

REPORT ON WORKING GROUP II-2  
"AUTOMATIC EQUIPMENT AND SYSTEMS"

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#### ABSTRACT

The report reviews the objectives, terms of reference, and activities of the Working Group II-2 in the period 1981 - 1984. Outlined are the main trends of development in the problem area, and some consideration is given to management of the Working Group. Most pronounced trends are: transition to digital techniques, introduction of flexible distributed network systems, profound interactive capabilities and effective quality control.

#### PREFACE

The Working Group II-2 was formed by Z. Jaksic in 1977 after the domain of the former Working Group II-3 was divided into two sub-areas, i.e., one devoted to analytical instrumentation and the other to automatic equipment and systems. In 1981, the Working Group (II-2) was reactivated with minor changes in membership. With great regret, the Working Group has lost through death, two very prominent members and respected colleagues, Dr. B. Dubuisson and Prof. Dr. G. Inghilleri. We remember with great admiration the professional enthusiasm and vitality of Dr. Dubuisson, and the piercing mind, combined with a good sense of humor, of Prof. Inghilleri. Membership of the Working Group has recently been extended, i.e., to give more emphasis to all-digital systems. The list of members is presented in annex 1.

#### INTRODUCTION

Because the first-half period (1981-82) was reported at the Commission II Symposium in Ottawa, 1982, this report focusses on the second half-period (1983 - 84) and the first period is summarized only briefly.

The basic objectives of W.G. II-2 have been:

- Promoting advancement of the equipment and systems for automation of photogrammetric processes;
- Disseminating up-to-date information on the achievements in the problem area.

Accordingly the terms of reference were formulated. These concern the following main issues:

- Theoretical studies, including definitions, processing and control techniques, feasibility, etc.;
- Design of existing and new systems, digital components, and integrated systems;

- Tests and performance, concerning experimental tests and theoretical assessment;
- Impact of automation on institutional and human environment, on compatibility, support, and changing technology;

These main terms were differentiated further (vide Ottawa report). Individual W.G. members identified the areas of their interest and some more specific topics. The latter tend to reflect research and development efforts of the members. Accordingly, a plan of activities and a schedule for the W.G. events was drawn up.

This report reviews chronologically the W.G. activities, summarises the development trends in the problem area, and gives some consideration to management of the W.G.

#### SUMMARY OF ACTIVITIES DURING 1981 - 82

The W.G. was reactivated in spring 1981; it comprised 20 members. First, the existing terms of reference were reviewed, upgraded, and further differentiated. Then the effort was focussed on three major areas of interest, i.e., advances in automation, integrated systems, and tests and performance (vide Ottawa report).

Communication was mainly written, i.e., by means of the W.G. newsletters and personal correspondence. In November 1981, the first W.G. meeting took place (jointly with the W.G. II-1) in Rockville, Maryland, U.S.A. There were three joint business meetings and two technical sessions for informal presentations of papers by the members of both W.G.s (annex 2). The main aim of the Rockville meeting was preparation for the Commission II Symposium (Ottawa, 1982).

In Ottawa, two joint business meetings were held with W.G. II-1, one before and another at the end of the symposium. W.G. II-2 held two technical sessions at which 10 papers were presented covering a wide spectrum of topics (annex 3). There was also a joint panel discussion session of W.G. II-1 and II-2. The theme was "Trends in development of digital and automated instrumentation."

#### ACTIVITIES DURING 1983 - 84

After the Ottawa symposium, attention was focussed on three main areas, i.e., new concepts and development, integrated systems, and tests and performance. These areas are interdependent and partly overlapping. The intention was to attain convergency in the efforts.

Several W.G. members have contributed to new concepts and developments. G.L. Hobrough and T.B. Hobrough have developed a new system for digital stereoisage perception and mensuration for robots. R.R. Real developed a portable system for digital processing of dynamic video imagery. T.O. Binford and H.H. Baker conceived a two stage (off-line) digital image matching system, i.e., by starting with edges and then proceeding to areas. G. Pape continued and accomplished the development of the Rastar correlator, and F.A. Scarano introduced some advanced concepts for digital image matching.

J.B. Case contributed to development of an automatic all-digital photogrammetric integrated system. Z. Jaksic analysed and assessed critically the potential and problems involved in all-digital systems.

Specific data base systems and/or parts thereof have been elaborated by G. Konecny (and his group) and by several representatives of instrument manufacturers (D. Hobbie, J. Klaver, E. Vozikis).

M.M. Allam took further initiative in the ISPRS Correlation Test; new test material, data and instructions were distributed to test-participants. F.A. Scarano proposed artificial test targets and a corresponding procedure for testing. I.J. Dowman analysed data on performance of the present systems. Moreover, considerations for theoretical assessment of the performance were made by U.V. Helava and the author.

In October 1983, a colloquium was held by W.G. II-1 and II-2 in Enschede. The main objective was to plan activities for the Congress in Rio de Janeiro. To this end, the technical information was previewed in three half-day sessions (annex 4). The colloquium was attended by 23 members and several guests and friends of both Working Groups. In addition to technical sessions, two business meetings were held, i.e., to plan papers for Rio, to consider proposals for resolutions, and for planning tentatively the W.G. sessions and business meetings to be held at the congress.

At the Rio congress, two technical sessions have been scheduled for W.G. II-2 on "Automatic Equipment and Systems". In addition there will be a joint panel discussion session with W.G. II-1. The following papers are scheduled for presentation at the first W.G. II-2 session:

- B. Makarovič: "Report on Working Group II-2"
- Z. Jaksic: "Automatic equipment and systems"
- G.L. Hobrough, "Stereo correlation for large scale"
- T.B. Hobrough:
- J. Albertz, G. Koenig: "A digital stereophotogrammetric system"

For the second session have been scheduled the following papers:

- T.O. Binford: "Intelligent system for stereo-mapping"
- M.M. Allam: "The status of the ISPRS Correlation Test"
- D. Pape: "Final report on the Rastor Correlator development"
- R.R. Real: "Portable system for digital processing of dynamic video imagery".

Other papers contributed to W.G. II-2 have not been scheduled for oral presentations at the sessions because of limitation in time.

The following issues have been considered for resolutions: The future of W.G. II-2, systems and equipment for training and research, and the name of the Commission II (e.g., "Photogrammetric systems for mensuration, processing and presentation of data").

## TRENDS OF TECHNICAL DEVELOPMENT

Within the scope of W.G. II-2, the trend of development can be summarised as follows (the sequence does not imply importance):

1. Emphasis is being displaced from analogue to digital means and techniques. On-line (real-time) systems are gaining in importance in robotics, and some other - mainly short range applications (to dynamic scenes). Off-line (time-delayed) systems seem to be well suited for mapping applications (to static scenes).
2. Individual autonomous items of equipment can be interconnected i.e., forming integrated system with distributed network architecture. Its parts can be connected in different combinations thus permitting different operations to be carried out simultaneously and/or sequentially.
3. Profound pre-processing, a flexible matching strategy, use of external information and collective processing improve accuracy and reliability of the results.
4. Human engineering principles are increasingly applied in design of hardware and software for interactive operation.
5. In all process stages, quality control is being improved.
6. Optimisation is applied to overall systems rather than to individual components.

## WORKING GROUP MANAGEMENT

Basic issues of management concern the W.G. formation, i.e., its composition, planning the work and events, communication, coordinating work, and arranging meetings and technical sessions.

The W.G. composition should be such as to permit autonomous functioning, i.e., the professional backgrounds of the members should match the entire problem area, and the members should be active. This diminishes the need for cooperation with other W.G.s, which is ineffective, except their memberships overlap significantly.

The W.G. members have been involved in all essential activities and decisions, including the initial planning and the later adjustments of plans.

The W.G. meetings were scheduled jointly with W.G.II-1. In addition to business meetings, there were previews of technical information and corresponding discussions. This provided an effective exchange of information and stimulated further efforts.

Communication by newsletters (10 in total) and individual correspondence was satisfactory, although not sufficient. Personal contacts at the W.G. meetings, combined with informal paper presentations and discussions are very useful. For organized effort in specific sub-areas, formation of sub-groups is useful. This holds particularly if the members of a sub-group can work in close contact.

## RECOMMENDATIONS

Present trends of development call for continuation of the W.G. activities. An important area to be dealt with is digital off-line systems for mapping and engineering construction works. Digital on-line systems for handling dynamic scenes, such as in industry and medicine, represent another important field. Integrated distributed network systems with automatic components incorporated are also gaining in importance, as well as the interactive (man-machine) capabilities. Moreover, improved quality control should be devised for all stages of the process.

## ACKNOWLEDGEMENT

It gives me great satisfaction to express my gratitude for excellent cooperation to Z. Jaksic, President of commission II, L.W. Fritz, Chairman of W.G. II-1, M. McKenzie, Secretary of WG II-1, Mr. J. Tariel, Secretary of W.G. II-2, and to all members of the W.G. II-2. My sincere thanks also to the Directorate of ITC for generous support throughout the whole period of the mandate, and in particular at the Enschede Colloquium.

## Annex 1

## LIST OF W.G. II-2 MEMBERS

Dr. M. M. Allam (Canada), Dr. H. H. Baker (USA), Prof. Dr. T. O. Binford (USA), Mr. E. B. Brunson (USA), Dr. J. B. Case (USA), Dr. I. J. Dowman (UK), Mr. M. G. Ducher (France), Mr. S. J. Friedman (USA), Dr.-Ing. U.V. Helava (USA), Mr. G. L. Hobrough (Canada), Dr. Z. Jaksic (Canada), Prof. Dr.-Ing. G. Konecny (W. Germany), Dr. Ing. G. Lindig (W. Germany), Mr. Ph. Munier (France), Dr.-Ing. D. Pape (W. Germany), Mr. R. R. Real (Canada), Mr. M. Roos (USA), Mr. F. A. Scarano (USA), Mr. G.K. Schleibener (Canada), Dr. Ch.C. Slama (USA), Mr. R. H. Seymour (USA), Mr. J. Tariel (The Netherlands), Dr.-Ing. E. Vozikis (Switzerland), Mr. G. A. Wood (USA), Mr. H. Yzerman (Switzerland).

## Annex 2

## ROCKVILLE MEETING

November 3 - 5, 1981

List of papers (unpublished)

Allam, M. M. "Future correlation tests"  
 Munier, Ph. "Report on orthophoto questionnaire OEEPE"  
 Case, J.B. "New Developments at US DMA"  
 Perry, L. "AP Software"  
 Lindig, Ing. G. "Current state and future of correlation tests"  
 Jaksic, Z. "Data base systems and management"  
 Scarano, F.A. "Advanced correlation technique"  
 Real, R.R. "Application of new electronic components to short range photogrammetry"  
 Makarovič, B. "Feedforward adaptive control in digital image matching".

## Annex 3

OTTAWA SYMPOSIUM  
August 30 - September 2, 1982

List of papers

- Konecny, G. "Evaluation of automatic equipment in photogrammetric restitution (unpublished)"  
 Helava, U.V. "Fundamentals of stereoscanning"  
 Real, R.R. "Fast digital image enhancement for video image transfer in photogrammetric instrumentation"  
 Baker, H.H, Binford, T.O. "A system for automated stereo mapping"  
 Allam, M. M. "Limitations of current automated photogrammetric instrumentation and the potential of future fully automated systems"  
 Scarano, F.A. "Standard tests for automated photogrammetric systems"  
 Dowman, I.J. "The performance of correlation systems"  
 Allam, M.M. "Phase II of the modified ISPRS correlation test"  
 Makarović, B. "Automatic equipment and systems - interim W.G. II-2 report".

## Annex 4

ENSCHUDE COLLOQUIUM  
October 26 - 28, 1983

List of papers (unpublished)

- |                      |  |
|----------------------|--|
| Slama, Ch.C.         | "Universal software for analytical plotters"                                   |
| Friedman, S.J.       | "The AS 11 P (PASS) analytical stereoplotter system"                           |
| Hobbie, D.           | "Zeiss components for integrated photogrammetric system"                       |
| Leonhardt, J.        | "Photogrammetric data acquisition for urban land information systems"          |
| Stampa-Wessel, U.    | "Analytical topocart retrofit"   |
| Helava (for Seymour) | "Conversion of Wild B8 to analytical plotter"                                  |
| Perry, L.            | "Analytical map revision equipment" or APY (Analytical Plotter Yzerman)        |
| Yzerman, H.          | "An operational system for composite sampling"                                 |
| Huurneman, G.C.      | "Photogrammetric processes and systems"  |
| Jaksic, Z.           | "On metric effects of digital image processing"                                |
| Helava, U.V.         | "Envelope correlation for stereopsis"  |
| Hobrough, G.L.       | "Progress on Raster correlator"  |
| Pape, D.             | "Real-time digital imaging applied to moire topography in scoliosis screening" |
| Real, R.R.           | "Point transfer by digital image correlation"                                  |
| Pertl, A.            |  |

Perry, L.	"Outline on testing procedures for analytical plotters"
Allam, M.M.	"The status of ISPRS correlation test"
Dowman, I.J.	"AP testing experiences" (on performance of DSR1)
Lummaux, J.C.	"Pre-report on orthophoto equipment"
Grabmaier, K.A.	"OR-1 interfaced to PDP 11/45 computer"
Makarovič, B.	"Considerations on performance of digital off-line generation of DTM data".