REPORT OF THE ACTIVITIES OF ISPRS WG V-3, 1980 - 1984 (RECORDING AND MEASUREMENT TECHNOLOGY FOR NEW APPLICATIONS)

Marius C. van Wijk
Chairman, WG V-3
National Research Council of Canada
Ottawa, Ontario, K1A 0R6
Commission V

ABSTRACT

This report describes the goals and the achievements of ISPRS Working Group V-3 (Recording and Measurement Technology for New Applications) during the period 1980-1984. Members of the Working Group are identified and their fields of interest listed. An outline of the technical program of the Working Group, planned for the 1984 ISPRS Congress in Rio de Janeiro, is given.

INTRODUCTION

Working Group V-3 was established following Resolution XIV T. V/1 made at the Hamburg Congress, which reads as follows:

> "The Congress, noting the incompletely exploited potential of optical metrology and general sensing techniques in connection with photogrammetry, recalling the resolution ISP XIII T. V/3 which called for the development of a variety of close-range sensors, realizing that new and relevant techniques of illumination may have impact on this subject, recognizing the need to extend the involvement of photogrammetry in new fields, recommends that a working group be established to attempt to develop the potential of the most promising techniques".

According to this Resolution the Working Group initiated an attempt to obtain information on the photogrammetric use of the various close range sensing techniques. It was felt that information, on matters such as calibration methods, control requirements, measuring techniques, and accuracy, has to be collected before the photogrammetric potential of a certain technique can be fully evaluated.

The techniques, considered to be of interest to the Working Group, as discussed during a Working Group business meeting during the Inter-Congress Symposium of Commission V in York, England, are the following:

- Electron microscopy
- Hologrammetry and speckle metrology
- Moiré topography
- Optical metrology, including high speed recording
- Raster photogrammetry
- Solid state imaging systems
- Ultrasonic imagery
- X-ray photogrammetry

A questionnaire, intended to collect information on these techniques from the Working Group members was finalized during the York Symposium and distributed among the members shortly after.

MEMBERSHIP AND AREAS OF INTEREST

The Working Group was composed of the following members:

NAME	COUNTRY	FIELD(S) OF INTEREST
Drerup, B.	F.R. Germany	Moiré Topography, X-ray Photogrammetry
Elghazali, M.S.*	Egypt	Electron Microscopy
Frobin, W.	F.R. Germany	Raster Photogrammetry, X-ray Photogrammetry
Ghosh, S.K.*	Canada	Electron Microscopy, X-ray Photogrammetry
Haggrén, H.*	Finland	Solid State Imaging Systems, Hologrammetry
Hierholzer, E.	F.R. Germany	Raster Photogrammetry, X-ray Photogrammetry
Karras, G.E.*	Greece	Moiré Topography
Oshima, T.	Japan	X-ray Photogrammetry
Pinkney, H.F.L.	Canada	Solid State Imaging Systems
Pryputniewicz, R.J.	USA	Hologrammetry, Speckle Metrology
Robertson, G.*	Canada	Ultrasonic Imagery
Takasaki, H.*	Japan	Moiré Topography
Tozer, B.A.*	England	Hologrammetry
Veress, S.A.*	USA	X-ray Photogrammetry
Williams, D.C.*	England	Optical Metrology
Wishahy, Z. (Mrs.)*	Egypt	Ultrasonic Imagery
Woltring, H.J.	The Netherlands	Solid State Imaging Systems

* Working Group members who participated in the questionnaire.

Additional persons who provided information by completing the Working Group questionnaire are the following:

NAME	COUNTRY	FIELD(S) OF INTEREST
Karppinen, H.	Finland	Hologrammetry and speckle Metrology
Koskinen, K.	Finland	Solid State Imaging Systems
Ollus, M.	Finland	Solid State Imaging Systems

INFORMATION PROVIDED BY WORKING GROUP MEMBERS

Information on the different techniques covered by the Working Group, derived from the completed questionnaires and from papers presented by Working Group members at the Inter Congress Symposium in York, England is the following:

Electron microscopy

Special photogrammetric solutions have been developed for processing measurements of the nearly parallel projective imagery obtained by electron microscopy. The images are corrected for radial and spiral distortions. Enlargement factors of up to 300 000 x are used and an accuracy of 0.02-0.05µm in X,Y and 0.25µm in Z can be obtained. Image resolutions of $6x10^4$ to $8x10^4$ ℓ/mm for scanning electron microscopes and 10^6 to $1.7x10^6$ ℓ/mm for transmission electron microscopes were reported. Applications include the determination of surface topography of microscopic objects.

Hologrammetry and speckle metrology

The derivation of geometric information from holographic techniques is mainly based on double exposure holographic interferometry and laser speckle metrology. Non-invasive measurements of motions and deformations ranging in magnitude from 1µm to 1.5mm, with a potential accuracy of up to 0.3nm, were reported. Another application of hologrammetry is the storage of archival data.

Moiré topography

Moiré topography is mainly used in biostereometrics for the measurement of human forms and deformations. Accuracies of 0.1 - 0.2mm can be obtained. Techniques for automated digital recording and processing are under development which eventually will allow for real-time computer processing and analysis of moiré images.

Optical metrology

Reported were applications in the car, ship and aircraft construction industry involving intersection techniques using theodolites. A relative accuracy of 1/10000 can be obtained.

Raster photogrammetry

Raster photogrammetry involves the projection of a grid with known dimensions on the object. Three-dimensional information on the object can then be obtained from a single image which allows for simple and relatively inexpensive measuring equipment. The technique offers a possibility for automated digitizing and real-time data processing and consequently will find application in robotics and computer vision.

Solid State imaging system

Solid state charge coupled device (CCD) cameras offer a high image stability. The data can be processed by a computer in real-time and the cameras will consequently be used in robotics and computer vision. This area of rapidly increasing importance needs further development and testing of data acquisition and on-line processing techniques. It will present a possibility of applying photogrammetry not only in monitoring but also in controlling

dynamic processes. Image resolution depends on the pixel array; arrays of up to 403x512 pixels are presently commercially available.

Ultrasonic imagery

Applications of the ultrasonic recording technique were reported in biostereometrics, where it is used in the scanning of internal organs. An image resolution of 16 to 20 lines/mm can be obtained.

X-ray photogrammetry

Work is in progress to solve special geometrical conditions, such as panoramic X-rays. This technique offers the advantage of decreasing projective deformations and improving image quality. Applications of X-ray photogrammetry were reported in biostereometrics where the technique is applied to the scanning of internal organs and prostetics. Images scales are usually 1:1 and accuracies (X,Y,Z) in the 0.02 to 0.06mm range were reported.

PROGRAM FOR THE 1984 ISPRS CONGRESS

The Working Group was assigned four 1½ hour technical sessions in the technical program of the 1984 ISPRS Congress in Rio de Janeiro. These sessions will be devoted to the following topics:

1. Non-conventional imaging systems.
2. Optical systems.
3. Systems for medical applications.
4. Real-time systems and computer vision.

Papers selected from those submitted to the Working Group, will be presented at the technical sessions. In addition, a number of papers in the field of interest of Working Group V/3 will be presented in the poster sessions.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to all Working Group members for their interest and cooperation and to Sabry El-Hakim, Working Group Co-chairman, for his support and assistance in carrying out the Working Group program.