III/IV and 1 Technical Session

for C II/III/V (intercommission session). In addition to the above sessions there were a Business Meeting and a number of Poster Sessions. Further, WG 4 had two panels in the scientific exhibition demonstrating results of the experiments in image matching.
The number of the C III papers published for the Kyoto Congress was 152. In addition, WG III/IV had its own papers. The large number of papers naturally indicates the correct selection of the current research areas. Most papers discuss a subject belonging to a Working Group. Thus the program of the Congress also corresponded well with the structure of Working Groups. Only one session was devoted to other topics of the Commission III.
The selection of papers for oral presentation was, as always, a difficult task. Only aboaut 25% of the papers could be presented orally. However, all other papers could be presented in the Poster Sessions, which formed also a good forum, especially for papers dealing with a very specific topic.
The summaries of the Technical Sessions will be published in the International Archives of Photogrammetry and Remote Sensing Vol. 27 Part A in the near future. Therefore the discussion of the Technical Sessions will be omitted here. Instead, below is a more detailed outline of characteristic features of high importance for mathematical data analysis methods and which heavily influence their development.

1.3 Charasteristic Features Influencing Mathematical Data Analysis Methods

1.3.1 Diversity and Abundance of Data

During the last years the most prominent feature has been the fast growing use of digital images taken with optoelectronical and microwave sensors having imaging geometry different from the central perspective. The images may cover a wide spectral range and may come from airborne or satellite sensors.
Further, there is a diversity of auxiliary data available, e.g. from statoscope, APR, GPS and INS. Especially GPS has shown to be very useful. With regard to photogrammetry it can be applied for photo flight navigation, aerial triangultion, direct determination of exterior orientation and orientation of new sensors. The first experiences of the use of GPS have been very promising.
As a general observation it can be said that diversity and abundance of data,and their simultaneous use for information extraction offer challenging tasks for photogrammetrists.

1.3.2 Complexity of Models

The least squares matching has proved successful in solving the matching problem. Through some generalization steps (multipoint matching and geometrically constrained matching) it has lead to an approach where image matching and object surface reconstruction are integrated. Geometric and radiometric parameters of the object surface and the orientation parameters of the images involved are estimated simultaneously in a least squares adjustment using pixel density values as observations. This may eventually lead to a unified geometric and interpretative analysis.
For a human observer points are natural features to measure. Considering the use of digital images and automation of photogrammetric reduction other features such as curves and surfaces are, however, more attractive and usable. Consequently, there is an obvious need for constructing both functional and stochastic models for the treatment of such features. We can talk in this context about feature based photogrammetry.
Finally, a distinct feature in modelling is the frequent exploitation of stochastic processes. They appear e.g. in dynamic problems and in problems where it is important to exhaust fully the information potential of observations. They are also applied for image analysis, e.g. classification and image modelling.

1.3.3 Speciality of Algorithms

The complexity of the models set high requirements for the algorithms used to solve parameters of them. To satisfy severe time requirements efficient recursive algorithms have to be used in dynamic problems. The use of special algorithms in problems with gridded data structure (DTM, image processing) may lead to remarkable savings in computational work. Special algorithms are also needed for the solution of constrained and rank-deficient problems. Sometimes it is more efficient to solve an estimation problem in frequency domain by applying transform techniques.

1.3.4 Advanced Quality Control

The establishment of data banks will further emphanize the importance of quality control. In the future design and optimization will surely be emphasized. Expert systems may prove valuable in this context, and naturally close cooperation with other disciplines will benefit us here greatly.

1.3.5 High Degree of Automation

Some aspects for automation have already been discussed above. The ultimate goal, fully automatic information extraction from images is distant, and we have to proceed step by step. In image matching a lot of work has been done. In image segmentation and recognition we are still at the very beginning and we should carefully follow the development in other areas, e.g. computer sciences.

1.3.6 Products

Products are nowadays more and more often digital, and this again makes possible effective quality control. There are products from the simple lists of coordinates up to complicated data banks including geographic and land information systems of different levels.

1.4 Resolutions

The development and current trends in Mathematical Analysis of Data can naturally also be identified from the resolutions initiated by Commission III and adopted by the General Assembly for the intercongress period 1988—1992. They cover the following topics:

(1) Quality Control for Point Determination Systems
(2) Digital Elevation Models
(3) Geographical Information Theory
(4) Algorithmic Aspects of Digital Photogrammetric Workstations
(5) Geometric Object Reconstruction by Image Analysis
(6) Thematic Information Extraction from Digital Images
(7) Knowledge Based Systems
The resolutions refer to seven special areas and are very futureoriented. We are really experiencing the time of transition and are moving from the analytical methods to the digital ones.

COMMISSION III Mathematical Analysis of Data

Session TO2, July 2, 1988:
Chairman: E. Kilpelä (Finland)

1. E. Kilpelä — Report on the Activities of Commission III 1984—1988 (Invited paper)

   The activities of Commission III during the inter-congress period 1984—1988 are discussed in the paper. It includes details e.g. on the tutorial and symposium of Commission III, and on the WG activities.

2. J.M. Goldfarb and M.A. Chapman (Canada) — Bandwidth Minimization of Using the Method of Simulated Annealing

   The presentation deals with the bandwidth minimization of the sparse normal coefficient matrices encountered in the adjustment of large photogrammetric blocks. The method of simulated annealing is a combinatorial opatimization technique which has recently been applied to the traveling salesman problem and to energy minimization in artificial neural networks. In the present study, the method is applied to both independent model and bundle adjustments. Comparisons between this method and two other methods are presented.

3. T. Sarjakoski (Finland) — Object-Oriented Approaches in the Design of More Capable Adjustment Systems

   The presentation reviews object-oriented approaches. Three views of them are considered: object-oriented programming, object-oriented databases, and object-oriented design. It is stated that there is a "methodological synergy" among various approaches although the background and terminology is often very different. Object-oriented approaches are seen as promising tools in the design of systems having more advanced capabilities, compared to the existing ones. The paper gives also a short review of related literature.

4. N.J. Mulder, H. Middelkoop and J. Miltenburg (The Netherlands) — Progress in the Application of Expert Systems for Knowledge Engineering in Image Interpretation and Classification

   The presentation describes the approach taken at I.T.C. to apply knowledge-engineering techniques in the fields of image interpretation and mapping. Expert systems are de-mystified by noting that the knowledge can often be presented by using proper methods for indexing or look-up tables. A case study about soil mapping from satellite imagery is reviewed. PROLOG and ENVISAGE-shell have been used for implementations. The paper concludes, in short, that the stimulus provided by applying knowledge engineering to the art of image interpretation was remarkable. It is stated, related to future research, that the interface between knowledge engineering systems and image processing and pattern recognition must be greatly improved.

5. R.A. McLaren and T.J.M. Kennie (United Kingdom) — Computer Graphics Techniques for Generating Terrain and Landscape Visualisations

   The presentation gives a review of methods of generating computer visualisations using digital terrain and landscape modelling data. The introduction states that the characteristics of the earth's surface often significantly limit the applicability of many of the more general purpose techniques, because, e.g., natural phenomena are inherently more complex than man-made objects. Related to visualisation strategies, two main classes of strategies are recognized: 1) the ones based on superimpositioning of new features on digitized images and 2) the ones where all the features to be presented are also mathematically modeled. In addition to the model of the terrain and associated landscape features, the visualisation process requires a number of other parameters commonly called "the viewing condition definitions" . As conclusion the authors state that visualisation techniques have tended to reduce the surveying industry's emphasis on 2-D methods of data presentation. They have also highlighted the 3-D deficiencies in sources of data, in terms of availability and accuracy. The search for increasing realism will continue to be a subject of importance for the future.

Session TO5, July 2, 1988: Integrated Network Design/Point Positioning Using Linear Array Imagery
Chairman: H. Ebner (F.R. Germany)

1. M. Molenaar (The Netherlands) — A Planning Strategy for Combined Photogrammetric Blocks and Terrestrial Networks (Invited Paper)

   The presentation gave an outline for a planning strategy to deal with a combination of a photogrammetric block and a supporting terrestrial network taking into account criteria for precision and reliability of the final coordinates of the newly

determined points. By a backward reasoning criteria for the individual block and network were derived from the criteria for the total system. Whereas for precision a strategy could be formulated based on a rigorous theoretical approach, this is difficult for reliability.

2. D. Li (China) and W. Foerstner (F.R. Germany) — On the Reliability of Additional Parameters

   Based upon the extended reliability theory the internal and external reliability of additional parameters were investigated. The determinability and sensitivity factors were calculated and analysed for a series of self-calibrating bundle block adjustments with different geometric configurations. The sensitivity test gave a most efficient measure for the correct selection of additional parameters.

3. O. Hofmann and F. Mueller (F.R. Germany) — Combined Point Determination Using Digital Data of Three Line Scanner Systems (Invited Paper)

   The investigations to examine the geometric properties of three line scanner systems were summarized. Results from adjustments of simulated strips and blocks were given, and the dependence on flight and camera parameters including various arrangements of the CCD-sensors in the focal plane was shown.

4. R. Shibasaki, S. Murai and T. Okuda (Japan) — SPOT Imagery Orientation with Auxiliary Satellite Position and Attitude Data

   A method of SPOT imagery orientation was proposed, where observed data and satellite position and attitude, provided in SPOT CCT, were employed as constraints. The experiment using "Mt. Fuji" images of SPOT HRV showed improvement of orientation accuracy when small number of ground control points were used.

Session TO8, July 2, 1988: Aerial Triangulation Using GPS, INS and DTM Data
Chairman: M. Molenaar (The Netherlands)

1. F. Ackermann (F.R. Germany) — Combined Adjustment of Airborne Navigation Data and Photogrammetric Blocks (Invited Paper)

   The presentation was concerned with observations relating to airborne navigation systems and their utilization for aerial triangultion by combined adjustment. GPS kinematic positioning was treated. The results of the first analyses of GPS flight data from a controlled photo flight with simultaneous GPS data recording over a test area in the Netherlands were presented and evaluated. The relative precision of camera positions obtained by GPS was of the order of a few decimeters.

2. G.H. Ligterink (The Netherlands) — GPS in Large Scale Photogrammetry, Practical and Simulated Investigations

   In 1987 a testflight was performed by the Survey Department of Rijkswaterstaat in cooperation with different organizations. The photoscale was 1:3,700 with a forward overlap of 70% and a sidelap of 60%. The results of the experiment were discussed. They were comparable to those given by F. Ackermann. Moreover, simulation studies were presented.

3. J.E. Julia, C.A. Lizana, E. Rolle and W.O. Williams (Argentina) — Feasibility of Using Auxiliary Data from an Inertial Navigation System for Aerial Triangulation

   An experiment to establish the accuracy of camera position and attitude provided by the Photogrammetric Integrated Control System (PICS) for further utilization in combined block adjustment has been carried out. Exterior orientations of camera stations derived from block adjustment were directly compared with PICS auxiliary data. First results and preliminary conclusions were presented.

4. H. Ebner and G. Strunz (F.R. Germany) — Combined Point Determination Using Digital Terrain Models as Control Information

   The mathematical model for the use of Digital Terrain Models as control information in aerial triangulation was described. The conditions for the absolute orientation of a block by the exclusive use of a DTM were derived theoretically. The accuracy of combined point determination was investigated by simulations. Finally, the results of a practical test were presented and future applications were mentioned.

5. A. Gruen and A. Runge (Switzerland) — The Accuracy Potential of Self-Calibrating Aerial Triangulation without Control

   With the use of synthetic and real block data it was examined to what extent additional parameters and the parameters of interior orientation can be recovered in a block with a poor or even no ground control. GPS data were simulated. The results showed that in future with the integration of GPS measurements the use of ground control points will only be necessary for the transformation of the photogrammetric block into the ground coordinate system and for the recovery of the interior orientation.

Session T21 Image Matching,
(Monday) July 4, 1988, 9—10:30 am

Chairman: Wolfgang Förstner

1. E. Gülch (F.R.Germany): Results of Test on Image Matching of ISPRS WG III/4

   The report contains the results of the ISPRS Test on "Image Matching" . 12 test image pairs of different complexity were distributed to more than 50 participants of the WG in order to get information on the state of art. From 18 answers 9 were from non-photogrammetrists. All type of algorithms, all degrees of flexibility and all levels of accuracy were obtained. The final report will contain a detailed analysis and conclusions.

2. M.J. Hannah (U.S.A.): Digital Stereo Image Matching Techniques

   After a review of currently applied matching algorithms and strategies, especially those developed at Stanford Research Institute, the author presented her own strategy and the experiences with the test material of the ISPRS Test on Image Matching. 11 from 12 image pairs were managed successfully with the same strategy without adapting any parameters. The procedure uses selected points, cross correlation performed in a hierarchy with numerous internal check on consistency.

3. J-P. Muller, K.A. Collins, G.P. Otto, J.B.G. Roberts (GB): Stereo Matching Using Transputer Arrays

   After a review of existing online and offline stereo matching systems and of computer architectures for image processing, the comparison of the implementation of three algorithms for image matching onto transputer arrays was reported on (Barnard/Thompson, PMF, Grün). Specifically the processor utilization and the individual implementation problems were discussed. A socalled "processor farm" , a MIMD architecture (Multiple instruction multiple data) based on transputer arrays was recommended.

4. B. Wrobel (FRG): Least Squares Methods for Surface Reconstruction from Images

   The review first gave a sketch on the evaluation of matching strategies from correlation techniques and patchwise Least Squares Matching to Least Squares Reconstruction of surfaces from multiple images. In all cases the density values are treated as original observations and the nodes of a finite element description of the objects as unknowns. This general concept independently has been developed by several other researchers, too (Helva, Rosenholm, Ebner). It can be seen as a new theoretical basis for photogrammetry when digital images are the basic information source.

Session T24, July 4, 1988: Image Analysis
Chairman: E.M. Mikhail (U.S.A.)
The following five papers were presented

1. Y. Rauste (Finland) — DEM-Based Image Processing Methods for SAR Images

   Mr. Rauste's paper proposed a method for computing relative backscattering coefficients of pixels in SAR images based on a given Digital Elevation Model. This computation is intended to reduce the effect of topography on scene variation. The method was tested on a Seasat scene for the purpose of separating four different vegetation covers. His conclusions include: (1) Separability improves with increased incidence angles, (2) L-band SAR with steep look angle may be used to derive DEM, and (3) Two SAR systems may be used, one with high frequency/shallow look angle for vegetation, and the other with low frequency/steep look angle for information on underlying soil.

2. J. Iisaka, R. Saper, and D.G. Goodenough (Canada) — Pixel Swapping — a New Technique for Spatial Data Analysis, by

   Not text for this paper is included in the proceedings.

3. A. Yaguchi, H. Murakami, K. Kamada (Japan) — Automatic Recognition of Road Information on Medium Scale Topographical Maps

   Mr. Yaguchi proposed a method for recognizing parallel lines in digitized 1:25,000 topographic maps. The method is based on vectorizing each of the lines of the road, and using inside lines of the digitized roads in order to avoid the problem of adjacent buildings which are directly connected to the roads. When analyzing intersections, the authors apply the method of Parallel Vector Tracer published in 1984 by Nakajima et al. The proposed method was tested on several topographic maps with a claimed success of 90%. There was no clear proposal as to how one can reduce the 10% error except perhaps on-line interactive inspection.

4. D.C. Mulawa and E.M. Mikhail (U.S.A.) — Photogrammetric Treatment of Linear Image Features

   The paper summarized a few aspects of an otherwise extensive research effort continuing at Purdue University on the use of linear features in the solution of various photogrammetric problems. The presentation was limited to straight lines and conic sections. Several mathematical modeling approaches were explained, and a robust and flexible model selected for experimentation. The presentation was concluded with a discussion of the importance of this research in as much as present and future photogrammetric activities are likely to rely heavily on the treatment of features. Proper geometric and stochastic treatment of features, linear and eventually areal, will significantly impact the progress of automating the extraction of information from digital imagery and construction of object models from such imagery.

5. K. Papanikolaou and E. Derenyi (Canada) — Structural Matching of Digital Images and Terrain Models

The paper involved a proposed method for registering digital imagery with a digital terrain model. The basis of the method is to extract line features from both the image and the DTM and then use structural matching techniques to accomplish registration. Ridges are used as the primary linear feature; methods of their extraction from DTM differ from those used with imagery where direction of illumination is used. The method was tested using DTM and a simulated image derived from the DTM. This test, as would be expected, demonstrated the ability to extract mountain ridges and to satisfactorily match ridges from the DTM and corresponding synthetic images. The authors plan further experimentation, particularly with real images.

Session T27, July 4, 1988: DTM — Data Acquisition
Chairman: O. Jacobi (Denmark)

1. K. Kubik (Australia) — Progress in Digital Terrain Model

The paper gave an overview on the main components in digital elevation model construction. The digifization of existing maps, manual as well as automatic scanning was discussed. It is however not clear how breaklines should be measured. Many interpolation procedures have been developed — and it is important that the user of these procedures have an understanding of the principles behind. Coding theory will be of increasing interest when databases are stored. The result will be data compression.

2. W. Reinhardt (F.R. Germany) — On-line Generation and Verification of Digital Terrain Models

The paper discussed the generation of a high quality, photogrammetrically sampled elevation model using superimposition. The requirements for such a system were listed including: short responsetime, continuous surface description, interaction, updating and representation of geomorphological data. Progressive sampling was applied together with a triangular variable grid structure. It was concluded that the system represented an improvement of the geomorphological description and contour quality.

3. O. Koelbl and I. da Silva (Switzerland) — Derivation of a Digital Terrain Model by Dynamic Programming

In order to reduce computing time, the Viterbi algorithm was introduced in relation to automatic datacapture on a Kern DSR-11 analytical plotter, using multipoint matching. The method was illustrated by low altitude photographs with profile measurements crossing houses and roads. Filtertechnique and smoothing are necessary to reduce noise in the data. The speaker concluded that the method will be operational in one or two years.

4. A. Yaguchi, S. Okuyama, K. Kamada and H. Murakami (Japan) — Automatic Assignment of Height Values to Digitized Contour Data

In order to reduce time and cost for the processes of getting a high resolution DEM, coarse DEM data, already prepared for the whole Japan on regular grids of 250 m intervals, is used for automatic assignment of height values to digitized contour data from 1:25,000 topographical maps.
The best results were obtained in mountains. In flat areas the method was not successful, as it could not identify small closed contours.

Session T47, July 8, 1988: On-Line Photogrammetric Triangulation
Chairman: A. Gruen (Switzerland)

1. E. Dorrer (F.R. Germany) — Current Status of On Line Point Positioning in Commercial Systems (Invited paper)

Current technology and methods for positioning in analytical plotters are outlined.

2. K.R. Holm (Norway) — Further Use of Givens Transformations in On-Line Phototriangulation

Techniques for efficient updating during triangulation are analysed. Theory and implementation characteristics of the Givens Transformation are given. The discussion shows that performance is sufficient for practical implementation.

3. K. Jacobsen (F.R. Germany) — Optimal Computer Support of Photo Coordinate Measurements and On-Line Data Check

Support techniques for operators are discussed. Throughput and quality can be improved with appropriate software.

4. F.C. Paderes Jr. and E.M. Mikhail (U.S.A.) — Photogrammetric Analysis of Stereo SPOT Imagery

Platform, sensor and mathematical model are outlined. Results of tests are explained. Accuracy is of the order of 12 —15 m.

5. H. Klein (F.R. Germany) — Block Adjustment on Personal Computer

Hardware, compilers and programming issues for PCs are discussed. The implementation characteristics and performance for model and bundle adjustments are given. Future developments for an improvement of the performance of PCs are discussed.

Session T53, July 9, 1988: Digital Terrain Modelling
Chairman: K. Kubik (Australia)

1. M.A.G. Toomey (Canada) — The Alberta Digital Elevation Model (Invited Paper)

The paper is based on experience from 4 years of datacapture, where a DEM of 40% of the 650,000 km² area of Alberta in Canada has been made. The terrain is rocky mountains, flat prairie and eroded valleys. The datacapture is made by private contractors. The production method is photogrammetry using 7 analytical plotters, measuring mass points, breaklines and characteristic spot heights. A mass point is measured for every 1.6 to 2.3 mm in photoscale. For the operator a feedback is made by producing a contour plot. Progressive sampling was not accepted by the operators, and it was considered difficult to extract test profiles for calculating the optimum point density. Measuring breaklines is very time consuming. The data processing is based on Wild CIP program, and the SCOP program for checking and preparing the database. The database consists of a variable grid (25, 50 or 100 meters) and breaklines stored by map sheets. The maps are scaled 1:20,000. From this database, production of 1:250,000 contour sheets are made by using a 200 meter grid. The conclusions are: DEM is a roautine production method today; users are becoming aware of possible uses; the data capture system will require imposition; the combination of DEM and 2D planimetry is more powerful than 3D map data.
To the question why progressive sampling was not used Toomey answered that the contractors reported that progressive sampling was too slow.

2. S. Viseshsin, S. Murai and S. Yanagida (Japan) — Automated Generation of DTM from Existing Topographic Maps

An automated system has been developed to generate and interpolate height data in a grid from contours of existing maps. The contours are first manually cleaned, converted to rasterdata by a scanner, and then an interactive editing determines the contour heights. Two case studies were shown. Contours were given a height automatically and afterwards the remaining contours were given heights by manual editing. Kraus commented, that experience in Austria had shown, that additional information about breaklines were needed, especially if a countour interval different from the original was derived. Another question from the audience was about the noise factors when several contours were running together. Viseshsin answered that they are still working on these problems and hope to present the results in near future.

3. L. Chen, L. Lee and S. Lee (China Taipei) — DTM Generation using SPOT Digital Data

First a bundle adjustment is used to determine the satellite orientation from ground control points. The mathematical model gives orientation parameters as a function of time. The images are resampled in an epipolar orientation. Image matching is done by NCC, LS-1 and LS-2 (least squares matching). A case study has shown, in 2500 points of a 2.5 by 2.5 km² area with 50 grids, the accuracy from 3.9 to 7.8 meters in X and Y and from 7.6 to 8.1 meters in Z depending on the image matching method. The conclusions are: There is potential of using SPOT digital data to generate DTM, but further improvements are needed.

SPOT ON! 10M MAPPING FROM SPACE?
(Working Group IV/3 — Session 1)

Sunday, 3 July 1988, 0900—1030
Chairman: A Baudoin (France)

1. *A Baudoin* (France) — Report of the Working Group.

This report was divided into three parts:
- From the answers to a questionnaire sent to all concerned organizations, several types of space maps were described and some examples were presented on slides.
- A synthetic survey of cartographic applications of the SPOT satellite was made from results presented on previous symposiums.
- A summary of discussions within the WG about classification of space maps, specifications and recommendations on the use of existing satellites for mapping.

2. *P Denis* and *A Baudoin* (France) — SPOT applications in topography at IGN.

Mr Denis described several aspects of the use of SPOT data for topographic mapping:
- Block space triangulation, how to use few known ground control points (about 6) to get a 10 m accuracy in planimetry and a 6 m accuracy in altimetry on checked points.
- Stereoplotting which is adapted for mapping at the scale of 1:50,000.
- Identification of details and map completion: between 40 and 100% of planimetric features can be correctly identified: to reach 1:50,000 standards field survey is necessary.
- Map editing and cost evaluation: the use of SPOT images could save between 30 and 50% of the cost of a topographic map.

3. *V Kratky* (Canada) — Universal Photogrammetric approach to Geometric Processing of SPOT Images.

   - Using a geometrical model of the satellite orbit and colinearity expectations Dr Kratky proposed a solution to process stereo-pairs of SPOT images either on analytical plotters or on digital computers. He can use 5 to 9 ground control points to get an accuracy of about 5 m in planimetry and 10 m in altimetry (with a B/H of 0.9).

One question was raised about the elimination of wrong GCP: it is possible to remove them from the higher values of residues.

4. *I J Dowman, G. Peacegood* (U.K) — Information Content of High Resolution Satellite Imagery.

   - This paper presented the results of a comparison between topographic information derived from TM and SPOT images and those on existing maps, in several areas (France, UK and Tanzania).
   From a geometrical point of view SPOT data is suitable for 1:50,000 mapping but from a map content point of view I Dowman showed that if some features are quite visible (major rivers) others are difficult to detect (minor roads and canals). Statistical results were presented. A proposition to produce 1:50,000 image maps with overlay features corresponding to 1:250,000 specifications was made.

5. *D G Rosenholm* (Sweden) — Usefulness of automatically generated height information for topographic mapping and land information purposes — with emphasis on data extracted from SPOT.

After recalling the interests of SPOT for mapping (10 m resolution, stereoscopy) the author presented some products derived from SPOT images by the Swedish Space Corporation. Digital Elevation Models using digital correlation can be produced with an internal accuracy of 0.2 pixels. Then orthophotos were presented at the scale of 1:50,000.

6. *R Shibasaki* and *S Murai* (Japan). Improvement of Mapping Accuracy by applying triplet matching to SPOT imagery.

The speaker presented how to improve the Digital Elevation Model's accuracy using three images (one vertical, one from the left, one from the right). Two methods were discussed: independent matching (using two images at the same time and comparing results from two stereopairs) and simultaneous matching (using directly the three images together). Results on a test area were presented which gave about 13 m in altimetry instead of 17 m by using stereopairs. The inconvenience of this method is that it needs three images instead of 2 and the cost is 50% higher.

EFFECTIVE TECHNIQUES FOR DEVELOPING COUNTRIES
(Working Group IV/2 — Session 1)

Sunday, 3 July, 1988, 1100—1230
Chairman: A S MacDonald (U.K)

In the unavoidable absence of the Chairman (Maj Gen G C Agarwal, India), the President (A S MacDonald, UK) took the chair and gave a brief report on the successful seminar organized by the Chairman in New Delhi in March 1985.
Dr A Bujakiewicz (Zimbabwe) then gave a paper describing some simple photogrammetric techniques which could accelerate land registration in rural farming areas. In a pilot scheme in Zambia, photo-coordinates are transformed to local ground control and areas and plot coordinates derived. Discussion was wide-ranging with questions from Ethiopia, the Philippines, India, Zimbabwe, Nigeria, USA, Portugal and Switzerland. The subject was clearly of great interest to those present.
The next paper, presented by Dr W Schurr (FR Germany), was on a similar theme — "Cadastral Mapping Methodology for Developing Countries" . Dr Schurr stressed the value of simple photo-identification techniques in flat land and described the procedure adopted in Thailand where 65% of the land falls in this country. Rectified photograhs are used to define parcels but stereo-restitution has to be used in hilly areas. A questioner from Zimbabwe was concerned lest the simpler technique encouraged the use of less educated staff who would not be able to deal with land ownership questions. Dr Schurr said the training was identical.
In the last paper, Dr Murad-al-Shaikh (Iraq) gave a commanding and wide-ranging revision on the use of Remote Sensing Products for Cartographic Applications in Developing Countries. He provided tables of sensors available and map scale upper limits for mapping from imagery. A Soviet delegate asked the author for his view of the value of the KAR 1000 imagery and received the general response that delegates were keen to obtain stereo-cover the carry out trials. He encouraged everyone to contact Soyozcarta for details.

MAP REVISION IN THE DIGITAL AGE
(Working Group IV/1 — Session 1)

Sunday, 3 July, 1988, 1330—1500
Chairman: J. Manning (Australia)

1. *J Manning* (Australia) — Report on Activities of Working Group IV/1 Map Revision.

The report included the terms of reference of the Group and results of a worldwide survey of the approaches of national mapping agencies to the planning, techniques of revision and the use of space imagery for revision. The group recommends continued activity in the period 1988—1992 on the specific study of digital and graphical superimposition for map revision.

2. *D W Proctor* and *P R T Newby* (U.K) — "Large Scale Map Revision in the Ordnance Survey U.K" (Invited Paper).

The continuous large scale revision systems employed in the Ordnance Survey were described. The application of digital techniques and the consequent reduction in process time were highlighted. Methods of making data available immediately after survey were illustrated. The benefits to user of revised data were briefly discussed.
Examples of the process and products were shown on 35 mm slides.

3. *J R R Gautier* (Canada) — "Map Revision with Satellite Imagery: a powerful alternative" .

The Canadian application of space imagery to achieve significant cost benefits in revision of national series maps was described. Savings were quantified and the benefits of the Canadian work and its application to forested areas were discussed.

4. *A P Eidenbenz* and *A Perret* (Switzerland) — "Map Revision supported by digital vector/raster techniques" .

The Federal Office of Topography maintains a 6 year map revision cycle for maps at 1:25,000 and smaller over the whole of Switzerland. With the application of analytical plotters new techniques of interpretation, detection of change and direct restitution of the photogrammetric instrument have been introduced. Experiences with building a uniform height model and the laser scanning of available map data were given.

5. *O Jacobi* — "Error Propagation in Digital Maps" .

The problems with current techniques in degrading data bases during revision processes were identified. A strong argument was given to store all original digital observations and to incorporate new data by readjusting all information. This would enhance not degrade the accuracy of the data base.

6. *A Ostman* (Sweden) and *M Tujunen* (Finland) —"Maintenance of Urban Information Systems using Photogrammetric Superimposition Technique" .

The maintenance of a large scale spatial database in the city of Helsinki was described using photogrammetric techniques on the Intergraph system. The use of 2D information was found to be sufficient for superimposition of graphics. The maintenance of ground control was simplified by the use of natural control points.

SPECIFICATIONS FOR MAPPING
(Working Group IV/4 — Session 1)

Wednesday, 6 July, 1988, 1330—1500
Chairman: J Kure (Netherlands)

1. *J Kure* (The Netherlands) — Guidelines in Establishing Mapping Specifications (WG Report).

The report outlined the terms of reference of the Working Group; the amendments made to these at the halfway period and some conclusions derived at the end. The WG's recommendations are:

- ISPRS is a very suitable forum for the presentation and exchange of views on mapping standards.
- It is impractical to attempt to establish a universally applicable set of mapping standards. Instead, member countries are referred to the valuable specifications prepared by both the RICS and the ASPRS and to the guidelines on pitfalls to be avoided, set out in the Report of WG IV/4.

2. *J D Leatherdale* (U.K) — RICS specification for mapping at scales between 1:1,000 and 1:10,000 (Invited Paper).

The report dealt with the considerations leading to the production of a greatly simplified second edition of the RICS Specification, initially presented to the 1980 Hamburg Congress. This edition has also been extended to cover digital mapping for automated drafting, for input to geographic information systems and for digital terrain models.
The report concluded with a brief outline of the RICS document prepared on Terms and Conditions for Survey Contracts.

3. *D Merchant* (USA) — ASPRS' Tentative Map Accuracy Standards for Large Scale Maps (Invited Paper).

The report described the evolution of the current tentative standard by a Standards and Specifications Committee of the American Society, motivated by perceived inadequacies in the existing standards and, above all, to obtain a consensus between users and producers on a standard. Characteristics of the tentative standard are that spatial accuracies are given at tarue (ground) scale and that it includes procedures for testing map accuracy.

4. *M Akiyama, N Takayama, S Okuyama, F Hisamatu, R Kojiroi, T Kiuchi* (Japan) — Standard Procedure and Data forma for digital mapping (Presented Paper).

The report outlined the activities of the Committee set up by the Geographical Survey Institute to standardise the digital mapping procedure and data format in Japan. The standard covers the mapping procedure to be used, the coding system, the data format of the exchange file and the geometric models to be used in structuring the data for use in a geographical information system.

5. *O Brande-Lavridsen* (Denmark) — The Danish Geographic Exchange Format (Presented Paper).

The report covered the work carried out by the Danish Society to establish an exchange format for topographical information, that was subsequently extended to cover cadastral and utility information. The format handles geographic, alfanumeric and structural information needed to exchange LIS data bases. Current initiatives are directed towards developing an interface to the Initial Graphics Exchange Speicification used in the Danish building industry.

LARGE SCALE APPLICATION OF PHOTOGRAMMETRY
(Working Group IV/5-Session 1)

Thursday, 7 July, 1988, 0900-1030
Chairman : R R Chamard (USA)

1. *R R Chamard* (USA) - Report of Working Group Activities.

The Working Group circulated a questionnaire through its members on status of Large Scale Mapping with emphasis on

Digital Mapping. Response was not overwhelming but sufficient for summary herein.

Percent of Digital Mapping by Scale

Scale	1 : 500	1 : 1000	1 : 2500	1 : 5000
Country				
World Average	44	36	39	38
Africa	27	29	21	26
North America	70	58	69	71
South America	44	31	26	9
Australia	73	50	53	36
East Europe	9	13	22	28
West Europe	38	35	44	58

Method of Data Acquisition for Topography

Contour Digitizing	44%
Grid //	33%
Pattern //	17%
Profiles //	6%*

* Mostly used in connection with orthophoto production

Most Used Programme to Convert Digital Data to Contours

HIFI
Surface Two
Intergraph
ACS
Wild CIP
AUTOCAD

Digital Systems in Use

Kern	30%
AUTOCAD	20%
Wild	10%
Intergraph	10%
KORK	8%
SYNERCON	6%
COMPUTERVISION	5%
DIGINITICS	2%
OTHERS	9%

Trends for Next four Years

- More CAD vse
- GIS, Heavy Impact
- Continue trend digital for highways
- PC will impact in data Acquisition
- More Analytical Systems
- Less Expensive Software
- Software more user friendly
- Digital photography will surface w/impact

2. *K Tachibana* and *H Hasegawa* (Japan) - FMC Camera, High Resolution Films and Very Large Scale Mapping. Presented by K Tachibana.

Discussed the use of FMC Camera the Ziess Jena LHK and its ability to present Forward image creation. Such use allowed use of very high resolution films under difficult light conditions. Combination of control scheme and high quality imagery allowed for very high accuracy in mapping at very large scales. At 1 : 2000 photo scale mapping RMS at 2.5 cm.

3. *J Hohle* (Denmark) - Determination of Water Depths in coastal areas and its practical problems.

Presented by O Jacobi.

Interesting presentations on underwater measurements on the huge coastline of Denmark using normal aerial photography and analytical stereoplotters in which water refraction computations were included in the operational software.

4. *I Rentsch* (FRG) - Methods of Photogrammetry in the Field of Glaciology.

Presented by H Rentsch

Knowing about glaciers is important not only in theory of glaciers' movement but in predictions of movement as it could affect habitation. Discussion of digital data acquisition of the glacier-Vaughn-Lewis-Icefield in Alaska USA and British Columbia Canada. Digital data is displayed on wireframe 3D, perspective views, contour maps and orthophotos.

5. *P Erixon* (Sweden) - The Swedish Progress from an Analogue System to a Digital Photogrammetric System in Road Design.

Presented by P Erixon,

Discussion on the transition in the 1950s of the Department using Multiplex stereoplotters through analogue instruments. Use of the analogue instruments with digital data acquisition hardware to the present most modern analytical stereoplotting system. The Swedish have developed their own Road CAD series of software for analysis of routes, road design, earthwork computations and final design layout on the ground. Digital does allow for good analysis of various designs allowing for optimal design for economies and environmental factors.

TRENDS IN MAPPING FROM SPACE IMAGERY
(Working Group IV/3 — Session 2)

Thursday, 7 July, 1988, 1100—1230
Chairman: A Colvocoresses (USA)

Four papers were presented as follows:

1. *A Konecny* (FRG) — reviewed the results of stereoscopic photogrammetric experiments conducted with the Metric camera (FRG), Large Format camera (USA) and the 200 and 1000 mm USSR cameras. He covered the determination of the three dimensional topographic model as well as the extent to which planimetric detail could be defined for all four systems.

2. *P Serra* (Brazil) — reviewed the Brazilian experience of mapping with satellite data. He showed how vast areas of basically unmapped areas in Brazil had been image mapped with Landsat and that major corrections and revisions had been made to the maps. Most of the mapping from satellite data has been at the 1:250,000 scale.

3. *S Wu* (USA) — reviewed the various efforts of the United States to map the planets — including the moon and Phobos.

4. *A Colvocoresses* (USA) — reviewed the experience of the US Geological Survey in the use of space imagery. He summarised the extent of the USGS image mapping programme and showed examples of how space provides advantages to the map maker and map user.

All of the above papers were followed by appropriate questions but as they were basically tutorial they did not provoke any extensive discussion.

TECHNIQUES FOR THE MANAGEMENT OF TOPOGRAPHIC INFORMATION
(Intercommission III/IV Working Group — Session 1)

Friday, 8 July, 1988, 0900—1030
Co-chairmen: R Welch (USA)
A S Macdonald (U.K)

1. *R. Welch* (U.S.A.) — Digital Technologies for the Integration of Photogrammetric and Remote Sensing Data with Land and Geographic Information ISystems (Invited Paper)

   The activities of Intercommission Working Group III/IV were reviewed, and examples of merged multisensor data sets and feature extraction techniques presented. A specific application of monitoring soil erosion from agricultural lands using photogrammetric data in combination with a GIS was used to illustrate the potential of an integrated database. A new pc software package, the Desktop Mapping System, that permits the integration of digital image data with vector GIS systems was described.

2. R. Simard, G. Rochon and A. Le Clerc (Canada) — Techniques for the Management of Topographic Information (Invited Paper)

   An automated mapping software package (CARTOSPOT) for deriving X, Y, Z terrain coordinates from stereoscopic satellite image data was described. Results obtained from tests conducted with SPOT image data recorded over Canada, Thailand and Malaysia demonstrate the feasiblity of deriving terrain elevations to accuracies of ±5 to ±10 m. Techniques are being developed to create topographic maps and to integrate the SPOT image data with digital terrain models for geologic exploration.

3. J. Desachy, P. Debord and S. Castan (France) — An Expert System for Satellite Image Interpretation and GIS Based Problem Solving

   A rules-based software package for use with integrated database is under development at the University of Toulouse. Theoretical concepts were discussed.

4. J. Dykstra, O. Long and K. Smith (U.S.A.) — The Integration of Image Processing and Topologically Structured GIS: One Company's Solution.

   Modules associated with the Intergraph TIGRIS system were described. These include software routines for data capture, image processing, spatial analysis and modeling. An example of map revision on an Intergraph work station was used to illustrate the capabilities of an integrated hardware/software system.

5. J.-P. Muller, T. Day, J. Kolbusz, M. Dalton, S. Richards and J.C. Pearson (U.K) — Visualization of Topographic Data Using Video Animation

   Dynamic visualisation of terrain requires the use of extremely fast computer systems. Techniques such as stereoimage matching, ray tracing, Lambertian shading and spatial analysis were described. A video flight simulation over rough terrain was employed to demonstrate the potential of fast image rendering techniques.

Inter-Commission III/IV Systematic Approaches to GIS and Digital Data

July 8 Friday, 1988 11:00—12:30
Special Session T44
H. SHIMADA

Session T44, one of 2 Commission III/IV session titled "Systematic Approaches to GIS and Digital Data" was held from 11:00 to 12:30 at room B-1. All the seven papers were presented as shown below.

1. "Integrated Classifiers for GIS and Remote Sensing", D.G. Goodenough, J. Iisaka, A. Menard, M. Robinson and R. Saper (Canada).
2. "Projection of Topographic Data into Remote Sensing Images", J. Besenicar and B. Kengen (The Netherlands).
3. "Errors due to Integration of Image Data to Geographical Information Systems", G. Schweinfurth (F.R. Germany).
4. "The Application of Integrated Raster — Vector Techniques to Cartographic and Photogrammetric Data in Map Revision Process", L. Suarace (Italy).
5. "Integration of a GIS and a DTM", J. Sandgaard (Denmark).
6. "Total Utility Management System in Kuwait (KUDAMS)", K. Ikeda (Japan).
7. "Geographical Information System with Remote Sensing Data and Its Application in Land Use Planning", E. Shimizu and H. Nakamura (Japan).

In the 1st paper, D. Goodenough from Canada Center for Remote Sensing has focused his talk to a new classification algorithm for forestry mapping though his paper discribes the total expert system. This algorithm is inherently a kind of binary tree classifier and utilizes different kind of features at each node.

In the second paper, J. Besenicar from the Netherlands has presented a paper concerning an overlay technique of vector data and raster image data.

In the third paper, G. Schweinfurt from Universität Karlsruhe has presented a paper showing several examples of errors included in existing geographic informations such as topographic maps.

In the fourth paper, L. Surace from Italy has presented a paper discribing a system for map revision using remote sensing data.

In the fifth paper, J. Sandgaard from Technical University of Denmark has introduced a GIS system which can handle both vector data and DTM data.

In the sixth paper, K. Ikeda from Asia Air Suarvey, Japan has presented a paper discribing a GIS system called KUDAMS. This system covers almost all of the residential area of Kuwait and handles most informations for communication, sewage, electricity, water, gas, etc.

In the last paper, E. Shimizu from the University of Tokyo Japan has presented a paper discribing a development of a GIS system and its application to a land use planning. This system includes image processing capabilities as well as an integration of GIS data and remote sensing data.

The room was full by participants, but discussions were not so active. As a whole, GIS system developments and its applications are moving from a research phase to an operational phase

Commission V Review and Advancements

Dr. V. Kratky (Canada)
President, Commission V

The mandate of Commission V is to promote and to help develop photogrammetric methods, techniques and applications in areas not related to general mapping. This definition covers a broad scope of diverse scientific and engineering disciplines, and directly contributes to the thematic variety, which is so typical of the Commission's work. In the recent past, heavy emphasis was placed on the exploration of newly emerging imaging sensors, for which a redefinition of some basic photogrammetric principles is needed, and on the exploitation of the new interaction potential of on-line photogrammetric systems. Other more traditional tasks of industrial, biomedical and architectural photogrammetry have been expanded with a primary goal of improving the communication and cooperation with the non-photogrammetric world and with related technical societies.

At the outset of the present term, four years ago, the overwhelming impact of new technology was self-evident from the following, at the time already well established facts:

1. Increased availability and improved performance of solid state cameras promised to affect drastically the future of close-range photogrammetry by expanding its potential into real-time applications and digital image processing.
2. Successful experiments with real-time feedback from image measurements and with their analysis confirmed that photogrammetry can be used not only to monitor, but also efficiently control dynamic engineering operations in three-dimensional space.
3. All-digital close-range photogrammetry appeared as a viable system to replace traditional photographs by imageries acquired, stored and used in a digital form. In this form, photogrammetry becomes directly compatible with methods of digital image analysis, enhancement and subsequent computer processing of any kind, so drastically improving conditions for effective automation efforts.

In the past term, for which we are accounting at this Congress, the activities of Commission V have been organized in six working groups and one committee, covering the following subjects and chaired by the following colleagues:

- Analytics of non-topographic photogrammetry
  (H.M. Karara, U.S.A.);
- Low altitude aerial photogrammetry
  (W. Wester-Ebbinghaus, F.R.G.);

- Unconventional technologies in close range photogrammetry
  (S. Ghosh, Canada);
- Close range photogrammetry in industry and applied science
  (L.P. Adams, South Africa);
- Biostereometrics
  (R.E. Herron, U.S.A. and I. Newton, U.K.);
- Digital and real-time close range photogrammetry
  (S.F. El-Hakim, Canada and K.W. Wong, U.S.A.);
- Architectural photogrammetry
  (R.W.A. Dallas, U.K.).

During 1984—88, Commission V has organized or actively sponsored eight successful symposia and conferences in seven different countries. A representative cross-section of the technical work conducted has been presented in eight technical sessions of Commission V and one joint session of Commissions II/III/V. In preparing their program we had solicited five invited papers and received a total of 140 additional abstract proposals, out of which we were able to accommodate only 41 as presented papers in the technical sessions, while the rest was accepted for presentation in poster sessions. A particular care was taken to avoid uncertainties in the final program and to reduce the risk of cancellations. I am happy to state that the effort has paid off. With no exception, all papers in technical sessions have been presented as scheduled in the printed program and the rate of accomplished poster presentations was reasonably high at 57%. The percentage of papers submitted in time to be included in the Proceedings is also very good, so that this permanent record of technical presentations reflects well the reality of the Congress and will serve to the international photogrammetric community as a rather complete reference.

Where are we now, after four years? The situation has again changed; however, very much in the direction expected. The current major challenge for Commission V remains to be associated with the high potential of real-time computer processing, based on the digital output from solid state cameras combined with extremely fast microprocessors. In the process of meeting this challenge, close range photogrammetry is reaching a major milestone in its general development, reaching far beyond the mandate of Commission V. Not any longer will general photogrammetry be applied only as a tool of passive recording and quantitative feature evaluation of objects, with the aid of photographs representing a still or time-fixed reality. The new breed of digital photogrammetry, supported by and combined with digital image processing capabilities, is on the threshold of assuming a novel, much more demanding role.

Let us take a closer look at some of the possibilities. First of all, many of the typical geometric reconstructions and quantitative evaluations can be performed almost instantly, without the so far everpresent balast of photo processing and physical separation of image acquisition and mensuration phases. Consequently, "instant" photogrammetry is then capable of an active monitoring and control of dynamic processes in three-dimensional space, within their inherent real-time constraints. Finally, suitable on-line procedures can take advantage of a full information feedback in the process and actively use it, thus offering a new, built-in capability of selfchecking and selfrefining.

What has to be done next? Primarily, we have to redefine, adapt and automate the mensuration process; however, most of the components needed to achieve this are already available and proven. With their proper integration we can establish a so far unparalleled flexibility in the use of photogrammetry and offer much more than ever before to other technical, engineering and industrial disciplines. Today, it is much more than a hope or a vision to expect that the new all-digital approach will eventually demonstrate how generic photogrammetric principles can and will serve as viable and reliable elements of highly sophisticated systems in such areas as engineering control in three-dimensions, robotics and machine vision.

In persuing these ambitious objectives, we cannot stay isolated. More than ever it is recognized that interactions with other technical disciplines and societies are absolutely needed, and that an efficient transfer of adapted technologies outside the field of photogrammetry is crucial for the success of Commission V. We already have a good record of successful cooperation with some organizations, such as SPIE, CIPA and ICOMOS, and we should expand efforts in the industrial field. The newly adopted resolutions clearly reflect this need in calling for an increasing integration of photogrammetric methods with CAD/CAM systems, and for a direct, more agressive extension of photogrammetry into the field of artificial vision. Ultimately, the assessment of out present situation and options resulted in the formulation of a new name for Commission V, "Close Range Photogrammetry and Machine Vision" , adopted by the General Assembly of this Congress. From this fact, you can clearly see where we are going.

Commission V has been fortunate to be in the enviable position to embrace the all-digital photogrammetric principles — and especially their real-time implementation — rather early, mainly because the close range environment of our work allows us to adapt and adjust to the imposed restrictions of the format and limited resolution of the new digital imaging systems. It has become clear at this Congress that the same trends are affecting the work of other Commissions, and the organization of intercommission Working Groups and meetings will obviously be very important in the next four years.

I would like to conclude by stating that it has been a pleasant and rewarding task for me to participate in the exciting development affecting Commission V so essentially.

ANALYTICS OF NON-TOPOGRAPHIC PHOTOGRAMMETRY WORKING GROUP I/V

SESSION T32
Thursday, July 7, 9:00—10:30

Chairman — C.S. Fraser (USA)

1. *W. Wester-Ebbinghaus* (F.R. Germany) — Analytics in Non-Topographic Photogrammetry (Invited Paper).

An overview of the analytics of bundle adjustment for close-range photogrammetry with particular emphasis on the recovery of interior orientation parameters for digital cameras was presented.

2. *J. Fryer* (Australia) — Lens Distortion and Film Flattening: Their Effect on Small Format Photogrammetry.

The results of recent work on the modelling and compensation of distortion in small format semi- and non-metric cameras were presented.

3. *L. Hinsken* (F.R. Germany) — A Singularity Free Algorithm for Spatial Orientation of Bundles.

A singularity free algorithm for the spatial orientation of bundles was introduced. This technique allows the least-squares computation of bundle adjustment, and also spatial resection, without the requirements for initial parameter approximations.

4. *S. Dequal* (Italy) — An Unconventional Application of Analytical Plotters to Architectural Photogrammetry: Parojection, Plotting and Digitizing on Non Plane Surfaces.

Analytical restitution of stereomodels in architectural photogrammetry using cylindrical coordinates with plane expansions was presented and examples of contour plotting in cylindrical coordinates were shown.

5. *R. Kotowski* (F.R. Germany) — Phototriangulation in Multi-Media Photogrammetry.

Presented was an extended functional model for bundle triangulation which accommodates multiple light-refracting surfaces.

Due primarily to time constraints, discussion on the presentations was confined to a single comment from F. Crosilla regarding the use of free network adjustment and transformations in photogrammetric network adjustment. This comment was made following the talk by Mr. Hinsken.

LOW ALTITUDE AERIAL PHOTOGRAMMETRY WORKING GROUP 2/V

SESSION T12
Sunday, July 3, 9:00—10:30
Chairman — W. Wester-Ebbinghaus (F.R. Germany)

1. *J. Peipe* (F.R. Germany) — Progress in Low Altitude Aerial Photogrammetry (Invited paper).

The state-of-the art in low altitude photogrammetric systems was describeld.

2. K.L. Busemeyer, J. Heckes, M. Kuegelgen, *L. Mauelshagen* (F.R. Germany) — Camera Platforms for Low Altitude Aerial Photogrammetry at the Deutsches Bergbau-Museum.

The state-of-the art in low altitude camera platforms was described

3. *G. Bozzolato* and M. Carabelli (Italy) — New Heliborne Equipment and Photogrammetric Survey Technique.

Practical applications and experience with new equipment were described.

4. *T. Oshima* and K. Miyashita (Japan) — Low Altitude Aerial Photogrammetry Using a Kite Balloon.

Practical applications of kite balloon photogrammetry were described.

5. M.R. Shortis and *C.L. Ogleby* (Australia) — Applications of Low Altitude Photogrammetry to Digital Mapping and Heritage Recording.

Practical experience with low-altitude photogrammetry was described.
As this was the first session of Commission V for this Congress, the Commission President addressed the audience by reviewing the Commission program.
Opening the session itself, the chairman anounced, that he considers the work of Working Group V/2 to be completed by the end of this Congress.
The presentation of technical papers started with the report of the Secretary reviewing the activities of the Working Group.
As a result of the session one can state, that there are now several camera platforms and imaging systems available, suitable for different applications in low altitude photogrammetry. However there is still a need for suitable navigation systems in order to use remotely contarolled unmanned imaging systems operationally.

UNCONVENTIONAL TECHNOLOGIES IN PHOTOGRAMMETRY WORKING GROUP 3/V

SESSION T15
Sunday, July 3, 11:00—12:30
Chairman — S.K. Ghosh (Canada)

1. *S.A. Veress* (USA) — X-Ray Photogrammetry, State-of-the-Art (Invited Paper).

The geometrical aspects of X-ray photogrammetry were analyzed with regard to better resolution and lower radiation. Calibration and hardware arrangement considerations were presented. Software potential in view of reliability, analysis and decision making were discussed. On-line analytical approaches were considered and so were the aspects of instrument

compatibility for such approaches.

2. *K. Jeyapalan* (USA) — Automated Pavement Evaluation Using Photogrammetry and Remote Sensing.

A system developed and being used in pavement evaluations was discussed. This considered roughness, cracking, patching and rut depths in the pavements (roads of both types, cemented and tarred). A slit camera (strip photography) and a pulse camera were the two principal data acquisition systems. Tracking wheels and laser sensors were two secondary data acquisition systems. Results from recent studies were presented.

3. T. Hoshi, T. Matsushita and *Y. Koishikawa* (Japan) — Accuracy of Stereo Matching Using Color CCD Camera.

The paper presented the procedures used and experience gathered in improving the accuracy of matching stereoscopic images taken outdoors by CCD cameras. The accuracy of stereo matching was evaluated. This involved the correspondence between edge patterns. Cross-correlation and SSDA (Sequential Simitarity Detection Algorithm) methods have been used with interesting results.

4. *K. Narigasawa*, Y. Gomi, K. Komiya, K. Fujisawa, I. Nakamura and M. Kudo (Japan) — Application of Thermal Infrared Video System in Spiral Flow Image Tracing for the Water Flow Velocity Distribution Measurement.

The paper discussed a method of measuring river flow velocity distribution by analyzing thermal infrared video images. It permits continuous observation of rivers even during the night or during adverse weather conditions.

5. M.S. Elghazali (Kuwait) and *Z.A. Wishahy* (Egypt) — Results of a Sequential Adjustment Procedure for Ultrasonography Using an Oscilloscope Camera.

The paper discussed the problems of dealing with hidden objects having no control points as well as the use of a non-metric imaging system. Developed mathematical models were presented. A sequential adjustment procedure for data handling was discussed.

6. *E. Baj* (Italy) — Prototype of a Metric Projector.

A prototype projector designed for raster photogrammetry was discussed. The author claimed the advantage that only one picture of the object needs to be taken and dynamic phenomena can be investigated without having to use stereophotogrammetric techniques. The experiments that were carried out in-doors indicated encouraging results.

CLOSE-RANGE PHOTOGRAMMETRICS IN INDUSTRY AND APPLIED SCIENCE WORKING GROUP 4/V

SESSION T35
Thursday, July 7, 11:00— 12:30
Chairman — H. Ruether (S. Africa)

The chairman expressed his regret concerning the limited time allocated for paper presentations for WG V/4 Only five of the 45 papers offered by working group members could be presented.

1. *C.S. Fraser* (USA) — State-of-the-art in Industrial Photogrammetry.

An overview covering the application areas of close-range photogrammetry was presented. The relationships between the various techniques employed in industrial photogrammetry were flowcharted and accuracies for a large number of photogrammetric systems were given.

2. *D. Leatherdale* and J. Turner (United Kingdom) — Commercial Underwater Photogrammetry — The First Decade.

The author described the instrumentation, techniques and the environment of underwater photogrammetry in North-Sea oil fields. Advantages of underwater photogrammetry as opposed to other techniques were emphasized.

3. *R. Larsson* (Sweden) — Photogrammetaric Close-Range CAD System.

The need to interface CAD and photogrammetric systems was discussed. Problems arising from the presentation of photogrammetrically obtained 3-D information were pointed out and advantages of CAD application linked to photogrammetric systems were shown.

4. *K. Guethner* and J. Peipe (F.R. Germany) — Motography and Photogrammetry for the Study of Movements.

Principles of motography were explained and several applications described. The efficiency of motography combined with photogrammetric restitution was demonstrated.

5. *T. Kawame*, F. Koga, S. Matsumoto, S. Ishiguro, Y. Watanabe, A. Tsubouchi, S. Murai (Japan) — Deformation Measurement of the Bandai Bridge by Close-Range Photogrammetry.

Photogrammetric monitoring of deformations of a bridge was described. Method, results and accuracies were given.

BIOSTEREOMETRICS WORKING GROUP 5/V

SESSION T18
Sunday, 3rd July, 13:30—15:00
Chairman — I. Newton (United Kingdom)

1. *Y. Yamashita* (Japan) — Biostereometrics in Japan (Invited Paper).

This paper dealt with several methods, which are in current use or have potential, for 3-D measurement of biological form

and function in Japan. Their applicability and shortcomings in the context of biostereometrics were also briefly discussed.

2. *G. Robertson* (Canada) — Mensuration of Body Shapes Using an Automated Photogrammetric Approach.

A research project to compare 6 different systems (moiré, rasterstereography, laser scanning, light sectioning, integrated shape imaging system and sonic digitizing) for measuring 3-D body shapes was reported. A comparison was made of such factors as accuracy, cost, operating requirements and speed.

3. *A. Coblentz* and R. Mollard (France) — Analyse de Gestes par Videogrammetrie.

A 3-D TV system (VICON) has been employed to collect, in real time, trajectories of targetted anatomical landmarks on the torso and arms during reach movements carried out by seated operators. Data acquisition, data reduction and 3-D trajectory computations were completed within 15 minutes to an accuracy of ±3 mm. The results are used for the representation of reach envelopes in computer aided design studies.

4. *T. Takamoto* and B. Schwartz (USA) — Photogrammetric Measurements of the Optic Disc Cupping and Retinal Nerve Fiber Layer Thickness.

New equipment and techniques to allow more accurate and less subjective evaluation of changes in cupping, pallor and nerve fibre layer (NFL) thickness of the optic disc were described. The techniques use both stereophotogrammetry and image analysis. Applications in ocular hypertension and glaucoma were also discussed.

5. M. Bougouss (Morocco) and *S.K. Ghosh* (Canada) — Use of Tomodensitometric Imagery for Prostheses of the Human Knee.

A new method for calibrating a tomodensitometric imaging system and for generating 3-D data was reported. The method has been used to obtain 3-D numerical data of the human knee in vivo with a standard error of less than ±0.3 mm. Such data allows the production of personalized knee prosthesis.

DIGITAL AND REAL-TIME CLOSE-RANGE PHOTOGRAMMETRY WORKING GROUP 6/V

SESSION T40
Friday, July 8, 9:00—10:30
Chairman — S.F. El-Hakim (Canada)

Seven papers were presented, one more than originally scheduled. The majority of the papers, four, dealt with the subject of geometric fidelity and stability of solid state cameras.

1. *R. Lenz* and D. Fritsch (F.R. Germany) — On the Accuracy of Videometry.

The various sources of geometlric errors were analysed. Also shown was a video tape of a system in action monitoring a robot movement.

2. *H.A. Beyer* (Switzerland) — Linejitter and Geometric Calibration of CCD Cameras.

The problem of linejitter, which affects the stability of CCD cameras by as much as 0.4 pixels in the horizontal direction, with a proposed solution was discussed.

3. *W. Wester Ebbinghaus* (F.R. Germany) — A Metric CCD System.

A camera built specially to eliminate the problem of linejitter was described.

4. J. Heikkila and *H. Haggren* (Finland) — Geometrical Calibration and On-Line Stability Control of Photogrammetric Solid State Camera Station.

The problem of linejitter was addressed from a practical point of view. As in the previous three papers the authors agreed on the fact that the best solution to many of the CCD camera problems, particularly linejitter, is through hardware rather than mathematical correction.

5. *Y. Yamashita*, N. Saeki, K. Hayashi, N. Suzuki (Japan) — Automated Three-Dimensional Measurement Using Multiple One Dimensional Solid-State Image Sensors and Laser Spot Scanners.

Automated three-dimensional measurement, using multiple one-dimensional solid-state image sensors and laser spot scanners, was described.

6. *W. Wester — Ebbinghaus* and H. Zamzow (F.R. Germany) — Real-Time Photogrammetry by Means of High-Speed Video.

This paper was aimed at applications involving moving objects and showed a high speed video camera system.

7. *M.J.P.M. Lemmens* (the Netherlands) — A Survey on Stereo Matching Techniques.

Several stereo matching techniques were reviewed.

DIGITAL AND REAL-TIME CLOSE-RANGE PHOTOGRAMMETRY WORKING GROUP 6/V

SESSION T43
Friday, July 8, 11:00—12:30
Chairman — K.W. Wong (USA)

All six scheduled papers were presented. Four of the papers were presented by the authors, and the remaining two papers were presented by associates of the authors. The session was well attended, on the average about 250 persons, and the discussions after each paper were relevant.

1. *K.W. Wong*, M. Lew, A.G. Wiley (USA) — 3-D Metric Vision for Engineering Construction.

An overview was presented of the research program at the University of Illinois, USA, on metric vision for engineering construction. This research program includes work on digital targetting, stereometric vision, system calibrations and application systems.

2. G. Bayer, P. Krzystek, W. Moehlenbrink (F.R. Germany) — Real-Time Positioning of Moving Objects by Dynamic Target Tracking.

This paper was presented by K. Linkwitz, who reported on the combination of digital camera and theodolites for construction applications.

3. *H. Schaefer* and S. Murai (Japan) — A Concept for Automated 3-D Measurement of Objects in Motion.

A concept was presented for 3-D measurement of objects in motion. It represents an approach from the field of machiane vision; an experimental system was described.

4. M. Clauss (F.R. Germany) — Experience with Indu SURF in 3-D Measurement of Industrial Surfaces.

This paper was presented by D. Hobbie. It presented a hybrid system for the measurement of body shapes of automobiles. Photographic images were digitized by a PLANICOMP 100 and point measurements were performed through digital image processing. An accuracy of 1:5,000 was achieved with a measurement time of about 2 seconds per point.

5. *P.C. Gustafson* (USA) — The Application of Real-Time and Near Real-Time Photogrammetry in Industry.

Presented were the results of an accuracy test on a digital camera. A pointing accuracy of ±0.05 pixels was reported.

6. *I. Hadem* (Norway) — Derivation of Approximate Values by Recognition of Circular Targets.

This paper described a method for computing the approximate coordinates of circular targets.

INTERNATIONAL COMMITTEE OF ARCHITECTURAL PHOTOGRAMMETRY (CIPA) ASSOCIATED WORKING GROUP TO COMMISSION V

SESSION T55 — Architectural and Heritage Recording through Photogrammetry
Saturday, 9th July, 13:30—15:00
Chairman — L. Mauelshagen (F.R. Germany)

1. M. Carbonnell (France) — Compte Rendu d'Activité du Comité International de Photogrammétrie Architecturale Pendant la Période 1984—1988.

The report, presented by L. Mauelshagen (F.R. Germany) in English, includes the description of the following: election of 10 representatives (formerly 8) of ISPRS and ICOMOS/UNESCO; participation of the president at the ICOMOS-meetings at Rostock and Dresden (D.R. Germany) in 1984 and at Washington (USA) in 1987 as well as the yearly consultative Committee of ICOMOS; ISPRS-meetings at Rio de Janeiro-Congress in 1984, WG V/2 at Bochum (FRG) in 1986, Symposium of Commission V and Seminar on "Historic Resource Photogrammetry" of ICOMOS-Canada at Ottawa in 1986; CIPA-Symposia and — Colloquia at Tunis (Tunesia) in 1984, "Lessons for Architects" at York (Great Britain) in 1985, at Strasbourg (ICOMOS-Council of EUROPE) in 1986, at Granada (Spain) in 1987, at Sofia (Bulgaria) Oct. 1988; doctrinal documents from CIPA/ICOMOS; contributions — to the work of Commission V on plates and films used in short-range photogrammetry; participation in the constitution of a regional photogrammetry centre (specialized in architectural surveys) at La Plata (Argentina); several publications.

2. *E. Lundemo*, O. Ofsti (Norway) — Photogrammetry for Preservation of Cultural Heritage.

Showing some examples for application of terrestrial photogrammetry in the field of cultural heritage, the authors point out that the collaboration between different disciplines, such as archaeology, architecture, conservation, photogrammetry, preservation and others, is essential. A project group has been formed and its recommendations will be reported in a manual that will be published around 1988/1989. This manual with guidelines, proposals and examples of application can help any one, who is involved in cultural heritage recording and associated themes.

3. *G. Birardi*, R. Carlucci, E. Ferrara, U. Giannoni, G. Maruffi (Italy) — The Photogrammetric Survey of the Coliseum in Rome.

The Coliseum, a world-wide known monument, was recorded by terrestrial and aerial photogrammetry at large scales. The first plottings have been worked out analytically as well as by an analogue plotter using terrestrial control points of high precision. Plans of the vertical external walls of the monument traced on a variable ellipsoid and a map of the elliptical curvature (horizontal section) are produced for a variety of architectural, constructional and conservation purposes.

4. *A. Georgopoulos*, C. Ioannidis, C. Potsiou, J. Badekas (Greece) — Analytical Approaches to the Problem of Architectural Restitution.

The Hadrian's gate at Athens has been chosen to demonstrate various analytical methods of data acquisition and graphic presentation of architectural restitution. The adopted and developed methods involve both simple and sophisticated equipment (Stereocord G2, analytical plotter BC2, monoscopic analytical restitution) and metric as well as non-metric photography. The three approaches are described and evaluated in terms of accuracy, cost and time.

5. P.R. Wolf, *H. Huang* (China Taipei) — Digital Orthophoto Mapping Using a Simple Camera.

Digital image processing is used for producing an orthophoto from a stereopair of convergent photos taken of a cylindrically shaped building. The system utilizes a 35 mm single lens reflex camera, a rotating-drum type scanning micro-densitometer and an IBM personal computer interfaced with a professional graphics display. The visual appearance of the orthophoto was excellent, its accuracy was evaluated and found to be of high order.

6. J. Heckes, *L. Mauelshagen*, M. Skalli (F.R. Germany) — Recording the Damages of Natural Stones.

Increasing stone decay of various kinds is becoming more serious and evident nowadays and has resulted in research programs as well as in collaboration of curators and natural scientists. Three examples are given how terrestrial and close-range photogrammetry can support this interdisciplinary research work.

7. *J.-P. Saint-Aubin* (France) — Pour une Nouvelle Technologie Photogrammétrique: Les 4 Dimensions de l'Architecture.

Starting with the geometrical analysis of a building and its components it was shown how all geometrical spatial features of a building and its details can be converted into highly resolving digital information. The method is based on photogrammetric recording techniques, which lead to synthetic images, that are shown on a monitor. Modifications of the numerical input can be visualized on a monitor and the synthetic images analysed. The method yields a better understanding of all types of architecture and their design in a chronological way. The flow of data is performed by a computer, a monitor, a hard-copy, a plotting table, film, video, etc.

SUMMARIES OF COMMISSION VI

Session T03: History/Professional Practice and Technical Cooperation

July 2, 1988 09:00—10:30
Chairman: Z. Sitek (Poland)

Prof. Hothmer was asked by Congress Director to introduce the chairman of the session. The chairman welcomed the audience the first session of Com. VI.
Then according to the program only three papers were presented.
1. N. Diete (GDR)
   From the Baloon Camera to the Microprocessor-controlled LMK Aerial Survey Camera System
2. O.L. Holland (The Netherlands)
   Consulting Activities at ITC
3. B. Yeu, J. Choi and J. Yom (Korea)
   Development of Photogrammetry in the Republic of Korea

Two other speakers were absent. After each presentation the discussion took place. There were questions and opinions delivered by Prof. Brandenberger, Prof. Oshima, Prof. Hothmer, Prof. Badekas and others.
Speakers and Chairman of the Session expressed their sorry that the Commission President could not attend the session.

Session T06: Status of Education in Photogrammetry and Remote Sensing

July 2, 1988 11:00—12:30
Chairman: A.J. Brandenberger (Canada)

Three papers were presented.
1. A. Ademec and G.P. Ellis (Australia)
   An Analysis of Photogrammetry and Remote Sensing Education in Australasia and Oceania

   The authors as chairmen of the sub-working group "Australasia and Oceania" in their paper reported on the surveys in their region carried out based on special questionnaires prepared by the chairman of WG VI/1. This report gives a fairy good picture of the situation in Australasia and Oceania and the information will be included in the general database of WG VI/1.
2. H. Kantelhardt (F.R. Germany)
   The Education of Surveying Engineers at the Universities of the Federal Republic of Germany in the Special Section of Photogrammetry and Remote Sensing

   The author presented a comprehensive report on the photogrammetry and remote sensing teaching programs at the university level, information of which will be included in the general database of WG/1.
3. J. Badekas (Greece)
   Teaching Photogrammetry in Developing Countries

   The author presented some basic ideas about how to approve teaching of photogrammetry and remote sensing in Third Word countries.

Session T09: New Trends in Photogrammetry and Remote Sensing

July 2, 1988 13:30—15:00
Chairman: J. Hothmer (F.R. Germany)

The following papers were presented.
1. S.K. Ghosh (Canada)
   Curriculum in Photogrammetry-A World Consensus

2. J.P. Agnard and P.A. Gagnon (Canada)
   L'Enseignement du Pointe Stereoscopique: Une Solution Nouvelle a un Probleme Permanent
3. K. Cho (Japan)
   Interactive Training System Using a Personal Computer
4. S.K. Ghosh (Canada)
   Task of Photogrammetric and Remote Sensing Education
5. R. Groot and C. Paresi (The Netherlands)
   Education in Photogrammetry at ITC, a New Concept, a New Programme

Quite some question evolved on the point whether a standardized curriculum is feasible. Some speakers were affirmative inasmuch as the content of lectures depends on the state of our technology and not on geographic regions. However, the mode of treating a curricula can depend on the content of primary and secondary education.

Session T28 : ISPRS Bibliographic Data Base/Multi-Lingual Dictionary

July 6, 1988 13:30—15:00
Chairman: T. Oshima (Japan)

MRS. O. Adekoya, President of Com. VI welcomed the audience to the session. The following 5 papers were presented in this session.

1. G. Lindig (F.R. Germany)
   Statue 1987 of ISPRS Dictionary

Dr. Kantelhardt gave us the report instead of Dr. Lindig. He reported on WG activity after the 1984 ISPRS Congress in conjunction with the WG report in Mainz and Rio especially on activity of Language Group of Multi-ligual Dictionary, of not only present status but also associated problems.

2. S. Paul (France)
   Constitution de la Partie Francaise du Dictionale de Photogrammetrie et de Teledetection (SIPT)

Prof. Paul reported on bi-lingual French/English dictionary of remote sensing and tri-lingual French/English/Spanish vocablary of remote sensing and also touched upon the French translation of ASP dictionary with 1,700 terms and difinitions. Finally he explained the future problems.

3. D. Burette, Ch. H. Latarche, D. Pouyllau (France) and J.H. Ten Haken (The Netherlands)
   Prospective Study for an ISPRS Database

As an invited paper, Mr. C.H. Latarche, GDTA reported firstly on the condition of necessary database in WG VI/3, such as types, volume of information management, computerized and non-computerized database, potentiality of existing resources, users requirement and attitude of potential network members. Finally he reported International ISPRS-IRS database and explained its configuration especially type of information and language as well as financial problems. He added on the Compact Disk of Sony Co,.

4. J.E. Clark and L.W. Fritz (U.S.A.)
   Toward an ISPRS Bibliographic Information Retrieval System

Mr. Clark stressed on computerized information service of on-line database and computerized retrospective searches and also united and integrated approaching way should be provided. He proposed its system such as retrieval system.

5. J. Hothmer(F.R. Germany)
   Information Retrieval for Literature and Factual Data in Photogrammetry and Remote Sensing

Prof. Hothmer stressed on the information retrieval requirement of database and host computer. He reported the present state and summarized detailes for establishing ISPRS-IRS, the information retrieval system of ISPRS, the problems, inparticular, the financial implications of establishing it.

Session T39: Inventory of Manpower, Education and Research Facilities

July 7, 1988 13:30—15:00
Chairman: S.K. Ghosh (Canada)

Three papers were presented as reported below. Average attendance was 28 participants.

1. A.J. Brandenberger (Canada)
   Photogrammetry & Remote Sensing: Manpower, Education & Research Facilities, International Documentation Center

The report discussed the organization of the WG (consisting of 19 regional sub-groups). It presented the general guidelines of supply of manpower, the available educational facilities and formation of the International Documentation Center on Surveying and Mapping. The report consisted of data on various details like teaching staff, Research & Development activities, annual expenditure and manpower.

2. T. Oshima and K. Maruo (Japan)
   Report of Working Group VI/1 Eastern Asian Countries:
   Inventory of Manpower and Education and Research Facilities

The paper was presented by the first listed author. The report is with regard to responses to the questionnaire of ISPRS VI/1. It concentrated on South Korea and Japan. Apart from relevant data, the organization of Japan's school system, characteristics and categories of academic institutions and programs. Other details like list of subjects, student/teacher ratios, teaching loads of professors, tuition fees etc. were presented.

3. O.O. Ayeni (Nigeria)
   Cartography and Remote Sensing Education in Africa

The paper presented primarily a list of detailed programs of all African countries. It discussed education at university level as well as at technologists, technicians and in- service training levels. Certain details were elaborated and analyses were

presented.

COMMISSION VII PRESIDENT REPORT TO THE PLENARY SESSION OF THE 16TH ISPRS CONFERENCE IN KYOTO

INTERPRETATION OF PHOTOGRAPHIC AND REMOTE SENSING DATA

WG. VII/1 VISIBLE AND INFRARED DATA

The topics covered in 1 plenary session and 2 poster sessions ranged from nearly operational techniques monitoring globally with weather satellites, to the automatic extraction of roads from large scale aerial photographs. Examples of other studies are: Combination of various remote sensing data (SPOT, TM, SIR-B), forest damage inventory with remote sensing data, region extraction in SPOT data, and calibration of determination of sea surface temperatures with NOAA/AVHRR data.

A reorganization of the WGS was suggested creating a new WG "Spatial information extraction and manipulation" for the integration of GIS with remote sensing, development of expert systems with extensive knowledge bases, improved analysis and modelling techniques, and the development of robust evaluation techniques for monitoring purposes.

The work in Commission VII should take into account results of analytical work conducted in other commissions and societies, the advances in the automation of information extraction in computer science, image processing and computer vision, and tools developed in areas such as artificial intelligence and expert system technology.

We strongly believe that in Commission VII new processing techniques have to be employed and consequently new end products have to be developed to make use of the tools of the information age. Consequently, the new Working Group will deal with the progress in automated information extraction within a GIS environment for remote sensing applications.

WG. VII/2 MICROWAVE DATA

During the period 1984—1988 the WG VII/2 has participated in two scientific meetings: the ENSCHEDE Commission VII symposium in 1986 and the joing WG VII/2,VII/3 colloquium in 1988 in Arssois.

At the ENSCHEDE symposium 2 sessions and 1 poster session have been devoted to WG VII.2 as well as one special session in combination with WG V in geology. The 2 sessions were related mainly to basic interpretation of radar backscattering measurements and image handling. The poster session and the joint session dealt with radar image evaluation and thematic interpretation.

At the Arssois colloquium, 16 presentations/poster dealt with microwave research, mostly with basic investigations including experimental and modelling aspects.

Conclusions and recommendations

1. There exists an increasing research activity during the last few years on the subject of basic signature studies including physical measurements and their interpretation by models.
2. A gap continues to exist between the *fundamental research* and the *user interpretation work*. In the same manner, *radar image analysis* is neither well incorporated in the chain. Pilot experiments mixing the three aspects must be developed.
3. Most of the work presented is done in preparation of radar observation by satellites. Further investigations will be made:
   a) To prepare the use of ERS-1 (1990) and other future spaceborne SARS (J-ERS-1 or RADARSAT);
   b) On the complementarity with optical data. In the next 10—20 years, it is not conceivable to use one of the optical microwave sensors alone for thematic purposes.
4. The microwave remote sensing methodology seems to be well considered:
   - Fundamental research can also be conducted with ground based instruments (RAMSES) *and* airborne systems (DUTSCAT);
   - Interpretation of *SAR images* can be undertaken with airborne SAR (VARAN-S), but the quality and the number of instruments must be increased and intercalibration should be obtained.
   - Modelling effort should be increased. Emphasis must be simple models in order to allow their inversion.
5. Standardization of radar and target measurements needs to be encouraged and a wide data base can be foreseen for exchange purposes.

WG. VII/3 SPECTRAL SIGNATURES OF OBJECTS

The working group organized an International Colloquium at Les Arcs (France, 16—20 December 1985) and jointly with Working Group VII/2 (Microwave data) an International Colloquium at Aussois (France, 18—22 January 1988). These two colloquia were research meetings designed to present result of actual work from ultraviolet to microwaves and to define future directions.
In view of the work accomplished during the last 4 years, the following 5 recommendations can be made:

1. To continue to develop studies on modelling

Three different orientations can be proposed:
- To continue the develop simplified but operational models. A strategy must be defined in which different models are used simultaneously.
- To continue to develop descriptive models, particularly in active and passive microwaves. These models are essential to understand the different physical mechanisms involved and to determine their relative weight.
- To develop models adapted to new technologies such as high spectral resolution, chlorophyll fluorescence...

2. To encourage research on new remote sensing domains

Three domains need to be investigated in more depth:

2.1 The passive microwaves which give complementary information for monitoring plant canopies and for determining the energy balance of the earth surface.

2.2 The high spectral resolution in which to application domains in particular, must be more thoroughly investigated:
- *Vegetation*: to analyse the mechanism of the shift of the red edge and the potential of *middle* infrared,
- *Geology*: the major effort needed now is in the visible and *near* infrared part of the electromagnetic spectrum.

2.3 The laser active remote sensing. Application areas include water quality or pollution, plant canopies stresses and geology. Two domains must be investigated:
- UV and visible domains where lasers are used to induce fluorescence. In these domains the physical phenomena involved in fluorescence must be more deeply investigated and the research must be oriented towards the analysis of the decay time of the fluorescence instead of the fluorescence intensity. These approaches could be applied either for discriminating crude oils at sea surface or the photosynthetic activity of a plant canopy.
- Thermal infrared: in this domain the lasers are used to determine the surface emissivity and the combination of active and passive measurements seems to be a promising approach.

3.3 To develop studies on the complementarity of measurements performed in different spectral domains and at different spectral scales

Some examples were presented in the two last colloquia but for the development of operational remote sensing systems it will be absolutely necessary to combine measurements obtained in different spectral domains and with different measuring instruments.
The combination of data corresponding to different spatial scales introduces a new problem on the significance of measurements performed at different spatial scales.

3.4 To standardize and harmonize the experimental methods and procedures in all of the spectral domains

The detailed analysis of the interaction mechanisms of electromagnetic radiation with natural surfaces will need accurate measurements near the ground surface and also methods to characterize the studied surface. It is then of importance to have an agreement between the scientistics to define: The last colloquium was organized by Working Group 2 (microwave data) and 3 (spectral signatures) of the Commission VII. This initiative was very very well agreed and the members of the International Scientific Committee as well as the participants have suggested that the future persons responsible of Commission VII, for the 1988—1992 period, amalgamate to the working groups into a larger one which could deal with physical measurements and signatures in any spectral domain.

3.5 To encourage the international cooperation for joint measuring campaigns focused on limited objectives

These campaigns will enable cross-calibration of the measuring methods.

Conclusion

During the 1984—1988 period the Working Group VII/3 has increased its activity compared to the 1980—1984 period. The number of participants and the number of represented countries show that the colloquia have a large international audience and correspond to a real need. For this reason, it is important to pursue this activity in the framework of ISPRS.

References

3rd International Colloquium on Spectral Signatures of Objects in Remote Sensing. Les Arcs (France). 16—29 December 1985. ESA SP-247.

4th International Colloquium on Spectral Signatures of Objects in Remote Sensing. Aussois (France). 18—22 January 1988. ESA SP-287.

WG. VII/4 RENEWABLE RESOURCES IN RURAL AREAS

Characteristical for the working group is its diversity of application as a result of the different objectives of the work, the initial databases, working methods and data processing techniques such as:
- Different types of initial data *resolution*: from large scale aerial photography to small scale satellite imagery.
- Different types of data forms: from digital data of MSS satellite or airborne scanners to anologue photography obtained from satellite, airborne and terrestrial platforms.
- Different types of methods and algorithms used in solving the problems: the presented solutions are mostly project oriented and only for a few cases system oriented.
- Diversity of hard-ware: from simple tools to the application of complicated and advanced systems.

The participants of Working Group IV stressed the need for a more uniform systematic and coherent approach in solving the problems of the practical application of Remote Sensing in the different thematic subjects and for the field conditions. Recommended is that for the digital processing of the data base techniques should be developed, which are based on personal computers using simple multipurpose software. These software programs should enable uniform base data management, image processing and overlay techniques.
Also recommended is more emphasis on the economical and financial aspects of the methods used.

WG. VII/5 NON-RENEWABLE RESOURCES

Recommendations

1. Encourage the representation of advances in computational techniques for multidata integration.
2. Encourage the development and integration of geobotanical and biogeochemical information in geological studies.
3. Place more emphasis on environmental hazards.
4. Place more emphasis on hydrogeology.

5. Pursue research and encourage applications involving advanced sensors and advanced techniques.
6. Consider high spectral resolution systems for the characterization of lithologic information.
7. Integrate two or more sensing systems in geological problem solving.

WG. VII/6 HYDROLOGY

Recommendations

1. That the Working Group should be renamed "WATER" to express the width of its mandate.
2. This Working Group should also become explicitely involved in the fields of atmospheric remote sensing in addition to surface water, oceanography, coastal zone, ice and snow.

WG. VII/7 HUMAN SETTLEMENTS

The Congress

Referring to the papers and reports presented by WG VII/7 to the 16th Congress and intercongress symposia.
Realizing that the availability of airborne and spaceborne remote sensing systems is increasing to monitor urban areas in a temporal and spatial framework appropriate to the needs of decisionmakers.
Recommends that the activities of WG VII/7 continue for the next intercongress period, and in particular recommends

1. That a collaborative study of multi-resolution and multi-spectral remotely sensed data be initiated to determine appropriate analysis levels for different scales of, and applications in human settlements, and the development of more systematic analysis methodologies.
2. That a database of papers and reports on remote sensing of human settlements be prepared and maintained, and be widely distributed.
3. That *regional* seminars on remote sensing of human settlements be conducted during the inter-congress period.

and in general recommends

4. That adequate resources be made available to developing countries to organize and manage suitable training programmes and develop relevant teaching materials and participate in international scientific meetings and information exchanges.
5. That ISPRS Commission VII promote the development of thematic map accuracy standards.
6. That working group 4 and working group 7 combine their efforts to study the conflicts between agricultural and urban land uses.
7. That support is given to the careful preservation of aerial photographs for historical studies.

Final remarks

In total over one thousand scientists have contributed papers to the meetings of Commission VII, most of them belonging to the applied sciences. It may be concluded, that Commission VII could become a useful interface between the ISPRS and the user community of geographical information. We trust that the Commission will be in good hands in Canada, where practical application of GIS and Remote Sensing are emerging more and more. The personal experience of the incoming President Frank Hegyi is very much in correspondence with the line of leadership needed during the coming years, which could witness a break through for R.S. and GIS. in *practical and cost effective applications.*

SUMMARY OF TECHNICAL SESSION
ISPRS COMMISSION VII

Interpretation of Photographic and Remote Sensing Data

Working Group 7
Human Settlements

Session T01
Chairman: Foster, B.C.(Australia)

Invited paper

Pollè, V.F.L. (The Netherlands)
Detection of city growth areas using SPOT image interpretation.

A detailed study of Bandung (Indonesia) using SPOT hardcopy images was presented, which showed the practical limitations of spaceborne data when interpreted by relatively inexperienced urban planners. An analysis of the errors of omission (9%) and commission (2%) i.e. missed urban and wrongly classified as urban, highlighted these limitations. Even with good ground truth knowledge errors still arose. The presentation was supported by slides, and resulted in two questions, one relating to the definition of urban areas and the other to the level of SPOT data used.

Oral presented

Axelsson, S.R.J. (Sweden)
On the estimation of energy losses from municipal heating networks by using IR-Ithermography.

Various factors influencing the temperature contrast of buried pipes in urban areas under different seasonal conditions were modelled. It was concluded that simple relationships between emittance measured by a TIR scanner and temperature contrast could be developed.

Forster, B.C., C. Jones and Chen Xing (Australia)
Urban monitoring using high resultion spaceborne sensors.

The potential radiometric variance as a measure of housing density was examined. It was shown not to be a significant variable but that SPOT XSZ as a single variable was most significant, particularly when aggregated over 180x180 metre areas. The investigation was conducted over Sydney, Australia, using 30 test sites of varying density.

Foresti C. (Brazil)
Environmental impact of the urban growth on the western Sao Paulo Mtropolitan area.

The city of Sao Paulo has dramatically increased in size over the past 50 years. The problems of rapidly acquiring information using conventional methods has led to the use of Landsat and Spot data for classifying urban areas and urban change, and the development of a vegetation cover index to predict environmental quality. The presentation was supported by slides.

Lo C.P. (USA)
A raster approach to population estimation using high altitude aerial and space photographs.

High altitude air photographs and LFC images were regularly interpreted in a raster based format to estimate percentage of building area. These values were then transformed into population estimates, that could be simply interfaced with convention GIS systems in a 0.4 x 0.4 km based cell. LFC derived data tended to underestimate population but could be adjusted by a log-log transformation. Air photograph provided better results. Problems related to residential and non-residential areas, and multi-storey buildings were discussed.

Working Group 3.1
High spectral resolution, atmospheric effects and radiometry

Session T04
Chairman: Guyot, G.(France)

Invited paper

Slater, P.N. (USA)
A review of the calibration of radiometric measurements from ground to satellite level.

This review presents the different methods used for radiometric calibration. It shows the necessity to have a redoundancy in the used methods to crosscompare them and to improve the accuracy of the calibration.

Oral presented

Watanabe, H. and T. Osanai (Japan)
Simulation of ERS-1 OPS by the use of airborne spectroradiometer.

Measurements performed in order to determine the best set of narrow spectral bands which will be used on the ERS-1 japanese satellite for identifying minerals. The measurements were performed with a spectroradiometer in visible and near IR with a 1.5 nm spectral resolution and in the SWIR (1,952—2,494 nm) with 64 bands (8.6 nm).

Miller, J.R., J. Wu, R.P. Gauthier, E.W. Hare, M.G. Boyer and M. Belanger (Canada)
Detection of spectral effects in individual tree crowns of metal-injected trees using high-resolution pushbroom imagery.

Measurements were performed with the MEIS II pushbroom spectral imaging radiometric with narrow spectral bands in visible and near IR in order to determine the shifts of the red edge on crowns of metal injected trees. The obtained results show some shifts of the red edge but the symptoms are not specific of a given metal. It is just possible to detect stresses and complementary measurements are necessary to determine the stressor.

Guyot G., F. Baret and D. Major (France)
High spectral resolution; determination of spectral shifts between the red and the near infrared.

An analysis based on model simulation at two different scales: the leaf and the plant canopy. This simulation shows the weight of the different factors acting on the shift of the red edge. The most inmportant factors are the leaf pigment contact, the leaf area index and the sun angle. The other factors such as: leaf internal structure, canopy geometry, soil optical properties have a lesser effect.
The introduction of the atmospheric effect shows that the wavelength of the inflection point of the red edge is practically non affected. In these conditions it will not be necessary to use sofisticate methods for atmospheric correction when interpreting high spectral resolution measurements.

Shikada M., K. Miyakita and Y. Haba (Japan)
On a conversion of airborne MSS data into reflectance by using a simulation model.

A simulation model the "Equivalent Reflection Model" has been developed in order to correct for the distorsion introduced into satellite measurements by the soil roughness. The study shows that the first order approximation of the model can be adopted to convert satellite data (CCT) into ground surface reflectance.

Working Group 1
Spatial information extraction

Session T07
Chairman: Quiel, F.(Sweden)

The session was conducted as scheduled with the exception of S.R.J. Axelsson's paper "Atmospheric correction of Thermal IR data for land surface temperature estimations", which was cancelled and replaced by a paper from M.J.P.M. Lemmens et al. "Linear feature extraction and road recognition for large scale digital aerial images".

The invited paper "Satellite environmental monitoring in support of global food security and desert locust plague prevention at FAO: The Artemis system" by *J.U. Hielkema* (Italy/FAO) provided a very interest overview of some of FAO activities for global monitoring in cooperation with e.g. NASA, ITC and the universities in Lund and Reading. Major input data for the Artemis system are provided by meteorological satellites, e.g. Meteosat and polar orbiting systems. Thermal IR data are used to provide cold cloud images and to produce estimated rainfall maps for 10 days periods based on approximately 500 images. Similarly NOAA satellite data are used to provide vegetation index maps since 1980. Major databases were created at FAO with cartographic data over Africa, agroclimatological data, the vegetation index and information on desert locust habitats. The resolution of the geographically referenced data is 7.5 km. Among others 10 days and monthly information on rainfall in mm and as percentage of normal rainfall and the number of rainfall days will be available. The system is delivered and production should start within the next months.

The paper "Region extraction in SPOT data" by *H. Egawa* and T. Kusaka (Japan) was presented by the second author. Grey levels in SPOT data were transformed to principal components and small endorsed primitive regions were extracted from that image based on color and edge information. Then segmented regions corresponding to typical land cover types were classified by using color, size and shape.

B.G.H. Gorte's and N.J. Mulders (the Netherlands) paper "Cartographic feature extraction and thematic classification based on context dependant filters" was presented by the first author. A comparison was made between the matched filters in the context vision GOP system and non linear filters. A feedback of contextual information at a higher processing level is provided to filter parameters at a lower level.

Y. Kawata (Japan) presented a paper "Comparative analysis of Landsat-5 TM and SPOT HRV data in Kanazawa Region", authored by S. Ueno, et al. SPOT and TM data were transformed to a 25 m grid and a summarised classification in 13 land use classes was performed, based on approximately 300 ground truth areas; 5 comprehensive categories were mainly considered for the comparison. On the average TM data provided higher accuracies for training areas, but for test areas the differences were small (78% versus 76%)

M.J.P.M. Lemmens et al. (the Netherlands) papers "Linear feature extraction and road recognition from large scale digital aerial images" described the use of edge detection and line following procedures to extract roads in color aerial photographs of urban areas with a scale of 1:3,500. Relaxation and dynamic programming techniques were developed for linear feature extraction.

Working Group 6.1
Hydrology (Oceanography and coastal Zones)

Session T20
Chairman: Ulbricht K.A. (F.R. Germany)

Invited paper

Tassan S. (Italy)
The use of thematic mapper for coastal water analysis.

The report used the thematic mapper data for the retrieval of phytoplancton and suspended sediment concentrations in coastal waters. It included theorical assessment of TM potential, a set-up of image destriping procedures, comparison of results obtained by diverse atmospheric correction schemes, determination of retrieval algorithms applying to TM data considering in-situ measurements, and finally evaluated two sets of TM scenes between Po-river and the gulf of Naples. Advantages and drawbacks of TM use were underlined.

Oral presented

Kamaki Y. (Japan)
Natural environment research of coastal sea area form the air.

Actual cases served for the discussion of the following points:
1. The merits and the limitation of the photogrammetric survey of shallow seabottom, as compared with echo-soundings.
2. The possibility of the air-photointerpretation on the materials, geologic structure, vegetation etc. of the sea bottom.
3. The sea water current and quality investigation methods by airborne MSS imagery.

As a conclusion the chairman read the conclusion of this working group.

Working Group 3.2
Spectral characterization of vegetation and soil

Session T23
Chairman: Guyot, G. (France)

Invited paper

Axelsson S.R.J. (Sweden)
On soil moisture mapping using IR-chamography.

An analysis of the energy balance of the soil surface is present and a model is proposed. The model gives the soil surface temperature as a function of surface soil moisture (1 cm surface layer) of soil composition an energy balance. The comparison of model simulation and measurement agree quite well.

Oral presented

Wiegand C.L. and J.L. Hatfield (USA)
The spectral-agronomic multisite-multicrop analyses (SAMMA) project.

This project presents the results of a multicrop and multisite experiment carried out in USA. The main problem in this experiment was to standardize the procedure for data acquisition and to have standard graphs for presenting the results. The interest of this program is to be the first one which uses such large number of different sites scattered in the USA with measurements on different crops. The methodology could be applied to most of the ground based remote sensing studies.

Batista G.T., B.F.T. Rudorff and C.A. Steffen (Brazil)
Study of the spectral response of soybeans.

The measurements were performed on soybean grown during the winter time in South Brazil. Three different sowing dates are compared. The evolution of the spectral reflectance as a function of the time is obtained and compared with the plantphenology. This experiment gives basic data for interpreting satellaite data in southern Brazil.

Shibayama M., C.L. Wiegand, T. Akiyama and Y. Yamagata (Japan)
Radiometric predictions for agronomic variables of rice canopies using a visible to mid-infrared spectroradiometer.

The measurements were performed over rice fields with a spectroradiometer working between 400 and 1900 nm. The head measuring the target radiance is connected to the monochromater with a quartz optical fiber 10 m long. The interest of this study is to show that the above-ground dry biomass and the grain yield, for rice fields, are both linearly related to the simple difference between 1100 and 1200 nm or 1100 and 1650 nm reflectances. These experimental results show the interest of near and middle infrared for monitoring rice production.
This paper also introduces a new perpendicular vegetation index which considers the turbid water line instead of the soil line.

Clevers J.G.P.W. (The Netherlands)
The application of the weighted near-infrared-red vegetation index for estimating LAI at the vegetative and generative stage of cereals.

When the classical normalized difference is used as vegetation index for estimating leaf area of green vegetation, the soil

background introduces some distortion. The proposed vegetation index: "The weighted near-infrared-red vegetation index" introduces the soil optical properties and give a more accurate estimate of the LAI. The presented paper gives a generatlzed version of this index (presented for the first time at Enschede's symposium of the commission VII) which can be applied on both vegetative and generative stages of cereals.

Working Group 5
Non-Renewable Resources

Session T26
Chairman: Mouat, D. (USA)

Invited paper

Langeraar W. (The Netherlands) and P. Fergestad (Norway)
Introducing ARGUS, an operational subsurface remote sensing system for groundwater exploration.

The discussion was on the Advanced Resolution Geological UHF Scanner (ARGUS) which might be mounted on an airborne platform (helicopter or fixed-wing aircraft) or ground transport. System performance is such that maximum range of ca. 200 dB to penetration of 10 m—1,000 m, the lower the frequency the deeper the penetration. For example, 2 MHz allows for 1,000 m penetration. The scanner was tested in Jordan and Ethiopia. Cost is approxiate US $ 200/km^2. The scanner is useful for groundwater exploration, snow thickness determination and mineral exploration, with the possibility of a future use in a satellite-hosted platform.

Oral presented

Wang, Pin-Qing (China)
Application of Landsat TM data into regional exploration of lead-zinc deposits.

The use of rigid statistical analysis for correlating lineaments with mineral deposits formed the focus of this presentation. Lineaments were interpreted from Landsat 4, 3 and 2. Statistical techniques involved Poisson distribuation and a Binomial distribution function. A probability map depicting likelihood of mineral occurrences was generated. The lineament map reflected the structural control of mineralization.

Murai S., C. Tanimoto, Y. Matsumoto and K. Nagata (Japan)
Development of borehole scanner for underground geological survey.

Speaker began by suggesting that an underground remote sensing approach is just as valid as a spaceborne approach. A comparison was made of conventional methods using borehole TV cameras with new approach which uses a rotating mirror borehole scanner mounted within a 66 mm diameter assembly. Conventional methods use laborious mosaicing contrasting with the new method which involves a spiral strip. Imagery of a number of geological environments was presented. Although the scanner can make use of thermal and near IR, the visible spectrum was used in the presentation.

Kennie T. and M.S. Rosenbaum (United Kingdom)
Analysis of multitemporal airborne remote sensing data for the location of solution features in the chalk of southern England.

The objectives involved in the detection of solution features included the sensor to be used, the acquisition of data and the combination of data with ancillary data. The use of remote sensing involved direct and indirect discrimination of solution features. Indirect evidence included lineament analysis, soil moisture variations and vegetation anomalies. The main emphasis was the use of CIR aerial photographs derived from Thermal IR sensing. An explanation of time of day and seasonality was given.

Working Group 4.2
Renewable Resources (Forest and vegitation)

Session T58
Chairman: Besenicar J. (Yougoslavia)

Invited paper

Hildebrandt G. (F.R. Germany)
Looking back and ahead-Developments and forecast of applied remote sensing.

Oral presented

Johansen B., A. Elvebakk and S. Spjelkavik (Norway)
Evaluation of grazing areas for reindeer on Svalbard, Arctic Norway, using Landsat 5 TM-Data.

Ueda T. (Japan)
Application of infrared color photographs on the study of effects of acid rain on forest ecosystem.

NOTE: Prof. K.J. Beek, President of Commission VII, congratulated Prof.Hildebrandt for his work in the past years for Commission VII.

Wolrking Group 4.1
Renewable Resources (Landuse and agriculture)

Session T46

Chairman: Besenicar J. (Yougoslavia)

Invited paper

Clevers J.G.P.W. (The Netherlands)
Crop monitoring for agricultural proposition.

Oral presented

Teotia H.S., W.C. Kennard, D.L. Civco (USA)
Optical and digital interpretation of SPOT imagery for Land Resources planning and management in N.E. Brazil.

Shutko A.M. (U.S.S.R.)
Possive microwave remote sensing of soil, vegetation and waters.

Shimoda H., K. Fukue, Y. Matumae, R. Yamaguti and T. Sakata (Japan)
Evaluation of Unsupervised methods for Landcover/use classification of Landsat TM data.

Working Group 6.2
Hydrology (Ice, snow and groundwater)

Session T49
Chairman: Ulbricht K.A. (F.R. Germany)

Invited paper

Vanouplines P.I. (Belgium)
The application of an atmospheric correction and chlorophyll algorithm on a TM image of central Lake Tanganyika: techniques and observations.

After destriping of the TM image, atmospheric correction was applied to imagery. The resulting radiances served for estimation of chlorophyll strips on central Lake Tanganyika. A geological investigation was used to relate to heat sources at lake bottom.
Several chlorophyll algorithms were introduced.

Oral presented

Uchida S. and T. Hoshi (Japan)
On the regional characteristics of actual evapotranspiration derived from LANDSAT MSS and elevation data.

LANDSAT MSS data served to estimate actual evapotranspiration, elevation data and meteorological elements adopting modified Penman's method. They were classified into landuse categories, thus giving monthly albedo and soil heat flux constant. Elevation data induced short wave radiation flux at daylight hours. The estimated value represented the distribution under specific topographic conditions and the comparable amount with the biase value of pan evaporation. Several watershed areas with different topography and landuse condition in Japan were selected. Calculated evapotranspiration results including the case of occuring landuse conversion were discussed from a hydrological environment standpoint.

Working Group 2
Microwave Data

Session T52
Chairman: Thuy le Toan (France)

Invited paper

Thuy le Toan (France)
An overview of the recent progress on Microwave Remote Sensing.

The first part of the presentation included a report of activities of the working group in the last 4-year period. A review is given on the papers relating to WG-2 presented at the Commission VII Symposium in Enschede (August 1986) and at the working groups 2 and 3 colloquium in Aussois (January 1988).
A state-of-the-art overview is then reported along three axes: "Spectral signature" studies, SAR image analysis and applications. The following observations have been made:
- an increase of research activities aiming at measuring and interpreting microwave signatures of objects, in particular experiments and modelling of vegetated areas.
- the use of SAR images by a larger community of investigators who participated an increasing number of airborne SAR campaigns.
- different levels of achievement in various applications including oceanography, geology, hydrology, agriculture and forestry.

Recommendations have been made on a) an intensification of basic researchs (on the ground experiments, airborne campaigns, modelling) and b) a preparation for the use of ERS-1, J.ERS1, as unique sensors and also jointly with optical systems.

Oral presented

Shutko, A.M. (U.S.S.R.)
Researches and approaches in microwave remote sensing in the USSR during the 1983—1988 period.

Topics presented were an overview of the investigations conducted recently in the USSR on microwave sensors, experi-

ments and applications on land, vegetation, ocean and ice. The salient points among others were a) the operational use of airborne microwave radiometers for soil moisture detection and b) the spaceborne SLAR images (on board COSMOS) shown by the author.

Soares J.V., R. Bernad and D. Vidal-Madjar (Brazil)
Caractérisation d'une région agricole á partir d'un radar bande C et d'un radiometre dans l'infrarouge thermique aeroportes.

Results of an airborne compaign with a C-band scatterometer and a Thermal Infrared radiometer were presented. Spatial properties of surface soil moisture derived from the C-band scatterometer and surface temperature derived from the thermal infrared radiometer are used in hydrological model to study drainage properties of agriculture fields.

Working Group 8
Geo Information System

Session T59
Chairman: Langeraar W. (The Netherlands)

Invited paper

Future Land use model using Integrated Land and Watershed Management Information System (ILWIS) was presented both by B.G.H. Gorte (the Netherlands) and C.R. Valenzuela (Bolivia). ILWIS is a user defined GIS which allows numerous data manipulations in the raster, vector and attitude domain. The system seems particularly suitable for generation of scenarios and as consequence should be an invaluable tool for land use planners.

Oral presented

Van der Laan F.R., (the Netherlands)
The use of topographic map data to archieve over 95% significance in information extracted from Satellite imagery.

The paper deals with the use of existing map data to improve classification results to a reliability level exceeding 95%. He described a technique to merge designated land use classes indicated on topographical maps with classes obtained through multispectral classification of satellite data.

Kennart W.D. et al. (USA)
The role of an automated GIS in the development and management of Renewable Resources Northeastern Brazil.

The paper emphasize the development of an automated GIS application for land use planning in N.E. Brazil using the ERDAS and Arc-Info packages as tool box.

Hawkins D. et al. (Canada)
Automatic planimetric feature extraction.

The paper dealt with results of investigations related to planimetric feature extraction using the Meridien system from satellite data. This conclusion was that, although time savings seem considerable, omission and commission errors appear to be too high as yet.

Commission VII
Interpretation of Photographic and Remote Sensing Data

Overall Data

Number of Working Groups	: 8
Number of Sessions	: 11
Number of Invited Papers	: 11
Number of Oral Presented Papers	: 31
Total number of Presented Papers	: 42
Number of Participants/Sessions	: 100—175
Number of Poster Sessions	: 10
Number of Presented Posters	: 98
(48% out of 206 abstracts)	

Special Sessions

SS1 Remote Sensing Projects in Japan
11:00—12:30 July 3, Sunday at Room D
SS2 How to Promote Remote Sensing Activities in Asia
13:30—15:00 July 3, Sunday at Room D
SS3 Planning for an International Mapping and Remote Sensing Satellite System
13:30—17:00 July 4, Monday at Room D
SS4 JOBRESA
11:00—12:30 July 6, Wednesday at Room D
SS5 IUSM
13:30—15:00 July 6, Wednesday at Room D
SS6 How to Promote Remote Sensing Activities in Africa

11:00—12:30 July 7, Tursday at Room D
SS7 How to Promote Remote Sensing Activities in Latin America
13:30—15:00 July 7, Thursday at Room D
SS8 Personal Computer Software Shows
13:30—16:30 July 6, 7, 8 and 9, at Room F

Joint Session of ISPRS and IUFRO on Forestry July 6 and 7, 1988

Special Session SS-1
Sunday, July 3
11:00—12:30

Remote Sensing Projects in Japan
Chairman: Prof. T. Sakata

1. Introduction of Space Development in Japan
   T. Sakata, Tokai Univ.
2. Policies of Space Development in Japan
   M. Kawasaki, Science & Technology Agency
3. Earth Observation Programs in Japan
   T. Tanaka, NASDA
4. Remote Sensing Data Distribution and Utilization in Japan
   H. Ishigami, RESTEC
5. Movie: Into the Space Age

Special Session SS-2

SUMMARY — PANEL DISCUSSION ON "HOW TO PROMOTE REMOTE SENSING ACTIVITIES IN ASIA"

July 3, 1988
Chairman: Prof. S. Murai (Japan)
Panel: Prof. Bruce Forster (Aus.)
Mr. Chu Lingcai (China)
Prof. Deekshatulu (India)
Mr. T. Tanaka (Japan)
Mr. C. Nanayakkara (Sri Lanka)
Mr. Suvit Vibulsresth (Thailand)
Prof. Nguyen Thuung Hung (Viet)

Recommendations:

Australia:
1. Develop multilateral programs
2. Develop list of high priority problem areas for common discussion and research
3. Encourage non-Asian funding for education, but also encourage governments of member countries to provide greater support.

China:
1. Strengthen cooperation to ensure adequate data resources, and national station operators to investigate possibility of intra-continental optimum use of resources.
2. Make greater use of regional training and educational facilities. Improve coordination and cooperation. Encourage specialized divisions between regional institutions and interchange of students.
3. Promote special seminars on problem areas, including exchange on management related problems and experience.
4. Better coordination and direction of available funds required to support regional projects.

India:
1. Availability of IRS data to any country
2. Greater focus on regional problems
3. Better use of available educational support programs
4. Optimum use of satellite data for any application
5. More inter-region exchange of personnel, and technology transfer
6. Efforts to reduce ground truth data
7. Greater use of indigeneous regional low cost instruments.

Japan:
1. Requirement for greater understanding of marine biology in S.E. Asia region.
2. Understand the importance of global change and that West Pacific is the "Engine for worldwide climatology".
3. Greater effort required in the area of ground truth and/or calibration.

Sri Lanka:
1. Training cannot be overemphasised, but must be in a range of countries for optimum benefit.
2. Promotion of seminars both technical and to policymakers. Need not to oversell remote sensing but to present potential applications, their limitations and cost.
3. Develop manual/guides on available systems and tested and proven applications.
4. Develop manual/guide on equipment, digital image processing systems, software availability and limitations.
5. Develop international collaboration programs.
6. Greater intra-region exchange of scientists.
7. Promote faster and cheaper land use planning/cadastre systems to encourage development that will ultimately fund remote sensing.

8. Strengthen regional cooperation.
9. Strengthen oceanographic applications and research.
10. Seek out all possible sources of funding from international bodies.

Thailand:
1. Establish in-country Remote Sensing Centres within government authority, with clean cut responsibilities. Level of applications are enhanced, more effective and extensive use of remote sensing data, and greater "public visibility" .
2. Strengthen private, government and university sector co-operation in line with Japanese model. Currently in Asia there is too much emphasis on government at the expense of universities and private sector.
3. Development projects should have a strong component of technology transfer.

Vietnam:
1. Develop better intra-region cooperation.
2. Determine what can be achieved more effectively using remote sensing.

Audience Comments

Australia (R.E. Reichelt): Support greater contribution and collaboration in ocean relted studies.

Indonesia (Dr. Ir. Soekotjo): Agreement that 3 sectors not adequately organized, but pointed out Indonesia experience of private sector involvement — worth-while model.

India (Professor Bausal): University based centres better than government centres, as greater flow of knowledge to community and users. Need to restructure P.G. and also U.G. programs to emphasise benefits of remote sensing.

USA (Dr. D.F. Baer). Planet earth concept with countries contributing to a standard international data base.

Korea (Young Kyu Yang): Training and education very important, but short term training is not useful, and long term training should be encouraged to promote regional cooperation.
Education of government policy makers is very important to gain support for remote sensing activities. Encourage regional seminars for this purpose.

Summary of Recommendations

1. Develop lists of high priority regional problem areas and investigate these areas.
2. Increase research and applications in oceanography.
3. Promote better cooperation and technology transfer on world agency funded projects.
4. Seek additional inter and intra regional sources of funds, and promote better coordination and direction of available funds.
5. Promote greater use of intra-regional educational facilities, and student and scientist exchange.
6. Strengthen intra-regional cooperation on data and equipment resources.
7. Promote greater understanding of regional ground truth needs.
8. Develop better manuals and guides on equipment, software and applications including all costs, compatibility, availability and limitations.
9. Promote greater integration of public, private and university sectors as equal contributors to remote sensing.
10. Promote greater visibility of remote sensing benefits by the establishment of national remote sensing centres.

Special Session SS-3

PLANNING FOR AN INTERNATIONAL MAPPING AND REMOTE SENSING SATELLITE SYSTEM

Monday, July 4, 1330—1700

AGENDA

1. Introduction
   Frederick J. Doyle, Past President, ISPRS
2. System Technical Characteristics
   Alden P. Colvocoresses, Chairman, ISPRS Working Group IV/3 (1980—84)
3. Models for International Cooperation in Satellite Systems
   John MacDonald, President, MacDonald Dettwiler Associates, Canada
4. The United Nations Perspective on International Satellites
   Adigun Abiodun, UN Outer Space Affairs Division
5. Views of Current Satellite Operators
   EOSAT - Peter N.P. Norris, Executive Vice President
   SPOT - Gerard Brachet, President, SPOT-IMAGE
   USSR - Aleksandr Draznjuk, Main Administration for Geodesy and Cartography
   India - B.L. Deekshatulu, National Remote Sensing Agency
   Japan - Kohei Cho, Remote Sensing Technology Center
6. Views of Satellite Data Users
   Federal Republic of Germany - Manfred Schroeder, German Aerospace Research Establishment
   Peoples Republic of China — Yang Kai, National Bureau of Surveying and Mapping, Beijing
   Australia — Peter Holland, Australian Surveying and Land Information Group
   Canada — Frank Hegyi, Ministry of Forests and Lands
7. Panel Discussion with Audience Participation
8. Summary and Resolution, Frederick J. Doyle

1. INTRODUCTION — Frederick J. Doyle, Past President, ISPRS.

Dr. Doyle reviewed the changes in satellite remote sensing since the 15th ISPRS Congress in Rio de Janeiro in 1984.

The USA Landsat program has been turned over to a commercial operator, EOSAT, which will build Landsat 6 for launch in 1991. Studies are being conducted to determine the technical configuration, funding mechanism, and operational structure for Landsat 7. In the meantime, the highly successful SPOT has been launched by France, the MOS-1 by Japan, the IRS-1 by India, and the USSR is making available high resolution multispectral and panchromatic photographs acquired by film cameras KATE-200 and KFA-1000 from spacecraft in the KOSMOS series.

2. SYSTEM TECHNICAL CHARACTERISTICS — Alden P. Colvocoresses, Chairman, ISPRS Working group IV/3 (1980—84).

   Dr. Colvocoresses described the technical parameters for a mapping and monitoring system based upon the recommendations of Working Group IV/3 adopted by the Congress in Rio de Janeiro. A dedicated spacecraft in an orbit similar to Landsat 1, 2, and 3 would carry a sensor consisting of three sets of linear arrays with optical systems directed 23° forward, vertical, and 23° aft, to produce stereo and multispectral data in three or four bands with 10-meter or better pixels. Programmed spacecraft attitude conatrol would permit stereo data to be acquired in epipolar form to simplify ground processing. Output product would be 1:50,000 scale image maps with 20 meter contour interval, digital terrain elevation data, and digital planimetric multispectral data.

3. MODELS FOR INTERNATIONAL COOPERATION IN SATELLITE SYSTEMS — John MacDonald, President, MacDonald Dettwiler Associates, Canada.

   Dr. MacDonald noted that in the next decade 16 countries would launch approximately 50 remote sensing satellites. Their design is driven by technology rather than real user needs, and for the most part they are retracing the development of Landsat since 1972. He proposed an international consortium like Inmarsat to develop a space segment -- called ENVIROSAT -- to acquire and perform initial processing. Each member country would receive data from its own area. He believes it will take five years to develop an effective organization structure and the system would not be self-supporting before the turn of the century.

4. UNITED NATIONS PERSPECTIVE ON INTERNATIONAL SATELLITES — Adigun Abiodun, UN Outer Space Affairs Division.

   Dr. Abiodun state that the United Nations has taken no position on international satellite operations. He noted that the USSR had proposed a World Space Organization, but that it contained only the ground segment; no spacecraft was included. He foresees considerable difficulty in reaching international agreement on requirements, financing, management, technology utilization, and national security. The UN Principles Relating to Remote Sensing of the Earth from Space favor international cooperation and encourage agreements to provide data collection, processing, and interpretation facilities which will maximize the availability of benefits from remote sensing. He believes that a commercially viable international space segment way be accomplished by the year 2000.

5. VIEWS OF CURRENT SATELLITE OPERATORS.

   (a) Mr. Peter N.P. Norris, Executive Vice President, EOSAT, stated that the current Landsat system is the result of $1.5 billion capitalization by the U.S. Government. It is already an international system as shown by the worldwide distribution of national receiving stations which contribute to the support of the program. He noted that, according to the EOSAT plans, Landsat 7 would have the capability of acquiring topographic data.

   (b) Mr. Gerard Brachet, President, SPOT-Image, stated that ISPRS consideration of an international system was 10 years too late -- it should have been in 1978 when current systems were being conceived. SPOT is already an international system with contributions from France, Belgium, and Sweden. He did not believe it was a good idea to cut off data at national borders. The European Space Agency Polar Platform would provide an opportunity for international space data acquisition in the next decade.

   (c) Dr. Yuri Kienko, General Director, State Scientific Center Priroda, (speaking for Dr. Aleksandr Draznjuk, First Deputy Chief, Main Administration for Geodesy and Cartography) stated that the USSR had always favored international cooperation in the peaceful use of space -- as demonstrated by the Apollo-Soyuz mission. The USSR is making high resolution space photographic data available to the international user community. Future systems must consider existing national systems, utilize the newest technology, and recognize the need for an all-weather capability. He recommended formation of an international working group to look at the political and economic concrete steps required to create a useful system.

   (d) Prof. B.L. Deekshatulu, Director, National Remote Sensing Agency, stated that the Indian Remote Sensing Satellite was created to provide data for integrated surveys to the people of India. He agreed with the requirements for higher resolution data and stereo coverage.

   (e) Mr. Kohei Cho, Remote Sensing Technology Center of Japan (RESTEC), described the Earth observation satellite programs in Japan. These include the current MOS-1, and the forthcoming JERS-1 and ADEOS. ADEOS is planned to carry both domestic and foreign sensors. An international network of MOS-1 receiving stations is in place, managed by the National Space Development Agency (NASDA) of Japan. A final policy on international data dissemination has not yet been established.

6. VIEWS OF SATELLITE DATA USERS.

   (a) Dr. Manfred Schroeder, German Aerospace Research Establishment (DFVLR) in the Federal Republic of Germany, stated that the primary users of satellite remote sensing data were still for pilot projects and research efforts with developing countries and Antarctica. The user community is slowly growing in numbers but sales of data remain about constant. The Metric Camera flown on Spacelab 1 acquired 500 stereo pairs but over 4,000 have been sold to users. There is a real requirement for high resolution continuous electro-optical stereo data which will eliminate the long wait to acquire stereo from side-looking systems. Four, or at most five, multispectral channels should be sufficient, and an international system would be the preferred mechanism for acquisition.

   (b) Mr. Yang Kai, National Bureau of Surveying and Mapping, Beijing, stated that his agency provides remote sensing data to all users in China. China has commercialized its launch vehicle, has already launched an experimental film

recovery system, and plans an electro-optical system in the near future. Nevertheless, an international acquisition system would be most efficient.

(c) Mr. Peter Holland, Australian Surveying and Land Information Group, stated that government agencies make up the user base and should support the acquisition system. The Australian government already supports the reception station at Alice Springs and the processing and dissemination system at Canberra. Some use has been made of the stereo data from the NASA Large Format Camera and the Soyuzkarta stereo film data. The Australian Space Board defined the following characteristics for a system in polar orbit:

Switchable 5- or 10-meter resolution
Stereo and multispectral
Seasonal coverage
Stable epipolar geometry
Compatability with existing ground facilities

He is confident that users will pay for a cost-effective system.

(d) Mr. Frank Hegyi, British Columbia Ministry of Forests and Lands in Canada, stated that the need is not just for maps, but for current information on resources. The system must provide the capability for rapid revision, and produce data compatible with existing information on ownership, boundaries, slope, elevation, aspect, etc. He foresees no problem selling an effective international system, and supports the appointment of an ISPRS Working Group to bring it to reality.

7. PANEL DISCUSSION WITH AUDIENCE PARTICIPATION.

The following points were made:

(a) Existing satellites may not be the best. Fore-and-aft stereo should be better than side-looking stereo.
(b) There is a need to train people to use existing systems and to be prepared for future systems.
(c) An international remote sensing system should support the planetary biology program.
(d) Researchers should learn how to use less data. One 5-meter pixel per field would be sufficient for classification.
(e) There is no need to fear too many remote sensing satellites in the future. Competition leads to progress.
(f) The 50 satellites, costing about $500 million each, represent an investment of $25 billion in the next decade. Most of this is redundant -- $5 billion should collect all the data the world needs -- leaving $20 billion which could go to users as a public service.
(g) The proposed international system will be frustrated by clouds. Continuous monitoring of change requires an all-weather radar system.
(h) Any new system must be compatible with existing ground reception stations.
(i) A data rate of 100 M bits/sec is adequate for any reasonable system, and existing stations can easily be modified to produce that capability.
(j) Consideration should be given to using the space station polar platforms.

8. RESOLULTION.

Based on the discussion, the following resolution was prepared. It was subsequently presented to the General Assembly on 8 July 1988, and to the Congress on 10 July 1988, and adopted unanimously by both bodies.

Special Plenary Session SS-3 Planning for an International Mapping and Remote Sensing Satellite System

THE CONGRESS

Noting
(a) That approximately 50 remote sensing satellites will be launched during the next decade by several nations
(b) That none of the planned systems are optimized to produce topographic mapping and monitoring data

Recognizing
(a) That the parameters established by Working Group IV/3 at the Congress in Rio de Janeiro form the basis for a successful design
(b) That there is a requirement for all weather microwave data in addition to visible and shortware infrared data
(c) That there is a desire to obtain these types of data from international satellite systems

Recommends
That an international working group be formed to verify the technical parameters of the system, and to pursue the political, organizational, and financial problems in bringing it to reality.

Special Session SS-4

"COORDINATION OF INTERNATIONAL REMOTE SENSING ACTIVITIES — JOBRESA — (Joint Board of Remote Sensing Activities)

Time: 11:00—12:30, Wednesday, July 6
Place: Room D

Programme:

1. INTRODUCTION: Review of objectives of JOBRESA, and forthcoming plans. G. Konecny, Chairman, JOBRESA
2. ASIAN ASSOCIATION ON REMOTE SENSING: Summary of recommendations of the Panel Discussion: How to promote Remote Sensing activities in Asia, held Sunday 3rd July 1988. C. Nanayakkara
3. EARSeL: Activities and Structure. R. Gombeer
4. IGARSS-IEEE: Scope of activities and future meetings. K. Itten

5. ISPRS: Future activities. K. Torlegard
6. SELPER: Recent and forthcoming events. P. Martini
7. ERIM: Objectives and future plans. A. Parker
8. INPE: Remote sensing activities at INPE, Brasil. Mr. Barbosa
9. THE REMOTE SENSING SOCIETY: Some suggestions for JOBRESA's consideration. J.A. Allan
10. UNITED NATIONS: Remote sensing activities of the U.N. Outer Space Affairs Division. A. Abiodun
11. ACADEMY OF SCIENCES, G.D.R.: Remote sensing activities in the German Democratic Republic and Inter-cosmos. R.P. Oesberg
12. DISCUSSION

Special Session SS-6

How to Promote Remote Sensing Activities in Africa

This special session convened on July 7, 1988 in room D of the Kyoto International Conference Hall (KICH) during the ISPRS' Congress. The session which met from 11:00 a.m. to 13:00 p.m. was attended by 66 delegates from 24 countries under the chairmanship of Dr. A.A. Abiodun. African delegates represented the following 12 countries: Nigeria, Zimbabwe, Tunisia, Morocco, Algeria, Madagascar, Kenya, Ethiopia, Egypt, Libya, Tanzania and Lesotho.

The Session received presentations on remote sensing activities in Africa from: The Rector of ITC, Professor Klaas Beek; the Director General of the Regional Centre for Services in Surveying, Mapping and Remote Sensing Mr. B.A. Sikilo; the Director General of the Ile-Ife Centre for Aero-space Services Dr. P. Ayeni, the Chief of the remote sensing centre in Ivory Coast Mr. M. Fofana, Provincial Surveys for Nairobi Mr. Agayo, General Manager of the Ethiopian Mapping Authority Mr. A. Fanta, representative of the Egyptian Remote Sensing Centre Dr. M.A. Deifallah, representative of the Nigerian Department of the Surveyor General Mrs. O. Adekoya, representative of the French National Space Centre Mr. J.P. Antikidis, representative of the MacDonald Dettwiler company Mr. R. W. Laing, Dr. J. van Genderen of ITC and Chairman of ERIM Mr. A. Parker.

The presentations were followed by discussions on the subject.

This special session noted among other things that
(1) A number of centres and organizations have been established in Africa for remote sensing activities and are operational since 1972.
(2) The activities of remote sensing centres include the provision of user services to contributing members educating discipline oriented personnel through seminars, workshops and courses of up to 9 months duration as well as offering consultancy services to contributing member countries.
(3) Some relatively large projects have been undertaken by these centres for photogrammetry and remote sensing such as crop forecast of 1.0 mill. km^2 in the Sudan by the Nairobi Centre.
(4) Some planning is underway for a ground receiving station to be financed by EEC through the Nairobi centre, a data base for oil spillage along the Atlantic coast of West Africa.
(5) The Egyptian remote sensing centre undertakes contracts regularly in aerial mapping.
(6) A large volume of data is available at the Nairobi Centre and elsewhere covering the continent. This is mainly from LANDSAT imagery.
(7) There is lack of coordination particularly in the major remote sensing activities that have regional and continental implications and which are being undertaken by various bodies outside of Africa in Africa.
(8) The African Remote Sensing Council (ARSC) and the African Cartographic Association (ACA) have merged to form the African Organization for Cartography and Remote Sensing (AOCRS). However, not all African countries are members of this organization.
(9) The AOCRS can only succeed in promoting remote sensing activities if each country establishes a local chapter for remote sensing and cartographic activities which could be affiliated to the continental body.
(10) African remote sensing specialists cannot meet regularly because of unavailability of funds. This impairs the exchange of ideas, can lead to expensive duplication of efforts and illadvised project formulations.

RECOMMENDATIONS

In order to promote remote sensing activities in Africa, this special session recommends that

1. The ISPRS sets up a Committee to promote remote sensing activities in Africa by
   a) encouraging each African country to set up a National Committee for remote sensing and mapping to be affiliated to the African Organization of Cartography and Remote Sensing (AOCRS);
   b) Setting up a register of individuals with expertise in remote sensing;
   c) Compiling, on behalf of the National Committees, a bibliography of all work undertaken in the Continent in remote sensing, including projects by non-African Centres of expertise;
   d) encouraging the use of remote sensing products in the national economies of African countries;
   e) Advising the regional centres, national organizations and committees on proposed and planned regional and continent-wide projects in remote sensing.

2. The ISPRS should solicit support from all possible sources to undertake a review-study of the current status of remote sensing, ISPRS should seek the co-operation of the United Nations bodies including the UNDP and the major donour countries in order to co-ordinate and streamline all major remote sensing efforts that have regional and continental-wide implications in Africa.

3. The ISPRS should co-operate with the United Nations to promote a programme on long-term education (with emphasis on the development of indigeneous capability) in remote sensing in Africa.

Special Session SS 7

PANEL DISCUSSION

"How to promote Remote Sensing activities in Latin America"

The meeting was held according to the program and it was attended by an audience of about 50 people.

The invited panelers were:

- Argentina: Ing. Jose E. Julia
  Institut de Geodesia, Univ. Nac. Tucuman
- Brazil: Ing. Ricardo Cartaxo de Souza
  Head, Image Processing Depart. — INPE
- Chile: Dr. Lautaro Rivas
  Jefe del Departamento Fotogrametrico, Instituto Geografico Militar
- Colombia: Dr. Alvaro Gonzalez
  Director del Instituto Geografico Agustin Codayyi, IGAC
- EOSAT: Mr. Richard Mroczynski
  Director of Public Affairs
- SELPER: Mr. Paulo Roberto Martini, ViE-President
- Spain: Prof. Serafin Lopez Cuervo y Estevez
  Universidad Politecnica de Madrid
- Portugal: Dr. Elvino A.A. Dias Duarte
  Director des Servicos de Fotogrametria, Inst. Geografico e Cadastral

U.N.: Dr. Adigun Ade Abiodun
Expert on Space Applications, Outer Space Division

As expected, the panelers briefly described the main activities, programs and experiences oriented to the promotion of remote sensing in Latin America.
Some important remarks were also provided by Jean-Pierre Paris (GDTA France) and Prof. Peter Baehr (Fed. Rep. of Germany).
At the end, participants agreed to prepare suggestions of the meeting in ISPRS Council. The conclusions are summarized as follows:

Taking into account that:

- There are no practical barriers as far as language is concerned amongst latin american countries;
- There are already in the region some well established facilities and experiences in both applied technologies and training
- There are several national members of ISPRS in the region helding and hosting symposia and or technical meetings in the field of RS

Recognizing that:

- Several UN bodies such as FAO, UNDP, UNESCO already have programs devoted to developing countries, aiming the use of space technologies and its applications;
- SELPER (The Latin America Society of Remote Sensing Specialists) is proving its ability to carry out regional comparative projects and scientific activities such as the Latin American RS Symposium, held every two years, in the different countries of the region;

The regional meeting of Latin America recommends that ISPRS should support;
UN and SELPER efforts in promoting the RS technologies and its applications in the region.

and additionally recommends:

any measures leading to a larger spreading of scientific information amongst the community of latin american countries in Spanish and Portuguese languages.
For that purpose the council will request the Photogrammetria Editorial Board to make a feasibility study for the publication of a special annual issue of its journal, devoted to articles of regional authers or written by the international community specially for this issue.
In order to achieve these goals, ISPRS Council

1) - encourages the futher cooperation amongst all ISPRS member organizations of LA and Iberian countries, with the necessary support of their respective governments, namely through joint projects;
2) - shall be represented by one of its officers in at least one of the annual meetings in the region.

The meeting, coordinated by Mr. Marcio Barbosa and having Prof. Placidino Fagundes as, both from Brazil, was carried out in a very warm and friendly environment.

Special Session SS-8

PERSONAL COMPUTER SOFTWARE SHOWS

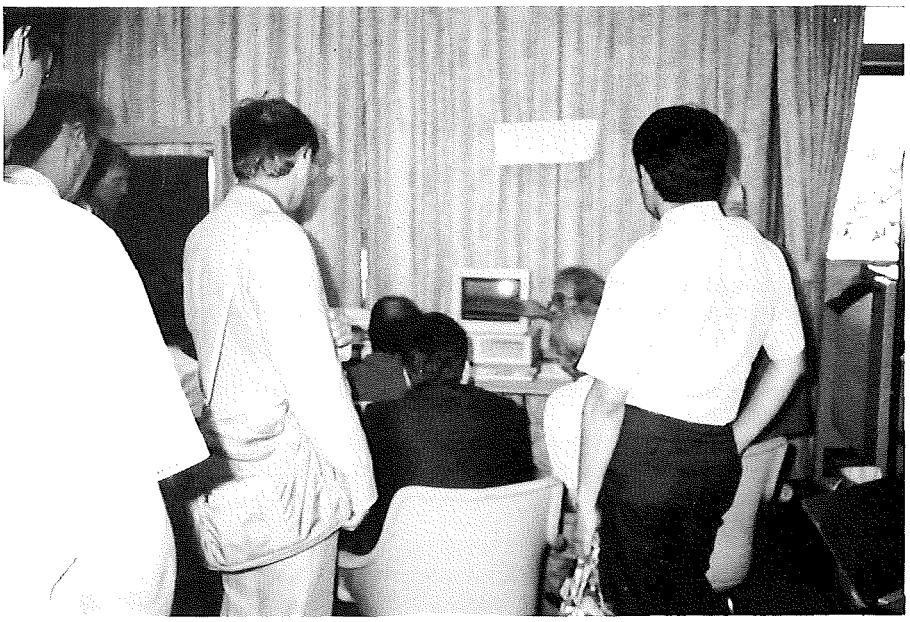
According to strong user requirements to user-friendly softwares for personal computers, "Personal Computer Software Shows" were held on July 6, 7, 8, and 9, 1988 in conjunction with the 16th ISPRS Congress in Kyoto. In the long history of ISPRS, it was the first time to hold such shows.

As the idea of holding the shows was authorized at the council meeting held in Europe in May, 1988, just before the ISPRS. Following this committee, the congress office started preparation of the shows, and announced the opportunity of attending the shows to the expected participants of the ISPRS. The outline of the shows were as follows.

Time : 13:30—16:30
Date : July 6, 7, 8 and 9, 1988
Place : Room F, Kyoto International Conference Hall (KICH)
Show Time: One hour was given on request to each applicant including demonstration and discussion.
Computer Facilities: IBM PC and NEC PC were available with color CRTs and 5 inch floppy disk drives. Any PCs were allowed to be transported to the show room at applicant's expense.
Demonstration Disciplines: Survey and Mapping, Cartography, GIS, Photogrammetry, Remote Sensing, Education and Training, etc.

Despite of the short period of time for application, total of 23 software packages from various organizations were demonstrated at the show (see Table 1). As the audience were able to touch the personal computers and try the softwares by themselves, many audience who were interested in the personal computer softwares visited the show room. It was also good opportunity for the demonstrators to exchange information and ideas with the experts in this field.

Recently, personal computers are aiming hardware compatible. This compatibility allows us to share good softwares developed at all over the world for education, research, etc. However, there are little opportunities of exchanging this kind of information. The success of the shows suggests the importance of continuing to hold this kind of shows in the fulture ISPRS.



Joint Session of ISPRS and IUFRO on Forestry

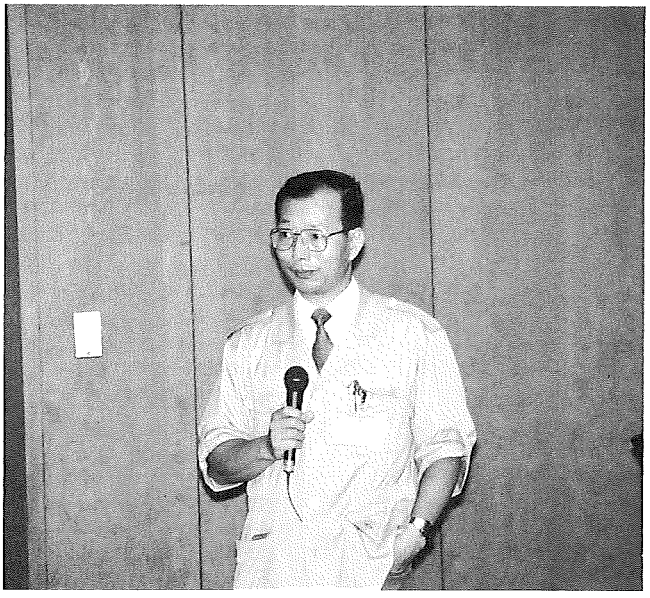
Five joint sessions of Commission 7 and Remote Sensing Study Group of International Union of Forestry Research Organizations (IUFRO) were held on July 6 and 7. These joint sessions focused attention on the following four subject areas concerning of forestry.

(1) Electro-optical and radar imagery for forestry,
(2) Forest and land information systems,
(3) Quantitative/qualitative remote sensing for forestry
(4) Digital image analysis for forestry.

The following 14 papers were presented and lots of fruitful discussions were made under the attendance of more than 50 members at each session.

1. Numerical interpretation of trees on color-infrared aerial photographs by S. Poso (Finland)
2. Estimation of rate of the crown area in Yezo spruce plantations with Landsat TM data by M. Kato (Japan)
3. Untersuchungen zur Reflexion von gesunden und geschaedigten Waldbaeumen im natuerlichen Jahresrhythmus auf der Grundlage von Labor- und Gelaendemessung by B. Koch et al. (FRG)
   (Investigation on reflectance of healthy and damaged forest trees in their annual growing rhythm on the basis of laboratory and in-site measurements)
   (this paper was presented by Prof. Dr. Hildebrandt)
4. Periodic timber volume increment from aerial photo and field plots by A. de Gier et al. (The Netherlands)
   (this paper was presented by Prof. Dr. Sicco Smith)
5. Development of a monitoring system model for tropical forest management using satellite remote sensing by I. Ohnuke et al. (Japan)
6. Classification of intensively managed forests in Germany by remote sensing — methodological aspects and latestresults by G. Hildebrandt et al. (FRG)
7. Forest cutting area detection by Landsat MSS data by Y. Awaya et al. (Japan)
8. Evaluation of ultraviolet photography in detection of seals by I. Ni et al. (Canada)
9. Comparison of Landsat TM and Shuttle Imaging Radar (SIR-B) data for mapping forested wetland by R.M. Hoffer (U.S.A.)
10. Remote sensing for forest resource management — advances in electro-optical and radar imaging systems by S.M. Till et al. (Canada)
11. Change detection techniques to assess deforestation using Seasat and SIR-B satellite radar data by R.M. Hoffer (U.S.A.)
12. Experimental results of L-band microwave penetration properties of trees by M. Murata et al. (Japan)
13. The effective integration of GIS and remotely sensed data for resource management by P. Sallaway & F. Hegyi (Canada) and
14. Forest Land Information Systems by C.H. Lyadda (Uganda)

The papers presented at the joint sessions are recorded in the separate proceedings which were published by the IUFRO Remote Sensing Study (S6.05) Group.



Special Session on Personal Computer Show

Date	Subject	Session	Time	Title of Software
July 6 (wed)	Photogrammetry and Remote Sensing	1-1	13:30-14:30	• The STARS Simulator for Interactive Network Design C.S. Fraser, P.C. Gustafson (USA) • PATM-PC and PATB-PC H. Klein (FRG) • Image Map System T. Kuroda (Japan) • Geographical Information System with Remote Sensing Data and Its Application in Land Use Planning E. Shimizu. H. Nakamura (Japan)
		1-2	14:30-15:30	• CAP : Combined Adjustment Program L. Hinsken (FRG)
		1-3	15:30-16:30	• LANDSAT Data Analysis System : OM-SAT M. Nakajima (Japan)
July 7 (Thu)	Education and Training	2-1	13:30-14:30	• End-user's Image Prosessing System for Training : ENDIPS-T/LODIA K. Cho (Japan) • APL for Photogrammetry E. Dorrer (FRG) • Geometric-BASIC (G-BASIC) S. Shimada (Japan)
		2-2	14:30-15:30	• Man-machine Communication System for Analysing Remote Sensing Data Based on a Micro-computer T. Oshima, K. Miyashita, A. Rikimaru (Japan) • Earth Resources Data Analysis System : ERDAS H. Ishii (Japen)
		2-3	15:30-16:30	• Teaching of Stereomeasurements A. Jean-Paul (Canada)
July 8 (Fri)	Survey and Mapping. Cartography	3-1	13:30-14:30	• GIS Information System(1) : PC ARC/INFO T. Yamamoto (Japan) • PC-Contour : A Formidable and Comprehensive Tools for Drawing Contour Line T. Yoshida (Japan)
		3-2	14:30-15:30	• Presentation of Snowcover-Maps by the Aid of "Digital Research GEM" Software Utilities O. Dick (Norway)
		3-3	15:30-16:30	• Digital Terrain Modeling N. Levy (Israel)
July 9 (Sat)	DTM, GIS	4-1	13:30-14:30	• Combined Data Analysis Software for Remote Sensing Data Analysis Using A Personal Computer S. Takeuchi, T. Tomita (Japan) • Integrated Image Processing and GIS with MicroImage and TerraPak D. Walklet, D. Segal (USA) • Simple Processing System to Survey and Recognize Natural Environment by Using Image and Cartographic Data M. Akiyama (Japan)
		4-2	14:30-15:30	• GIS Information System(2) : PC ARC/INFO T. Yamamoto (Japan) • Land Use Evaluation N. C. M System S. Yanagida, N. Ohno (Japan)
		4-3	15:30-16:30	• DTM Route Location Demonstration Phoneko (Singapore)