XIV CONGRESS of the INTERNATIONAL SOCIETY for PHOTOGRAMMETRY

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NATIONAL REPORT

of the

REPUBLIC of SOUTH AFRICA

The Photogrammetric Society of South Africa
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THE NATIONAL REPORT OF THE PHOTOGRAMMETRIC SOCIETY OF SOUTH AFRICA TO THE XIVTH CONGRESS OF THE INTERNATIONAL SOCIETY OF PHOTOGRAMMETRY, HAMBURG, 1980

This report has been compiled by the Council of the Photogrammetric Society of South Africa. It includes information on developments that have taken place since the XIIIth Congress in Helsinki, Finland in 1976. It also covers information supplied by its Rhodesian Branch.

COMMISSION I. PRIMARY DATA ACQUISITION

RAPPORTEUR: Mr G.E. Belling

1. International Participation

South Africa contributed to the activities of Group 3 'Image properties with environmental factors' - by way of a comprehensive response to a detailed questionnaire from the Chairman of the working group, Clarice L. Norton.

2. Remote Sensing

The National Committee for Remote Sensing, established under the authority of the South African Council for Scientific and Industrial Research and Chairmanship of Dr Francis Hewitt, has met at regular intervals over the past four years. Members of the Committee represent various state, educational or private institutions whilst some members have been appointed to the committee by virtue of their individual interests and involvements in the field of Remote Sensing.

The National Committee has initiated and supported a number of projects of both National and International value and interest. Among the more prominent projects have been:

(1) The establishment of the Satellite Remote Sensing Centre near Johannesburg.

(2) Joint Botswana/South Africa participation in the NASA Heat Capacity Mapping Mission.

(3) Geological and Engineering Geological Studies of a Project Area some 200 Km^2 in extent near Johannesburg using Panchromatic, black and white, infra red, colour and false colour aerial photography; thermal infra red scanner imagery and various forms of LANDSTAT imagery.

The Committee continues to meet regularly and evaluate and co-ordinate much of the Remote Sensing activity in South Africa.

Remote Sensing Unit - University of Natal

A Remote Sensing Research Unit has been established at the University of Natal and is sponsored by the Natal Town and Regional Planning

Commission and the Department of Environmental Planning and Energy.

Airborne Photography

Commercial firms continue to offer Aerial Photographic services providing photography at a variety of scales ranging from 1:2000 to 1:150000.

National Small Scale Coverage during the past four years can be summarised as follows:

1976-1979	1:20000 - 1:36000	Approximately 110 000 Km^2
1976-1979	1:36000 - 1:150000	Approximately 700 000 Km^2

COMMISSION II. INSTRUMENTATION FOR DATA REDUCTION

RAPPORTEUR: Mr D.S. Clegg

Over the past four years, all the activity relating to this commission that has taken place in South Africa has been confined to the automotion for instruments and most organisations have used a Mini Computer to upgrade their plotting facility.

The Department of Trigonometrical Survey has three A8's, a Planicart and five PG's on-line to individual Texas Instruments Mini Computers and are collecting the data onto 9-track tapes. This data is principally used to drive an OR1 Orthophoto Projector.

The Department of Water Affairs has an A7, A8 and a PG3 all on-line to a single 64K Texas Instruments Mini. They also have a 10 megabyte disc and a 9-track tape. They capture information mostly for aerial triangulation purposes which they calculate on the Mini. They also occasionally capture profiles and cross-section information.

Republic Aerial Surveys have an A10 on-line to a 32K Texas Mini and capture data onto two floppy discs. They capture both point data and string D.T.M. data and use the computer off-line for aerial triangulation calculations and volume calculations.

Planning and Mapping have an A8 on-line to a 24K Texas Instruments Mini and they capture a full range of D.T.M. data and string D.T.M's. They also are able to drive the A8 by means of stepper motors to pre-determined co-ordinate positions. They have a second 48K Mini for aerial triangulation calculations and volume calculations and in addition they drive a Data Technology flatbed plotter.

Mike Antelme (Pty) Limited has an A7 on-line to a Texas Mini used mainly for capturing aerial triangulation data. The Mini is then used for a variety of field survey calculations.

Air Survey Company of Africa have a B8 and an A8 on-line to a Wang 32K Mini Computer. The A8 is fitted with linear encoders as opposed to rotary. They capture data onto floppy discs for aerial triangulation purposes and volume calculations both in point mode and as a string D.T.M. They also drive a Wild Flatbed Plotter and plot engineering graphics.

Photo Surveys have put a 24K Texas Mini plus a 4K Mini on-line to a PG2

and they also have a Data Technology Flatbed Plotter. The 4K Mini is used to drive the table in track and line mode and they have their own software suite called Digmap which will plot detail in real time and produce maps of a visual quality approaching that fairdrawing at enlargements up to 15 times.

Aircraft Operating Company have expanded their system and now have four A8's and a B8 on-line to a CDC18-20 Computer and they continue to drive in addition a GZ1 Orthophoto Projector on-line.

COMMISSION III. MATHEMATICAL ANALYSIS OF DATA

RAPPORTEUR: Professor H.S. Williams

Improved data processing facilities during the last decade-and-a-half, the publication of results of both random and a few controlled digital aerial triangulation experiments involving test areas and the application of aerial triangulation generally in mapping has established that AT, when judged in terms of conventional mapping aims, has reached its final state of development. Prior to 1972 such a conclusion could not easily have been drawn. The trend in South Africa to move toward analytical aerial triangulation systems reported to the Helsinki Congress in 1976 has continued during the inter-congress period 1976-1980. The disappearance of analogue AT methods in government, public and private sectors is virtually complete. But, analogue restitution of models in independent model strip formation procedures continues to find favour in a number of developed mapping systems, or to exist as system options.

Advances in computer technology and the appearance of the scientific programmable minicomputer in South Africa circa 1975, saw the beginning of the development of the first on-line AAT system locally using a minicomputer. The private company concerned has since extended this to on-line digital mapping. There are at present (1980) a number of organisations that have acquired, and are operating, digital mapping systems of one type or another, however, no wholly automatic digital mapping systems are as yet operational in South Africa. An AAT system offering a number of adjustment options for a maximum block size of some 300 models has been programmed for a minicomputer with a 16 Kbyte direct access memory and 5 Mbyte of accessible disc memory. This latter system became operational circa 1977 but does not include a bundle adjustment facility. None of the operational mapping systems in use in South Africa at the present time are using bundle adjustment as far as is known. It is questionable, of course, whether such adjustment refinement is justified for conventional mapping. Interest in the bundle and modified bundle adjustment procedures continues at research level. The first operational bundle adjustment program was written in 1971/72 and was used in the controlled study reported in the invited paper, "On the influence of a metrical precision threshold on absolute accuracy in analytical aerial triangulation", (Williams) to the ISP (Commission III) Symposium, Stuttgart in September 1974.

Present research activies in AAT in South Africa are concerned with either (i) digital systems development using known technique, mainly for mapping; or (ii) fundamental research of an empirical or theoretical nature. Much of the work under (i) concerns Commission IV as well. Test Areas for various research purposes are being established near Cape Town and

Durban by the Universities of Cape Town and Natal. The study of discrete point fixation using photogrammetric methodology carried out during 1972-76 is being continued.

The Commission's interest in the geometry of images obtained by the various remote sensing methods has been noted in the Republic of South Africa. A number of scientists are aware of the need for image processing and rectification of non-traditional imagery but, so far, little has been done in South Africa. The University of Natal has received some financial support to enable it to undertake a programme of investigation of the land use inventory and mapping uses of both LANDSAT and other imagery.

Digital terrain models are in fairly common use in South Africa now for surface modelling, height interpolation and slope definition. One private company uses the DTM under certain circumstances for driving an orthophoto contouring system.

References:

Williams, H.S. 1976 — XIIIth International Congress for Photogrammetry, Helsinki, July 11-23, 1976. Report prepared for the Council for Scientific and Industrial Research, Pretoria and the University of the Witwatersrand, Johannesburg. 35 pages. Unpublished.

---------- 1976 — The National Report of the Photogrammetric Society of South Africa to the 13th Congress of the International Society of Photogrammetry. The S.A. Journal of Photogrammetry, 8, 1: 27-34, October 1976.

Williams, H.S. 1975 — The International Society for Photogrammetry (Commission III) Symposium, Stuttgart, 1974. The S.A. Journal of Photogrammetry, 7, 1: 36-40, September 1975.

Thorpe, J.A. 1976 — Report on the 13th International Congress for Photogrammetry, July 11-23, 1976. The S.A. Journal of Photogrammetry, 8, 1: 35-40, October 1976.

COMMISSION IV. TOPOGRAPHIC AND CARTOGRAPHIC APPLICATIONS

RAPPORTEUR: Mr K.J. Lester

Since 1976 considerable progress has been made in completing the various mapping series of the Republic of South Africa.

The demand for 1:10 000 orthophoto maps continues to grow, as does the number of different kinds of specialists who, on first making acquaintance with the series, find this map provides the ideal answer to their needs. More than 3 000 sheets have already been produced and if the demands are an indication of things to come, this series will cover a considerable area in a few years' time. With the acquisition of the Wild ORI system it has become possible to produce about 800 sheets per year.

Since the completion, recorded in the previous report, of the initial mapping at 1:50 000 of the entire area of South Africa, the main emphasis has been on revision and metrication of the series. As far as possible revision is being carried out in conformity with a systematic programme designed to ensure that sheets are updated at intervals varying with the development of the terrain. Successful tests have been carried out in the use of ultra-small scale aerial photography at 1:150 000 for the dual purpose of revision of the 1:50 000 topographical maps and the plotting of 20 metre contours. By the use of orthophoto techniques, a planimetrically -accurate 1:50 000 map is produced which can be used to revise detail on the 1:50 000 standing material by direct tracing. Very promising results have been achieved.

Since the previous report was made on the 1:250 000 series, the new metricated edition based on the larger-scale mapping has been completed.

The 1:500 000 series, which was the first series to provide complete cover for the territory of the Republic of South Africa, is being redrawn and metricated from larger-scale mapping.

The private sector has been actively engaged on mapping for large-scale engineering surveys. Close-contour orthophoto mapping of urban and peri-urban areas at large scales has been produced for municipalities and local authorities.

Messrs G.E. Belling, N.W. Riley and K.J. Lester attended and presented papers at the Symposium on New Technology for Mapping organised by Commission IV which was held in Ottawa, Canada from October 2 to 6, 1978. In a paper titled "Railway Route Selection - A Limited Exercise in Data Banking and Retrieval", G.E. Belling described the use of a Wild A 10 plotter for acquiring D T M and the Jena Topocart for Orthophoto production. "Methods of Manipulating Geo-Coded Data through Social Indicators for Use in Simulation Modelling and Decision Taking" was presented by N.W. Riley while K.J. Lester discussed "Map Revision in South Africa".

COMMISSION V: NON-TOPOGRAPHIC PHOTOGRAMMETRY

RAPPORTEUR: Professor L.P. Adams

Since 1976 new developments in the application of short-range and terrestrial photogrammetry have taken place in South Africa although activities have been mainly confined to non-commercial organisations such as Universities. To a large extent these activities have been concerned with the application of short-range photogrammetric techniques to varied disciplines including medicine, dentistry, archaeology, ornithology, wild life management and coastal engineering.

The following applications can be mentioned:-

- Use of X-ray Stereophotogrammetry in the location of foreign bodies and in the study of the morphology of skeletal remains in ornithology.
- Use of non-metric underwater cameras employed in a stereometric mode in the study of the sea bed and underwater marine structures.

- Short-range stereophotogrammetry applied to the study of normal and cleft palate casts.
- Measurement and mapping of wave forms in model harbour studies using stereometric cameras.
- The monitoring of small movements in historical structures.
- The stereophotographic recording and mapping of archaeological finds, historical buildings and monuments.
- The height measurement of wild elephants using stereometric cameras mounted in safari vehicles.

COMMISSION VI. ECONOMIC, PROFESSIONAL AND EDUCATIONAL ASPECTS OF PHOTOGRAMMETRY.

RAPPORTEUR: Professor H.S. Williams

During the inter-Congress period 1976-80 the teaching of photogrammetry in the universities and colleges of advanced technical education (now called technikons) has remained much as it was for the period (1972-76) which was covered by the Society's previous report. One or two-year courses are included in the curricula of surveying degrees at the Universities of Cape Town, Natal, Pretoria and the Witwatersrand, Johannesburg. Ancillary courses in photogrammetry are also provided for students of civil engineering and allied fields. Some photogrammetric teaching is also undertaken at the University of Stellenbosch for engineering and other students. Facilities for post-graduate work in photogrammetry exist at the first four universities mentioned. Special level courses in photogrammetry are provided at the technikons within the framework of their survey technician diploma programmes. In-house training of plotter operators is carried out by a number of private firms and government departments.

The Commission's interest in establishing cost models in photogrammetry has been noted in South Africa. An individual's overview of the stage reached by photogrammetric education and research in South Africa by 1976 was provided by H.S. Williams in a presented paper to the Helsinki Congress. In another presented paper (Williams) the contribution made by South Africa to the International Bibliography of Photogrammetry during the period 1972-1976 was also provided.

Bibliography of Publications Deriving from South Africa during 1976-80:

(i) The South African Journal of Photogrammetry, Vol.8, No.1, October, 1976

Clegg, D.S.	:	An automated orthophoto system
Krahmann, H.	:	The evolution of Zeiss aerial survey cameras
Rawiel, R.F.	:	A direct solution for a three-dimensional rotation of a stereomodel
Belling, G.E.	:	The ITC post-Congress seminar, Enschede

2-6 August, 1976

Schneider, H. : Zeiss Equipment for map revision

Williams, H.S. : Letter to the Editor

Vol.9, No.1, October 1977

---------- : Proceedings of all-day symposium, 2nd March 1977

Scott, P.J. : Photogrammetry in the measurement of structural deformation in box girders

Vol.10, December 1978

Fisher, R.C. : 6th Conference of South African Surveyors

Viljoen, M. : A method of compensation for systematic error in stereoplotters using earth curvature devices.

Greggor, K. : Routines for solving very large least squares problems

Scogings, D.A. : Some reflections on aerial survey camera lens calibration.

Mohl, H. and Faust, H.W. : Computer-aided interpretation of aerial photography using the Stereocord G2

Tolson, J. : Developments in digitising and voice recognition to meet the requirements of hydrography and cartography

(ii) The Photogrammetric Record
Vol.IX, No.51, April 1978

Adams, L.P. : The use of a non-metric camera for very short range dental stereophotogrammetry

Vol.IX, No.54, October 1979

Adams, L.P. : An experiment with analytical shadow stereophotogrammetry

Vol.X, No.55, April 1980

Adams, L.P. : The use of short range stereophotogrammetry in the study of the morphology of the Shoebill bill.

(iii) The South African Survey Journal
Vol.XV, No.91, Part 4, April 1976

Marriot, G.E. : Measurement of tunnel surface roughness by close-range photogrammetry

Vol.XV, No.93, Part 6, December 1976

Adams, L.P. : Palatal analysis by a stereophotogrammetric method

Marriot, G.E. : Photogrammetry as a means of cadastral surveying

Vol.XVI, No.95, Part 2, September 1977

Marriot, G.E. et al. : Hydrographic survey by photogrammetry

(iv) South African Archaeological Bulletin No. 31, 1976

Adams, L.P. : Photogrammetric survey of stone structure between gracht walls, Golden Acre Site, Cape Town.

(v) Proceedings of the 6th Conference of South African Surveyors, February 1978

Adams, L.P. : The use of photogrammetry in the study of the sea and coasts

Zarzycki, J.M. : Digital mapping and computer-assisted cartography

Greer, E.B. : An on-line digital mapping system

Schwebel, R. : Computer-supported and computer controlled stereoplotting with special allowance for Zeiss C-100 Planicomp

Doyle, F.J. : The new decade of satellite remote sensing

(vi) Archives of Photogrammetry, Vol.XXI (Proceedings of XIIIth Congress of the International Society for Photogrammetry, Helsinki, 1976)

Commission II

Clegg, D.S. : An automated orthophoto system (presented paper)

Commission VI

Williams, H.S. : Contributions by South Africa to the International Bibliography of Photogrammetry, 1972-1976 (presented paper)

Williams, H.S. : Present state of photogrammetric education and research in South Africa (presented paper)

(vii) ISP (Commission IV) Symposium, Ottawa, 1978

Belling, G.E. : Railway route selection: a limited exercise in data banking and retrieval (invited paper)

Riley, N.W. and Sturgeon, K.D. : Methods of manipulating geocoded data through socio-economic indicators for use in simulated modelling and decision taking (invited paper)

Lester, K.J. : Map revision in South Africa (invited paper)

(viii) Post-graduate Degrees Awarded During the Period 1976-80

Rawiel, R.F.	:	The practical application of close range photogrammetry. Ph.D., 1978, University of the Witwatersrand, Johannesburg.
Arbuckle, M.E.	:	Minicomputers applied to digital photogrammetry. M.Sc.(Eng.), 1979, University of the Witwatersrand, Johannesburg.
Eekhout, L.	:	Simulation and analysis of analytical aerial triangulation. M.Sc.(Survey, 1978, University of Natal, Durban.

(xi) "Koedoe", Research Journal for the National Parks of South Africa
No. 22, 1979

Hall-Martin, A.J. and Rüther, H.	:	Application of Stereo Photogrammetric Technique for Measuring African Elephants.

COMMISSION VII. INTERPRETATION OF DATA

RAPPORTEUR: Mr T.C. Partridge

During the period 1976-1980 remote sensing techniques have been increasingly applied in a variety of disciplines in South Africa. Its use continues to be widespread in the Earth Sciences, but significant advances have also been made in the use of a variety of remote sensing techniques in vegetation studies, and airphoto interpretation has played an important role in several agricultural and geographical surveys.

1. National Committee on Remote Sensing

An important development during this period has been the establishment of the National Committee on Remote Sensing (NCORS) which is convened under the aegis of the Co-operative Scientific Programmes Division of the South African Council for Scientific and Industrial Research. This committee has helped to co-ordinate research in remote sensing in South Africa by actively promoting comparative programmes and the interchange of results and experience between different disciplines which make use of remotely sensed data. Several research projects have been initiated and administered through this committee; reference is made to certain of these below.

2. Applications in Geology

The past four years have seen a great increase in the local acceptance of airphoto interpretation, thermal linescan imagery and satellite imagery as aids in mineral exploration programmes, and there is a pronounced trend towards the integration of other multidisciplinary studies, particularly geophysical and geochemical surveys, with data obtained by these means.

Useful comparative data were obtained from a research project of NCORS to evaluate the relative advantages of panchromatic, B & W infra-red, colour and false-colour airphotos and thermal linescan imagery flown concurrently over a test area to the north-west of Johannesburg. The

The usefulness of each type of imagery in interpreations of geological structure, stratigraphy and mapping for mineral exploration and engineering geological uses was compared over a test area of about 200 square kilometres by specialists in the respective fields, and the results are incorporated in a report prepared in 1979 (Reference 1). A general conclusion from this study is that aerial photographs incorporating wavebands in the visible and near infra-red, used in conjunction with thermal linescan imagery, have significant advantages over conventional panchromatic and colour photography in most geological applications.

3. Applications in Agriculture

A continuing and important application of remote sensing imagery is in the preparation of national resource inventory maps by the Soil and Irrigation Research Institute of the Department of Agriculture, in which considerable use is made of the comprehensive coverage of standard panchromatic airphotos available for South Africa. Both panchromatic and colour aerial photographs are routinely used by several workers in the preparation of pedological maps and the assessment of forestry potential.

A collaborative project of the National Physical Research Laboratory of the CSIR and the Department of Agricultural Technical Services is currently in progress to compare ground truth and the results of airborne multi-spectral scanning with the spectral signatures of different cultivated areas on Landsat imagery for the prediction of crop yields.

A pilot project to map different forest types in Southern Africa from Landsat imagery, by means of the computerised classification of spectral signatures, is also being carried out by the Department of Forestry.

4. Applications to Vegetation Studies

A particularly good example of the application of advanced remote sensing interpretation in this field is the Fynbos Remote Sensing Project of the University of Cape Town. In this study various techniques are being evaluated as an aid to the study and mapping of a large and important biome within the winter rainfall region of South Africa. The procedure which has been followed is to apply an iterative clustering algorithm to the Landsat data for selected small test areas, and to compare the derivative information with airphoto images and the ground truth at representative training sites. When a satisfactory fit is obtained between the various sets of data, they are used to train a Bayesian classifier for application to the whole area. In this way a good correlation has been obtained between the computer-generated classification maps and field botanical maps. A report is expected in 1981.

Similar techniques have been used to good effect in ecological studies of several South African estuaries, and comparative studies of dune vegetation in South West Africa-Namibia have also been undertaken using Landsat imagery.

5. Applications in Meteorology

Continuing use is being made of Meteosat imagery in the analysis of past events, in forecasting, in the analysis of winds in the upper air, in a weather modification project in progress in the eastern Orange Free State and in a study of the frequency and distribution of fog and rain in the Namib Desert.

6. Development of New Sensor Packages

Spectral Africa Limited, in collaboration with the South African Council for Scientific and Industrial Research, is in the process of developing a new remote sensing package in which thermal linescan data in the 8 - 14 μ range will be combined with imagery in the near and visible infra-red range below 1,1 μ. This package is expected to have useful applications in geological, agricultural and botanical surveys.

References

1. Viljoen, R.P.; Newton, A.R.; Partridge, T.C.; Walraven, F. and Minnitt, R.C.A. 1979. Krugersdorp Remote Sensing Research Project. Report No. 15 of the Engineering Geology and Geology Planning Sub-committee of the National Committee on Remote Sensing, CSIR.