SUMMARY OF TECHNICAL SESSIONS

ISPRS, COMMISSION I
PRIMARY DATA ACQUISITION
WORKING GROUP 1
Image Data Quality

SESSION I – Image Date Quality –
Monday, 18th June, 11-12.30

Chairman – J.C. Trinder

1. J.C. Trinder (Aust.) – Report of Activities of Commission I (Invited Paper)

The report included a description of the terms of reference of the working groups, the major activities of the working groups and some conclusions derived from the 4-year period. Working Group I/1 recommends the use of MTF and IFOV for measures of image quality for photographic and electro-optical systems respectively. Working Group I/2 recommends the preparation of a new set of Recommended Procedures for Camera Calibration. Working Group I/3 will show that accurate aircraft position can be determined in flight using a combined GPS/INS system. There are a large number of satellite systems planned in the next decade. The majority of these systems are described under working Group I/4. A set of specifications for aerial photography has been derived by Working Group I/5, and recommended for endorsement by the Congress.

2. J.C. Trinder (Aust.), R. Welch (U.S.A.) – Measures of Data Quality for Photographic, Electro-optical and SAR Imaging Systems (Invited Paper).
Presented by Professor Welch

Topics discussed were resolving power and MTF (hence the frequency limit) for photographic systems, and IFOV and radiometric quality for electro-optical systems. The completeness of mapping derived from various types of data e.g. Landsat MSS, RBV and the ETC (Earth Terrain Camera) was related to the IFOV at that data. In addition the IFOV was related to field sizes to demonstrate that pixel size requirements vary according to the areas being studied. IFOV sizes were also compared with the accuracy of registration of the images to ground coordinate systems. SAR images were discussed briefly.

3. A. Goetz (U.S.A.) – The Shuttle Imaging Spectrometer Experiments.

The Shuttle Imaging Spectrometer is planned for launch at the end of this decade. The present EO imaging systems do not have the potential for acquiring the full information available of the terrain. The spectrometer uses area arrays to detect the data in a large number of channels – up to 128. Aircraft flights have already been made.

4. G. Begni (France) – La Qualité des Images Issue du System SPOT et Son Controle Après le Lancement du Satellite.

The following topics of the SPOT program were discussed; the overall program, the products, the geometry of the data, attitude measurement and the MTF of the SPOT images.

5. N. Binger and T. Ory (U.S.A.) – The 1983 SPOT Simulation Campaign: Maximising the Potential of Aerial Image Acquisition.

The campaign was aimed at deriving simulated products which could be displayed to potential SPOT users. A Deadelus scanner was flown in a Learjet Aircraft. Imaging time had to be limited to 1000 to 1400 hours to simulate that of SPOT. Over 23 days, 61 sites over the U.S.A. were visited requiring 20,000 miles flying.

Examples of the images were shown on 35mm slides.

WORKING GROUP 5
Acquisiton and Processing of Aerial Photography

SESSION I – Processing and Printing of Aerial Photography – Tuesday, 19th June, 9.00 to 10.30.

Chairman – R.W. Lorenz

1. R.W. Lorenz (Neth.) – Report of the Working Group I/5

Referring to the terms of reference a short review was given on the period 1980 to 1982 until the Symposium and the period 1982 to 1984. The Working Group has dealt with specifications for aerial photography (by a subcommittee) processing of aerial photography and aerial films, printing of aerial photography, equipment and materials, small format aerial photography, assessment of quality of aerial photography.

These five items have also been planned for the two sessions at the Congress with Session I concerned with "Processing and Printing of Aerial Photography" and Session II with "Acquisition of Aerial Photography".

One of the main activities of the working group was the preparation of the specificacions for vertical aerial photography, first edition, to be accepte by the Congress. The presentation and discussion will take place in the

second session, Today, Tuesday, June 19th, 11.00 to 12.30.

2. R.W. Graham, R.W. Lorenz, M. Hassan – Processing of Aerial Photography (Invited Paper)
Presented by R.W. Lorenz

The two types of processing, continuous and rewind and the importance of processing in general have been reported. Advantages and disadvantages of both types have been listed with the conclusion that continuous processing gives the best results, but these processors need careful maintenance and servicing and they consume a great deal of electricity and water.
Rewind processing is most ideal but it creates non-uniform processing results. Rewind processing however is the cheapest, least complicated method while the equipment can easily be transported.

3. H. Walter (FRG) – Processing of Various Aerial Films with a Pakotone Processor
Presented by R.W. Lorenz

The title of the paper was slightly changed to "Processing of Various Aerial Films with Sensitometric Control Using Continuous Processors (Versamat and Pakotone)", and is the continuation of the investigation presented at the Symposium in Canberra. It shows the results of processing of films from an actual mission in the Antarctic with a continuous processor and confirms that this processing gives the best results but requires utmost care.

4. R.W. Lorenz (Neth), R.C.A. Dando (U.K.) – Comparative Testing of Continuous Processors for Aerial Films

A comparison of the two types of continuous processors, roller transport and loop or pull-through type shows a clear advantage of the roller transport type. The investigation should be continued to find whether the reliability of the loop processor could be improved by minor modifications. Loop processors are simpler in the design and therefore smaller and cheaper.

5. J.A. Horn, J.M. Tugwood (Neth.) – Some Investigations into Optimizing Exposure and Processing for Aerial Photography.
Presented by J.A. Horn

Well prepared sensitometric control of the material processing combination makes suitable data available to the aerial photographer who should while airborne measure the brightness luminance in detail. This should include the determination of haze influence, and a decision on the proper film-processing combination. This should lead to the contrast factor needed for the object luminance range present and exposure, according to the speed, resulting from the combination. The maintenance of decisions made during photography i.e. processing the aerial photography as pre-determined, will then and only then lead to acceptable results. This method requires however, professional personnel in the air and in the laboratory.

6. R.W. Lorenz, S. Visch (Neth.) – Electronic Contrast Modulation in Printing Aerial Photography With a Modified Concept of the Electronic Masking Printer Scanatron.
Presented by R.W. Lorenz

An introduction to the principle of photographic and electronic masking and electronic contrast modulation showing masked and not masked photography. An introduction to what is changed electronically to improve the performance of the electronic contrast modulation leads to the explanation of the modified concept i.e. changing the scanning direction adapted to the individual negative and changing the contrast modulation along that direction continuously so it is adapted to the requirement of the negative. In this way local contrast enhancement can be applied. The importance of the contrast factor of the material processing combination used was pointed out. A new masking method on the negative using liquid crystal with individual adaptation to the density level to avoid the halo effect along the edges was announced.

7. J.V. Baccoli, C.S. Heinmiller (U.S.A.) – "Effects of changing the spectral sensitization of an aerial film to improve product performance".

A test has been carried out to improve atmospheric penetration, more effective signal to noise ratio, higher recorded target contrasts, and samller filter factors with no perceived or measurable image quality losses.
This might be a product available in the future if enough interest from potential users were indicated.

8. W. Liekens, N. Verycken, H. Van Den Poel – Photographic and Physical Characteristics of a new Generation of Aerial Films
I – Aviphot Pan 150 PE
II – Avitone, Duplicating Film
Presented by R.W. Lorenz

A short summary was given to indicate the characteristics such as spectral sensitivity, speed, granularity, resolving power and processing chemistry of both films, the negative and the duplicating film.

WORKING GROUP I/5

Acquisition and Processing of Aerial Photography

SESSION II – Acquisition of Aerial Photography – Tuesday, 19th June, 11-12.30

Chairman – L.C. Holstein

1. R.W. Lorenz (Neth.) – Specifications for Aerial Photography – A review, critical remarks and outlook

Dr. Lorenz reviewed the history of the current draft of the specifications for Aerial Photography. Copies were available

for the members of the audience. He pointed out that the specifications had been distributed to all National Correspondents and were very similar to that published in Canberra 1982 and by the RICS.

Discussion followed and two members of the audience suggested that, not enough time had been given to consider the specifications. Another suggested that it did not take into account electro-optical cameras and that it is becoming less important to fly in straight lines. Also the ISO standards are not mentioned.

Upon a vote of the audience it was decided to postpone consideration of the Specifications until the Commission I business meeting on the 26th June.

2. G. Fulmer (U.S.A.) — Application of electro-photography to remote sensing (Invited Paper)

This paper gave the state-of-the-art in photo-conductive (PC) technology films. Dr. Fulner (from Eastman Kodak) showed the technical characteristics of Kodak's PC films. Also discussed were the film copier and processor (at this stage for 5½" wide film). An informative paper concerning very high resolution films.

3. W. Brindöpke (FRG), M. Jaakkola (Fin.), O. Kobl (Switz.) and P. Noukka (Fin.) — Optimum Emulsion for Large Scale Mapping

Dr. Brindopke presented the results of an O.E.E.P.E. investigation of which film emulsion has the capability of producing the highest accuracy measurements in instruments. It appears that panchromatic photography results in marginally less accurate measurements than colour photography although the differences were not significant. This research is on-going.

4. R.W. Lorenz (Neth.) — Assessment of Quality of Aerial Photography.

This presentation gave a brief review of the factors to be considered when assessing the quality of aerial photography.

5. R.W. Graham (U.K.), J. Kure and R.E. Read (Neth.) — Small Format Microlight Surveys.
Presented by Mr. John Horn (ITC)

The presentation gave details of three types of microlight aircraft. One aircraft is able to fly at heights of up to 10,000 feet but it takes up to ½ hour to attain that height. This same microlight is a two seater, one is used for the pilot, the other is for a camera. Using such an aircraft the acquisition of photography is low cost because the microlight can be flown to the area cheaply and quickly. For take-off and landing a strip of only 30 metres length is needed.

WORKING GROUP 2

Camera Calibration and Effects of the Enfironment

SESSION I — Camera Calibration — Friday, 22 June, 11-12.30

Chairman — L. Peck (U.S.A.)

1. H. Ziemann (Canada) — Comparison of Camera Calibration Procedures (Invited Paper)

The study began in 1973 with 6 participants involving different calibration methods. The mathematical relationships for camera calibration were given. These formulations were required before the comparison could be made. Parameters included the calibrated focal length, decentring distortion principal point of best symmetry and principal point of auto-collimation.

The final result should be available within a year.

2. J. Hakkareinen (Fin.) — Geometric Stability of Aerial Cameras (Invited Paper)

The study involved 4 participants, the NRC with 27 cameras, Wild Heerbrugg with 8 cameras, and Helsinki Technical University with 4 cameras. Changes in the calibrated focal length, tangential and radial lens distortion and the principal point of auto-collimation and principal point of best symmetry were studied over a period of up to 12 years. In general there were only very small variations in these parameters. The calibration of a camera is very stable and hence the period between calibrations should be 2-3 years provided the camera has not been treated improperly or maintained.

3. H. Ziemann (Can.) — On the Stability of Lenses for Aerial Mapping Photography.

Only preliminary results are available for this study on a total of 632 calibrations. Fiducial marks, principal points and focal length are currently being investigated.

4. T. Hirai and S. Yagi (Japan) — Total System for Evaluating Aerial Cameras
Given by M. Akiyama

Techniques and equipment used for camera calibration in Japan were described. They include principal point, calibrated focal length, distortion, film and pressure plate flatness, image quality by resolving power and MTF, and photometric performance including exposure time, uniformity of image illuminance and glare spots. The primary equipment is an 81 collimator array extending up to angles of 60° from the optical axis of the camera.

5. G. Voss and U. Zeth (DDR) — The Lmk Camera System
Paper given by Dr. K. Szangolies

The Lmk manufactured by Carl Zeiss Jena was described. The particular feature of this new camera is that it incorporates forward motion compensation to a maximum of 32mm/sec.

WORKING GROUP 2

Camera Calibration and Effects of the Environment

SESSION 2 – Camera Calibration and the Environment – Friday, 22 June, 11-12.30

Chairman – W. Tayman (USA)

1. C.L.Norton (U.S.A.) and H. Ziemann (Can.) – Report on Activites of Working Group I/2

The terms of reference laid down by the Commission President were described. The projects which were formulated for the working group from the terms of reference were then given and progress in each of these projects was outlined.

2. C.L.Norton and L.C. Peck (U...S.A.) – Image and Geometric Effects of Operational Environments on Aerial Cameras (Invited Paper)
   Paper given by L.C. Peck

The paper reviewed the U.S. Hill Air Force Base activities on the determination of the effects of the environment on camera geometry and image quality. An environmental chamber designed for testing was described, but no results are available. It was stated that papers at the 1980 Congress revealed that environmental affects on cameras are greater than previously expects.
Image motion compensation is difficult to maintain within 5% of the expected value. This has been tested using a moving target simulator.

3. H.-K. Meier (FRG) – Progress in Improving Performance on Zeiss Aerial Cameras.

The steps taken by Zeiss to derive better image quality aerial photography were described. Firstly, the lens should be stopped down as much as possible. Then a high quality film should be selected. The Kodak 2412 Panatomic X is a slower film, but of higher quality than standard aerial films. Next, forward motion compensation (FMC) should be built into the camera to enable the use of the slower films. Image movement must be reduced to less than 20μm. The new Zeiss cameras are equipped with FMC. FMC can be installed in Zeiss cameras less than about 10 years old. Examples of photography taken with the new camera lenses with FMC and Panatomic X films showed the vast improvements in image quality which can be obtained.

4. J.B. Andrade (Brazil) – The Brazilian Experience on Camera Calibration

No facilities exist in Brazil for camera calibration. To avoid sending cameras overseas, a field calibration technique was developed. The basic model used to determine the calibration was given, based on the collinearity condition with addition parameters for symmetrical and decentring distortion. The test area was marked with 36 targets which is being maintained for later calibrations. Calibrations were obtained with this test range, the standard errors of the calibration parameters were very small.

5. G. Voss and U. Zeth (DDR) – Some Aspects of Forward Motion Compensation in an Aerial Camera.
   Paper given by Dr. K. Szangolies

Like Dr. Meier, Dr. Szangolies described the need to reduce the effect of image movement in aerial photography. He said the performance of aerial photography can be improved by using slower films and optimum exposure. The most efficient use of films will enable substantial improvements in image quality. The quality of the camera objective cannot be significantly improved. The FMC facility of the Lmk Camera was described and typical photographs derived from the camera shown.
The Chairman summarised the session by stating that there had been significant improvements in image quality of aerial photography because of the introduction of FMC and aerial films such as Kodak 2412 Panatomic X.

JOINT SESSION OF COMMISSIONS I, III AND V

System and Self-Calibration

Friday, 22 June, 15.30-17.00

Chairman – H. Ziemann (Canada)

Papers were presented by Torlegard (invited); Nekhin; Kupfer, Mauelshagen and Zulsdorf; and Ziemann and El-Hakim (Invited) Papers 1 and 2 are found in Part 36 of the proceedings, paper 3 in Part 1; the last paper is not included.

1. A.K.I. Torlegard (Sweden) – Multimodels Increase Accuracy – Summary of an Experiment.

Torlegard discussed the increase in accuracy obtained by imaging the same object on several pairs of photographs. The evaluation of Hasselblad MK70 photographs was carried out disregarding lens distortion, photogrammetric refraction and earth curvature. It was shown that the improvement in accuracy was better, the smaller the chosen image scale; in position there was a nearly linear in accuracy with the number of models used, while there was no clear tendency for improvement in elevation results.

2. S.S. Nekhin (U.S.S.R.) – Test Object Photographs for Experimental Estimation of Aerial Survey Camera and Photos by Field Experiment.

Nekhin reported on accuracy increases achieved for system

calibrations of aerial cameras over testfields. Initial interior orientation parameter values were those from laboratory calibrations. A procedure introducing interior orientation parameters gradually, depending upon the amount of relief within the test area was indicated. Improvements of 20-30% resulted from the system calibrations.

3. G. Kupfer Mauelshagen and Zulsdorf (FRG) – Full System Calibration in Aerial Photogrammetry Results and Prospects
   Presented by Zulsdorf.

Kupfer, Mauelshagen and Zulsdorf reported on a system calibration experiment using targets placed on the slope side of an open pit mine. Promising results were obtained in attempts to decorelate (calibrated) focal length and flying heights and to decorrelate (calibrated) focal focal length with good accuracy ($\sim$ 10-20μm)

4. H. Ziemann and S.F. Hakim (Canada) – The interrelationship between Calibration Parameters Determined by System Calibration and Self-Calibration

Ziemann and El-Hakim reported results on system and self-calibrations over two flat test areas using set of 13 photographs consisting of a 3 x 3 block with 60% overlap in both directions, overflown by 4 photographs each covering the area of the block in the four different possible orientations. The results indicate that self-calibration parameter sets are not equally effective and may work only on the type of photograph they were developed for. They also show that image deformation correction based on réseaux combined with lens distortion data (in the form of polynomials) derived from system calibration are nearly as effective in improving aerial triangulation results as the most effective self-calibration procedures.

WORKING GROUP I/1

Image Data Quality

SESSION 2 – Image Data Quality –
Monday, 25 June, 13.30-15.00

Chairman – R. Welch

1. S.R. Brooks and A.P. Luscombe (U.K.) – Synthetic Aperture Radar Data Image Quality and Meassurement (Invited Paper)
   Presented by A.P. Luscombe

The paper discussed the analysis of SAR data quality by a theoretical analysis, image assessment and SAR simulation. Under theoretical analysis which would test the full system, the measures are typically spatial resolution, radiometric resolution, energy distribution and image contrast. For image assessment, testing relative processor performance, spatial and radiometric resolution would be used, which under SAR simulation, testing the processor spatial and radiometric resolution, energy distribution and image contrast would be considered. Verification sites employing corner reflectors would enable a more accurate assessment of the system.

2. H. Engel, G. Konecny, J. Wu, A. Schuering, H. Schuhr and P. Lohmann (FRG) – Investigations of Metric Camera Data Quality

The metric camera was launched on the Space Shuttle in November/December 1983. Images have subsequently become available. The theoretical quality of the data prior to launch was discussed and the minimum pixel sizes of electro-optical data required for the identification of features for 1:50,000 mapping were given for both mono and stereo observations.

3. J.C. Trinder (Aust.) – Potentials of Monocular and Stereoscopic Observations in Aerial Photography

The results obtainable from monocular and stereoscopic observations on target points were given for current photographic image quality, and for image qualities which whould be obtainable in the future. High optical magnifications should be used. For high image quality precisions of X and Y measurement can be better than 1μm and height observations about 0.01$^{o}/_{oo}$ of the flying height.

Panel Discussion – Measures of Image Quality
Professor Welch (U.S.A.), Professor Trinder (Aust.), Mr. Luscombe (U.K.), Dr. Schuhr (FRG), Dr. Wellman (U.S.A.)

The panel discussion considered the suitable measures of image quality, and optimum optical magnification. The use of MTF for photography was stress. For EO system, IFOV needs investigation but MTF may be a suitable measure as well. Further work is needed on this subject. The problem of image speckle in SAR data was mentioned.
The optimum magnification recommended depends on the quality and contrast of the image. Magnifications as high as 20-30x can be used for observations on photography, but much lower magnifications are recommended for the metric camera photography or for the production of line maps.

WORKING GROUP 2

Camera Calibration and Effects on the Environment

SESSION 3 – Standards for Camera Calibration – Wednesday, 25th June, 5.30-17.00

Chairman – H. Ziemann (Canada)

1. The session commenced with a movie film on the ISO organisation, and the reason for establishment of the standards.

2. H. Ziemann (Can.) and W. Tayman (U.S.A.) – ISPRS Recommended Procedures and Specifications for Camera Calibration (Invited Paper)

The paper reviewed the status of ISPRS, and recommended an association with the ISO standards. It recommended an update of the ISPRS Recommended Procedures based on the ISO standards. The groups of ISO which are of interest to ISPRS were demonstrated.

3. H. Ziemann (Can.) – The Determination of Parameters of the interior Orientation of Photogrammetric Cameras – A Bibliography.

A short paper to describe a bibliography being compiled incorporating over 600 references.

4. **Panel Discussion** – ISPRS Recommended Procedures and Specifications for Camera Calibration

Chaired by J.C. Trinder

Tayman: The Recommended Procedures should be updated now.
Meier: The present standards were introduced in 1952 and any new standard would destroy the old standards for camera calibration. Caution should therefore be used in introducing the new standards hastily.
Peck: There is a need for a measure of image quality that everyone is familiar with.
Corten: Reviewed the history of the previous set of recommended procedures and recommended that ISPRS formalise new standards.
Lorenz: The aerial photography specifications were now complete and should be adopted at this Congress. They should be maintained in the future.
Ziemann: The Recommended Procedures were not adopted by ISPRS in 1980. A new version should be prepared for 1988 Congress. Results of calibration cannot be compared unless a standardized method of calibration and reporting was introduced. The current procedures cover the items that should be determined, but they are not sufficiently rigid.
The new Recommended Procedures will not be an ISO standard, but will be based on them where relevant. The new Procedures should be very specific about certain items which may be left blank for the user to complete. Explanatory notes should accompany the text which act as a manual explaining the use of the procedures.

MANUFACTURERS SESSION

SESSION I – Thursday, 28 June, 9-10.30

Chairman – J.C. Trinder (Aust.)

1. K. Szangolies (DDR) – The Equipment System of VLB Carl Zeiss Jena for Remote Sensing of the Earth

Optical photographic techniques are used by Zeiss Jena. Information content and resolution are important for interpretation and photogrammetry. Three sets of data can be acquired by spacecraft, aircraft or helicopter.

(i) Space camera MKF-6M acquires 6 channels of data
(ii) The helicopter and aircraft camera MSK-4 acquires 4 channels. Both of these cameras have high resolution of up to 150 lines/mm
(iii) LMK aerial camera.

All three cameras are used to acquire remote sensing data. Other equipment relevant to Commission I were also described.

2. W. Liekens, N. Verycken and H. Van den Poel (Belgium) – Aviphot and Avitone films manufactured by Agfa-Gevaert.

Aviphot Pan 200 PE film is a fine grain high resolution emulsion. It is sensitive up to 740nm wavelength light, With a resolution varying from 100 to 50 line pairs/mm for high and low contrast respectively and on EAFS 160-500.

Aviphot Pan 150 has an EAFS from 100 to 250 and resolution from 140 to 40 line pairs/mm for high and low contrast respectively. Both films are on a 0.1mm polyester base.

Avitone films are a new generation of b/w duplicating films. Resolution varies from 200 to 160 line pairs/mm for high and low contrast respectively. The base is polyester with thickness of 0.18mm.

3. U. Zeth (DDR) – Exposure Metering and Control in the LMK Aerial Survey Camera System.

Paper given by Dr. Marckwardt.

The exposure meter control is based on a separate control unit which measures the luminance of the field 38 times per second. The field angle is 1.5° which is equivalent to 2mm for SWA and 6mm for WA. A microcomputer computes the lightest and darkest areas and hence the brightness range and exposure. The required density range can be present while a film gamma can also be recommended. Automatic and manual modes are possible.

4. J. Graham (U.S.A.) – Kodak Aerial Photographic Products.

Kodak manufacturers over 30 products for aerial photography with EAFS vary from 9-600, with high and low grain and resolution varying from 100 to about 900 line pairs/mm. Silver halide technology has made rapid advances in the last 10 years. New advances are in what is called T-grain technology.

Specifications of Kodak films were listed e.g., 3412, 2412 Panatonic X, 3410 and 3414. All these films have very high resolutions.

Kodak processors 1140 and 1811 were also described. The equipment for exposing and developing photo-conductive (PC) materials 5½" wide was then presented. The PC materials have very low granularity.

5. A. Dodds (U.K.) – Products Marketed by Milligan Electronics.

Equipment described was primarily the Milligan CP25 electronic processor for aerial film. This equipment has been upgraded from a previous model.

WORKING GROUP 3
Sensor Orientation and Navigation

SESSION I – Sensor Orientation and Navigation – Thursday, 28 June, 11.00

Chairman – F.L. Corten (Neth.)

1. F.L. Corten (Neth.) – presented the Working Group Report.

Working Group I/3 which has been in existence since the London Congress, 1960. It has served usefully as a platform to report on recent performances, and was created mainly by navigation instrument manufacturers.

In future, however, work will have to be carried out by a group of internationally cooperating specialists, to effectuate the RESOLUTION: "Commission I recommends the construction of one or more data acquisition management computer systems which will make possible the in-flight recording of sensor exterior orientation elements".

2. F.L. Corten (Neth.) – Navigation and Sensor Orientation Systems in Aerial Survey (Invited Paper).

After summarizing the methods which are useful for survey navigations and for determining the elements of the sensor exterior orientation, the author reviewed the applications for navigation, aerial triangulation and establishment of control. Recent and near-future improvements in high-technology instruments make it possible to replace costly and time consuming establishment of control by airborne methods, introducing not only image coordinates and ground coordinates but also sensors position and attitude data into aerial tringulation programs.

Particularly promising is the use of integrated systems, i.e. GPS (Navstar) Inertial navigation with a ground GPS monitor.

This use can revolutionize and significantly improve the economy of aerial survey by triangulation without ground control, particularly in remote and inaccessible areas. The methods are expected to become viable for medium scale mapping in the very near future.

3. S. De Camp (U.S.A.) – Consideration of Inertial and Other Navigation Systems and Methods (Invited Paper)

Navigation systems and instrumentation are not tuned to the needs of aerial survey. For his reason, if we want to make use of high performance systems, one or more survey flight management systems will have to be constructed. Manufacturers, however, will not be interested to do this.

As replacement of groud control, establishment by modern airborne means is highly important. It will be the task of the survey world to initiate the actual construction of such a survey management computer system.

4. R. Keegan (U.S.A.) – Global positioning and applications to photogrammetry.

Navigation systems integrating differential GPS (Navstar) i.e. GPS with corrected systematic errors by means of an aircraft – communicating with a ground monitor and a precision inertial system can produce extremely accurate navigation.

Such navigation systems can be coupled to autopilot and to camera. In-flight recording of the 3 position coordinates X, Y, Z will allow for post-flight processing of the navigation data and the monitor.

This mode of aerial triangulation could eliminate the need for ground control.

5. A. Grimm and F. Heimes (FRG) – CPNS – Computer-controlled photo-navigation system; new aspects for aerial survey.

A survey flight managing computer plus navigator display has been designed and constructed. It accepts the output of any navigation sensor. Tests have been flown by CPNS coupled onto microwave beacons (ground based).

Navigational results are of the order of 20m; triangulation results based on a four-beacon array perform to an order of accuracy of 1mm within the beacon quadrangle and of 3m outside the quadrangle, which is sufficient for large scale mapping and map revision.

6. H. Sinha (India) — Application of Sensor Orientation data in aerial triangulation.

Simulation by means of the GIANT program indicates that sensor's position data should be accurate to about 2m, for medium scale mapping for it to be of practical use in aerial triangulation in replacing ground control by sensor's exterior orientation data.

7. K. Schwarz (Can.), C. Fraser (U.S.A.) and P. Gustafson (Can.) — Aerial Triangulation Without Ground Control.

Tests and simulation of the use of GPS-Navstar/INS combination prove that already standard errors of as little as $\sigma = \pm 5$m can be obtained.

In the near future using the next generation equipment, standard errors $\sigma = \pm 2$m will be possible when GPS/INS/monitor is applied.

When air station positions in flight having $\sigma = \pm 2$m accuracy are used in aerotriangulation, the precision of ground points with $\sigma \cong \pm 1$m accuracy will be possible.

ISPRS, COMISSION II
INSTRUMENTATION FOR DATA REDUCTION
AND ANALYSIS

President: Z. Jaksic (Canada)
Secretary: W.M. Strome (Canada)

MANUFACTURERS' FORUM

(Session 1 – Photogrammetric Instruments)

Monday, 18 June, 1984, 11:00 – 12:30
Chairman: Z. Jaksic (Canada)

A.M. Colla (Italy) "O.M.I. Announces a New High-Performance, Low Cost Analytical Stereoplotter, the AP-5 Bravo".
A new high-performance, cost-effective analytical stereoplotter system in the4 μ mprecision range was presented.

G. Robertson, A. Wyatt (Canada) "P.A.S.S. 2000 / Real-Time Image Processing and Target Recognition System for Photogrammetric Mensuration". (presented by G. Robertson)
The system and its components were described briefly, with the indication of some current applications of the system.

D. Hobbie (FRG) "The Zeiss Line of Photogrammetric Systems".
The available products and services and the systematic extention and completion of the new line of computer-supported photogrammetric systems introduced in Helsinki in 1976 and in Hamburg in 1980 were described.

D. Hobbie, H. Rüdenauer (FRG) "The Zeiss Planicomp Family: A User-Oriented Solution to Practical Requirements". (presented by D. Hobbie)
The variety of hardware and software components and configurations of the Planicomp system were presented with emphasis on major innovations.

E. Assmus (Switzerland) "A New Software System for Digital Mapping". (presented by W. Kreiling)
A software package which solves effectively the needs of digital mapping from aerial and terrestrial photographs by analytical and analog instruments was described.

J. Höhle (Switzerland) "The Development of the Photogrammetric Digital Plotting Tables at Wild Heerbrugg". (presented by W. Kreiling)
This paper reviewed the expansion of application areas and the optimisation of performance parameters during a ten year development period of Wild photogrammetric plotting tables.

R.A. McLaren, A.R. Berrill (Switzerland) "Photogrammetric Data Capture: The Intelligent Approach". (presented by R.A. McLaren)
This paper described the functionality to be made available in the next generation of intelligent photogrammetric acquisition stations and reviewed the hardware and software components necessary for the achievement of this objective.

J. Klaver (Switzerland) "The Kern Computer Aided Mapping System New Developments". (presented by T.P. Roberts)
The evaluation of the Kern CAM System during the past four years was presented.

MANUFACTURERS' FORUM

(Session 2 – Photogrammetric and Remote Sensing Instruments)

Monday, 18 June, 1984, 13:30 – 15:00
Chairman: L.W. Fritz (USA)

A. Chapuis (Switzerland) "The New Kern DSR 11 First Order Analytical Plotter Based on Distributed Processing".
The instrument, which evolved from the DSR 1 analytical plotter introduced in Hamburg in 1980, and its optional peripherals were described.

L. Cogan, D. Hunter (Switzerland) "An Application of the Kern Correlator". (presented by L. Cogan)
The design principles of the correlator and ist application for DTM generation were presented.

C. Vigneron (France) "TRASTER Family". (presented by J. Hughes)
The various models of the TRASTER System produced by MATRA were described.

K. Szangolies (GDR) "Development of New Equipment for Photogrammetry by VEB Carl Zeiss, Jena, from 1980 to 1984".
This paper reviewed the progress since 1980 in aerial and terrestrial cameras, analog instruments and analytical plotters.

W. Marckwardt (GDR) "Rectification Systems from Jena".

The recent developments of rectification systems at VEB Carl Zeiss, Jena, were reviewed.

H. Stiller (USA) "Quality Services provided by Precision Photo Laboratory Inc.".
The instrumentation and the techniques used in the laboratory for prescision film processing were presented.

C. Dorn (GDR) "Interactive Image Processing in Cosmic Remote Exploration with GDR Image Processing Systems".
The paper discussed interactive image processing as developed in the GDR.

H. Yzerman (Switzerland) "A New Instrument for Revision, the APY".
A new map revision instrument based upon analytical stereoplotter principles was described.

MANUFACTURERS' FORUM

(Session 3 – Remote Sensing Instruments)

Monday, 18 June, 1984, 15:30 – 17:00
Chairman: W.M. Strome (Canada)

J.L. Seligmann (France) "PICTRAL a MATRA Line of Image Processing Terminals for Large Size Imagery".
(presented by P. Demathiew and G. Queixalos)
The PICTRAL line of terminals developed in response to the image processing requirements of high volume imagery such as Landsat D and SPOT was presented. The main system design features were described and the need for new, high-performance functions outlined.

V. Dubé and M.A. Schindler (Canada) "ARIES-II Image Analysis System and the New Advanced Image Processing Architecture for Thematic Mapper and SPOT Data".
(presented by W.M. Strome)
The capabilities of the DIPIX ARIES II series of image analysis systems, networks and work stations were presented. Features including ease of operation, expandability and display flexibility and options including remote terminals offering multiple user access were described.

M. Nakamura, S. Deguchi, K. Suzuki and T. Harada (Japan) "Raster-to-Vector Conversion System". (presented by M. Nakamura)
The raster-to-vector conversion system used in earth mapping application for converting 1024 x 1024 digital terrain array map subsections into contour vectors was described.

K. Szangolies (GDR) "The Equipment System of VEB Carl Zeiss Jena for the Remote Sensing of the Earth".
The problems related to the transfer of technology for photographing the earth's surface by photogrammetric aerial cameras to satellites were reviewed. The results of a number of experiments with satellite-borne photogrammetric cameras were presented and the current intensive development of satellite-borne cameras outlined.

Q: W.M. Strome: It has been my experience that while photographic equipment for earth sensing provides very high resolution, electro-optical sensors are radiometrically superior. Would you care to comment?
A: K. Szangolies: Yes, for some specialized projects it is necessary to fly a radiometer as well, however, photographic instruments alone are sufficient for most mapping requirements.

B. Grush (Canada) "Perceptron's Expert Analysis System Interface".
The Expert Analysis System Interface (EASI) a high-level user language which is application independent though specialized for scientific analysis was described. A variety of capabilities provided by its syntax were discussed and the options including a programmer support library and an image processing analysis package were outlined.

J.R. Bennett, R.A. Deane and D. Okerson (Canada) "New Generation Integrated Radar Mapping System IRIS".
(presented by K. Link)
The MacDonald, Dettweiler and Associates airborne Synthetic Aperture Imaging Radar (IRIS) was presented. The features of this entirely digital system which produces the image on the aircraft and can record the unprocessed data or the processed image onboard the aircraft were discussed. The capability of the system to transmit the image to the mobile ground terminals via VHF radio was described.

P. Cannon (USA) "Image Processing Applications for the ST-100 Array Processor". (presented by W.M. Strome)
STAR Technologies ST-100 Array Processor's architecture, hardware and application to image analysis were described. Features including a 200 million floating-point logic operations per second capability and a very flexible addressing of memory were discussed. The characteristics of the air-cooled design with very large scale integration and Emmitter-Coupled Logic for the achievement of the high speed were outlined and the support software was reviewed.

ANALYTICAL AND HYBRID PHOTOGRAMMETRIC INSTRUMENTS

(Working Group II/1 – Session 1)

Tuesday, 19 June, 1984, 9:00 – 10:30
Chairman: L.W. Fritz (USA)

L.W. Fritz (USA) "Report of Working Group II/1 on Analytical and Hybrid Photogrammetric Instruments"

V. Kratky (Canada) "Software Simulations of On-line Analytical Systems".
The development of a software simulation system for programing and testing of on-line analytical systems independently of the system hardware was described. The successful simulation of an analytical plotter was demonstrated by two examples.

M.C. van Wijk (Canada) "Instrumentation for a Cadastral Land Information System".
The requirements for photogrammetric instrumentation for data acquisition in a computerised land information system were discussed. The configuration of a prototype system which was installed in Columbia as part of a joint pilot project was described. Test results obtained with the stereo-orthophoto components of the system were presented.

G. Konecny (FRG) "Photogrammetric Data Acquisition for Land Information Systems"
Strategies and alternatives to establish an intergrated land information system with photogrammetric data as an essential element were discussed. The Kuwait Utility Data Management System and the project Neustadt were presented as examples.

U. Stampa-Wessel, J. Leonhard and K. Jacobsen (FRG) "The Use of Analytical Stereoplotters for the Establishment of Land Information Systems". (presented by U. Stampa-Wessel and K. Jacobsen)
The use of an analytical plotter system for the establishment of the land information system for the experimental project Neustadt was discussed. Hardware and software components required to correlate aerial photographs and already existing maps on a geometrically correct basis were described. The techniques for the combination of data from aerial photographs and existing maps using an interactive graphic system were presented.

INSTRUMENTS FOR ANALYSIS OF REMOTELY SENSED DATA

(Working Group II/3 – Session 1)

Tuesday, 19 June, 1984, 11:00 – 12:30
Chairman: F.C. Billingsley (USA)

F.C. Billingsley (USA) "Report of Working Group II/3 on Instruments for Analysis of Remotely Sensed Data".

W.M. Strome, D.G. Goodenough, K.B. Fung, A.J. Baillie (Canada) "Array Processing Techniques for Image Analysis". (presented by W.M. Strome)
The factors which must be considered in implementing typical image analysis algorithms on array processors were described. Some of the architectural and data flow problems were discussed.

B. Grush (Canada) "User Interface and Digital Remote Sensing Analysis".
Four hypothetical classes of digital image processing systems for analysis of remotely sensed data were described. Typical problems encountered in their software design, especially in respect to the user interface were discussed. The "complete" user interface was defined.

INSTRUMENTS FOR ANALYSIS OF REMOTELY SENSED DATA

(Working Group II/3 – Session 2)

Thursday, 21 June, 1984, 9:00 – 10:30
Chairman: W.M. Strome (Canada)

T. Oshima, K. Miyashita, S. Tanaka (Japan), J. Lisaka (USA) "A Remote Sensing Data Processing System using a microcomputer and its analysis example". (presented by T. Oshima)
A micro-computer based man-machine communication system for analysis of remotely sensed data which was developed by the authors was presented.

M. Uehara (Japan) "Interactive Image Processing System using a General Purpose Computer"

A system for analysis of remotely sensed data which was developed and implemented by the author on a large general purpose computer was presented. The capability of the system to process large volume of data in a simultaneous, interactive, multiple-user mode was described. The design principles and the system functions were outlined.

AUTOMATED PHOTOGRAMMETRIC INSTRUMENTS AND SYSTEMS

(Working Group II/2 – Session 1)

Thursday, 21 June, 1984, 11:00 – 12:30
Chairman: B. Makarovic (Netherlands)

B. Makarovic (Netherlands) "Report of Working Group II/2 on Automatic Equipment and Systems"

Z. Jaksic (Canada) "Photogrammetric Processes and Systems".
The paper covered a broad area of equipment and systems, and emphasized new developments. Attention was given to analytical instrumentation, automation, data base systems, and all-digital systems.

Q: B. Makarovic: Are real-time systems needed for mapping?
A: Z. Jaksic: No, they are not. Complexity of some processes would impose limitations on real-time operation.

Q: H. Yzerman: Will human interpretation of space be replaced by automatic systems?
A: Z. Jaksic: Presumably not in the near future.

Q: B. Makarovic: The term "photogrammetry" comprises "photo (light)", "graphics" and "metrics". Hence, it is not restricted to analogue images and techniques. Therefore, the term is adequate if a broader meaning is given to it.
A: Z. Jaksic: Photogrammetry comprises image metrology and interpretation in a broad sense.

G.L. Hobrough, T.B. Hobrough (Canada), "Stereo Correlation for Large Scale Photogrammetry" (presented by B. Makarovic)

The paper reviewed the real-time automated systems in which the authors were involved. Attention was focused on the latest development – the stereopsis system and, in particular, on the envelope correlation.

J. Albertz, G. Koenig (West Germany), "A Digital Stereophotogrammetric System" (presented by J. Albertz)

The paper described an all-digital system and its components, being developed at the T.U. of West Berlin. Attention was given to operational aspects, data processing, and system characteristics.

Q: K. Grabmeier: Should not both images be rectified instead of only one?
A: J. Albertz: This might be required, but has not yet been implemented.

Q: U.V. Helava: Should rectification be carried out off-line, i.e., prior to mapping or in real-time?
A: J. Albertz: Off-line, i.e., before mapping.

Q: U.V. Helava: How is data storage organized for image scrolling?
A: J. Albertz: There are two basic display memory sets and two background sets.

INSTRUMENTS FOR PREPROCESSING, STORAGE AND DISSEMINATION OF REMOTELY SENSED DATA

(Working Group II/4 – Session 1)

Thursday, 21 June, 1984, 15:30 – 17:00
Chairman: W. Webb (USA)

L. Marelli (Italy), "Report of Working Group II/4 on Instruments for Preprocessing, Storage and Dissemination of Remotely Sensed Data".

B.P. Clark (USA), L. Fusco (Italy) and J. Murphy (Canada), "Comparison of TM Ground Stations: Similarities and Differences in Image Products". (presented by B.P. Clark)

Results of a joint experiment NOAA/ESA/CCRS to compare landsat TM products were presented.

Q: J.C. Degavre: Will the experiment continue in future?
A: B.P. Clark: Yes, using TDRS data.

Q: J.C. Degavre: Why not to transfer on board the common preprocessing?
A: B.P. Clark: NASA has already studied this aspect for MSS only. Reliability is the problem.

K. Tsuchiya (Japan), "Remote Sensing Sensor Performance Assessment: Instrumentation, Methods and Results". (presented by Y. Yamamoto)

The MSS calibration variation in time and brightness variation within the scene were discussed.

Y. Yamamoto (Japan), "Landsat TM Processing System at EOC".
The Japanese TM processing system installed at the Earth Observation Center of NASDA was described.

S.P. Pereira (Brasil), "The New Brasilian Landsat 4/5 Station".
The significant features of the hybrid SW/HW Landsat 4/5 processing system were presented.

Ph. Couillard (France), "Preprocessing of SPOT Data at the Two Central Ground Stations". (presented by Y. Trempat)

The hardware and the procedures for the planned SPOT data preprocessing were described.

AUTOMATED PHOTOGRAMMETRIC INSTRUMENTS AND SYSTEMS

(Working Group II/2 – Session 2)

Friday, 22 June, 1984, 9:00 – 10:30
Chairman: U.V. Helava (USA)

T. O. Binford (USA), "Intelligent System for Stereo-mapping".
A review was given of the problems related to the design of intelligent systems and to the mechanisms for stereo image matching. Some general and specific geometric constraints were listed. Attention was given to intelligent systems for photogrammetry and to issues such as general theory and perceptual principles.

Q: A.D. Goldfinger: To what extent are these principles implemented in the working expert systems?
A: T.O. Binford: A new improved system is under development in which these principles are being incorporated.

Q: M.M. Allam: Does the system produce locational (geometric) data or is it used onlv for feature extraction?
A: T.O. Binford: The system has capability for "geometric reasoning" and for "symbolic" (semantic) prediction.

M.M. Allam (Canada) "The Status of the ISPRS Correlation Test".
Phase 2 of the ISPRS correlation test comprised, in additon to overall accuracy assessment, the effect of several influencing factors, such as the lack of homogenous image data, terrain relief with steep slopes and discontinuities. Results of experiments were reviewed and discussed.

D. Pape (FRG) "Final Report on the Rastar Correlator Development"
The overall system configuration was outlined. Some results of experiments were reviewed ant the basic feactures of the Rastar Correlator were listed.

R.R. Real (Canada) "A System for Digital Processing of Dynamic Imagery" (presented by S.F. El-Hakim)
A real-time system for sensing and processing of dynamic scenes was presented. An outline of the system configuration and an example of systems application to scoliosis detection were described. In addition, the capability of the system for real-time image enhancement was discussed.

E. Gülch (FRG) "Geometric Calibration of Two CCD Cameras Used for Digital Image Correlation on the Planicomp C-100"
After the architecture of the system was described, the principles of calibration for CCD cameras were outlined. Some experiments were described and the calibration results were presented.

INSTRUMENTS FOR PREPROCESSING, STORAGE AND DISSEMINATION OF REMOTELY SENSED DATA

(Working Group II/4 – Session 2)

Friday, 22 June, 1984, 11:00 – 12:30
Chairman: L. Marelli (Italy)

F.E. Guertin, R. Simard, D. Friedmann (Canada) "Multiple Sensor Geocoded Products". (presented by J. Murphy)
The geocoded products to be made available by the MOSAICS system in Canada were reviewed.

B.P. Clark (USA), L. Fusco (Italy) "Landsat Digital Data Quality Control Standards". (presented by L. Fusco)
Status and problem areas in the Landsat digital data quality operations were reviewed.

D. Stanley, K. Green (U.K.) "Near Real-Time Distribution of Digital Remote Sensing Data". (presented by M. Dillon)
Different concepts of real-time distribution of RS data were presented with specific reference to ESA s ERS1 requirements.

W. Webb, W. Watt (USA) "The Landsat-5 System: Description and Preliminary Assessment". (presented by W. Watt)
The operational Landsat-5 processing system and its most challenging aspects were presented.

J.Cl. Degavre (Netherlands) "Compression of Image Data from Remote Sensing Satellites".
Data compression using FFT techniques was presented. Potential applications were addressed.

EQUIPMENT FOR PROCESSING SYNTHETIC APERTURE RADAR DATA

(Working Group II/5 – Session 1)

Monday, 25 June, 1984, 9:00 – 10:30
Chairman: J.P. Guignard (Netherlands)

R. Okkes (Netherlands) "On-board SAR Processing" (presented by J.Cl. Degavre)
The approaches to SAR processing have been presented which are suitable for on-board implementation.

J. Gredel (FRG), N. Ito (Japan), H. Schroeter (FRG) "Evolution of Digital Ground SAR Processing Systems".
Past, present and future SAR sensors and SAR processors have been reviewed. A categorisation of hardware configurations was presented.

S.R. Brooks (UK), S. Bruzzi (Netherlands) "Acquisiton/Validation/Simulation/Calibration". (presented by S. Bruzzi)
A review of state-of-the-art in the above fields has been presented. Some recommendations have been made for the short to mid-term (5 years) missions.

A.D. Goldfinger (USA) "SAR Processing and Image Interpretation".
A summary and sample results of work performed on oceanographic applications of SAR, have been presented.

F. Leberl, G. Domik, J. Raggam (Austria), M. Kobrick (USA) "Radargrammetry" (presented by F. Leberl)
Progress in radargrammetry over the last 5 years has been reviewed.

ANALYTICAL AND HYBRID PHOTOGRAMMETRIC INSTRUMENTS

(Working Group II/1 – Session 2)

Monday, 25 June, 1984, 11:00 – 12:30
Chairman: M. L. McKenzie (USA)

G. Ducher and J.C. Lummaux (France) "Trends in Orthophoto Instruments Development". (presentd by J.C. Lummaux)
The results of a survey, conducted in late 1983, concerning equipment manufactures and other organizations were summarized. The results concluded very little activity in the development of new hardware, with most of the effort being centered around software improvements. There are, however, considerable activities in the area of digital image processing. The advantages of totally digital systems were discussed.

Q: K. Sangolies: The computer controlled on-line orthophoto generating techniques will continue to be in use for the next 10 to 20 years.

A: J.C. Lummaux: Probably, but the introduction of new digital image processing equipment will make the totally digital approach increasingly attractive.

C.C. Slama, (USA) "Standardization of Analytical Plotter Input, Output and Algorithms".
The impending conversion of the mapping industry from analog to analytical instruments requiring a close examination of the entire production process was discussed. It was pointed out that many functions which were formely sequential in nature, and were performed by different instruments, can now be accomplished on the same instrument. The areas within which standardization should be pursued were outlined.

Q: L.C. Holstein: Is the proposed standardization meant to be internal or external, i.e., within the instrument itself or between different instruments?

A: C.C. Slama: Standardization for analytical plotters is vested in the algorithm for transformation, thus the standardization should be external.

K.A. Grabmaier (Netherlands) "ORI Linked with a PDP-11 Minicomputer".
The advantages derived from the interfacing of the OR-1 orthophotoprinter with a PDP-11 minicomputer were discussed. The existing software was described and the intended software development was outlined.

L.C. Holstein and L. Berlin (Australia) "An Evaluation and Test of the QASCO SD-4 Stereodigitizer". (presented by L.C. Holstein)

The results of testing and evaluation of the QASCO SD-4 analytical plotter were reported. The implemented procedures were, in general, those proposed by Working Group II/1.

M. Stephani (FRG) "Analytical Plotters and Simultaneous Processing of Photogrammetric, Geodetic and Object Information".
The paper dealt with a universal image orientation procedure and a computer program to be used in conjuction with analytical plotters. The procedure is based on a general bundle adjustment for two images. Results from both fictitious and practical data were presented.

DEVELOPMENTS IN ANALYTICAL, DIGITAL AND AUTOMATED SYSTEMS

(Working Group II/1 and II/2 joint Panel Discussion)

Tuesday, 26 June, 1984, 9:00-10:30

MODERATOR: Z. Jaksic

PANEL MEMBERS: L.W. Fritz
C.C. Slama
G. Konecny
B. Makarovic
U.V. Helava
T.O. Binford

Z. Jaksic — Introduced the panel members and the topics to be addressed.

L.W. Fritz — **Analytical Plotter, Hardware:**
Reviewed the state of analytical plotter hardware and commented on the conversion of existing analog plotters to analytical plotters. Outlined the advantages of analytical plotters using 9" x 18" format, such as the parallel restitution of more than one stereopair, digital point transfer and simultaneous aerial triangulation and compilation. Indicated some development trends in the hardware design of analytical plotters such as the outputs in digital form and graphic superposition (mono, stereo, colour) and commented on the transition to all-digital systems.

C.C. Slama — **Analytical Plotter, Software:**
Presented a general functional scheme of analytical plotters with emphasis on the main software system components. Analysed in some detail a number of software modules and concluded that the standardization of the software for analytical plotters is feasible and essential. Recommended the cooperation on standardization with Commision I, II and IV.

G. Konecny — **Data Integration Systems:**
Reviewed the different types of land information systems and identified several basic problems related to the integration of information from diverse sources. Discussed various aspects of the hardware architecture of photogrammetric data compilation systems for data bases and demonstrated some of their characteristics on examples from two projects.

B. Makarovic — **Automated Systems:**
Reviewed the trends in automation emphasizing the increasing complexity and sophistication of automated systems, the transition to all-digital systems and the integration of external information. Discussed a number of problems related to optimisation, man-machine interaction, handling of large scale images and performance characteristics.

U.V. Helava — **Photogrammetric Digital Image Processing Systems:**
Discussed the transition from analog to analytical and all-digital systems. Commented on some problems in the design of all-digital systems related to large quantity of image data, to required storage capacity and to required processing speed.

T.O Binford — **Intelligent Systems for Stereo Mapping:**
Showed examples of automatic feature extraction and editing. Outlined the general characteristics of a system, under development at the Stanford University, for automatic mapping of urban areas from large scale photographs, with features such as edge detection, surface models and geometric constraints implemented in the system. Indicated that the new technology in array processing will contribute to the future development of the system.

Discussion:

Z. Jaksic — Commented on the potential problems in education of photogrammetrists arising from the need for the introduction in the curricula of new areas of knowledge related to new technologies. Raised the question of optimisation of procedures for processing of metric and semantic information.

B. Makarovic — Demonstrated the procedures for integration of two kinds of data flows (i.e., metric and semantic).

G. Konecny — Stated that for some applications analog techniques may be more advantageous than digital and vice versa. Expressed the opinion that in the near future fully digital orthophoto equipment will be introduced.

U.V. Helava — Commented on the prolems concerning the digital storage of entire images and underlined the fact that the photographic image is still the best storage medium.

Z. Jaksic — Indicated that the analytical plotters can handle any sensor data provided that the records are converted into analog image. Stated that for fully digital processing the alternatives are: the conversion of all analog images into digital form which causes the earlier mentioned problems with

storage or the selective analog to digital conversion in real-time (i.e., in the course of processing) while retaining the analog images as the permanent storage medium.

M.B. Faintich — Emphasized that the digitising of entire images is purposeful only if digital images of different sources need be combined and handled together.

Z. Jaksic — Agreed that the form of images (i.e., analog or digital) will be dictated by the intended use.

G. Konecny — Remarked that for thematic mapping combinations of images are important.

L.W. Fritz — Stated that combinations of images are possible on analytical plotters by image superposition, and that the all-digital processing seems to be very complex.

U.A. Rauhala — Indicated that array algebra is very effective for photogrammetric digital image processing and recommended a close cooperation with Commission III on essential mathematical aspects.

K. Torlegard — Commented that the introduction of concepts and techniques of artificial intelligence in photogrammetry is relatively new and inquired about the time when the systems with incorporated feature extraction capability may be availabe.

T.O. Binford — Replied that the automatic parallax (disparity) mapping will be functional within about 2 years, and within 10 years it will be operational.

Z. Jaksic — Commented that some parts of the system might be introduced much earlier for specific applications.

J.M. Zarzycki — Indicated that there are in general three stages of development: the first stage is "curiosity and trials", the second stage is "application to anything" and the third stage is "scaling to reality". Suggested that in the development of digital image processing the third stage is being approached.

D. Hobbie — Inquired about the time when the balance will be achieved in the use of survey (frame) cameras and other (e.g., CCD) sensors.

G. Konecny — Replied that at present survey cameras are superior because of their high geometric quality, high resolution and large image format. Indicated that if the same characteristics could be met in the future by a solid state camera the problem of cost would still remain.

EQUIPMENT FOR PROCESSING SYNTHETIC APERTURE RADAR DATA

(Working Group II/5 – Session 2)

Tuesday, 26 June, 1984, 15:30 – 17:00
Chairman: A. D. Goldfinger (USA)

I.G. Cumming, P. George, J. Lim (Canada) "Architectures for High Speed SAR Processing". (presented by I.G. Cumming)

A number of solutions have been presented and discussed in terms of performance, cost, generality and flexibility.

R. Okkes (Netherlands) "The Information Content of RADAR Images Modeled According to Correlation Properties of the Signal". (presented by J.Cl. Degavre)

A definition of information content was given and its relationship to correlation of signal was demonstrated.

C. Wu (USA) "JPL SAR Processor Development in Support of Flight Missions". (presented by S.R. Saunders)

The real-time airborne SAR processor was described. SIR-B Digital processor characteristics have been reviewed. Advanced digital SAR processor (to be completed in 1986) was introduced. A summary of a survey of users' needs was provided.

J.P. Guignard (Netherlands) "Report of Working Group II/5 on Equipment for Processing Synthetic Aperture Radar Data"

Discussion:
Following the presentation of the report, the new activities of W.G. II/5 for the next four years were discussed. Two areas of main concern, the optimal extraction of thematic information and the optimal use of SAR data in a multisensor approach, were defined. Uses of expert systems and AI for extraction of information from SAR images were reviewed and the continuation of collaboration with W.G. II/4 in particular on standardizing products and formats for multispectral and SAR sensors was proposed.

ISPRS, COMMISSION III
Wednesday, June 20, 1984 from 13.30 to 15.00
Session 1 of Commission III

Topic: Presentation of Commission III Activities
Chairman: Prof. Dr. E. Kilpelä (Finland)

E. Kilpelä (Finland): Report on the Activities of Commission III 1980 – 1984.

F. Ackermann (FRG): Report on the Activities of Working Group III/1 during 1980 – 1984.

V. Kratky (Canada): Report on Activities of Working Group III/2 in 1980 – 1984.

K. Torlegard (Sweden): Mathematical Aspects of Digital Terrain Information; Report from ISPRS Working Group III/3 for the period 1980 – 1984.

M. Mikhail and P.E. Anuta (USA) (presented by E.M. Mikhail): Working Group III/4 Report.

F. Leberl (Austria): Mathematical Pattern Recognition and Image Analysis Report of Working Group III/5.

No discussion took place in the meeting.

Wednesday, June 20, 1984 from 15.30 to 17.00
Session 1 of Commission III/1

Topic: Detection of Gross Errors in Aerial Triangulation
Chairman: Prof. Dr. F. Ackermann (FRG)

W. Förstner: (FRG): **Results of Test 2 on Gross Error Detection of ISP WG III/1 and OEEPE**

Ackermann: Thank you very much, Dr. Förstner, for your presentation, we have one or two minutes, if you want to make some questions. Would anybody want to ask something?

Stoch (Israel): Excuse my ignorance, but could you explain to me what is meant by data snooping?

Förstner: Data snooping is a specific statistical test which takes into account a local geometry. That means you divide the residual by its own standard deviation instead of only by the standard deviation of the observation. The name comes from Prof. Baarda who proposed this test, and he said it is like snooping at all those observations and looking to see whether they are correct or not.

Ackermann: Any other questions? If not, then we thank once more. We all learned a lot from this test which in the beginning looked quite straight forward and we had to debate whether it could be worthwile, but certainly it was a great experience for all participants, and a number of things came up which were not predictable from theory. I may add that the set of data is available. If anybody would like to have it we could provide this test data so that everybody can play with it.

We move now to the next paper. This is an invited paper with still the same topic, gross erros, and we have asked Prof. Kubik from Aalborg in Denmark to give us his views, somewhat deeper views, on the problem of the definition of gross erros in general and on the methods to locate them and to find them. And those who know Prof. Kubik know that he is always good for suprises and so he came up with the title which is at least not in the dictionary. Perhaps he would like to explain it a little. Would you please give your presentation.

Kurt Kubik (Denmark): **Gross erros**

Ackermann: Tkank you very much, Kurt. Ladies and gentlemen, you see why we invited him for the presentation. It is certainly on of the most remarkable I have ever heard, and it is also quite certain that you brought your message over. The only question is now if anyone dares ask a normal question. I might throw in one: why don't you fire your photographer in the first place?

Any other questions? No. Then thank you once more very much. I think there are two aspects to this paper. The first is really, switching over the theory, which would mean that up to now we had a theory of errors normal distribution and least square adjustment, and there were blunders and such things which simply did not fit in. They are excluded, but this is really a big progress and a new way of thinking that the phenomena we used to call blunders don't exist; but anyway we may call them this. That is really taking into account a matter of normal everyday life, and we had better do something to find a method to handle them, and that is very clear. There are really quite a number of more interesting things in the written paper, which is worthwile to be read. And we go here later on in one of the presentations to some applications of this Danish method. Thank you very much once more.

Now the next paper is of quite a different kind. It is by Colombo and Mussio, and is simply a statistical review of a number of practical block adjustments and summarizes how many gross errors are discovered and happen to appear in that block and how many runs of adjustment are necessary to deal with them. This is in a way a very simple investigation, but it is a necessary one, because only gradually did you realize in last years of regular applications of aerial triangulation that gross errors and data clearing, the handling of such things, are the main problem; and it is more serious than we used to think ten years ago. This paper will be presented by Dr. Mussio, he is an associated professor at the Polytechnical University in Milan. Would you, please, give your presentation.

L. Colombo, L. Mussio (Italy): **Experimental Classification of Gross Errors in Aerial Block Triangulation by Independent Models.**

Ackermann: Thank you very much. Unfortunately the viewgraph is too small to be read, but if you read the full text it is an interesting collection of the frequency of gross errors. Are there any questions. If not, I thank you very much.

The last presentation is a report on the development of and the experience with the blunder detection program, on block adjustment with the independent models. And it is actually a Danish method, with stepping down the weight for certain groups of observations. This development has been carried out by Mr. Klein, and he himself will present this paper. You know that Mr. Klein is a scientific collaborator in my institute and has been working with computer programs for block adjustment for a long time.

H. Klein, W. Forstner (FRG): **Realization of Automatic Erro Detection in the Block Adjustmente Program PAT-M43 Using Robust Estimators.**

Ackermann: Thank you very much, Mr. Klein. You have shown us quite a complete program system based on the Danish method. You also showed that the Danish method alone, without modification, is not sufficient, with apologies to Kurt Kubik, of course. But you also showed that, with a number of precautions, you can really succeed with automatic error detection. It is possible and successful in ordinary cases, whether you have very large blunders or down to very small ones.

Thursday, June 21, 1984 from 9.00 to 10.30
Session 2 of Commission III/1

Topic: The Status of Mathematical Models for Photogrammetric Point Determination.
Chairman: Prof. Dr. E.M. Mikhail (USA)

M. Molenaar (NETH): **The Presente Status of the Theory for the Evaluation of the Quality of Photogrammetric Point Determination (IP)**

Mikhail: Thank you very much, Prof. Molenaar. The next two papers are quite related to the presentation of Prof. Molenaar, so we decided that we go ahead with the next two papers. And I again call on the gentlemen to cooperate in keeping the time short, so that we will have a discussion after the two next papers. The next one is by Prof. Dr. Schroth from Stuttgart University.

R. Schroth (FRG): **An Extended Mathematical Model for Aerial Triangulation.**

Mikhail: Thank you very much, Dr. Schroth, and particularly thank you for keeping to your time. The next paper is by Dr. Karsten Jacobsen from the University of Hannover.

K. Jacobsen (FRG): **Analysis of Remaining Systematic Image Errors.**

Mikhail: Thank you very much, Dr. Jacobsen. Now I would like to open the floor to questions. Anybody who has a question, please, proceed to the microphone and state your name and the affliliation to any of the first three speakers.

Proctor (UK): You used a reseau to compensate for film distortion and film non-flatness. Which is more significant?

Mikhail: Anyone wants to comment on that, either Dr. Jacobsen, Dr. Schroth, or anyone in the audience?

Grün (Switzerland): Dr. Schroth, how did you determine the stochastic variations between parameter sets?

Schroth: We determined the variations with reseau measurements.

Mikhail: Did you work with any real data set?

Schroth: No, only with simulation data. It is necessary to look at simulation data first.

Förstner (FRG): The differences are early explained by looking at the standard erros σ_0 in the results of Jacobsen is between $3 - 5\,\mu$. In our case we had reseau measurements which were accurate to 1μ. So we were able to find small variations which are random in a size of between $1-2\mu$, which cannot be found if σ_0 is 5μ.

Mikhail: Dr. Molenaar, do robust estimators fit into the process of evaluating realibility?

Molenaar: In no way yet. I said in the presentation that this robust estimation causes a very interesting approach. It can be compared only with an approach like data snooping if it comes out with a quality theory. Then I think the two methods can be compared. It cannot be compared just by examples. I think it is too weak a document to decide between the two theories.

Mikhail: Don't you think it is implied that at least with a method like roubst estimation he was illuminating some of the observations, therefore it's inplied that he had blunders, whether he calls them that or not.

Molenaar: Of course, it is a method of error detection even if Kubik denies that blunders do exist. It is apllied as a method of error detection. It was proved in the OEEPE and ISP project that it worked well, but it never exeeded in its final results the results obtained by data snooping. You can also prove that on the hypothesis of your functional model being correct and of the normality of your data that the data snooping technique is the best test. So, in its limits, the robust method can reach the

quality of the data snooping technique, but it cannot exceed it.

Mikhail: Thank you very much. I must move on now, because I don't want to rob the fair share of the time for presentations.

O. Kölbl (Switzerland): **Vergleichende Aerotriangulation**

Mikhail: Thank you very much Prof. Kölbl. I know we run overtime, but I should give a chance for at least one question.

Davies (USA): Have you made adjustment without applying film deformation corrections and made comparisons.

Kölbl: We did block adjustment without additional parameters. It was just on affinity transformation done on the fiducial marks. Anyhow, that means already correction for film deformation.

Mikhail: I want to thank you, everybody, for being patient, and apologize for running overtime. It was a pleasure to have you here. I want to thank all the speakers, and remind you that at 11 o'clock there is another session for Commission III, chaired by Prof. Kölbl and I invite you all to come. Thank you very much.

Thursday, June 21, 1984 from 11.00 to 12.30
Session 2 of Comission III

Topic: Aerial Triangulation — Programs and Experiences
Chairman: Prof. Dr. O. Kölbl (Switzerland)

Kölbl: If you allow, I would suggest that we continue discussing aerotriangulation. I wish you pleasure to continue discussing. I think that most of you, who will have concentrated the whole day on aerotriangulation, won't forget that in the afternoon there are very interesting poster sessions waiting for you. For this morning session we have five papers under the rather general title "Aerotriangulation — Programs and Experiences". We have interesting papers from Latin America and also from Europe, as usual. And I suggest that we have a short discussion immediately after each paper. Therefore I ask the speakers not to speak longer than ten to maximum 12 minutes. The first speaker is Mr. Salmenperä. He comes from Finland. He works at the Tampere University of Technology and the title of his conference is "A Multipurpose System for the Processing of Geometric Observations Adapted to Different Computer Installations". I would like Mr. Salmenperä to start his lecture.

H. Salmenperä (Finland): **A Multipurpose System for the Processing of Geometric Observations Adapted to Different Computer Installations.**

Kölbl: I would like to thank Mr. Salmenperä for his paper and his interesting subject. As I know Tampere University is specialized in this discipline, and also took over the pilot center for research started of OEEPE, International Organization for Photogrammetric Experimental Rescard, in this subject. So it can be considered as the pilot center for similar works in Europe. Are there questions on the paper of Mr. Salmenperä?
I would like to ask you if efficient large computers are needed for the computation? One could also imagine that you just use the computers available for analytical plotters in order to do the computation for block adjustment, which are normally available for this type of machines.

Salmenperä: It is possible to use the minicomputers available for analytical plotters. It is time-consuming, but it is possible.

Kölbl: Are there no more questions? I would like to thank again Mr. Salmenperä, and I would like to ask Mr. José Juliá to present his paper. He will speal on the subject: "A General Rigorous Method for Block Adjustment with Models in Mini and Micro Computers". Mr. Juliá comes from Universidad Nacional Tucumán in Argentina where he has done his work. He also was visiting professor in Munich for one year. Please, Mr. Juliá, will you start your lecture.

J.E. Juliá (Argentina): **A General Rigorous Metod for Block Adjustment with Models in Mini and Micro Computers.**

Kölbl: Thank you, Mr. Juliá. These kinds of programs are certainly needed. How did you solve the problem of documentation?

Juliá: Documentation is simple and it is easy to use for anyone who is interested. The program itself is clear. I could also do better documentation if needed

Kölbl: Some more questions? If not, I thank Mr. Juliá once more.

J. Bittencourt de Andrade, F.A. Rosier, M.A.A. Olivas (Brazil) (presented by J. Bittencourt): **Very Large Block Aerial Triangulation (VLBA) — II**

Kölbl: Thank you for your presentation, Mr. Bittencourt. Are there questions on this paper? If not, I thank you again, Mr. Bittencourt. Our next paper is by Mr. Schwarz and Mr. Vanessen from the Netherlands, and Mr. Schwarz is going to present it. Please, the floor is yours.

P.G. Schwarz, E.M.J. Vanessen (Neth) (presented by P.G. Schwarz): **FOTEF: Experiences with Data Snooping in Photogrammetric Production.**

Kölbl: I would like to thank Mr. Schwarz for his presentation and I would like to felicitate him for his viewgraphs which should have been readable even in the last rows. That was even exceptional. Thank you. It was an

interesting approach we heard from Mr. Schwarz. Do you have questions on the paper of Mr. Schwarz?

Bittencourt: Please, what do you mean by pseudo least square adjustment?

Schwarz: Pseudo least square adjustment. It is the type of adjustment leaving the control points uncorrected, so they get variances equal to zero in the last adjustment. In a rigorous adjustment they get a weight corresponding to a-priori variance and so the correction, which is required in the testing procedure.

Kölbl: Some more questions? Yes, please.

Passini (Argentina): What computer facilities do you have in order to run this program and what should be the minimum CPU facility you would need to run the program. What is the minimum disk capacity that you have?

Schwarz: We need a rather large main frame system for this program. We ourselves use a Univac Sperry computer 11 00 System. We have various versions of the program. E.g., we have a version which can run on with some 50 Kbytes, but mostly use a much larger version needing some 250 Kbytes. But that is no problem if you have at your disposal a main frame system.

Schwarz: That's right. Actually FOTEF runs also in Vax at the Dutch cadaster.

Kölbl: Are there comments or questions? Then I would like to thank Mr. Schwarz for his presentation. It is always interesting to hear papers from practice. We had now several speakers who reported not from the point of view of the university only, but also on the practical applications. Our last conference concerns aerotriangulation using data from analogue plotters. We are somewhat on the same lines as the second and the third conference. The paper was written by Mr. Faig and Mr. Atilola from Canada. They are form the University of New Brunswick. Mr. Atilola will present this paper. I would like to ask you to come to the floor.

W. Faig, O. Atilola (Canada) (presented by O. Atilola): **Aerotriangulation Using Data from Analogue Plotters.**

Kölbl: I would like to thank Mr. Atilola for his presentation. It was interesting to hear the conclusions. I wonder which application you mainly speak of, topographic mapping or cadastral survey. I don't know whether we really should go back to analogue plotters for doing aerotriangulation. This would be my first approach, but maybe you have other comments and other opinions. Would you like to comment on my question? For which purpose do you mainly use your procedure: aerotriangulation in topographic mapping or large scale photography for cadastral survey?

Atilola: As I said in my talk most accuracies for medium scale and small scale control are satisfied by present aerotriangulation and most organization use this kind of approach. If you want an accuracy for cadastral mapping you have to do it with the comparator and with bundle adjustment.

Kölbl: Thank you. Are there other questions or comments from the audience. If you have questions also concerning the other papers we have five minutes, if you would like, we can discuss generally all the other papers. Yes, please.

Proctor (UK): I would like to make a general remark not specifically addressed to anyone of this morning's papers. We have heard various comments about least square weight matrices, robust estimators, and the Danish method. Whilst I cannot pretend to resolve this issue, I cannot resist joining in the discussion. We all agree that observations which depart significantly from the truth (if they are not gross errors, what are they?) should not be allowed to distort the adjustment. I cannot see in the final result that it makes a lot of difference whether this is achieved by assembling the observations into discrete groups of varying weight down to, and including, zero or by some high order mathematical function of the residual in the previous adjustment so that very large residuals get infinitesimal weights. Until recently I worked with the Directorate of Overseas Surveys who use the Stuttgart PAT-M43 adjustment program reported by P.R.T. Newby as the 1982 Helsinki Symposium. In this various weight matrices are used for assorted observation and at least one is assigned zero weight for using as chekpoints. On several occcasions suspect points have been transferred into the group having zero weight; further adjustments and further transfers have subsequently shown those points to be sound and they have been reintroduced. If there are two or more gross errors, their relative magnitude and position can mean that the point with the highest residual is not necessarily one with a gross error. There is therefore a subtle but real difference between rejecting (discarding) a point and giving it zero weight. I must advocate not throwing away data until it is ascertained with certainty that it is erroneous, and preferably not even then. I suppose either method, discrete weight matrices or functional calculation of weights, could be programmed for automatic handling, i.e., by software without the intervention of the human computer. Beware! Gross erros do occur even if Kurt Kubik does not believe in them. Transposition of point numbers, of ground station coordinates, of two points getting the same number, etc. These are blunders. Frequently they can be found and corrected in the computing office with painstaking reference to field sheets, field survey computations, photogrammetric observing lists, etc. The software enthusiast may be all for saving money on the time of these human computers by letting the program sort out (down-weight) such points, but in remote areas the field surveyor costs many times as much as the technician in the data processing and computing office; I do not want to see his valuable fieldwork receiving zero or near zero weight in an adjustment until the office staff have made exhaustive efforts to correct any blunders. Automation can certainly indicate the presence of gross error, frequently their location too can be determined, but correction needs an investigation into data probably not accessible by the adjustment program.

Kölbl: Thank you for the comment, and I could suggest Mr. Schwarz could say something.

Schwarz: Well, I think data snooping could also be applied

in an automated way. You could also build a program adjustment automatically the standardize residual as you can judge the non standardized residuals and I think the adjustment standardized residuals will bring you further in this case. I think that's it.

Kölbl: Thank you. Personally i have the same opinion as our discussion speaker. We always have the difficulty in cadastral survey that we shouldn't throw out many points, and we have quite some difficulties to keep them into. Are there other questions on this subject in general. Well, if not, we had a long discussion, but I still would like to invite you to more discussions on aerotriangulation. The chairman of Commission III wants to draw your attention specially to the conferences of the poster session, which is in room C and which concerns the analysis of data. There will be conferences from Finland, Sarjakoski, then Mr. Larsson, Mr. Wang, and Mr. Stefanovic. I think it will be interesting. I would like to thank the speakers for the presentations and would like to wish you an interesting day, and I would like to close the session.

Friday, June 22, 1984 from 9.00 to 10.30
Session 1 of Commission III/3

Topic: Mathematical Aspects of Digital Terrain Information
Chairman: Prof. Dr. K. Torlegård (Sweden)

Torlegård: Ladies and Gentlemen. Welcome to the first session of WG 3 of C III. As you know the topic of WG 3 is: "Mathematical Aspects of Digital Terrain Information", and we have in this first session two invited paperps and one presented paper to listen to. The first paper today is given by Marshall Faintich. Dr. Faintich is chief of the Advanced Technology Division at the Defence Mapping Agency in St. Louis, Missouri, United States of AMerica. He has his Ph.D. in astronomy and he is not a photogrammetrist, but he has been working with digital image processing and has been involved in advanced cartographic systems, sensor scene simultation, and digital image technology in general at the Defence Mapping Agency. In that work he has worked very much with DEM and he will now present his paper.

M.B. Faintich (USA): **State-of-the-Art and Future Needs for Development of Digital Terrain Models, IP**

Torlegård: Thank you very much for your interesting presentation. We all understand that Marshall Faintich has large experience in working with digital terrain data. There might be a lot of questions to be raised after this presentation. So I give the floor for questions.

Strome (Canada): I wanted to ask you how the color images were plotted with respect to hue, saturation, and intensity.

Faintich: The normal shaded relief or slope is plotted along the intensity axes, the saturation is constant, and the map overlay is plotted along the hue axis.

Torlegård: Any other questions? Well, that seems to be all the questions we have. I would like to make a comment here and say that this apparently applies to very large data bases of terrain information dealt with here, and this is perhaps a little bit unusual for photogrammetrists in general who are used to working on more limited areas and with larger map scales if we compare the data bases to sort of a map.

Faintich: I would make a comment on here. People usually just make and use their own small pieces. The DMA (Defense Mapping Agency) uses different models and puts them together.

Torlegård: One very last question before we turn to the next presentation.

Stoch (Israel): Can you tell whether anything of the method showed is in production.

Faintich: That's a good question. The system is so far in a test stage. But all data are run through a convolution filter in order to detect anomalies. By the time the users get the data, these anomalies are removed so they don't notice them.

Torlegård: That is all that we have for this paper. Now I want to thank you again, Marshall, for your presentation, and I will announce the next IP from our WG. It is under the title: "Modelling and Classifying Terrain", It has been written by three authors, P. Fredriksen, O. Jacobi and K. Kubik. The two first authors are working at the Technical University in Kopenhagen and K. Kubik, who will present the paper, is professor in photogrammetry at the Aalborg University Center.

P. Fredriksen, O. Jacobi, K. Kubik (Denmark) (presented by K. Kubik): **Modelling and Classifying Terrain, IP**

Torlegård: Thank you very much, Kurt, for this very interesting and stimulating presentation of theories of digital elevation modelling. I give the floor for questions and remarks to this.

Förstner (FRG): I have only a practical question. You said you can interpolate with fractals by using the finite elements with this method. Could you explain that a little bit?

Kubik: That's a difficult question. Remember that in the finite element method you minimize the square sum or the integral of one of these derivatives, first or second derivatives. If you use the fractal description of the terrain, you minimize, the γ – derivative or the square sum of this γ – derivative. I think I have to let it like this because ortherwise we come into too much detail here.

Torlegård: Is there another question?

Mussio (Italy): Have you made two-dimensional Fourier analysis also?

Kubik: We did. I think you had better ask my colleagues. Ole or Poul. Who actually would care to answer?

Jacobi: We have made Fourier transformations in two dimensions. There are no special problems in a two-dimensional case, it's only a matter of more numbers. If you use only one dimension, you look at waves in one direction; and you might have a landscape with different wave lengths in one direction than in the other, and then you should use two-dimensional Fourier transformation.

Torlegård: Well, that seems to be the end of the questions. We thank you once again for your presentation. The last presentation this morning is a paper on "Digital Terrain Models – Conspicuous Elements". It has been written by Dr. Gerald Gros from Paris, and it will be presented by Klaus Tempfli from ITC in Enschede. I give the floor to you for the presentation of the paper written by Mr. Gros.

G. Gros (France) (presented by Dr. K. Tempfli, Neth): **Digital Terrain Models – Conspicious Elements**

Since Dr. Gros didn't attend the Congress, his paper was not presented. Instead, Dr. K. Tempfli informed the audience of the activities of OEEP in the field of digital elevation models. There were no questions to Dr. Tempfli.

Torlegård: Thank you very much for this information of the activities of the experiments within OEEPE. As Dr. Tempfli mentioned in his introduction, he will have difficulties in answering detailed questions, but if you have questions of a more general kind it could be possible for him to give a replay. Well, there seem to be no questions. So I thank you for your presentation. This has brought us to the end of presentations this morning. We have a few minutes left of the session. I would like to take the opportunity to invite you to our next session which will take place at 11 o'clock this morning in Hall H. That is the session of this WG of C III. I also will take the oportunity to invite you to propose subjects for resolutions within this scope of C III. The Commission Resolution Group will have a meeting on Monday afternoon. You can convey your proposals to anyone of the WG chairmen or the president or secretary of the C III our proposals for topics for resolutions are very welcome. Within the area of this WG of DEM, during these last days three different topics has been discussed that could be a basis for a resolution. I will present them very briefly here now to you so that you are informed of the discussions that have gone on. There is one possible resolution within the area of image correlations and digital elevation measurements. We all know that there are automated procedures to produce DEMs by correlation techniques, and this is an interface so to say between the WG:s 3 and 4. That could be of interest for further investigations. The second topic that could be a basis for a resolution was raised by Marshall Faintich. In his presentation, at the very end, he indicated future needs in the field of standards of accuracy of DEM and methods to assess this accuracy. This could be another area.
Then we have the third topic within our WG that could be a basis for a resolution. That is the further development of terrain classification. The application of available classification methods for various types of terrain has been presented by Prof. Kubik this morning. So, these are the three areas within our WG that could be of interest for resolutions. If you have comments right now you are welcome to bring them foreward. Well, this is an information that has just come to you. It is not easy to react immediately on it, but I invite everyone of you that has ideas, to discuss with anyone of us, and we will try to convey it to the General Assembly for a resolution in one way or another. With this I close the session this morning and wish you welcome to the next at 11 o'clock.

Friday, June 22, 1984 from 9.00 to 10.30
Session 2 of Commission III/3

Topic: Accuracy of Digital Elevation Models
Chairman: Prof. Dr. H. Ebner (FRG)

Ebner: Ladies and Gentlemen. Welcome to our second session fo Working Group III/3. We will have four papers during this session. The first one is an invited paper by the authors Torlegård, Östman, and Lindgren, which will be presented by Prof. Torlegård. The other papers will deal with specific aspects of Digital Elevation Models. We will give almost half of the time available to the invited paper, and I would like to ask Kennert Torlegård to present his paper.

K. Torlegård, A. östman, and R. Lindgren (Sweden) (presented by K. Torlegård): **A Comparative Test of Photogrammetrically Sampled Digital Elevation Models.**

Ebner: Thank you very much, Kennert, for this fine presentation. It is not an easy task to lead such an international test.
May I ask for questions or comments.

Förstner (FRG): Can you give me some information on procedures used by the participants to estimate the accuracy and on how this fits the results between their estimations and the truth.

Torlegård: We actually do not have detailed information from the participants as to what procedure they used to estimate the accuracy. But most of the participants gave an estimate as the standard error in elevation.

Ebner: Thank you, are there other questions? I would like to thank you again, Kennert, for this presentation. Our next paper is written by three authors, P. Fredriksen,

O. Jacobi, and K. Kubik, and will be presented by Mr. Fredriksen from the University of Copenhagen.

P. Fredriksen, O. Jacobi and K. Kubik (Denmark) (presented by P. Fredriksen): **Accuracy Prediction for Digital Elevation Models**

Ebner: Thank you very much, Paul, for this presentation. May I ask the audience for questions and comments.

Tempfli (Neth): You did use two profiles to estimate the accuracy. The question is which procedures were used to determine the terrain spectra.

Fredriksen: We used the profiles delivered by the participants of the DEM-test and also our own measurements, then calculating a mean spectrum.

Ebner: Are there further questions? No, thank you very much, Paul. We go to the next presentation. It is not necessary to present Prof. Mikhail.

J.S. Bethel and E.M. Mikhail (USA) (presented by E.M. Mikhail): **Terrain Surface Approximation and On-line Quality Assessment**

Ebner: Thank you very much, Ed, for this interesting presentation. You have raised the very important point of quality assessment and quality control, which really is very important in practice. My personal feeling is that we are still at the very beginning in this topic, which, by far, has not reached the point that presently has been reached in aerial triangulation and photogrammetric point determination. We are quite uncertain in this field. The situation you have treated here is, however, rather simple from that point of view that the mesh size of the DTM you are using is rather large in comparison with the quantity of the measured points. And in this case, indeed, it is easier to obtain and perform quality control. This is unfortunately not the case in many cases where the points are measured ordinarily, not automatically, where the mesh size is smaller. Then you are not able to apply these functions; and another point, of course, is that the measured points are not regularly distributed, and this makes the situation even more complicated.

Rauhala (USA): I would like to make a comment about a study I presented in Hamburg. In that case the main mesh-width of the line DEM grid is exactly the same as the sampling grid. The elevations were then filtered by the method of finite elements and by using array algebra.

F. Ammanati, B. Betti, and L. Mussio (Italy) (presented by L. Mussio): **Statistical Analysis of Relevant Terrain Features Through Digital Elevation Models**

Ebner: Thank you, Dr. Mussio. We all know how important it is to consider geomorphological information, if DTM of high quality is wanted. It is quite interesting to see to which extent you were able to extract this geomorphological information from the data without measuring them directly. May I ask the audience to ask questions or make comments? I would like to ask you one question. I can imagine that it is possible, to quite an extent, to extract structural lines, e.g., from created data using your method of first and second differences, but I am in doubt that you will be successful at the same level if you have real breaklines. You know then that you have a sharp bench, and the problem is that, particularly in large scale DTM, people want to have those breaklines exactly in the right location. Could you give answer to this question.

Mussio: Our experience is not very large, but until now we have found all breaklines. The investigations are going on.

Ebner: Thank you. Indeed, it is an important point, because we know that the measurement of geomorphological data is quite time-consuming. It is much more time-consuming than measuring regular grid points. Particulary today when progressive sampling is beginning to be applied, the difference between measuring time of mass points and geomorpholofical information is still increased. It would be quite a sucess, if it would be possible to extract at least to some extent this geomorphological information. Thank you, all, the audience, too. The session is closed.

Monday, June 25, 1984 from 9:00 to 10:30
Session 1 of Commission III/2

Topic: Algorithms and Structures in On-line Photogrammetric Triangulation
Chairmann: Dr. V. Kratky

Kratky: Ladies and Gentlemen. We have accumulated a large enough crowd to start with at a minimum delay. My name is Kratky from Canada and I am the chairman of WG III/2, which deals with on-line photogrammetric triangulations. I am happy to let you know we have organized two sessions which follow in close sequence. Immediately after this one we have the other one in Room H. This sessions would deal with algorithmic and structural aspects of on-line triangulation. We have four speakers. The first one, Dr. Grün, was asked and kindly volunteered to present an invited paper, which would make you familiar with the development, including the historical background of on-line triangulation efforts. As an IP it will deserve a little more time so we can probably listen to him for about half an hour and then, after discussing his invited paper, please, feel free to try to clarify all the aspects. He will precede three presented papers. Dr. Grün, could you please string the floor.

A. Grün (Switzerland): **Algorithmic Aspects in On-line Triangulation, IP**

Kratky: Thank you Armin for your very thorough view.

I am happy to see that part of his paper reflected also the main streams of studying the algorithmes in my W.G, certainly the three algorithmes he mentioned represent nowadays' main approaches. Could I open discussion, questions, comments, and suggestions.
You are welcome, Dr. Förstener, please.

Förstner (FRG): What is of main interest to on-line triangulation: data cleaning or estimation of final parameters?

Grün: It is primarily data cleaning except for small networks in close range applications.

Förstner: Does Molenaar's approach, discussed in the paper, avoid nonlinearity problems?

Grün: I do not consider that approach to be strictly rigorous in treating the full covariance matrix.

Molenaar (Neth): The method is rigorous if collinearity is true: then it represents an adjustment in steps. However, systematical deformations are not recovered well in on-line triangulation since complete information is not available.

Kratky: Thank you very much, Armin. Could you stick to half a minute now?

Grün: Dr. Molenaar, can editing be done plate to plate?

Molenaar: It is feasible, but has not been tried.

Kratky: At this point I would interrupt discussion. Hopefully you can clarify things later on. Thank you again Armin. The next speaker Prof. Dr. J.A.R. Blais would actually follow the outline of the first part.

J.A.R. Blais (Canada): **Optimization of Least-Squares Computations in On-Line Photogrammetry.**

Kratky: Thank you. Since there are one or more papers addressing the algorithmic part of the session, I would like to continue immediatley. And then we may discuss both papers together. Welcome, Mr. Mussio. The title of his paper is "Application of the Incomplete Cholesky Conjugate Gradient Method".

B. Benciolini, L. Mussio, L. Surace (Italy) (presented by L. Mussio): **Applications of the Incomplete Cholesky Conjugate Gradient Method in Block Adjustment.**

Kratky: Thank you. And now we have one or two minutes for questions or comments to Dr. Blais and then to Dr. Mussio. Are there none? Thank you, Dr. Mussio. Now we come to an important part of aerotriangulation: how to structure a computation. Dr. A. Elassal is a speaker who will deal with this subject.

A.A. Elassal (USA): **On-Line Display of Aerotriangulation Results.**

Kratky: Thank you very much for the nice timing. I am opening a discussion. Please would you identify yourself and say something about your affiliation.

Davies (USA): Why was PL/1 used in programming and not FORTAN? What is the size of the software in lines of code? Does the Tektronix 4114A provide any computing support to the system?

Elassal: PL/1 is more suitable for dynamic programming, especially for the control of computing resources. For example, the least-squares adjustment subsystem GALS has 4000 lines of code. All computations are run by the host computer Amdahl V7.

Kratky: Can the graphic functions be called at any time during the on-line process?

Elassal: Yes, graphics can be generated from the data base whenever it is updated.

Kratly: Thank you. Anyone else? If not before adjourning the meeting, I would like to make two announcements. The first announcements concerns, besides the next session which will follow in about half an hour, the few poster sessions that we have this afternoon taking place at 13.15. I definitely invite you to be there. The second announcement is for the members of my WG III/2 on On-line Triangulation. The session of the WG III/2 is on 28 June at 9 o'clock, Room H. Thank you very much.

Monday, June 25, 1984 from 11:00 to 12:30
Session 2 of Commission III/2

Topic: Operational Aspects of On-line Photogrammetric Triangulation.
Chairman: Dr. A.A. Elassal (USA)

A.A. Elassal: I welcome you to the second session of the WG III/2. The first speaker is Prof. Dorrer from FRG and he presents an invited paper.

E. Dorrer (FRG): **Operational Aspects of On-line Photogrammetric Triangulation (IP).**

Elassal: Thank you, Prof. Dorrer, I would like to open the floor for discussion.

Grün (Switzerland): Even though the lateral overlap is extremely important, it is not quite clear if we are to use 20% or 60%? In general, in point positioning where high precision is the issue, 60% is the standard and 20% should be used only for mapping. The additional flight cost is no problem. Also with 60% sidelap one can get better results in the construction of a data base and in connection with models. What is your position?

Dorrer: The general feeling in Europe at the present is that 20% sidelap is sufficient. There is not too much interest in measuring twice the number of photos. No doubt, reliability increases with 60% sidelap; however, from the practical point of view, 60% sidelap does present problems. For a complete point transfer it may be necessary to handle the same photo several times and for that a complex organization will be required. Only with a high degree of automation will 60% sidelap be practical in on-line triangulation. There are, of course, also simple systems using 20% sidelap for a point transfer across the strips.

Elassal: We have to stop the discussion now. Our next speaker is Dr. Kratky from NRC.

V. Kratky (Canada): **On-line Triangulation Performance of the NRC Anaplot.**

Elassal: Thank you, Dr. Kratky. I would like to proceed with the next paper and have the discussion at the end of the session. The next speaker is Dr. Kilpelã from Finland.

J. Heikkilä and E. Kilpelä (Finland) presented by E. Kilpelã): **Aerial Triangulation by Analytical Plotter.**

Elassal: Thank you very much, Prof. Kilpelã. I would like to proceed with the last paper this morning. The next speaker is Dr. Jacobsen from FRG.

K. Jacobsen (FRG): **Data Collection for Bundle Block Adjustment on Analytical Plotters.**

Elassal: Thank you very much, Dr. Jacobsen. I would like to open the floor for questions. Please, mention whon your question is directed to.

Grün: Referring to the last paper, I object to the statement that we do not need on-line triangulation, especially for blunder checking. We accumulate data on-line primarily to improve results and detect blunders. Another remark, to Kilpelä's presentation. I am very pleased to see something happening in this area, because, as Dr. Dorrer pointed out, the stage of software procedures which are offered by manufacturers is really very poor. Only one remark to your procedure. I think we should really consider across the strip measurements, automatic positioning across the strip direction, and checking for blunders including those measurements.

Jacobsen: I like to answer your remark. It is true that we can't check all the photos beforehand, which means you can check only the last model, located in the instrument, not the previous models.
So we can check it also with off-line computation. And, in addition, in the case of targeted points addressed in my paper, there was no need for an on-line check. This would not be the case for non-signalized points.

Elassal: Thank you, any more questions? I would like to make a couple of remarks myself. It was very pleasant for me to chair this session. It is encouraging to see on-line triangulation take such an important place. These systems really affect the people who work with them. There is no single solution, but there are intelligent choices. There are extremely powerful hardware components, either available now or being developed, which we will have to integrate into our future systems.

Wednesday, June 27, 1984 from 15:30 to 17:00

Topic: Business Meeting
Chairman: Prof. Dr. Einari Kilpelä (Finland)

Kilpelä informed that the main items to be discussed in this business meeting were the proposals for the resolutions of Commission III for the period 1984 – 1988. After this business meeting would have approved the proposals, they would be passed to the Resolution Committee chaired by the first Vice President of the Society, Dr. Zarzycki. He would present the resolutions of all commissions to the General Assembly for its approval. Kilpelã had informed the audience at the first session of Commission III that the chairman of the Working Groups and he himself formed the Resolution. Group of the Commission. The Resolution Group had received a lot of good proposals for resolutions for the period 1984 – 1988. Yesterday afternoon the Resolution Group had discussed the proposals.

Based on the proposals received, the Resolution Group had agreed to suggest 5 resolutions to this Business Meeting for its approval. Each resolution covers a very broad area of interest. That means that the coming Commission President has a little bit of freedom to organize the Commission activities.
Five resolutions were presented to the audience, one at a time. The WG-chairman gave a short explanation of the subjects which were handled in their Working Groups in the period 1980 – 1984.
After discussion, very slight modifications were made, and the resolutions were approved. Dr. Kilpelä extended his sincere thanks to the Resolution Group and to all those who had contributed to the work of Commission III during the past four years and at the Congress.

Thursday, June 28, 1984, from 9.00 to 10.30
Session 1 of Commission III/4-5

Topic: Rectification and Registration
Chairman: Dr. W. Göpfert (FRG)

J.W. Wiesel (FRG): **Image Rectification and Registration**

Göpfert: Thank you for your interesting comprehensive paper, Dr. Wiesel. I think we have to move on to the next paper. If you have some questions, you might keep them in your mind, and at the end of the session we can deal with the questions at once. The next paper will introduce a newly developed map model to process satellite scanner data. The co-authors are Mr. Paderes and Prof. Mikhail from Purdue University of the United States and the title is "Rectification of Single and Overlapping Frames of Satellite Scanner Data.

F.C. Paderes and E.M.Mikhail (USA) (presented by E.M.Mikhail):
Rectification of Single and Overlapping Frames of Satellite Scanner Imageries

Göpfert: Thank you for your interesting paper, Prof. Mikhail, I am sorry that we do not have much more time to listen to those interesting results, but you can read it all in the Proceedings. We have to leave it to these short remarks. Our next speaker will be Prof. Leberl who will present a paper on processing techniques of radar images.

G. Domik, J.Raggam, F. Leberl (Austria) (presented by F. Leberl): **Rectification of Radar Images Using Stereo-Derived Height Models and Simulation.**

Göpfert: Thank you for your interesting paper, and I think we move right on to the next paper. Time is getting short, we just have about 20 minutes left, and we still have two papers to go. So I hope the two speakers would be able to concentrate in ten of twelve minutes on the most importat highlights. The next paper will discuss a new approach to the problem of computing orientation parameters of images, by employing control features instead of using point definitions. It will be an interesting one. The writers are Prof. Lugnani from the Federal University of Parana and Mr. Souza, from the Federal University of Rio Grande do Sul, both from Brazil.

J.B. Lugnani, F.C.B. Souza (Brazil) (presented by J.B. Lugnani):
Control Features – An Alternative Source for Urban Area Control.

Göpfert: Thank you for your interesting paper. The last paper will lead us now from space to underwater photography, Dr. Kolouch from Hannover University from the Federal Republic of Germany will report on the processing of Side-Scan-Sonar data. For the next ten minutes he will highlight the most important aspects of this important data processing of underwater recording.

D. Kolouch (FRG): **Digital Geometric** Rectification of **SONAR Images with Interferometric Methods.**

Göpfert: Thank you very much, Dr. Kolouch, for your interesting and very concise paper. I am sorry I took already 5 minutes from your coffee break, but if you have one short question I would be willing to allow for one question. No questions. I thank you for your attendace and conclude the session. Thank you!

Thursday, June 28, 1984, from 11.00 to 12.30
Session 2 of Commission III/4-5

Topic: Precision, Correction, and Targeting in Digital Images
Chairman: Prof. Dr. E.M.Mikhail (USA)

W. Förstner (FRG): **Quality Assesment of Object Location and Point Transfer Using Digital Image Correlation Techniques, IP**

Mikhail: Thank you, Dr. Förstner, for your very exhaustive coverage. Although there are relationships with the other papers later on I think it will be good to take a question or two at this point. Anybody in the audience would like to ask a question? Dr. Rauhala, please.

Rauhala (USA): My question is if you have tried to put these patches also together so that you have neighbourhood relations in order to include a geometrical solution, which would mean that you make a kind of DTM of all parallaxes over the whole stereomodel, and then you build observation equations and normal equations in terms of say two hundred by four hundred unknows, and then you use the available differences as the observations.

Förstner: We have not tried to approach. We just started some years ago, three four years ago, with the classical correlation. I think one should, of course, go in that direction and take the local geometry of the object into account. But I think there is quite a lot to be done.

Mikhail: May I ask a question. You notice that there is the inverse relationship with the number of pixels used for correlation. Do you think that will continue regardless of how large it is or is there a cut-off point.

Förstner: If the model is correct there is no cut-off point. But the model is not correct. So you have to look for the optimal patch size. And this is let's say 2 mm in this special case I showed. So, if you go beyond this, you get worse results. And, if you have locally edges and ridges or even occlusions then this model is quite false.

Mikhail: Thank you. Any other questions? Right, lets move on to the next paper on geometric precision in digital images. It is offered by Mr. Havelock of the National Research Council of Canada, but he is not here, and it will be presented by Dr. Kratky who is one of his colleagues at the National Recearch Council.

Dr. Havelock (Canada) (presented by V. Kratky): **Geometric Precision in Digital Images.**

Mikhail: Thank you Dr. Kratky particulary for keeping to the correct time. I will allow one question or comment, if anybody wants to.

Förstner: Only a short comment. I think it is a very interesting approach, because it links interpretability of objects and precision which has not been done up to now. There are some investigations on locating edges in binary images which seem to be related to this type of approach. I think one should pursue this type.

Krathy: It will be done.

Mikhail: Thank you again. The next paper is offered by Nasu, Shimamoto, and Fuchimoto of Japan. It is going to be presented by Dr. Nasu.

M.Nasu, K.Shimamoto, M.Fuchimoto (Japan) (presented by M. Nasu):
Fine Registration and Rectification of Airborne MSS Remote Sensing Data Using Visual Dynamic Correlation Method and Applications of the Results.

Mikhail: Thank you, Dr. Nasu, for your very interesting and practical paper. Sorry for the time shortness. Because we still have two more speakers to go, I will proceed with the next one. It's coauthored by Mascarenhas and Erthal from this lovely country, Brazil. and the title is "On the Relationship between Gaussian and Binomial Models for Image Registration by Sequential Tests of Hypothesis". It will be presented by Mr. Mascarenhas.

N.D.A. Mascarenhas and G.J. Erthal (Brazil) (presented by N.D.A. Mascarenhas) :
On the Relationship between Gaussian and Binomial Models for Image Registration by Sequential Tests of Hypothesis".

Mikhail: Thank you very much for a very interesting paper. We have on more paper to be given by Dr. Ehlers from FRG.

M.Ehlers (FRG): **On the Probability of Generalized Correlation Functions.**

Mikhail: Thank you very much, Dr. Ehlers. I want to apologize to the speakers if I was less than a gentleman in having them hurry up. I do really appreciate their cooperation, we did not run overtime too badly. I am willing to stay for a couple or three minutes if anyone wants to ask question of the last three speakers or make any comments. I have one myself to Dr. Ehlers with regard to the model. Yours allows only for two shifts, Δx and Δy in correlation. Can it be extended to include any other parameters such as rotation or a scale change.
Ehlers: You are absolutely right for the first. We are working on what you said.
Mikhail Any others? I want to make an announcement before we close. There are two poster sessions this afternoon: one on the Digital Terrain Model and the other on Digital Image Processing and related matters. We cordially invite you to wander over and listen to the speakers. They worked just as hard as anybody that made their presentation here. You have been a very patient and very cooperative audience. I thank you for listening, and onto lunch!

Thursday, June 28, 1984, from 15.30 to 17.00
Commission III/General Papers

Topic: Combined Adjustment of Photogrammetric and Non-Photogrammetric Data.
Chairman: Prof. Dr. W.B. Ebbinghaus (FRG)

Ebbinghaus: In this session of Commission III the topic is Combined Adjustment of Photogrammetric and Non-Photogrammetric data. There has been no Working Group on this subject till now, and I hope there will be one after this congress. We have five papers today. One invited paper by professor Ebner and four presented papers.

H. Ebner (FRG): **Combined Adjustment of Photogrammetric and Non-Photogrammetric Information, IP**

Ebbinghaus: Thank you very much for this presentation. May I ask for questions or comments? There are no questions. So I thank again the speaker and we go on to the second paper. It will be presented by Dr. Blais from Canada.

J.A.R. Blais (Canada): **The Use of Auxiliary Data in Photogrammetric Block Adjustments of Stereomodels.**

Ebbinghaus: Thank you, Dr. Blais. Are there any questions? Thank you very much again. I call the next speaker Prof. Ackerman from FRG Stuttgart University to give us his paper.

F. Ackermann (FRG): **Utilization of Navigation Data for Aerial Triangulation.**

Ebbinghaus: Thank you, Prof. Ackermann. Are there questions?

Proctor (UK):

Professor Ackermann has stressed the use of navigation data in rather large photo sclae. I can see immediately that with much smaller scale photography in aerial large blocks this

will be a great benefit if one can get the reasonable coordinates and biconstructions alternatively with few bias parameters to take out systematic errors. It will still be a great saving to small scale aerial triangulation, I just imagine,

Ackermann: Yes, that's very true. My point is, of course, that in the small scale blocks this auxiliary data would work even very much better than in this very large scale.

Ebbinghaus: Another question? Thank you very much again, Prof. Ackermann. And I call the next speaker Dr. El-Hakim from Canada, NRC, to read his paper.

S.F. El-Hakim (Canada): **On the Detection of Gross and Systematic Errors in Combined Adjustment of Terrestrial and Photogrammetric Data.**

Ebbinghaus: Thank you, Dr. El-Hakim. Are there questions? I have one. In close-range blocks, you mentioned here, the parameters of the interior orientation of the camera have to be determined very precisely in many cases. Did you investigate the possibilities to use simultaneous calibration of the camera system by introducing additional observations?

El-Hakim: No, this hasn't been considered.

Ebbinghaus: So, these parameters of interior orientation are not controlled in your block. You use them as you get them from the manufacturer. You dont't apply simultaneous calibration.

El-Hakim: No, there is no calibration.

Ebbinghaus: But you can do this by additional observations in object space. It's possible to do this with distances and directions, and so on.

El-Hakim: That was the main objection, to try to do that not by selfcalibration but by additional observations.

Ebbinghaus: Thank you, are there questions? Now I come to the last speaker Dr. Molenaar from Wagening Agricultural University.

M. Molenaar (Neth): **The Connection of Aerotriangulation Blocks and Ground Control Reconsidered.**

Ebbinghaus: Thank you, Dr. Molenaar. Are there questions?

Mussio (Italy): Mr. Chairman, I have no question, bu I must request permission to make a very brief an announcement.

Ebbinghaus: Briefly, yes, but at firts we should ask questions concerning the presentation. I think that geodesists and photogrammetrists should speak together, and I think that combined adjustment cannot be finished otherwise. I think it's a very good way to do that. Are there no questions? So, you may make your nouncement.

Mussio: Thank you, Mr. Chairman. At the Institute of Geodesy and Photogrammetry of the University of Milan we performed a program of combined adjustement of geodetic and photogrammetric data. This program is very new; it was terminated about 20 days ago.

Ebbinghaus: Thank you very much for your information. So, I close this session by thanking all the speakers, and the staff, and the interpreters.

Friday, June 29, 1984 from 9.00 to 10.30
Session 3 of Commission III/4-5

Topic: Image Transformation and Analysis
Chairman: Dr. F.C. Billingsley (USA)

R.H.Haralic (USA): **Image Transformation and Analysis IP**

Billingsley: Thank you. We have time for a couple of questions.

Förstner (FRG): Only a technical question. Where did you publish the first part with the pixel classification?

Haralic: The context classification has not yet been published. This is the first presentation I made. I expect it will be out in published form sometime next year. We are now compiling results that cross compare this technique with the techniques which involve only neighbourhood information, we rather get estimates on a wide variety of images, benchmarking basically. What we next have to do to complete the paper, is not find out that kind of generalization the cartographers are doing, in some qualitative fashion, so that I could say, in conclusion of the paper, now to go beyond the micro context which comes out of Markow random field, to go beyond that. This is the kind of information which has to be taken into account and this is the direction in which you have to be looking for models which are able to do that. There is something going on, but I do not feel that we have enough yet for a paper.

Mulder (Neth): I wonder how far your Markow process is staple of the whole image, or whether you have to use different Markow prosesses for different parts.

Haralic: In all the work, which we did, the same Markow process was all over the image. I showed you three results here. We have made them on a few dozen images and we have never seen any run away form in shape of any region, any time, okey?

E.Dennert-Möller (FRG): **Utilization of Ancillary Information for Improvement of Digital Multispectral Classification.**

Billingsley: Thank you. We have time for a couple of questions. I have one for you. The use of ancillary information in an auxillary channel. That ancillary

information is quite often gathered at quite different spatial resolutions in the data channel, e.g., in Landsat pictures, Do you have any comments on relative resolution and it's effects.

Dennert-Möller: The example I showed was a very typical one for what you are saying about the resolution. We had only 22 points in the whole Landsat scene, but normally one uses very rough models and there the geometrical resolution is not so important, I think.

D. Fritsch (FRG): **Two-Dimensional Finite Impulse Response (FIR) — Linear Systems in Digital Photogrammetry.**

Faintich (USA): We have done those things for many years just as everybody else has, but I have a question. We found on large images, unless you have an array processor, it is computationally much more efficient to make a design of a spatial convolution filter and process the image rapidly, going to the frequency domain, because of the time it took to do the Fourier transformation and inverse Fourier you using array processors also?

Fritsch: If you go with fast Fourier transformation in the frequency domain procedure, how can you design the system? And then you can design the system very simply by array algebra technics. It is very fast, and I have found that this array algebra technics is very suitable to doing such a design.

Mulder: The old question comes back to conference again and again. The criteria in the frequecy domain are usually not related to anything you can understand in an image. What is your feeling about that? If you want to make an ideal cut-off filtering in the frequency domain, it's complete nonsense in that special domain. So, why try for ideal criteria in the frequency domain.

Fritsch: My opinion is that it is a nice tool to look in the frequency domain what will happen. Because you don't know if you have any other method, any pragmatic method, you don't know what will happen in the time domain. I think you have to think in the frequency domain at first and then go to the time domain.

Mulder: If we have a spatial operator, you can predict what will happen. Convolution is something we can undertand. We can understand what happens in spatial domain but you cant not imagine what happens in the frequency domain.

Fritsch: The frequency domain is only a tool to see what happens there.

Haralich (USA): I would just liketo make a comment on the question that Marshall Faintich asked, about the speed — space domain versus the frequency domain. I think that if you take a filter, that is a space domain filter, and perform a singular value decomposition on it, you will be able to run the filter in the space domain much faster. Singular value vectors may be a quarter 2, may be a quarter 3, and come very very close, especially with all of those symmetric filters. And that is really the fastest way in which one could process those effects.

Fritsch: We agree.

Billingsley: It may turn out that there is no one answer to the question which is the best way to do it. Okay, we better move on to next paper.

G.Domik and F. Leberl (Austria) (presented by F. Leberl): **Radar Image Simulation and Its Application in Image Analysis.**

Billinghsley: Thank you. We can take one question.

Mulder: It's about terminology. I wonder why you use density numbers if we are relating intensities to intensities.

Leberl: Everybody calls DN:s density numbers, did I invent it? What should it be?

Mulder: You are relating say photon counts now to radar intensity, radar power. They should relate to your light and not to the carrier. If you talk about sound you don't talk about magnetic intensity on tape but about sound level.

Billingsley: I thank the speakers and the audience as well as the staff and conclude the session.

Friday, June 29, 1984, from 11.00 to 12.30
Session 4 of Commission III/4-5

Topic: Pattern Recognition
Chairman: Dr. F. Leberl

Leberl: Welcome to a tired group to the last session of this congress, other than the closing session. We do not seem to have much competition with just one other session, bibliography. This is the last session in a series that were organized by the WG's on Image Processing and Pattern Recognition, Prof. Mikhail and myself. And this is a session that was meant to address particulary subjects from Pattern Recognition and we have the good fortune that somebody from the image understanding community, as it is called in USA, Davi McKeown from the Carnegie Mellon University was willing to accept the invitation to present the work on image undestanding as it relates to digital mapping, together with George E. Lukes. David is working at the Computer Science Department of Carnegie Mellon Univ. as a senior research scientist. And George Lukes, the co-author, is working at the Ingenieur Topographic Laboratory also concerned with image understanding work. Well, G. Lukes is also more a photogrammetrist and David is more a computer scientist. David has been exposed to remote sensing prior to joining Carnegie Mellon when he worked at Goddard Spaceflight Center on the LAZY project. So, we

hope to get about half an hour of an interesting presentation on image understanding.

D.M. McKeown, G.E. Lukes (USA) (presented by D.M. McKeown):
Digital Mapping and Image Understanding, IP

Leberl: Thank you. A lot of things were said. There could be a lot of discussion. Maybe some of the terminology that you used was unclear. The DLMS data is one of US planimetric data bases. You used the word photogrammetrics. some photogrammetrics or some geodetics, which I thought refreshing, if unusual. Can I wait for some questions, comments.

Faintich (USA): This one is to make one point that I have seen the Carnegie Mellon system in operation. One thing that you can not see from the slides is the speed at which the data base is accessed on those slides, where, I guess, you have a hundred or so images, and when you ask for the Kennedy Center it is a matter of only a few seconds that all these images of the Kennedy Center from every image show up on screen. It's not just sitting there and waiting for a half an hour. That's a very impresssive system.

Leberl: Thank you. Any other comments, clarifications, desired questions? I will have one. You said along the way when you showed the map covering the area of the data base that you do not store map data, or it's not map data. I didn't understand the comment. In what sense is it not? Why couldn't you extract from your data base something like a map and recreate a map at any scale? What is the principle that prevents you from doing that?

McKeown: I guess that getting up was that I showed a finished map product with all the symbolization on it. And I think that the symbolization, production side of that, is something that we aren't really addressing, but in principle, the kind of data base that we would have could be used for something that we could generate on that location. It's clear that we can generate, take out data and generate at any scale, but we have not looked at the issue of producing finished cartographic products.

Leberl: Does there seem to be anything due to which it couldn't be done if it were to be found useful?

McKeown: No, but it's not made your piece of work.

Leberl: I may have forgotten to say at the beginning that we are short one paper. Addie Goldfinger has already left the conference, so this paper will be cancelled. So we only have three more papers. There will be a little more discussion. The next paper will be presented by Nanno Mulder. He is a physicist, graduate of the University of Delft. He has been eating pattern recognition food since his early days. He was introduced to it by professor Van Haglen and has been working on pattern recognition ever since. He has just now been appointed to a professorship in remote sensing at the ITC in Holland. His co-author Mr. Sijmons is a cartographer. So we have a happy marriage between pattern recognition and cartography, cartography at the ITC as well.

N.J. Mulder, K. Sijmons (Neth) (presented by N.J. Mulder):
Image Segmentation
Using Conditional Rankorder Filtering.

Leberl: Thank you. So, any questions, comments, please.

Förstner (FRG): Can you say something about the image model, which is behind that application of this process you use. Because, I am not sure, that whether you apply another technique, you come to similar results; and if they are not similar how do you evaluate the results?

Mulder: Modelling is an important thing, but there is a choice of many models, so for understanding. I think you use a model for understanding. So you can interpret the measure in terms of facet modelling. You can interpret the commissional smoothings in terms of maximum likelihood, if you want, and the model I prefer is starting with very low level structure and linking that up into a larger structure. So, you find primitive structure at very early low level and then you build the map when you merge from the low level to the high level. Is that the answer to your question?

Leberl: Are there other comments. Well, when I was listening I was wondering how this relates to earlier papers today. You were basically working on black and white images.

Mulder: Obviously. Now the method is generally applied to multispectral images, but just for demonstrations's sake and lack of time I limited myself to one channel.

Leberl: But if you were studying the uses of multispectral images, in how far does this relate to what we heard earlier from Prof. Haralick?

Mulder: Okay, I think in general. If you work with multispectral data, you have to separate the data first and that's a problem of your feature struction, and into intensity information, which is related to a lot of things, among them the scanangle, slope, and so on. And you separate into spectral reflenctances by normalizing the data. Now, things like texture I would extract from the intensity image, and the class segmentation would be relevant in the spectral reflectances. It is a bit of a problem there, how you go about rank order, but for the moment I would use a sort of box approach, treat them independently, and on the segment level I would merge the various plains.

Haralick (USA): I can make a comment about the relationship I think between the conditional smoothing technique. What I did, in the context classification, presumed that there is a reasonable way of computing class conditional probabilities. As a matter of fact, the usual parametric techniques, where you use gaussians or any sort of unimonials class conditional probabilities. That's a very strong assumption and the really match the gaussian. particularly the reality doesn't eally match the gaussian. When you analyse what you have to do for maximum likelihood when the reality is non-gaussian, it becomes very complicated. You can view this technique that he has presented as really a robust estimation technique for the great con-intensity on each pixel. A robust rechnique for

the estimation of the great con-intensity in the scene of the pixel. So that the gaussian techniques, that will be gaussian class conditional probabilities, you are going to apply therefore unimonial class conditional probabilities you are applying in classification, become more reasonable. You fix up this confusion. So that later on it is easy to calculate. And technique that it is using is a kind of robust technique, but, in fact, it is actually not the optimal robust technique, but perhaps it's quicker to do it this way and be suboptimal. Thank you.

Leberl: We come to the next – to the last paper. It is a joint paper from Mr. Kolouch and Mr. Ehlers from the University of Hannover. Mr. Kolouch has presented yesterday his work on creating an interferometric underwater imaging device. Today he is going to discuss a little the enhancement of the images which suffer from a lot of noise.

D. Kolouch, M. Ehlers (FRG) (presented by D. Kolouch): **Digital Enhancement of Interferometric SONAR Imagery for Fringe Pattern Recognition.**

Leberl: Thank you, you already called for questions, comments, or suggestions. I was a little confused by your use of the words better and worse. When are you happy about the filter, when are you unhappy about the filter?

Kolouch: In filtering we are using the very simple line following techniques and we are unhappy about the filter if it works all over the image. You see that's only a small part that you have seen of the enormous standard size. An image has about 3 500 lines, and if you start with line following, and it goes out of the line, you cannot detect anymore. Okay?

Leberl: That was a simple answer.

Billingsley: I realize that for the things you are doing, you obtain nice results, but I have a comment in terms – the general question terms – of general image quality, as image people might have seen a gap with the filtering. I noticed in your filtering in special directions you use sharp edges on the filters, and in the result on images there was the structure which apparently was a ringing structure as associated with a sharp edge in a frequency filter.

Kolouch: I said in the beginning of my presentation that we were smoothing these edges, because, without this you are getting phenomena you don't want.

Leberl: Thank you. The honour of giving the last paper of the conference in an uncompeted session is taken up by our next speaker, the last speaker, Fred Billingsley from the Jet Propulsion Laboratory. Let me introduce the two authors. Mr. Gokhman works with Fred Billingsley and implemented an interesting camera. Mr. Gokhman got his education in the Soviet Union and now he works for 1½ years at Jet Propulsion Laboratory. The system he has studied was conceived by Fred Billingsley.

And we have seen some interesting digital cameras during this conference, mapsat, spot, and then Prof. Murai's and Dr. Hofmann's for forward, downward, backward looking linear arrays; this is going to be a different one.

B. Gokhman, F.C. Billingsley (USA) (presented by F. C. Billingsley): **Mathematical Modeling of the Attitude Tracker.**

Leberl: Thank you Fred. Are there any questions or comments? Who has been working with the DPS digital photogrammetric system of MBB. Well, I gess that a similar aim is involved there also, reconstructing the flight path.

Förstner: Do you know of any attempt to include the motion of the air frame? You know the inertial properties of the plain that the platform cannot move in any direction.

Billingsley: That's right. As a matter of fact, in a written paper that was not one of the areas, we talked about of Kalman filtering which will involve. The fact that the airplane can only change altitude within certain range over the given altitude.

Leberl: Any questions? If not, then, because this is the last time when I am saying something, I would like to express on everybody's behalf our gratitude that we have light when we need light, darkness when we need darkness, microphones working when we need them, and slide projectors and overheads, thank you very much for your assistance.

So, Prof. Kilpelä. Who is the old and also the new president of Commission III, has asked to have some closing words. So I leave the floor to him and thank you very much for this session.

E. Kilpelä (Finland): Ladies and Gentlemen, as this was the last session and Dr. Billingsley gave the last paper I want to say few words here.

I thank everyone of you for your attendance at our sessions and especially those who contributed someway to our program. The Working Group Chairmen deserve to be commended for the excellent way they ran their Working Groups. In consequence of that the program of the Commission has been outstanding.
Maybe you already know that Finland will host Commission III also during the period 1984 – 1988. I invite all of you to participate in the program of Commission III. We will form again Working Groups and Study Groups to which you are welcome to contribute. All information will be sent to the Member Societies and to the National Correspondents. If you are personally interested in Commission III work, please contact us. Thank you.

Report of Commission IV

Roy R. Mullen

Let us first take note that during the period 1980-84, the name of Commission IV was changed from "Topographic and Cartographic Applications" to "Cartographic and Data Bank Applications for Photogrammetry and Remote Sensing." This change was most appropriate in this information age we have entered. Among the specific developments worthy of note was the extensive study done under Working Group 3, Mapping from Space Borne Imagery by the committee entitled "Acquisition and Processing of Space Data for Mapping Purposes." In response to a resolution passed by the 1980 Congress recommending that the Landsat series of satellites be continued by the United States, this suggestion was made and transmitted to the NASA Associate Administrator for Space and Terrestrial Applications, and he responded. . . "I suggest the ISPRS could perform a very valuable service to the international community by translating resource exploitation, assessment, development, inventory, monitoring, and forecasting needs into the scale, accuracies, and formats in which spatial arrangements, geometry, and size of topographic and surface cover elements must be measured for optimal development of global resource and environmental information. Once such an analysis is in hand technologists can efficiently design the optimal collecting systems for the highest multiplicity of users." In summary, this committee, which carried out its work under the auspices of Commission I as well as Commission IV, believes that "it is now possible to deploy an electro-optical space system which will materially contribute to the mapping of the earth's surface at scales as large as 1:50,000 with 20-meter contours." It also suggests that "such a system in a large part be automated and that the time and cost for such mapping, as compared to conventional mapping can be reduced." Suggested parameters for such a system are:

orbit — 919 km altitude, same as the Landsat series.
sensors — linear arrays, 3 optics, looking 23° forward, down and 23° aft.
resolution — variable, to 10 meter pixels
sensitivity — 256 levels, compressed on board to 6 or fewer bits.
swath width — 180 km
transmission — s or x band, data rate up to 48 Mb/s
processing — digital
expected life — 7 years

A second major activity of the Commission was conducted by Working Group 2, Mapping Technology and Applications for Developing Countries. Through the efforts of General Agarwal, after meetings held in Crystal City and Delhi, a series of points for consideration were developed for guiding the activity of this Working Group. An extensive questionnaire has been proposed to further develop information on which to base future activities of the proposed continued Working Group of the 1984-88 Commission IV.

Working Group 8 — Digital Applications for Cartography and Remote Sensing conducted a study of the status of large-scale digital terrain modeling in North America that was reported on in a paper contained in the proceding, by Wayne Valentine and R. Boller of the U.S. Forest Service.

The Commission encountered one area of disappointment in its efforts to follow on to a recommendation at an inter-society meeting held in Zurich which proposed that ISPRS, ICA, and FIG hold a joint session on digital cartography at Montreux in 1981. The ISPRS and ICA were represented at the meeting and from a later joint board meeting of the ISPRS, FIG, ICA, ISM, and IAG it was reported that joint ISPRS, FIG-ICA symposia were not considered appropriate. This is considered unfortunate in that the technologies and even certain aims among these organizations are not that disparate.

As we look to the future trends of the commission, I would suggest that none of the subject areas of the proposed working groups can escape the expansion in technology that surrounds us. Advances in the use of computer technology, in remote sensing, and inertial and satellite surveying systems are changing the foundation of our disciplines. We can no longer be concerned only with the creation of the map and its images. The demand for data in digital form will continue to grow. We must continue to look for ways to develop and implement digital techniques and procedures for merging non-spatial data with conventional hypsometric and planimetric data. Attention is needed in developing the formats, procedures and techniques for the graphic display and presentation of spatial information. The operational functions of data capture, structuring, editing, conversion, generalization, enhancement, classification, statistical generation, retrieval, overlaying, display and data management must continue to have our utmost attention.

Technological advances in establishing positions accurately by equipment such as the global positioning system will challenge us to devise ways to incorporate this highly accurate information into less exact historical records of the earth, such as existing maps. One can envision the time when every image pixel would have an absolute position and the advantages (and problems) this will provide are evident. In mapping, the technology for rapid electronic scanning of graphics exists; however, functional algorithms for manipulating and managing these data still require further development.

I wish to thank those who served as Working Group Chairmen and those who contributed your papers and efforts to the success of Commission IV activities during the 1980-84 period.

Respectively submitted,

Roy R. Mullen

COMMISSION V

Monday June 18 11.00–12.30

Session 1 WG V/1 Analytics in Non-topographical Photogrammetry

Attendance 45-50

Chairman Dr. J.W.C Gates (UK)

The President of Commission V 1980-84, Dr. John Gates, introduced himself and welcomed all present to the Congress in Rio, and to all the sessions of Comission V. He briefly described the organisation of ISPRS, its Commissions and its Working Groups and then outlined the activities of the Groups during the four year period now past. It appears that certain themes have particular significance, and these will be reviewed by the members of the Commission at the Business Meeting and extended in accordance with developments during the Congress.

Karara then presented his report on the activities of Working Group V/1 under the title "Analytics of Non-Topographical Photogrammetry", to inaugurate the session as a Working Group V/1 activity.

The technical papers then commenced with the invited paper by Brown "Unflatness of Plates as a Source of Systematic Error in Close Range Photogrammetry". A comprehensive review of the ways in which photographic plates fall short of the desired performance was given, with extensive support from practical measurements. It is clear that almost all photogrammetrists have too optimistic a view of the dependability of the plates normally used, and the paper included very valuable information on preferable thecniques in using plates and in computing from data obtained from records on plates.

There was a lively series of questions and answers that elicited further details. These included warnings about the effects of gravity on plates used at a different angle from that at which they were tested, and about the distortions caused by the springs retaining the plates in the camera and at the measurement stage. Complicated methods have been derived that can greatly reduce the errors caused by unflatness of high spatial frequency ("orange peel").

To complete the session, the paper by Fraser entitled "Network Design Optimization in Non-Topographic Photogrammetry" was brought forward from the afternoon session (1/2). Questions were deferred until the beginning of the afternoon session because the session overran time and finished at 12.45

Monday 18 June 13.30 – 15.00

Session 2 WG V/1

Attendance range 50 – 120

Chairman H.M.Karara (USA)

Karara opened the session and invited questions on Fraser's paper "Network design optimization in non-topographic photogrammetry" which was presented in an earlier session. No discussion was generated.

Wester-Ebbinghaus presented his paper "MOR – A general procedure for multi-image orientation" and summarized Kruck's paper "BINGO: A program for bundle adjustment for engineering applications – Possibilities, facilities, and practical results". Essentially both papers discussed various aspects of data reduction schemes which combine the adjustment of photogrammetric and geodetic observations. The discussion which followed had to do with the numerical stability of networks and comparison of the accuracy obtainable using distances rather than spatial co-ordinates for object-space control.

Jaakkola presented his paper "On the accuracy of non-topographic plotting". A simultaneous bundle adjustment program combining both photogrametric and geodetic adjustments was presented. Various configurations of geodetic control were discussed. No discussion was generated by the paper.

Tuesday June 19 15.30–17.00

Session 3 WG V/1

Attendance range 50-150

Chairman E. Dorrer (FRG)

Dorrer opened the session and outlined the program of the meeting, then introduced the first speaker Chamard.

Chamard presented his paper "US-2's non-topographical applications", outlining the hardware and software of this analytical plotter. Special emphasis was given to the software developed for close range photogrammetric tasks. In the discussion which followed, Chamard confirmed the fact hat data reduction from non-metric photography can be handled in the US-2. He also mentioned that the software which he outlined is actually operational.

Leberl presented the paper "Universal analytical plotter

software for photographs with perspective geometry (CRISP)" co-authored by him and Fuchs. He discussed software developed for CRISP and stressed the fact that metric, non-metric, or a combination thereof, can be used. The discussion touched upon the methodology of observing multi-models; as well as the incorporation of the human operator and the machine (KERN DSR-11) in the data reduction system.

McGlone presented the paper "Use of MACO 35/70 in close-range photogrammetry" co-authored by him and Gillen. He discussed the hardware and software of this analytical plotter which is designed to handle non-metric imagery of small format, and presented a number of operational results. He stressed the fact that the resolution of small format imagery is superior to that of metric imagery currently produced by metric cameras. In answer to a question from the floor, McGlone stated that the largest format that can be accommodated in the MACO 36/70 is 70mm square. In answer to another question he indicated that his data reduction scheme is based on a modified version of the DLT approach rather than the bundle adjustment solution and explained the reason for this choice.

Fuchs then presented his paper "Ultra-close range non-metric camera set-up on an analytical plotter". He discussed a pilot project in which a data reduction system was developed for quality control in industry. He showed results for various object-space control and photography configurations. In the discussion he explained the reasons for selecting the DLT approach rather than the bundle adjustment for data reduction. He agreed that a larger format reseau camera (60 x 60mm) could give him better results than the 35mm camera which he used. He also mentioned the well known fact that the DLT solution is sensitive to eventual weaknesses in object-space control configuration.

The session was then adjourned at 5.00 pm.

Wednesday June 20 9.00–10.30
Session 4 WG V/1

Attendance range 100-120

Chairman C. S. Fraser (USA)

Fraser opened the meeting by reviewing the programme of the session, then presented his paper "Multiple exposures as a practical means to enhance the accuracy of non-metric camera application". He discussed the advantages and disadvantages of non-metric cameras and compared the sequential solution to the simultaneous data reduction schemes. In both approaches, the accuracy of spatial co-ordinates of object-space points can be enhanced by a factor of 4 to 10 times using multiple photography. In answer to a question from the floor, he indicated that he uses the relative accuracy because most of his engineering customers think in these terms. He also indicated that small format images create less difficulties regarding film unflatness than large format photography. In answer to another question, he indicated that réseau cameras do not provide satisfactory corrections for film deformation.

Gruen presented his paper "Processing of amateur photographs". The perspective transformation method he used is the same method utilized by Thompson in the renovation project of Castle Howard. The solution incoporates additional parameters and has a blunder detection facility. He concluded by stressing the need for closer co-operation with other scientific communities regarding real time operations and on the resolution of digital cameras. The paper generated no discussion but a remark was made that Thompson used the method described in this paper to measure a church clock tower that was to be transported to Missouri, USA from London, UK.

Müller presented the paper "Efficient consideration of geodetic observations and object information in bundle adjustment" co-authored by him and Stephani. This combined adjustment of photogrammetric and geodetic observations improves the accuracy, reliability and economy of data reduction. He discussed the formulation of the computer program, and showd a few examples of practical applications including the measurement of a radar reflector. The discussion that followed touched upon the normal equations structure in the solution.

Rüther presented the paper "Two phase photogrammetry with displaced control", co-authored by him and Adams. Using a non-metric camera, a photograph is taken of a co-ordinated control area, followed by a photograph(s) of the object (whales in the ocean!), then finally another photograph of the control area. Results of the two methods use for data reduction (projective transformations and relative orientation) were compared and discussed. By this photogrammetric technique it has been possible for the first time to measure free-swimming, living whales in their natural environment, to about 10-15cm in 15m. No discussion was generated by this paper.

The meeting was adjourned at 10.30.

Wednesday June 20 11.0–12.30
Session 5 WG V/1

Attendance range 30-40

Chairman S. Murai (Japan)

Murai opened the session and introduced the first speaker, Karara, who presented the paper "Optimization of non-metric analytical close-range photogrammetric networks" co-authored by him and Chen. The DLT is used as an initial stage in a 3-stage modular, fully integrated scheme based on spatial co-ordinates and additional parameters to meet low, moderate and high accuracy requirements. The discussion which followed had to do with comparing object space control requirements in the DLT solution and in the simultaneous (bundle) approach.

Murai then presented the paper "A study on analytical calibration for non-metric camera and accuracy of three dimensional measurement", co-authored by him, Matsouka and Okuda. He reported on the calibration or a number of non-metric cameras and one metric camera using high accuracy control points. Various mathematical models were used and the accuracies obtained were quoted. In the discussion which followed, Murai further explained the mathematical models used.

Karara then moderated the business meeting of WG V/1, where a draft resolution concerning the 1984-88 WG on "Analytics" was discussed and finalized for presentation at the business meeting of Commission V. The desirability of holding a colloquium on "analytics" was also discussed. It was agreed to have the colloquium focus on only one topic. Network design optimization in non-topographical photogrammetry was suggested as the topic. No decision on timing or the location of the colloquium was made pending the appointment of the incoming president of Commission V and the selection of the 1984-88 chairman of the WG on "analytics".

The session was then adjourned.

Tuesday June 26 9.00–10.30
Session 6 WG V/1

Attendance range 50-110

Chairman I. Hadem (Norway)

Hodem opened the session by reviewing the program of the meeting and then presented his paper "Generalized analytical relative orientation in close range photogrammetriy". He outlined the way in which relative orientation parameters are determined without using approximate initial values for the unknowns. He stressed the fact that the problem of solving non-linear equations is far from being solved satisfactorily and that mathematicians are still working on this rather difficult topic. In the discussion which followed, the uniqueness of the solution presented was discussed. The method of least squares provides numerical answers which differ slightly from results obtained by other approaches. In Hodem's opinion, however, all such solutions are acceptable.

Hunt's paper "Estimation of initial values before bundle adjustment of close range data" was presented by Oldfield. Using a calibrated metric camera, the optimum locations of three control points were determined such that the triangular area spanned by the three control points was maximum. No least squares procedure is used in the solution.

Waldhaüsl then presented the paper "Metric restitution of traffic accident scenes from non-metric photographs" which he co-authored with Kager. He discussed the program ORIENT used for data reduction, and viewed the simple instructions used to familiarize policemen with data acquisition and data reduction operations. No discussion was generated by this most interesting paper.

Wong then presented his paper "Photogrammetric measurement of movements of jointed rocks in tunnel studies". Normal case photography was taken by a Kodak bellows type camera because of the difficulty of getting plates for metric cameras quickly. Data reduction was done by program SAPGO and another time by program GEBAT. Results obtained were very satisfactory. The possibility of using rectification was brought up in the discussion which followed. This approach would have been possible if the camera maintained its spatial location, which was not the case in this experiment. Comparison of photogrammetric and mechanical dial gauge measurements showed conclusively that the mechanical measuremensts were very seriously in error, because it was not obvious that the structure used for the location of the "fixed" end of the dial gauges was far from stable as the hydraulic force was altered.

Rüther suggested that perhaps the stereophotogrammetric procedure was not necessary, since the measured set of points was essentially in a plane, and only single photographs were necessary. Wong replied that it was not possible to be sure of reproducible camera location or camera characteristics, and the procedure dealt with this.

The session was adjourned at 10.30.

Friday June 29 9.00–10.30
Session 7 WG V/1

Attendance range 30-60

Chairman H.M.Karara (USA)

Karara called the meeting to order at 9.05 and outlined the program of the session.

Atilola highlighted the paper by Faig entitled "Subsidence monitoring in mountainous terrain – An example of four dimensional photogrammetry" and that by Armenakis on "Deformation measurements from aerial photographs". He discussed the advantages and disadvantages of photogrammetric and geodetic methods for monitoring subsidence in mountainous terrain and concluded that photogrammetry is a viable method for monitoring subsidence in such areas. The discussion which followed touched upon the effect of eventual vegetation on the decrease of accuracy. The speaker agreed but indicated that vegetation is seldom encountered in projects they had been involved in so far. The effect of erosion was also mentioned as a source for decrease of accuracy.

Dorrer then presented his paper "APL application software for analytical underwater photogrammetry". Objects to be surveyed had to stay underwater. Analytics were used in data reduction to increase accuracy. APL was used to provide a solution in an environment where many unknown conditions exist, such as inhomogeneity of water. He showed results of a study using simulated data. In the discussion which followed, Dorrer mentioned that he has worked only with simulated data so far, and that the object space control used consisted of a modular frame which is geodetically co-ordinated away from the site of work.

Wu highlighted his paper "Error analysis of mapping using facsimile cameras". He outlined the on-line and off-line approaches used. The components and the operation of the camera were described. No discussion was generated by this most interesting paper.

Karara then declared the technical program of WG V/1 in Rio concluded and thanked all members of WG V/1 for their co-operation during the past four years. He also thanked all authors and speakers for providing such an excellent program. Karara expressed gratitude to the five moderators who chaired five of the seven sessions of WG V/1. He then indicated that he was sure that the entire audience would join him in saluting the magnificent performance of the Gates/Atkinson team and wished them success in all their future undertakings. Thanks were also expressed to the translators who helped in other sessions of WG V/1 and to all service personnel.

Speaking for himself as well as for John Gates, Atkinson thanked all board members for their co-operation during the past four years. He congratulated the incoming president and secretary of Commission V (Kratky and Van Wijk) and wished them every success in their administration of Commission V during the four coming years.

Karara then adjourned the meeting at 10.15.

Tuesday 19 June 9.00–10.30
Session 1 WG V/2

Low altitude aerial photography

Attendance range 30–40

Chairman W.Wester-Ebbinghaus (FRG)

The Chairman opened with a brief report on the activities of the Working Group and then introduced the invited paper by Heckes "Uberblick über Fugsysteme für Photogrammetrische Luftaufnahmen im Nahbereich". This contained a comprehensive review of all types of camera platform including kites, lighter-than-air balloons and dirigibles (both gasfilled and hot-air), remotely-piloted fixed-wing aircraft and helicopters, light aircraft, ultralight aircraft, piloted helicopters, airships, and balloons. The photographic equipment relating to various types of platform, and the problems, were also described. Questions were asked about the difficulties of flying accurate strips and blocks with ultralight (and especially microlight?) aircraft, and about vibration in helicopters. It was also suggested that the use of a light aircraft could be no more expensive to use than remotely controlled aircraft as well as being simpler and more reliable.

The next presentation was given by Mauelshagen and was entitled "Balloon – Photogrammetrie über dem Grabungsfeld von Mohenjo Daro/Pakistan" with co-authors Heckes and Kotowski; the papers by Busemeyer, "Einsatz und Verwendungsmoglichkeiten von ferngelenkten Luftschiffen und Ballonen bei der Luftbilderstellung" and by Wanzke, "The Employment of a Hot-air Ship for the Stereophotogrammetric Documentation of Antique Ruins" were not presented by their authors, but their main features were reported by Mauelshagen. The account described the first use of a remote-controlled tethered hot-air dirigible for mapping and recording detail in this exceptional ancient city-complex that has been excavated over several years.

The final paper of the session was given by Meid (co-author Hansch), entitled "Ein praktischer Beispiel zur Nahberei chsluftbildphotogrammetrie", and described the basic elements in the use of a helicopter equipped with a 6cm x 6cm réseau camera for detailing town plans. A pratical example of photography of the Temple of the Tooth, Kandy, Sri Lanka was described.

The session was adjourned at 10.35.

Tuesday 19 June 11.00–12.30
Session 2 WG V/2 Low altitude aerial photography

Attendance range 35-45

Chairman L. Mauelshagen

The first paper was presented by Atkinson (co-author Bolt) and entitled "Space Resection of 35mm Model Aircraft Photography), and described a pioneering effort to improve the usefulness of pictorial aerial recording by attempting to introduce some photogrammetric control. Only a limited opportunity was offered, but the success of the operation was at least as high as could be expected with the constraints imposed by the conditions. Discussion ensued on the possible advantagens of 6cm x 6cm cameras (not agreed) and on the possible use of a bundle adjustment (not justified).

The second paper by Oshima, Miyashita and Cho was entitled "Development of a "radicon" (radio control) system using model plane and kite balloon and some applications". Two specially developed helium balloons were employed of $7m^3$ and $30m^3$ capacity respectively, and also a power model aeroplane which was recovered by parachute after photography was completed. A Bronica camera was employed, and examples were shown of agricultural records, and the erosion by flooding of a field system.

Heckes then presented the paper by Kunkel "Der Einsatz von Drachen für Luftaufnahmen im Nahbereich". This described the use of a developed form of the Hargrave Box Kite of 1890 which could carry a camera to a height of 200m in a wind of 10km h^{-1}, and compared the performance of a number of other commercially available kites.

Business meeting of WG V/2 at 11.58
Discussion on cameras and equipment, and consideration of the future. The need for simpler, cheaper, analytical plotters was agreed, but an objection that there might be overlap with WG V/3 was countered as being less objectionable than having gaps between the fields. The Chairman reported great difficulty in obtaining response outside Germany, and it was resolved to extend the geographical range of contact in this most promising field of study.

Monday 18 June 15.30–17.00
Session 1 WG V/3 + B Biostereometrics

Attendance range 50-60

Chairman I. Newton (UK)

Karara presented the report by Herron on the activities of Application Group B on Biostereometrics during the period 1980-84. The past four years have seen a steady growth of Biostereometrics, largely due to the continuing rapid evolution of biomedical instrumentation, especially imaging devices and computer graphics technology. It is estimated that the community of interested individuals now numbers around 500.

Butcher and Wright – An Application of Holography in Medicine and Dentistry: The Measurement of Reflection Holograms of Plaster Facemasks. (presented by Butcher)

This paper reported a non-photogrammetric technique using the Reflex Metrograph for measuring plaster face masks and their holographic images. There was no discussion.

Ghosh and Boulianne – X-ray Photogrammetry and Floating Lines in Support of Neurosurgery (presented by Ghosh)

Clinicians have a need for accuracy to locate intra-cranial lesions. A method based on X-ray photogrammetry and floating lines to a positional accuracy of ±0.2mm is discussed in this paper. A question by Newton related to the acceptance of this technique by clinicians. It appears that the surgeons are very satisfied, especially by the precision of the method, which is well within their tolerance.

Vozikis, Baumann and Koenig – Use of Phtogrammetry in Orthopaedics and Surgery (presented by Vozikis).

This paper described a pilot project carried out by Wild Heerbrugg on the application of photogrammetry in orthopaedics and oral surgery. Photography was taken with Wild P32 cameras and analysed in a Wild Aviolyt plotter and a high accuracy was attained. Butcher asked a question relating to the reproducibility of the system.

Robertson and Miles – Measurement of Ultrasonic Imagery using a Photogrammetric Method (presented by Robertson)

This paper, which is not in the published **Archives,** discusses a method using a three dimensional ultrasonic image to visualise kidneys. Several methods of analysing the data were used, the most realistic involving image enhancement. Good results were achieved. There were no questions.

A short Business Meeting followed to discuss the future of Biostereometrics within ISPRS. There was positive suport for the reestablishment of a Working Group with responsibility for this topic.

The meeting closed at 17.00 hours.

Wednesday 20 June 11.00–12.30
Session 2 WG V/3

Attendance 40

Chairman M.C.van Wijk (Canada)

Recording and measurement technology for new applications

The report on the activities during the period 1980-84 of Working Group V/3 on recording and measurement tecnology for new applications was presented by Working Group chairman M.C.van Wijk.

The first technical paper in the session was presented by Pryputniewicz who reported on the use of high precision heterodyne holographic photogrammetry tecniques for the quantitative analysis of structural deformations and strains in the nanometre range in microcircuit chips and chip carriers only a few millimetres in size. During the question period the possibility of interpolating the fringe to better than 1/2000 of one fringe interval was questioned. This high interpolation accuracy is possible because, in the discussed system, phase differences can be measured to within o.3 degrees, permitting the quoted interpolation accuracy.

The next paper was presented by Vozikis who discussed the results of a photogrammetric analysis of photomacrographs. The increased use of analytical plotters in this application was noted.

In the absence of the remaining speakers in this session, highlights of the paper by Elghazali were presented by Ghosh. This paper was concerned with the system calibration of scanning electron microscopes. It appears that electron microscopes can give more stable imagery than is usually expected, but scaling is uncertain to 2% – 3%.

Oshima presented a brief review on the work in Japan carried out in the field of X-ray photogrammetry. Notable results reported included the three dimensional mapping of the intricate networks of vessels within a human kidney to 0.1 mm, and the contouring of a brain cell of stellate form at 2μm intervals.

Wednesday 20 June 13.30–15.00
Session 3 WG V/3

Attendance range 40-50

Chairman S.F.ElHakim (Canada)

Recording and measurement technology for new applications: Optical Systems.

Three papers were presented followed by the business meeting of the working group. The first paper, co-authored by Burch and Forno of the National Physical Laboratory (NPL) was presented by Oldfield, also of NPL. The paper was on the progress with the NPL CENTRAX system for precision photogrammetry intended for measurement precision approaching 1 part in a million. The paper was followed by a discussion centred on the parallactic correction and plate flatness. In the second paper, authored and presented by Hellmeier, the use of fish-eye lenses in close range photogrammetry was introduced. A short discussion on the correction terms for radial lens distortion of this lens followed the paper. The third paper, co-authored by Antipovand Kivaev, was presented by Antipov. The paper was on the application of panoramic photographs in close range photogrammetry. The session concluded with the business meeting of working group V/3 chaired by Van Wijk of NRC, Canada. The main resolution for the next four years is that higher attention should be given to the application of real time image processing in photogrammetry.

Friday 22 June 13.30–15.00
Session 4 WG V/3

Attendance range 50-60

Chairman M.C. van Wijk (Canada)

The invited paper "New Vistas for Industrial Photogrammetry" by Haggrèn described an experimental real time photogrammetric system based on two video cameras. An obtained accuracy of 1:50 of the object space was reported. In the discussion the question of the suitability of the cross-type targets in video systems was debated. It also became obvious that at the early stage of the project, the measurements were done manually by operator intervention.

The following paper "Photogrammetric Vision System for Robots" was presented by El-Hakim. The question of accuracy was brought yp in the discussion. However the paper was of a theoretical nature and no accuracy results are available as yet.

The last paper "Digital Processing of Dynamic Moiré Imagery as an Aid in Scoliosis Screening" by Real was

presented in an abreviated form by van Wijk due to the absence of the author. It referred to the successful development of procedures for use in clinical testing for the existence of scoliosis, by examining the geometrical symmetry of form of patients' backs, as a real time routine screening procedure.

Wednesday 20 June 15.30 – 17.00
Session 1 WG V/4

Attendance range 50 – 70

Chairman I. Newton (UK)

Photogrammetry for industrial construction and mensuration

Three papers were presented on the measurement of different engineering structures.

The first paper by Baldwin (An underwater photogrammetric measurement system for structural inspection) dealt with an underwater photogrammetric measurement system for structural inspection work. Details of the system were given together with examples of applications. A question by Welham concerned the use of multiple models to cover large objects and Adams queried the use of both the relative orientation and projective transformation methods. Adams also commented that the approach is essentially the same as the two phase photogrammetry (discussed in the paper by Rüther and Adams) but applied underwater.

The second paper, presented by Brande-Lavridsen (A photogrammetric survey of a drilling platform) concerned the application of photogrammetry for dimensional control during the construction of an offshore drilling platform. Discussion was related to the time taken to plan such a project and to perform the analysis. The Chairman also stressed the need for adequate access to the structure in order to perform the important as-built dimensional survey.

Oldfield (Photogrammetric determination of the form of a 10m diameter radio antenna) then presented his paper which described a survey carried out to conform the shape of a radio dish antenna. A question by Robertson queried whether the possible change in shape when exposed to sunlight had been considered. Further questions by Haggren and Dallas concerned the remote positioning of the exposure stations. A long discussion centred around the use of high resolution plates (Agfa Gevaert 10E75) holographic material) as opposed to normal panchromatic plates. Several speakers expressed dissatisfaction with the current availability of plates and it was agreed to draft a Resolution which would highlight the concern of Commision V.

The session closed at 16.45hrs.

Monday 25 June 9.00 – 10.30
Session 2 V/4 Working Goup

Attendance range 50 – 70

Chairman L.P.Adams (South Africa)

The session began with an interesting paper by Kruck and Wrobel on surveying a cooling tower from a helicopter. Questions on operating the helicopter elicited the information that the aircraft was positioned 50m from the surface of the tower and the film used was Agfa Pan 200 developed for fine grain.

Stewart presented his paper "Photogrammetry for the non-invasive measurement of void fraction and velocity in two phase flow". This described the techniques employed to make optical measurement with photogrammetric processing of the various types of flow of mixtures of oil and nitrogen in a transparent tube as the rates of gas/liquid, pressure, and velocity were changed. Discussion on the problems of space control in this rig ensued.

Christensen presented the paper "A photogrammetric method for determining the loading angle of a vessel during the test of transverse stability" (co-authors Jacobi and Thorsen). This was an attempt to recover metrical data about the stability of the vessel from an amateur film shot during the initial testing, after the vessel had been found to be in a capsized condition when in operation, with tragic results.

Powell presented his paper on "The use of photogrammetry in the manufacture of high performance aircraft". Considerable saving of otherwise lost production time is now made by using photogrammetric methods instead of mechanical gauging of tools and jigs, and archival records of the geometry of the structures is proving useful for subsequent comparisons. A complete operational aeroplane has also been surveyed by photogrammetry, and provides a check on its final assembled form and correspondence with design. Vigorous discussion on many details was evidence of the potential for application of techniques, similar to this very satisfactory example, in related production.

Monday 25 June 11.00 – 12.30
Session 3 WG V/4

Attendance 35

Chairman H. Rüther (South Africa)

This session opened with Wester-Ebbinghaus presenting the paper "Numerical photogrammetry of the supporting framework of the Wuppertal suspension railway" with co-authors and Hossler. The work was concerned with establishing the relationship of the structural bridge elements in order to replace the links between the elements which were in danger of failing. On questioning, it was stated that the work of replacing these links has now been half completed, with very satisfactory fit being obtained, thus confirming the adequacy of the method.

Ei-Hakim then presented his paper "Precision photogrammetry for microwave antennae manufacturing". Photography from four locations of each component panel was carried out to attempt to determine the form to 150μm. It was claimed that the evidence from the variance-covariance matrix analysis indicated that the square root of the variance was 70μm, but discussion raised doubt on the validity of this test when the co-ordinates were not well defined. Further discussion underlined the difficulties of alternative methods such as mechanical offset measurement and theodolite survey.

Boone then presented the paper "Study of microdeformations of concrete by coherent optical techniques" (co-authors de Caluwé and van Nieuwenburgh). This employed holographic interferometry to detect the progress of very gradual shrinkages in drying and with unusual loading conditions in which failure might occur.

Bittencourt de Andrade, "Monitoring deformations in structural elements of concrete" (co-author Mendonça) also described work with similar objectives, but used photogrammetric recording with a Rollei SLX camera. Differences in parallel tests were within 30μm and distortion was measureable to 1 part in 1000 (of the displacement?).

Finally, Newton presented the paper by Cooper, Lindsey and Stirling "Monitoring the three dimensional movement of a large stone structure".

Monday 25 June 13.30 – 15.00
Session 4 WG V/4

Attendance range 60 – 70

Chairman A.K.I. Torlegord (Seweden)

Brown presented his paper "A large format, microprocessor controlled film camera optimized for industrial photogrammetry". There are many innovations in this Close Range Camera CRC1 that successfully deal with problems of these applications. The film is held flat by a vacuum back and the lateral stability is controlled to 4μm – 6μm with the addition of back projected, réseau target points. There was much discussion on this paper which included queries on the disadvantages of such a large and heavy camera, on the choice of control, and the possibilities of calibration.

Wester-Ebbinghaus then presented the paper by Reichenbach, "Terrestrial photogrammetry surveying of a large coal excavator" which had been transferred from Session 4/1, which was concerned with monitoring deflections under load of this large fabrication and was achieved with single station self calibration of the recording system.

The next paper, by Heister and Peipe "Length calibration by close range photogrammetry at large photoscale" was presented by Peipe, and sought to explore the advantages of photogrammetric methods, compared with straightforward optical and photoelectric procedures, for measuring the intervals on glass scales.

Finally, Horibe presented an account of various applications of close range photogrammetry under the title "Some examples of industrial application of close range photogrammetry in Japan".

The meeting was concluded at 14.53.

Monday 24 June 15.30 – 17.00
Session 5 WG V/4

Attendence 50

Chairman L.P.Adams (South Africa)

Newton presented a comprehensive and informative review entitled "The current state of underwater photogrammetry". There was a lively discussion that reflects the growing interest in this application largely concerned with the techniques used and overcoming the many difficulties. Special lighting, and water corrected lenses are now customarily in use, and at least one stereocomparator (the Ross SFS-3) for this specialization is available.

Ostbye then gave his paper (co-author Holm) on "Photogrammetry on marine structures". As an engineer in the shipbuilding industry in Norway, the author was well able to present the many difficulties in making use of photogrammetric methods in ensuring the accurate location of extensive structures, fabricated separately, when they come to be joined. The very bad conditions of snow and poor lighting in northern latitudes was also evident, but obviously were overcome.

The next paper by Elfick and Fryer "Underwater close range photogrammetry" described the problems of surveying the Great Barrier Reef, just under the surface of the water, off the north eastern coast of Australia. The various stages of evolution of suitable equipment have developed into a pyramidal structure of buoyant PVC pipes supporting a pair of cameras looking down into the water, with clear plastic trays floating on top of the water over the field of view. In the discussion it was evident how successful this was seen to be, and questions on its extension led to a statement that a depth of water up to 5m could be penetrated by the photographs in conditions of natural sunlight.

After the presentation of these papers, the business meeting of WG V/4 was held. Continuing and increasing support for the work of this group was evident, and development of real time and on line methods (eg. for inspection of components) was seen to be very important.

Monday 25 June 13.30 – 15.00
Session 1 WG V/A

Attendance 20

Chairman R.W.A.Dallas(UK)

The session began with Giuliani presenting a paper (co-authored by Piccarreta and Verduchi) on detailed plotting of the Roman forum using an analytical plotter. Waldhausl then gave his invited paper (co-authored by Platzer and Kandler) on "Instant plans by Polaroid instant photography for archaeology and architecture" in which he described a very useful and simple approach to archaeological recording using Polaroid material which is now available as an archaeological pack. Miller's paper on "Application of modern photogrammetric equipment in architectural phtogrammetry" returned to the use of analytical plotting and included a Brazilian example of work in progress. Kager's interesting paper on "Single image stereogrammetry", presented by Waldhausl, was concerned with the rectification of old single photographs with subsequent stereoplotting of images of similar features on a Viennese building. A second example dealt with the reconstruction of period furniture.

Tuesday June 26 15.30 – 17.00
Session 2WG V/A

Chairman R.W.A. Dallas (UK)

Dallas began by presenting the CIPA report prepared by Carbonnell "Comité Internationale de Photogrammétrie Architecturale: Compte-rendu d'activité pour la periode 1980-84". The report showed a healthy interest in the use of photogrammetry in architecture, though there was a need to develop equipment for this specialised use that would be faster and more economic, and would use some of the newer techniques of information technology. A current vital interest was to provide for rapid surveying in earthquake zones.

Saint-Aubin gave his invited paper "Modèles mathematiques et stéréomodèles architecturaux: construction, structure et théorie" which dealt with the topic of analytical plotters in architectural photogrammetry. It is believed that Saint-Aubin's section within the French Inventaire Général is the first to have an analytical plotter solely devoted to architectural work. His paper demonstrated convincingly how the manipulative capabilities of the analytical plotter can bring a new dimension to the analysis of architectural form and purpose.

Monti then presented his paper "L'analyse de l'architecure et les extensions cartographiques des relevements" in which he also made use of the analytical plotter's capabilities.

Finally, Kanngieser presented his account (co-authors Biethan, Jacobsen and Schuhr) on "Analytics of a historic single photo of the archaeologic discovery place of the Hildesheim silver treasure". This remarkable account of the use of old photography reflected a trend within Commission V during this Congress.

At the end of the session, a short business meeting was held. The chairman (Dallas) stressed the importance of the link with and cooperation between ISPRS and CIPA and pointed out that, while in many respects CIPA has become the central forum for the discussion and promotion of architectural photogrammetry, we should not forget that it did so with the support of ISPRS. Moreover, he expressed the view that ISPRS was probably the best forum for presenting and reviewing developments of a technical nature. He also wondered whether it would be valuable to form a Working Group concerned with architectural pthotogrammetry and mentioned specific areas where he felt that study would be of value. These included problems of presentation of photogrammetrically derived material to architect clients, technical problems (such as the suitability and range of cameras) and designing systems for archaeologists.

Comission V Poster Sessions

19 June 13.30 – 15.00
Rüther and Adams: Two phase photogrammetry with displaced control (WG V/1)

21 June 13.30 – 15.00
Adams and Pos: Wave height measurements in model harbours using close range photogrammetry (WG V/4)
Welham: The development of an underwater measuring capability using photogrammetric techniques (WG V/4)

Zhu and Yang: The optimum configuration of the convergent case of close range photogrammetry (WG V/1)

26 June 13.30 – 17.00
Coblentz **et al:** Étude biostéréométrique de gestes par strobophotogrammétrie infrarouge. (WG V/B)

Coblentz **et al.:** Conception et realisation d'une station de photogrammétrie adaptée a l'étude de la morphologie du corps humain (WG V/B)

Peipe and Güthner: A study of displacements in a soil mechanical model test using motography in the uv-spectrum (WG V/3)

28 June 13.30 – 15.00
Ghosh and Adiguzel: Image rotation vis-a-vis magnification: a phenomenon in electron micrography (WG V/3)

Pryputniewicz: Speckle metrology: computer aided analysis of three dimensional deformations (WG V/3)

Pryputniewicz: Time average holography for quantitative vibration analysis (WG V/3)

Voss: The UMK system in the year 1984 (WG V/3)

During the course of the Congress, these ten papers were presented at poster sessions. The standard of display material was good. In particular the three South African papers were supported by excellent visual displays.

A great deal of time and effort had been expended by a number of authors at poster sessions. However the Congress organisation of poster sessions left much to be desired, and resulted in damage to display material because of bad manners and lack of overall controll. Participants in future Congresses who are allocated poster time will be reluctant to display unless they are assured to better treatment and consideration.

Tuesday June 26 11.00 – 12.45
Comission V – Business Meeting

Chairman Dr. J.W.C. Gates (UK)

Attendance 44 including 8 non-photogrammetrists

The President outlined the purpose of the meeting which was concerned with discussion and approval of draft resolutions for transmission to the General Assembly. Gates presented six resolutions which had emanated from each of the four working groups and two applications groups. Following an intervention by Torlegård and considerable discussion relating to the number of resolutions, the meeting agreed by a majority of 19 to 12 to support the original resolution on analytics (T.V/1), together with a new resolution on real time close range photogrammetry (T.V/2) proposed by Kratky and a new resolution on applications of close range photogrammetry (T.V/3) proposed by Torlegård.

A resolution on photographic materials for close range photogrammetry was approved by a majority of 15 to 7 after some discussion (T.V/4).

A resolution on marketing strategy for close range photogrammetry (T.V/5) was approved after a minor amendment.

A resolution on the name of Commission V (T.V/6) was accepted after a tied vote, the President casting his vote in favour of the resolution. A more strongly worded resolution on the same subject found no support.

At the outset, the President had pointed out that minority interests should be presented through the medium of resolutions just as importantly as majority feelings. However, the meeting appeared to favour simple majority voting.

Economics, Professional Aspects, Education, Periodicals, Terminology, Bibliography, History, International Exchange of Information

Sessions were organized so as to provide ample time for discussions. As an outcome, presentation of papers during sessions of Commission VI was limited, in general, to

President: Prof. Dr. J. Hothmer – FR Germany
Secretary: Dipl. Ing. H. Kantelhardt – FR Germany

reports of Working Group Chairmen, whereas other papers were given at poster sessions. All papers are printed in the International Archives of Photogrammetry and Remote Sensing, Volume XXV, Part A 6 or Part A 8.

Session 1, Monday 18 June 1984, 15:30 – 17:00

Topic: Activities of Commission VI 1980 – 1984
Chairwoman: O. Adekoya – Nigeria
Rapporteur: C. Paresi – Netherlands
J. Hothmer – FR Germany presented the report (XXV/A 6/137-150).

The discussion revealed that Adamec – Australian, Ihemadu – Nigeria and other WG Chairmen experienced little response within their fields. Envisaging that active participation within the assignments of Commission VI is smaller compared to other Commissions, Coker – Nigeria and Ghosh – Canada made a plea for reducing the task loaded on Commission VI. The audience was aware that this is within the responsibility of the General Assembly. Pourkamal – Iran and the Chairwoman, when closing the discussion, expressed gratitude to the President of Commission VI for his most active engagement.

Session 2, Tuesday 19 June 1984, 15:30 – 17:00

Topic: Standards of education
Chairman: T. Oshima – Japan
Rapporteur: S. Ghosh – Canada

A. Adamec – Australia, Chairman of WG VI – 10, presented a detailed report (XXV/A 6/1-28) which was followed by a vivid discussion.

Session 3, Wednesday 20 June 1984, 13:30 – 1500

Topic: Education
Chairman: S. Ghosh – Canada
Rapporteur: S. Ihemadu – Nigeria

Four papers were presented:
+ Prof. Dr. Zhizhuo Wang – PR China: Feasibility for the Establishment of an Educational System of Surveying and Mapping on a High Academic Level for the Region of Southeast Asia and its possible Curriculum (XXV/A 6 323-339).
+ C. Paresi – Netherlands: Individualized Training Packages; an ITC Contribution for the Improvement of Photogrammetric Operator and Technician Training System (XXV/A //254-263).
+ B. Forster – Australia: A Master's Degree Program in Remote Sensing – An Australian Example (XXV/A 6/114-119).
+ Prof. P. Fagundes – Brazil: The Meaning of Cartographic Engineering in Brazil (XXV/A 6/95-101).

Discussing the paper on high level education, C. Weir – Canada, in his capacity as President of the International Federation of Surveyors (FIG), recommended that a Joint Working Group of ISPRS, FIG and ICA (International Cartographic Association) should tackle the task not only for Southeast Asia but for other regions as well.
Zolfagheri – Iran commented that primary education in several countries may not be adequate to prepare for high level studies.

Session 4, Wednesday 20 June, 15:30 – 17:00

Topic: Inventory of manpower and education facilities
Chairman: S. Ihemadu – Nigeria
Rapporteur: A. Adamec – Australia

The paper by A. Brandenberger – Canada (Chairman WG VI – 1) on "Education and Research Facilities" (XVV/A 6/71-78) was presented by S. Ghosh – Canada.
Ms. Adekoya – Nigeria inquired on the sources information for the report and questioned its accuracy.

S. Ghosh mentioned the difficulties of information collection in obtaining few systematic answers, and lack of cooperation from some countries which results sometimes even in misleading information. In some instances, the meaning of terms varies greatly between countries. As an example, cadastral plans are for Australia at 1 : 25 000 and for Hong Kong 1 : 1 000.
A. Adamec – Australia asked for the date of validity of the report. The answer was that the data were valid for the end of 1981.

O. Coker – Nigeria asked whether our Commission serves the UN or ISPRS, and whether we are after information on surveying and mapping as the UN needs it, or after remote sensing and photogrammetric and the relevant cartographic content as our organization needs it. He also doubts that all the questionnaires mailed were in fact obtained by the supposed receivers. S. Ghosh commented that Prof. Brandenberger often uses personal connections in cease where breakdowns of communications caused by mail may have occured.

D. Fernando – Sri Lanka noted that more interest has been shown in the report on qualifications and manpower at tertiary level than at technician level. A. Adamec – Australia commented that from his experience it is relatively easy to obtain information from tertiary and other educational instittutions than from employers employing the bulk of technicians and operators.

Topic: Technical co-operation for development
Chairman: J. Hothmer – FR Germany
Rapporteur: D. Fernando – Sri Lanka

On the basis of paragraph 4.3.3 in XXV/A 6 page 141 the Chairman presented the question whether individuals can be allocated who are willing to do some work within the Working Group devoted to this topic.

Many views were expressed on the continuity of this Working Group. There was concensus that any effort should be done to continue the WG with the tasks as outlined at the Symposium 1982 of Commission VI.

Session 5, Thursday 21 June 1984, 15:30 – 17:00

Topic: Promotion of education
Chairman: C. Paresi – Netherlands
Rapporteur: A. Adamec – Australia

S. Ghosh – Canada, Chairman WG VI – 8, presented the report (XVV/A 6/120-128).

Ms. Adekoya – Nigeria commented there are contraditions between the task definitions of WG VI – 8 and the resolutions of both regional conferences in Ile Ife and Kuala Lumpur having been organized by WG VI – 8. S. Ghosh replied that small conferences can only recommend but not implement. He would like to see broad task definitions and bend them when necessary. J. Hothmer – FR Germany commented the latter is not in accordance with the Statute ISPRS. He pointed out that resolutions require follow-up activities in order to achieve government credibility.

R. Stoch – Israel mentioned the ITC is doing a good job whilst building inexpensive equipment and using expensive equipment efficiently for training. He would like to see statistics on whether graduates of ITC are used in their respective countries efficiently. S. Ghosh commented that time has come for regions to have self help.

Session 6, Friday 22 June, 9:00 – 10:30

Topic: Professional strategy
Chairman: President ISPRS F. Doyle – USA
Rapporteur: J. Visser – Netherlands

D. Fernando – Sri Lanka, Rapporteur WG VI – 12, read his paper entitled "Professional Aspects with Emphasis on Developing Countries" (XXV/A 6/102-113).

Ms. Adekoya – Nigeria wondered who may be called a professional photogrammetrist. ISPRS can not deal with that question because it is not a professional institution. Recognition is in the first place a national affair. S. Ghosh added that each country has its own constraints of laws, needs etc; ISPRS can only advise. O. Coker – Nigeria points out that in Africa there are two systems, the former French and the former English system. Mutual recognition is making slow progress, but we do have evolution and do not need revolution. He furthermore stressed that we must make ourselves professionally recognized by using standards of education.

President ISPRS F. Doyle summarized the constructive discussion by recognizing that the problem as outlined by D. Fernando does exist, and by questioning what ISPRS can do. We must bear in mind that our Society is an association of country-members and not of individuals, and further, that ISPRS is a learned society and not a professional society. Hence, ISPRS can only give recommendations and can not impose something. He refered to the International Hydrographic Union which has gone as far as to publish recommended standards of education. If countries meet these standards, then licenses may be granted. He appreciated the report presented by A. Adamec on standards of education for ISPRS wishing WG VI – 10 good success for finalizing the subject. Finally, Chairman Doyle refered to the recently established co-operation between ISPRS, FIG, IAG, ICA and ISM. This Union can provide a united front for our common profession.

Session 7, Monday 25 June, 15:30 – 17:00

Topic: ISPRS Multilingual Dictionary
Chairman: H Bähr – FR Germany
Rapporteur: C. Burnside – UK

G. Lindig – FR Germany, Chairman WG VI – 3, presented his report on the status of the ISPRS Multilingual Dictionary MLD (XXV/A 6/199-208).

The President Com. VI reported that the American Society of Photogrammetry (ASP) had been invited several times to co-operate with ISPRS, however ASP decided, unfortunately, to produce its own multilingual dictionary.

S. Paul – France pointed on coherence in the text of the MLD requiring that with each article there is an indication of the particular field to which the term is being applied. For example, an optical term might well be used in a geometric-optical context or in a photogrammetric-optical sense. He suggested this should be made clear in the article.

This subject, and other ones were discussed with contributions from K. Phoneko – Singapore, S. Ghosh and others. The Chairman summarized that technical and scientific considerations on the ISPRS – MLD must be kept in balance with the practical requirement to finish and publish the MLD within a reasonable time schedule. We should also be aware that, fortunately, the concept of Dr. Lindig for the ISPRS – MLD allows updating at any time. Hence, the ISPRS – MLD can remain a powerful tool for decades to come.

Session 8, Tuesday 26 June, 11:00 – 12:30

Topic: Periodicals and international exchange of information
Chairman: A. Adamec – Australia
Rapporteur: C. Paresi – Netherlands

J. Hothmer, Chairman WG VI– 6, presented two papers:
a) Endeavours of ISPRS on the Subjects of International Exchange of Information and Periodicals (XXV/A 6/129-136), and
b) The Future of PHOTOGRAMMETRIA as Official Journal of ISPRS (XXV/A 6/151-154).

O. Ayeni – Nigeria inquired on the position of the ISPRS Council concerning RIP's (Regional International Periodicals), and on the affect on PHOTOGRAMMETRIA if RIP's will be created. J. Hothmer answered the Council is supporting the issue of RIP's if created by the regions themselves. RIP's do not replace PHOTOGRAMMETRIA. D. Proctor – UK commented it would have been better to think in terms of linguistic groups rather than regional groups, and that RIP's should not be imposed by ISPRS. The Society should just stimulate co-operation. D. Fernando – Sri Lanka felt that time has come for Asian countries to join for producing a RIP.

Allan – UK, Fernando – Sri Lanka, Ihemadu – Nigeria, Pourkmal – Iran and Proctor – UK participated in a constructive discussion on PHOTOGRAMMETRIA. The Chairman closed the session by wishing Prof. Dr. J. Hothmer as newly appointed Chief Editor all possible success when rejuvenating the Official Journal of ISPRS.

Session 9, Thursday 28 June, 11:00 – 12:30

Topic: Business Meeting Commission VI
Chairman: J. Hothmer – FR Germany
Rapporteur: H. Kantelhardt – FR Germany

Ms. Adekoya – Nigeria was appointed resolutions editor. The outcome is printed in XXV/B.

Session 10, Friday 29 June, 9:00 – 10:30

Topic: Present state of periodicals and other series publications on photogrammetry and remote sensing with an outlook into the next decade
Chairman: Z. Wang – PR China
Rapporteur: NN

The following papers were presented:
+ O. Ayeni – Nigeria for Africa (XXV/A 6/53-64).
+ M. Thompson – USA (read by. W. French – USA) for North America (XXV/A 6/300-306),
3 S. Walker – UK (read by W. Hofmann – FR Germany) for Western Europe (XXV/A 6/307-317).

O. Coker – Nigeria thought that the ECA Regional Center in Ile Ife could be a nucleus for a RIP Africa, and thus follow the example set by the ITC.

Discussing the costs for producing a RIP, W. French – USA reported that ASP just breaks even with the revenue received from subscribers and advertisements,

Session 11, Friday 29 June, 11:00 – 12:30

Topic: Bibliography
Chairman: J. Clark – USA
Rapporteur: NN

The following papers were presented:

+ J. Hothmer – FR Germany on "The Information Retrieval System ISPRS – IRS for Literature and Factual Data (report of WG VI – 4)", XXV/A 6/155-169;
+ H. Latarche – France on "Contribution du GDTA à l'Evolution des Bases de Donées en Ligne pour la Télédétection", XXV/A 6/185-198;
+ J. Clark – USA on "Accessing the Resources of the National Technical Information Service", XXV/A 6/89-94.

The discussion focused on proprietary problems and on costs of computerized literature retrieval.

ISPRS, COMMISSION VII
Rio de Janeiro, le 29 juillet 1984

Louis LAIDET

Monsieur le Président, Madames, Mademoiselles, Messieurs,

A la fin de notre mandat en tant que responsables de la Commission VII, A. BAUDOIN et moi-même aimerions résumer en quelques mots l'activité de cette Commission durant la periode 1980-1984.

Le rôle de la Commission VII est délicat dans la mesure où il traîte de l'interprétation des données de photogrammétrie et télédétection: le danger existe de trop aborder les aspects applications (qui peuvent être traités par ailleurs dans d'autres disciplines scientifiques ou techniques) et de ne pas traiter suffisamment la méthodologie de l'interprétation elle-même.

C'est pourquoi, dès le début nous avons décidé de créer deux nouveaux WG traitant spécifiquement de la méthodologie de l'interprétation
— l'un dans le domaîne V et IR (WG VII-1)
— l'autre dans le domaine MW (WG VII-2).

Le troisième groupe de travail (WG VII-3), existant déjà, est considéré comme un groupe de recherche qui a pour objectif de développer les échanges scientifiques sur l'analyse des phénomènes de base en télédétection pour préparer les méthodes d'interprétation.

Le nombre des applications étant devenu maintenant particulièrement nombreux, il nous avait paru souhaitable de diviser les WG en autant de domaînes et c'est là un des problèmes rencontrés par la Commission VII lorsqu'il s'agit de manager des groupes aussi diversifiés et aussi nombreux.

WG VII- 4: Renewable Ressources (Vegetation, Agriculture, Forest, Water, . . .)

WG VII- 5: Non-Renewable Resources

WG VII- 6: Environmental Monitoring (Land and Water)

WG VII- 7: Oceanography and Coastal Zone

WG VII- 8: Ice and Snow

WG VII- 9: Land Use and Land Cover

WG VII-10: Remote Sensing in Engineering Projects and Industrial Processes

WG VII-11: Vegetation Damage in Agriculture and Foresty

I — Méthodologie de l'interprétation

1 — On a constaté, dans le domaine de la méthodologie de l'interprétation des images, la nécessité de combiner l'interprétation visuelle avec les méthodes de classification automatique.

On a constaté également un développement des méthodes de classification des images qui font appel à des critères autres que l'analyse multispectrale:

— analyse des textures
— analyse des structures
— utilisation des données multitemporelles
— utilisation des données multisources.

On a insisté sur la nécessité de définir des critères objectifs permettant d'évaluer la précision des classifications.

2 — Développement relatif des recherches dans les différents domaines spectraux.

• Il existe un déséquilibre entre Visible et NIR et les autres domaines. Mais la progression dans l'IRT et MW entre Avignon 81 et Bordeaux (83) montre que ce déséquilibre tend à se combler progressivement.

3 — Utilisation des modèles.

• On observe un très fort développement de la modélisation dans tous les domaines spectraux et la tendance est vers une approche plus rationnelle des problèmes, ce qui nécessite la compréhension des phénomènes physiques de base. Les recherches se sont développées et se poursuivent dans ce sens. Ces travaux ont porté, sur les couverts végétaux, dans les domaines des courtes longueurs d'onde. Les modèles sont suffisamment avancés pour que l'on puisse envisager leur inversion (mesure de la luminance du couvert et on en déduit les paramètres biologiques). Démarche trés importante et très intéressante: c'est le but ultime des recherches dans ce domaine (courte).

• IRT et MW: dans ce domaine la modélisation est moins avancée, mais elle progressera:

1) vers l'établissement de modèles très complexes qui tiennent compte de tous les paramètres.

2) vers des modèles simplifiés qui ne tiennent compte que des paramètres principaux et qui seront des modèles utilisés opérationnellement par la suite.

4 — Evolution vers une **meilleure résolution spectrale et spatiale.**

• La nouvelle génération de satellite va aller dans le sens d'une meilleure résolution spatiale (prise en compte des distributions statistiques des valeurs de luminence dans les différentes parcelles).

— Dans le visible:
apparition de systèmes spectro-imageurs: application à l'océanographie, aussi bien que pour le suivi des cultures.
— Dans l'IR moyen:
utilisation de bandes spectrales étroites (SMIRR) — possibilités intéressantes en géologie.
— Dans l'IR thermique:
utilisation de l'IR thermique multispectral (en géologie pour commencer).

5 — Utilisation des visées obliques.

• C'est l'utilisation de la stéréoradiométrie (ex.: SPOT) pour une meilleure identification des couverts végétaux (cultures, forêts). Et utilisation de modèles de correction des effets angulaires pour les satellites à grand champ (ex.: AVHRR).

6 — Correction des effets atmosphériques.

• Travaux développés dans le V et le proche IR. Ils vont se développer dans l'IR thermique (recherche en cours). L'utilisation de ces modèles nécessite la mesure de certains paramètres climatiques qui ne sont pas déterminés (connus) par les réseaux météorologiques classiques.

Il faut faire une action pour que dans l'avenir ces paramètres soient pris en compte.

7 — Dernier problème (plus général).

• Problème de compatibilité des mesures (standardisation, calibration, définition précise des paramètres d'environnement à prendre en compte).

II — Végétation

En végétation on observe un déséquilibre entre les perspectives offertes par les recherches méthodologiques en cours et les applications concrètes et opérationnelles.

Les outils nécessaires pour mettre en oeuvre les résultats obtenus dans le domaine de la recherche ne sont pas encore suffisamment opérationnels.

III — Géologie

1 — Utilisation du V et proche IR.

• Utilisation opérationnelle dans certains domaines (discrimination de l'abondance de l'oxyde de fer dans les minérals — USA)

• R et D dans le domaine des anomalies géobotaniques

• USA et Canada (océanographie) ont un programme de R&D utilisant un radiomètre spectro-imageur (haute résolution spectrale déjà mentionnée).

2 — Utilisation de l'IR thermique.

• On constate une absence de modèle d'interprétation pour l'utilisation de l'IR thermique.
• Nouvelle techique (déjà mentionnée): l'IR thermique multispectral.

3 — Micro-onde.

• en 1981, vol du SIR-A
— pénétration du sol dans les zones hyperarides.
— mises en évidence de structures géologiques cachées par le sable (et archéologie également)

• en octobre 1984, vol du SIR-B

• espoir pour SIR-C (1989).

IV — Océanographie, neige et glace polaire

— Domaine difficilement pris en compte dans le cadre de l'ISPRS
— Cependant très intéressant et prometteur.

1 — Océanographie.

• nouveaux projets en cours de développement (après SEASAT, TOPEX-POSEIDON et Shuttle) — de nombreux chercheurs travaillent maintenant sur la modélisation de l'état de surface des océans.

• modélisation également de la couleur des océans.

2 — Glace polaire.

• intérêt des recherches sur les zones polaires: corrélation avec climatologie mondiale.

V — Environnement, Land Use

Intérêt d'intégrer les donnés d'origines diverses concernant l'environnement et l'occupation du sol avec les données de télédétection aérospatiales: combinaison des
MNT,
des données météorologiques
des données biologiques
des données statistiques

avec les données spatiales.

VI — Conclusions

1 — On peut noter tout d'abord l'extraordinaire pénétration de la télédétection dans tous les domaines d'applications.

2 — Ensuite, il faut souligner le fait que les utilisateurs ont tendance à mieux s'organiser et à exprimer leurs besoins de façon plus précise au lieu de se contenter d'exploiter les données acquises. Ils connaissent beaucoup mieux les caractéristiques des données qui leur sont nécessaires:

— spécifications géométriques
— ou radiométriques

— formats
— modes d'acquisition (en particulier ils deviennent plus exigeants sur les délais).

3 — La rencontre entre les photogrammètres et les télédétecteurs est bénéfique pour les deux parties:

— Les premiers imposent peu à peu leur rigueur scientifique, forgée au cours des précédentes décennies et amènent les seconds à définir des normes des références et une nomenclature.

— Les seconds élargissent leurs domaines d'investigation et d'applications.

4 — Le problème posé par l'utilisation de la télédétction spatiale est à l'heure actuelle beaucoup plus un problème d'organisation qu'un problème technique. En effet, beaucoup de méthodes de routines sont encore basées sur l'usage essentiel de la photogrammétrie, et de nombreux progrès restent à faire pour faire sortir la télédétection des laboratoires de recherche et en faire un outil véritablement opérationnel.

5 — C'est pourquoi il est important d'accroître les efforts de formation des hommes qui seront appelés demain à utiliser la télédétection dans les service ou les structures d'applications. Cette formation devra se faire à tous les niveaux:

— ingénieurs, cadres, agents divers
— techniciens ou thématiciens
— tous les pays, aussi bien dans les nations industrialisées que dans celles en voie de développment.