

PHOTOGRAMMETRY IN SCIENCE AND TECHNOLOGY:
 A report on the activities of Commission V
 of the International Society for Photogrammetry
 and Remote Sensing (1980-84)
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 Commission V report

Abstract

The Commission V Officers report progress since the Hamburg Congress of the International Society for Photogrammetry and Remote Sensing in 1980. Efforts to concentrate on the Technical Resolutions from that Congress mean that work has centred upon (i) analytics in non-topographical photogrammetry, (ii) low altitude aerial photography, (iii) new kinds of recording and measurement and (iv) industrial applications. Considerable activity is noted in all of these subject areas. Prospects for the Commission beyond 1984 are outlined.

INTRODUCTION .

At the time of the transfer of responsibility for Commission V, the activities of the Working Groups were showing evidence of a healthy diversification into several new lines of study, and this was reflected in the content of the Hamburg Congress resolutions relating to the Commission. In response to these recommendations, and to try to bring the activities into a closer relation, only four Working Groups instead of six were set up for the period 1980-84. Most of the remaining interests of the Commission were continued, however, but in a form that should give more scope for liaison with "sister organisations" of ISPRS, and provide for better co-ordination within Commission V. Responsibility for this additional area of activity was allocated to the Secretary of the Commission, Mr.K.B.Atkinson. The special concern with the architectural aspects of photogrammetry and the contact with the Comité International de Photogrammétrie Architecturale (CIPA) through its President M.Carbonnell continues. During the 1980-84 period, CIPA has met in Rouen, Vienna, Siena and Lisbon and an important colloquium of experts took place in Paris in 1980. A similar relationship with the field of Biostereometrics is maintained through the previous Chairman of the Working Group, Dr.R.E.Herron, and several active national and international groups in this field.

The four working Groups for 1980-84 were constituted as follows:

V/1 Analytics of Non-Topographical Photogrammetry. Chairman,
 Professor H.M.Karara, Department of Civil Engineering, University
 of Illinois, Newmark Civil Engineering Laboratory,
 208 North Romine Street, Urbana, Illinois 61801, USA.

- V/2 Low altitude Aerial Photography. Chairman,
Professor Dr.-Ing.W.Wester-Ebbinghaus, Institut für
Photogrammetrie und Ingenieurvermessungen, Universität Hannover,
3000 Hannover 1, Nienburger Strasse 1, FR Germany.
- V/3 Recording and Measurement Technology for New Applications.
Chairman, Mr.M.C.van Wijk, Division of Physics, National Research
Council, Ottawa K1A 0R6, Canada.
- V/4 Photogrammetry for Industrial Construction and Mensuration.
Chairman (1980-1982), Professor Dr.-Ing.K.Linkwitz, Chairmanship
transferred in 1982 to Professor L.P.Adams, Department of
Surveying, University of Cape Town, Rondebosch 7700, South Africa.

CONTINUITY WITH THE ORGANISATION OF COMMISSION V (1976-1980)

The management of the Committee was in the hands of Professor A.K.I.Torlegård from 1976 to 1980 and, before that, Professor H.M.Karara was President from 1972 to 1976. There was every possibility, therefore, of ensuring very good continuation of the topics of current interest and both of the ex-Presidents have advised on the planning of the Commission's work from positions on the Commission Board.

Over 100 papers were submitted and preprinted as part of the contribution to Commission V at the Hamburg Congress in 1980. Their distribution amongst the various interests represented by the Working Groups gives a rough idea of the balance of interests (some papers relate to more than one WG).

Working Group V/1	22 papers	Analytics of close photogrammetry
V/2	3	Cost effectiveness in close range photogrammetry
V/3	26	Non-conventional imaging
V/4	1	Dissemination of information
V/5	33	Industrial photogrammetry
V/6	14	Biostereometrics
CIPA	16	Architectural photogrammetry

The resolutions passed by the General Assembly in Hamburg reflect the balance of interest to some extent. It should be remembered, however, that the choice of topic for a paper to be submitted would have been made at least one to two years before the Congress resolutions were considered, and the resolutions more closely reflect the result of discussions during the Congress on the material presented. The objectives are summarised below.

1. To form a working group to develop techniques of optical metrology and general sensing to extend the involvement of photogrammetry in new fields.

2. To form a working group to co-ordinate and develop activities in low altitude aerial photogrammetry.
3. To form a working group to develop the potential of offshore and underwater photogrammetry and to explore promising avenues of application in industry.
4. To continue the activities of the working group in the very lively area of analytical methods in non-topographic photogrammetry.
5. To promote collaboration between close range photogrammetry and related disciplines.

INITIAL ACTIVITIES AFTER THE HAMBURG CONGRESS

The technical resolutions of the Hamburg Congress led directly to the establishment of four Working Groups and two Applications Groups within Commission V. The main concerns of each group may be summarised.

Commission V Working Groups (1980-1984)

V/1 Analytics of Non-Topographical Photogrammetry

The group has continued the studies of WG V/1 (1976-1980). The objectives included the exploitation of mathematical developments and new methods of data reduction in close range photogrammetry especially applied to the prediction of precision and reliability, and to the design of optimum object space control.

Non-metric cameras are now fully accepted as viable data acquisition systems in non-topographic photogrammetry. Current activities of the WG concentrate on

1. Improvement of the accuracy of both metric and non-metric close range photogrammetric systems.
2. Introduction of new metric cameras (both film and plate)
3. Improvement of camera calibration methods and accuracy
4. Improvement of software accuracy and capabilities
5. Work on reliability and statistical concepts
6. Earth subsidence
7. Improvements of the DLT and DLT-type methods
8. Overall improvements of accuracy

V/2 Low Altitude Aerial Photography

The objectives of the group were to study the recent developments of close range photogrammetry by photography from small aircraft, kites, balloons and other skyhooks, and to promote collaboration in methods, equipment and materials, especially in engineering fields. Work has shown that there is an increasing number of types of camera platform, especially

1. Microlight aircraft and
2. Gyro stabilisation and that

3.Applications are now better appreciated for:

- (a) Precise local photogrammetry
- (b) Point location and determination
- (c) Agriculture
- (d) Accident recording

V/3 Recording and measurement technology for new applications

The group continued the study of some of the fields of the previous working group V/3 (1976-1980) "Non-conventional imaging systems", selecting those most topically relevant in photogrammetry. The general objective was to explore the extension of photogrammetric methods into new areas of physics and engineering, and to exploit useful techniques from those areas to advance the development of photogrammetry. These include electron microscopy, high speed photography, hologrammetry, moiré topography, optical metrology, raster stereography, solid state imaging systems, underwater photogrammetry, X-ray imagery and ultrasonics. This working group obviously impinges upon other working groups to a wide extent, while providing one of the growth points for the subject of photogrammetry as a whole. It has tried not to duplicate the functions of other working groups or to compete with them. Other working groups of all Commissions should accept the advantages of approaches to problems from new angles that a relatively unfettered approach can reveal.

V/4 Photogrammetry for industrial construction and mensuration

The inter-Congress Symposium held in Stockholm in 1978 had as its theme "Photogrammetry for Industry" and the Working Group V/5 under Professor K.Linkwitz which was then charged with the study of photogrammetry for industrial applications played a major part. The Congress in Hamburg saw fit to stress the importance of photogrammetry in offshore and underwater construction. The group has pursued the study of

- 1.Underwater measurement technologies and water surface waveform
- 2.Control of form and deformation of machines and large structures
- 3.Digital on-line photogrammetry
- 4.Integration of photogrammetry into production systems

THE FIELD OF INTEREST OF COMMISSION V

A formally agreed statement of the field of interest of the whole Society does not seem to exist. The best that we have been able to find originated with G.C. Tewinkel. "Photogrammetry", for the purpose of the Society, should be considered as the science and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting photographs and patterns produced by radiant energy derived from sensor systems.

At the XIV Congress in Hamburg, the By-Law 18 which was adopted by General Assembly seemed to restrict the field of interest of Commission V to a list of applications. The implication seems to be that the specially developed form of photogrammetry that has been applied so effectively to the task of mapping from air photographs, and has been

the mainstay of the Society and the basis of the work of most of the other Commissions, may be "applied" at close range. It is the view of most contributors to Commission V that this may be misleading. Distinctly different technology is frequently necessary and this distinction is a safer guide to the kind of work one would have to allocate to Commission V. We feel that the resolutions were not intended to exclude the more general techniques of photogrammetry, and that a name needed to be found that would be satisfactory to more of our collaborators.

The features distinguishing the current extension of "photogrammetry" into these wider and more diverse applications relate far more closely to inherent differences in techniques than to applications, though there is a broad distinction in respect of application in the term non-topographic which has been used in the past. As a consequence of recent discussions we have come to realise that Commission V's concern is more with the means of measurement of man-made objects (Technology) and with understanding the nature and behaviour of such objects (Science) than with the mapping of terrestrial or other locations.

Characteristics that distinguish techniques reported in Commission V include

1. Cameras operate at finite conjugates, and suitable metric cameras may not be available.
2. Limitations arising from the requirement for greater depth of field have to be overcome.
3. Recording with convergent axes is often necessary and advantageous.
4. Stereoscopic measurement may not be possible. Other methods of measurement may be necessary or advantageous.
5. Multistation recording may be possible and advantageous.
6. Self calibration of the cameras is possible with multistation operation and reduces the disadvantages of using non-metric or uncalibrated cameras.
7. Additional complications may be introduced at close range by the possibility that the external perspective centre may vary in position with focus and field angle to an extent that is significant in relation to the distances to be derived in the object space.

THE RANGE OF REQUIREMENTS

Much greater ranges of variations are encountered in the general scope of measurement problems to which photogrammetry is now being applied in the field of Commission V. Objects vary considerably in size, and the scale factors also are of a greater range.

Two important parameters which also vary widely, and which need to be assessed carefully in relation to available techniques, are the requirements in respect of

- Precision (for example, a higher level in engineering measurement, but lower in underwater applications)
and
Speed (very important in production engineering and control, less important in architecture and archaeology).

These two aspects were used as the basis for the theme of the York Inter-Congress Symposium and lively sessions ensued.

METHODS OF RECORDING AND MEASUREMENT

Requirements for recording at close range can only partly be satisfied by existing metric cameras. All of these show some disadvantages when used for purposes outside the specialised application to topographic mapping. Development of more suitable cameras, the use of unconventional sensitive materials, and other sensor systems are important factors, and will be the concern initially of Commission V in relation to the innovations that call for such development.

Extraction of data from the records and the subsequent computation involve new techniques extending beyond the techniques of classical photogrammetry initially, at least, it seems justifiable that Commission V should be permitted to include the development of such techniques as part of the new close range techniques. It would, of course, be open to other Commissions to act as they see fit and take over responsibility for developments that become established as relevant to classical technology and their terms of reference.

OTHER ACTIVITIES

1. The Commission was involved jointly with Commission 6 of FIG in promoting the "Industrial and Engineering Survey Conference" in September 1980 in London, England.
2. Commission V has been approached by Dr.J.van den Berg, President of Commission 6, FIG to assist with advice on the possibility of Photogrammetry being useful to include in an ISO code of practice for the building industry.
3. The President, Commission V, participated in the "Joint Days" of the FIG Congress in Montreux, in August 1981.
4. He also represented the Commission at the Centennial of the Canadian Institute of Surveyors in Ottawa in April, 1982, presented a paper "Recent Developments in Close Range Mapping", and visited National Research Council, Ottawa and University of New Brunswick in the Commissions' interests.
5. As a continuation of the Resolutions of FIG at the Montreux Congress of FIG, a recommendation from the III International Symposium on Deformation Measurements by Geodetic Methods, in Budapest, 25-27 August 1982, has requested the co-operation of Commission V. This was discussed at York, and was welcomed.
6. The President and Secretary had meetings with Professor L.P.Adams (Cape Town) in December 1982 to facilitate transfer of responsibilities for WG V/4.

7. The Secretary, Commission V, paid useful discussion visits to the Ministère de Travaux Publics, Bruxelles, Institut Géographique National and Inventaire Général, Paris during 1983 to maintain and further this Commission's activities. The President visited photogrammetric organisations in The Netherlands.
8. As well as the continuing special contacts with the fields of Architecture and Biostereometrics, useful contacts have been established with

The Association for High Speed Photography
 The British National Committee for High Speed Photography
 The Society of Photographic Instrumentation Engineers
 The Institute of Physics
 The National Engineering Laboratory (Scotland)
 The UK Medical Photogrammetry Discussion Group

THE INTER-CONGRESS SYMPOSIUM, YORK, SEPTEMBER 1982 (Fig.1)

Launched with the theme "Precision and Speed in Close Range Photogrammetry", the Symposium was held in the University of York from 5th to 10th September, 1982. 57 papers were accepted and preprinted for us by the Royal Institution of Chartered Surveyors. The resulting proceedings are bound in two A4 volumes (International Archives of Photogrammetry, 24 (V/1 and V/2)) and were distributed to each participant. Over 170 attended and more than 60 presentations were made in various ways. There was also an Exhibition with about 20 major stands and a considerable number of displays of extra material by authors. The UK Medical Photogrammetry Discussion Group joined in the Biostereometrics sessions on the last day. Receptions were held in the Guildhall of the City of York, at which the Sheriff of York welcomed us to the City, at Castle Howard (by the sponsoring bodies, the Photogrammetric Society and the Royal Institution of Chartered Surveyors) and at Heslington Hall (by Professor Douglass Wise of the Institute of Advanced Architectural Studies, University of York). A closing banquet rounded off the proceedings, except for an opportunity to visit the photogrammetric unit of the IAAS in The King's Manor.

A NAME FOR COMMISSION V

After the discussions at York on the field of interest of the Commission and the prospects for future work, there was a convenient opportunity to obtain the reaction of those present to the various names that had been proposed to describe the Commission's function. The Secretary had collected the main facts and which he presented. Many other suggestions were put forward, but eventually one was selected by a show of hands and after much lively debate. This has now been proposed for the Council's consideration. It is

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(The current version of By-Law 18 has "Other applications of photogrammetry and remote sensing" which is untenable).

PROSPECTS FOR THE IMMEDIATE FUTURE OF COMMISSION V

The themes currently most important to the Commission as a whole may be summarised as

Low altitude techniques of aerial photography and applications
 Underwater photogrammetry
 Development of new software in analytics
 Real time measurements, and robotics
 Obtaining results more rapidly
 Cost factors, and the presentation of proposals to management
 New technologies at close range
 Archaeological applications

The developing maturity of the work of the Commission and of the widespread acceptance of close range photogrammetry has been characterised by the publication of two books (Karara, 1979 and Atkinson, 1980) which assist the study of this subject area. Equally significant is the publication of Duncan and Mair (1983) which deals with the specific topic of surface description and generation and sets close range photogrammetry importantly central in this theme. These texts should all help to consolidate the impressive current use of close range photogrammetry in scientific and technological fields.

The basic concept that most clearly distinguishes photogrammetry from other measurement techniques is the essential step of a "recording" stage in the process, which enables the subsequent measurements to be made

1. in ideal conditions, whatever the conditions prevailing at the time of recording
2. using a single highly specialised measuring system, irrespective of the size and nature of the object measured
3. to any degree, repeated, and refined from first attempts at measurement.
4. at any time, or not at all.

These features are related to the conditions in which Thompson (1962) thought that photogrammetry could be useful, but he was thinking of what has been called classical photogrammetry. Harley (1967) also considered Thompson's comments and adapted them to the more specific case of close range photogrammetry. Greater convenience and flexibility is gradually creeping into the field and some of the reservations expressed in 1962 do not have the same force today. More important, however, are the various new related technologies that impinge upon fields of application for classical photogrammetry and, it is argued, should be admitted within the purview of general photogrammetry, for the sake of the benefits that close examination may bring.

In the field of photogrammetry in science and technology, at least, there is a mandate to pursue these ends, within Commission V of the ISPRS, which may in future operate under the appropriate title of "Photogrammetry in Science and Technology".

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The Photogrammetric Society

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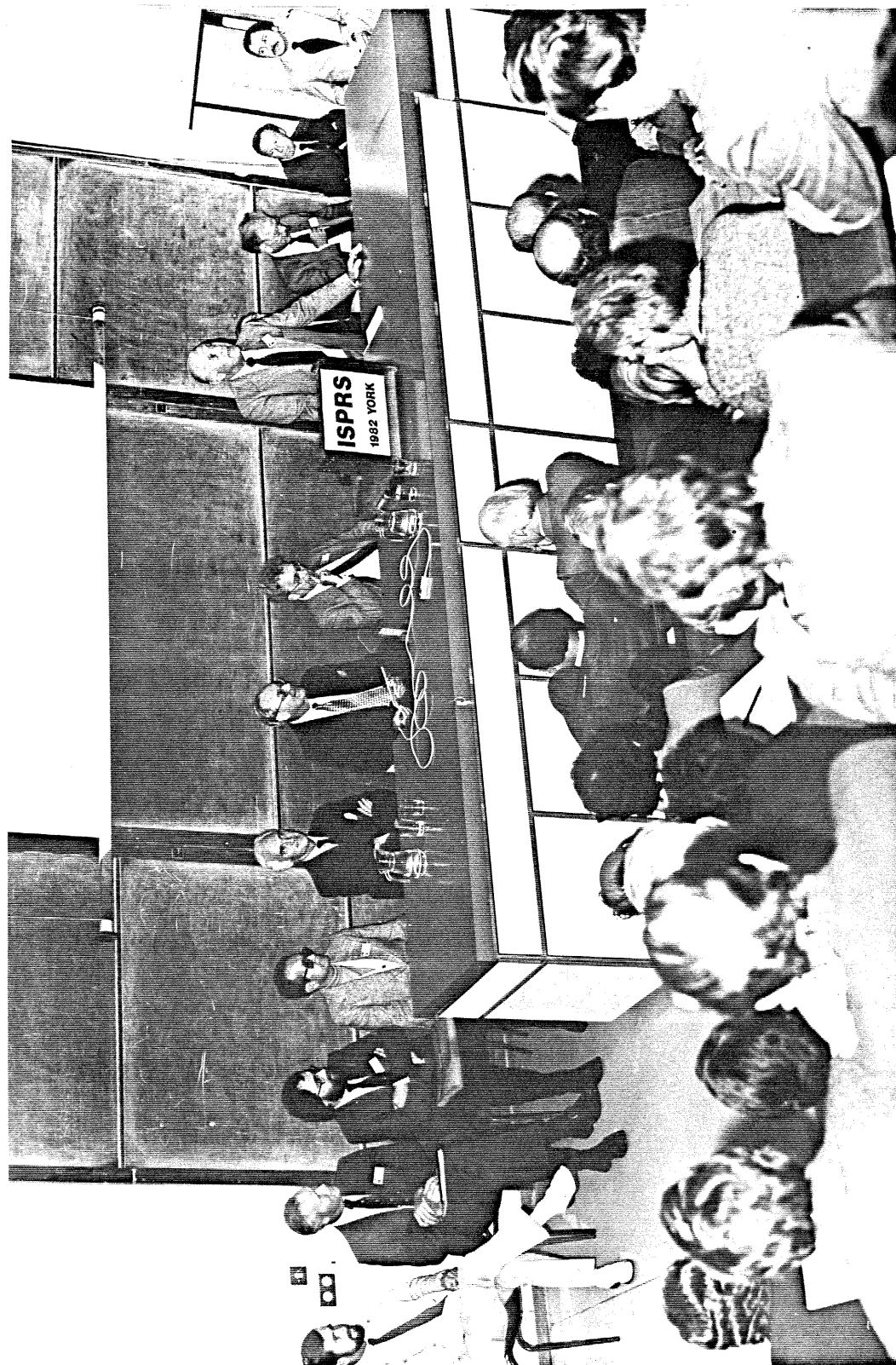


Fig.1

The opening session of the Commission V Symposium at York in September 1982. From left to right: A.K.I.Torlegård(Sweden), M.C.van Wijk(Canada), W.Wester-Ebbinghaus(FR Germany), H.M.Karara(USA), D.Wise(UK), F.J.Doyle(USA), J.W.C.Gates, J.Kelsey, H.F.Ross(partly hidden), A.L.Allan, K.B.Atkinson and R.W.A.Dallas (all UK).