

International Union for Surveys and Mapping (IUSM) Working Group Sessions



IUSM Working Group on Education (WG EDU)

Sessions IU - ED1, ED2 Status and Trends in Surveying and Mapping Education

August 8, 1992, 08:30-12:00

Session Reporter: Dr. Richard Hoisl

Chairs: Dr. Richard Hoisl and Dr. Edward Krakiwsky

The IUSM Working Group presented an overview on the "Status and Trends in Surveying and Mapping Education" in two sessions. About 70 persons attended each session.

The first session, "Summary of Studies and Symposia," provided a summary of recent activities regarding professional education in the sister organizations. The following papers were presented: ISPRS - **A. Georgopoulos** (Greece), **J. Badekas - Trends of Education in Photogrammetry and Remote Sensing: The Rhodes Symposium Experience**; IAG - **E. Krakiwsky** (Canada), **I. Mueller - Toward World Surveying and Mapping Education** (Banff Symposium); FIG - **P. Cavero** (Spain) - **Symposium on University Education for Surveyors** (Madrid 1988); **D. Woolnough** (Canada), **Kenned - The Canadian Geomatics Human Resources Planning Study**; FIG - **A.I. Allan** (UK) - **The Philosophy and Methodology of Analysing the Education and Practice of Surveyors in Europe**; ICA - **F. Ormeling** (Netherlands) - **Education and Training on Cartography 1987-1992**. The speakers gave reports on symposia, which were held by the IUSM-member organizations (FIG, IAG, ICA, and ISPRS) during recent years, and on important studies on education. The authors of papers were very competent in their topics; either they were directors of the symposia or leaders of the studies. The papers gave an informative introduction to the following second session.

The second session, "Position Papers and Panel Discussion," included speakers from IAG, FIG, ISPRS, and ICA who presented the following position papers on the respective roles in education of their societies: IAG - **R. Langley** (Canada), **E. Krakiwsky - The Role of Geodesy in Surveying and Mapping Education**; FIG - **R. Hoisl** (Germany), **S. Härmälä - Education of Surveyors as a Response to the Challenges of the Society**; ISPRS - **J. Badekas** (Greece), **G. Konecny - Surveyors Education at a Turning Point**; ICA - **R. Dahlberg** (USA) - **ICA/CET Position Paper on Cartographic Education and Training**.

The speakers were joined in a panel discussion by D. Brown, President of Geodetic Services, Inc., Melbourne, Florida; J. Morgan, Chief Surveyor, Chevron, Houston, Texas; and D. F. Taylor, Professor, Carleton University, Ottawa, Canada, to include diverse opinions. Several issues were raised and conclusions offered in the

discussion: (1) Industrial representatives cautioned that care be taken when using technologies as black boxes; modeling and quality control skills should not be abandoned when moving towards the application end of the R & D spectrum; (2) the poor financial conditions of the developing countries do not allow educators in these countries to respond in a meaningful way to the challenges outlined; thus, assistance is badly needed, (3) the days of the sister organizations working in isolation are gone and the need to integrate our activities in both the technical and educational realms is a necessity if the challenges of an application oriented society and global economy are to be met, and (4) the barriers between geodesy, photogrammetry and remote sensing, surveying, and cartography need to be removed, and integration along with a systems approach needs to be adopted in responding to user needs.

Subsequent to these sessions, the IUSM Working Group on Education held an activities planning meeting. The results of the sessions will be summarized by the IUSM Working Group on Education and will be discussed at the next working group session, to be held in 1993 during the ICA Congress in Cologne, Germany.

IUSM Working Group on Automated Control Systems (WG-ACM)

Session IU - AC1 Automated Control Measurements

Session I -- State of the Art Reviews

by IAG, ISPRS, FIG, ICA

August 9, 1992, 08:30-10:00

Session Reporter: Dr. Klaus Linkwitz

Chairman: Dr. Klaus Linkwitz

Heribert Kahmen (Austria) - **Hybrid Measurement Robots in Engineering Surveys**

Three key points were addressed: (1) Automated measurement devices have properties typical of a robot; (2) for regular, repetitive survey (control) work, survey-robot systems are appropriate; and (3) survey robot systems must be robust with respect to errors in handling and must possess a user friendly interface.

In order to increase productivity, reduce product and personnel costs, and improve product quality and reliability in connection with engineering surveys, new forms of automation had to be found. Because during surveying tasks a lot of repetitive work normally has to be done, it seems necessary to study the impact that robot systems can have on surveying systems. The paper describes optical 3D measurement techniques, the geometrical model of videometric imaging systems, and the technical components and typical structures of surveying robots. Some applications are presented.

Horst A. Beyer (Switzerland) - Digital Close-Range Photogrammetry in Industrial Measurement

Three key points were addressed: (1) Digital close-range photogrammetry has the advantage of being a non-contact procedure with a short-time data acquisition; (2) fast processing and automation are possible; and (3) the selection of appropriate camera type and system components is critical.

Digital close-range photogrammetry has evolved from a scientific research topic into a viable tool for various industrial measurement tasks. Some systems have passed pilot tests under factory floor conditions, and others have already been installed on production lines and/or are being used in industrial measurement tasks on a routine basis. A review of the development of systems and their performance is given and the state-of-the-art in various applications is discussed. The potential of the technology in industrial measurement of targeted structures, deformation analysis, surface measurement, position of parts, and quality control in general is discussed.

Adam Chrzanowski (Canada) - Interdisciplinary Approach to Deformation Monitoring and Analysis

Three key points were addressed: (1) Deformation measurements and analyses have a huge potential for application to large dams, (2) an integrated approach combining geometrical and geotechnical methods is essential, and (3) analysis necessitates an integrated approach.

Development of new methods and techniques for monitoring, analysis, and interpretation of deformations in engineering and geoscience projects has been a subject of intensive research within the activity of FIG Study Group 6C over the last two decades. Some new methods arising from the activity include the generalized method of geometrical analysis of integrated deformation surveys, the combination of deterministic and statistical models of deformation in the physical analysis, etc.

The developed methods are applicable to the analysis of any type of deformation measurements whether dealt with by geodesists, geophysicists, photogrammetrists, or by structural, geotechnical, and rock mechanics engineers. Due to the rapid progress in geodetic, geotechnical, and structural measuring techniques, the gap between the techniques used by different specialists is disappearing. A truly interdisciplinary effort is needed in exchanging information on the new developments and in the optimal use of the new methods and techniques.

Henrik Haggrén (Finland), P. Pekkinen - Stability Control of Photogrammetric Stations

Three key points were addressed: (1) In control measurements, the monitoring of the measuring devices themselves is essential, (2) the above comprises both prior set up and on-line use, and (3) the subject is of basic importance in all deformation-measurement set ups.

Automated photogrammetric stations are used for on-line control of the manufacturing processes. The

primary task is to provide on-line control with feed-back concerning those dynamic deformations which are caused by the process and measured on the products. In order to refer continually to the same (original) object reference, the stability of the station itself has to be controlled. The stability is controlled first during the set-up calibration, and then during the actual on-line use. The procedures and practical results are presented, and further needs for interdisciplinary research are proposed.

**Session IU -AC2 Automated Control Measurements
Session II -- Examples of Industrial Usage**

August 9, 1992, 10:30-12:00

Session Reporter: H. Haggrén

Chairman: Mr. Henrik Haggrén (Finland)

Toni Schenk (USA) - Machine Vision and Close-Range Photogrammetry

One key point was addressed: The information transfer process in human visual perception must be understood thoroughly in order to develop viable tools for machine vision.

The key issues of human vision which will affect future research needs as they relate to the wider usage of machine vision in photogrammetric applications were presented. The importance of understanding the visual perception process, including image formation in the human eyes, information transfer through neuro-physiological networking, and the final perceptual organization of the inference process in human brain, were addressed. The research task was divided into (1) computational theory, (2) object representations and algorithms, and (3) hardware implementation. Referring to currently installed photogrammetric machine vision systems, research needs to be concentrated more extensively on the basics rather than to straightforward hardware implementation.

Werner Bösemann (Germany) - Evaluation of Three-Dimensional Geometric Features of Industrial Objects

One key point was addressed: 3D - object geometry models need to be included in the object space based image matching process.

The author, referring to the already existing automated photogrammetric applications in industry, described the main problems as being the long processing times, the low level of automation, and the high level of skill required from users. He then pointed out the *a priori* knowledge which is available in most industrial applications: the interior and exterior orientation and the object geometry. He applied CAD surface descriptions and elementary feature information to the global matching procedure. He presented results of an experiment dealing with geometric control of industrial tooling, where the top surface was reconstructed. A structured grid was projected onto the surface. The results were compared with the known object geometry, showing an accuracy level corresponding to a 0.1-pixel precision in image space.

Peter C. Gustafson (USA), G. J. Johanning - Application of Photogrammetry in Industry

One key point was addressed: High accuracy photogrammetry has become an "off-the-shelf" tool for use in today's industry.

Four examples of high accuracy applications in industry were presented. All examples were based on the use of the ASI STARS system, routinely providing accuracies at the rate of better than 1:100,000 within rather complicated object space environments. The examples were (1) geometry verification of a sonar mold dome; (2) as-built modelling of a tank comprising wall nozzles, floor pins, and floor studs; (3) environmental testing at an antenna airborne structure in a thermal vacuum chamber; and (4) determination of the external and internal circularity of submarines. Within the last example, special emphasis was put on outside-in surveys, the task being the transfer of the exterior coordinate system to the inside of the ship. This was established by interior camera stations looking out, exterior ones looking in, and by means of two hull-penetrating rods. All examples showed the current stage of analytical photogrammetry, by means of large format analog images, to be an off-the-shelf tool for today's industry users.

IUSM Working Group on Land Information Systems/Geographical Information Systems (WG-GIS)

Session IU - GI1 GIS, Remote Sensing and Cartographic Data Integration: Theoretical and Practical Issues -- Session I

August 11, 1992, 08:30-10:00

Chairman: Dr. Jean-Claude Müller (Netherlands)

Marek Baranowski (Poland) - Land-Use Mapping from Landsat TM Images in GIS Environment

Three key points were addressed: (1) The use of Landsat 1:200,000-scale imagery without any correction, (2) the integration of vector and raster information, and (3) the development of a data set displaying land-use coverage.

The various land-use imaging stages were shown. A system called SINUS, with a set of functions analog to many existing commercial systems in GIS, was developed. A polygon image displaying land-use was shown.

J. E. Farrow (United Kingdom) -A. Coote, P. E. Haywood, D. W. Murphy - Data Integration and Spatial Change

Three key points were addressed: (1) An explanation of Ordnance Survey objectives, (2) data integration in perspectives, and (3) the possibility of supplying updates on demand. A GIS should provide the technology to do so.

A control problem of the Ordnance Survey is map revision. Revision and supply according to user views and needs are considered. It should be possible to obtain geometric improvement in the revision process.

Heinz Bruggemann (Germany) - DIM, DLM and DKM Data Integration -- The Case of "ATKIS"

Three key points were addressed: (1) Many have developed a topographic/cartographic information system, (2) two components in the system are DLM (Digital Landscape Model) and DCM (Digital Cartographic Model), and (3) traditional and digital techniques have to be integrated in the ATKIS Project.

The project has a collection of topographic mapping sources which provide the basis for an analog information system. The data set schema contains unknown models.

Bertrand Galtier (France), A. Baudoin - Image Maps

Three key points were addressed: (1) Image maps have a geometric and semantic descriptor, (2) shortcomings of the first GISs were the lack of topological descriptors, and (3) integration of image maps into GIS is still lacking. The main problem is to produce 1,000 image maps.

In a GIS, the semantic descriptor is explicit. In an image map, the semantic descriptor is implicit. The production of image maps has increased significantly.

Nanno J. Mulder (Netherlands) - A Three-Dimensional GIS Used for Model-Based Image Analysis and Cartographic Visualization

Three key points were addressed: (1) All objects in a GIS can be observed in terms of basic volume, (2) attribute assignments to volumes are not simply defined, and (3) most images in nature are three dimensional.

A mathematical topology is necessary to define the volume object. Cost function is an essential tool to measure the efficiency.

Session IU-GI2 - GIS, Remote Sensing and Cartographic Data Integration: Theoretical and Practical Issues -- Session II

August 11, 1992, 10:30-12:00

Chairman: Dr. Jean-Claude Muller (Netherlands)

R. Eric Anderson (U.S.A.), K. E. Anderson - The Development of Multisource Databases for GIS Analysis

Three key points were addressed: (1) The need to have a coherent database, (2) dealing with a very large data volume, and (3) producing land characteristics databases.

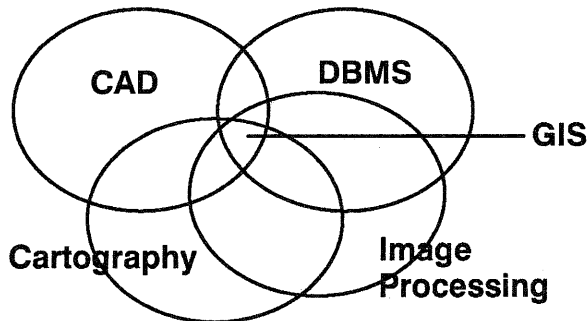
A series of maps showing integration of satellite images and vector maps at very small scale for the entire US showing vegetation has been produced. Global modeling requires multi-source databases. The purpose of the work is not limited to the production of "pretty pictures," but to the possibility of modeling the environment at the base level using GIS.

Manfred Ehlers (Germany) - GIS, Remote Sensing and Cartographic Data Integration: Theoretical and Practical Issues

Three key points were addressed: (1) The coming of

a new discipline: Bioinformatics; (2) Do we need to preserve former disciplines? and (3) Bioinformatics is more than GIS, which is just a tool.

Remote sensing needs the GIS to provide the accuracy of the databases. GIS rejuvenates photogrammetry.



Alfred Mehlbreuer (Netherlands), - Integrating Classified Remote Sensing Data and Map Data in a Digital Landscape Model

Three key points were addressed: 1) The CORINE is producing a scale accuracy which is not warranted by the resolution; 2) CORINE features are only separated by using sophisticated descriptive methods or are for accuracy from the Remote Sensing procedures in the CORINE program; 3) Twenty three percent of features needed in CORINE Aeroscan are not presently available on topographic maps.

Information system CORINE resolution is 25 ha on 1:100,000 scale.

**Session IU - GIS and LIS in a Global Environment--
Session III**

August 11, 1992, 10:30-12:00

Session Reporter: Marc D'Iorio

Chairman: Dr. Pamela Sallaway (Canada)

Susan K. Jensen (USA) - Availability of Global Digital Topographic Data

Three key points were addressed: (1) The meeting of scientific requirements for DEM, (2) integration tests with ETOPO5, DCW, and DMA DTED1, and (3) world digital topographic data will be much improved if Military level 1 data are declassified.

DCW (Digital Chart of the World) provides topographic data at a higher resolution than ETOPO5. Integration of the two provides better results because of complementary points. The best topography is obtained using DMA (Defense Mapping Agency) DTED 1 topography. These data are still classified but may be released in the near future.

Major applications benefiting from better data are better image registration and correction, resulting in better hydrology and watershed studies.

Mario Valério-Filho (Brazil), A. G. de Castro - Remote Sensing Data and Geographic Information Systems for the Characterization of Areas of Soil Erosion

Two key points were addressed: (1) Evaluation of remote sensing and GIS for erosion studies at regional scales, and (2) definition of monitoring indices for erosion.

TM imagery from September 1990, 1:50,000-scale topographic maps, soil maps, and climatology maps were integrated into a GIS to derive various erosion indices. TM data were used to determine land use.

Various erosion indices showed very different critical erosion potential, depending on whether vegetation types were taken into account.

Marc D'Iorio (Canada), J. C. Eidenshink, C. R. Morasse - Towards a North American Continental AVHRR Dataset - An International Effort

Two key points were addressed: (1) High quality integrated products are achievable, and (2) elaboration of common processing standards is important for this type of work.

A North American composite of NOAA AVHRR HRPT data is built using blocks of data processed independently at the Canada Centre for Remote Sensing and at the EROS Data Center. The preparatory work included the establishment of common standards for radiometric correction, geometric corrections, map projections, data format, compositing period/standards/methods, output products, etc. Very good results were achieved producing an NDVI map, a pseudo natural color map, and a CD ROM product.

Norman B. Bliss (USA) - Global Soil Databases for Environmental Modeling

Three key points were addressed: (1) Data from as many sources possible should be integrated, (2) a master database should be built to answer the specific needs of researchers, and (3) international collaboration is absolutely essential.

The method used is to build a conceptual framework for a master database. This database has to take into account the very high complexity of defining and characterizing soils, including parameters such as texture, structure, horizons — i.e., hierarchy in time (from seconds to thousands of years), and hierarchy in taxonomy and series — etc.

It should not be necessary to produce soil maps from scratch each time a researcher has a specific need for data. Such needs should be answered by creating a product line from this master database. International contributions and collaboration are essential to create such an information source.

Luc Daels (Belgium) - Aerial Photographs and Satellite Images as an Archives (Information Power in Horizontal and Vertical Sense)

Two key points were addressed: (1) Integration of field surveys/aerial photos/satellite imagery is essential in the study of the landscape, and (2) understanding of

historical data and human geography are factors critical in understanding the European landscape.

The use of "horizontal and vertical" integration in understanding and interpreting data was promoted. "Horizontal integration" is the use of data from various sensors and source, such as field data, aerial photography, and satellite imagery. "Vertical integration" is the understanding human settlements in the last three thousand years with respect to physical geography. One must be able to recognize patterns of human geography factors.

IUSM Working Group on Global Positioning System (WG-GPS)

Session IU-GP1 - "The Impact of GPS on Surveying and Mapping"

Session 1 – General Aspects

August 12, 1992, 08:30-10:00

Session Reporter: G. Seeber

Chairman: Dr. Günter Seeber (Germany)

Günter Seeber (Germany), Larry Hothem - The Impact of GPS on Surveying and Mapping - Introduction, Summary, Review and Prospects

Three key points were addressed: (1) The last 10 years have provided a tremendous increase in accuracy, flexibility, and application; (2) GPS has become a key factor in all fields of surveying and mapping; and (3) GPS has an integrating effect on geodesy, surveying, cartography, photogrammetry, and related fields.

Gerhard Beutler (Switzerland) - The Impact of the "International GPS Geodynamics Service" (IGS) on the Surveying and Mapping Community

Three key points were addressed: (1) GPS is a military system; this is why we need an independent service; (2) the 1992 IGS test campaign is successful; and (3) with IGS orbits, we obtain baseline accuracies of about 0.01 ppm.

The International GPS Geodynamics Service has been established as a scientific group. A first experimental campaign was run during the summer of 1992 with a number of Core Stations, about 120 epoch stations, and six processing centers. Preliminary orbit computation yields baseline accuracies about 20 times better than with broadcast orbits. Pole positions agree on a level of 0.1 milliarc seconds. It is hoped that the experiment will continue for the next year, providing precise information on GPS to the IUSM user community.

John Oswald (U.S.A.), Cannon - Present and Future Impacts of Satellite Survey Techniques in the FIG Community - presented by L. Hothem

Three key points were addressed: (1) FIG's mission is to educate surveyors in all aspects of using GPS; (2) the role of the surveyor is changing; and (3) future developments are being driven by new hardware, new processing techniques, and new applications.

GPS introduces a changing role of the surveyor; data collection is simplified, but data have to be analyzed and integrated. Surveyors are experts in reference systems (e.g., for GIS), and experts in the acquisition, analysis, storage, distribution, management, and application of data. Present uses are in land surveying, marine navigation, airborne navigation, and GIS. We will see new hardware developments, new techniques, and new applications.

Bertrand Garlier (France), M. Bernard - The Role of GPS Technology in Cartographic Products

Three key points were addressed: (1) In the production of space maps, GPS is used mainly in the determination of ground control points; (2) points have to be identified on the images before the survey; and (3) at least three points are required at both ends of an image.

Session IU-GP2 - "The Impact of GPS on Surveying and Mapping"

Session II -- Photogrammetry and Remote Sensing

August 12, 1992, 10:30-12:00

Chairman: Larry Hothem (U.S.A.)

Fritz Ackermann (Germany) - GPS Application in Photogrammetry

Three key points were addressed: (1) GPS is providing a critical need for accurate and reliable guidance and navigation of aircraft during photo survey missions; (2) from post-mission data processing, precise coordinates of camera exposure stations can be determined and incorporated in the aerial triangulation adjustment; and (3) incorporating drift parameters in the aerotriangulation adjustment will result in significantly improved accuracy when using GPS-derived camera exposure station coordinates.

GPS positioning is now being used operationally with mature software and state-of-the-art GPS receivers on camera systems. The experience in the application of GPS for photogrammetry is being extended to other airborne operations such as laser profiling. Accuracies of 15 cm have been achieved in determining changes in a vertical profile.

Kurt Kubik (Australia) - Aspects of GPS Use for Aircraft Positioning

Three key points were addressed: (1) Simple interpolations for estimating the camera exposure station coordinates can result in error that is significant; short period movement of aircraft can be several meters; (2) the filtering incorporated in GPS receivers can result in error in the timing which affects accuracy of the interpolation of the GPS coordinates; thus, one must have proper understanding of filters; and (3) predicting differential corrections must be done carefully to reflect the delay time in propagating the correction to the aircraft; this becomes very important when SA (selective availability) is invoked.

Peter M. Connors (U.S.A.) - An Integrated GPS Flight Management System

Three key points were addressed: (1) The system uses off-the-shelf hardware including a PC, GPS receiver, display, and data logger; thus, software to interface these systems offers generic input; (2) the system was developed to improve efficiency in airborne photogrammetry; the result has been a tremendous improvement in data quality and significant cost savings; and (3) staffing on the aircraft was reduced from 3 to 2 persons.

The Integrated GPS Flight Management System is a guidance and positioning system for aerial survey missions. It was developed by NOAA for operating NOAA aircraft. The system provides a complete solution to mission planning, aircraft guidance, and camera control during the photo flight mission and record keeping, data management, and documentation after the mission.

Karsten Jacobsen (Germany), K. Li - Recent Experiences in Combined Block Adjustment with Kinematic GPS Data

Three key points were addressed: (1) Determination of projection centers for the camera reference system requires accuracies of 0.1 to 1 ms; this is central for accurate interpolation of the GPS coordinates; (2) when control points are reduced, there can be significant errors in the vertical, but, with flight cross-strips, this can be effectively reduced; and (3) for accurate evaluation of

projection centers, a shift correction parameter in the aerotriangulation adjustment should be included.

The program file of BLUH incorporates a structured correction for shift and drift. Software BINGO was designed to effectively estimate aerotriangulation shift and drift parameters. Cross-strips incorporated in the aerotriangulation include only four control points and will be comparable to the use of normal conjugates of ground control with no GPS. At least two cross-strips are recommended.

Holger Schade (Germany) - Reduction of Systematic Errors in GPS-Based Photogrammetry by Fast Ambiguity Resolution Techniques

Three key points were addressed: (1) Typical GPS error sources affecting land-based operations are critical for airborne operation, but, in a moving platform at high speeds, resolving cycle slips and ambiguity will be more complex; (2) fast ambiguity resolution will not be effective unless code and carrier phase are compatible; and (3) position is rarely or not at all affected by drift error if ambiguity parameters resolved relief.

Possible methods for resolving the ambiguity function include starting and ending at known points, or use of an inertial navigation system and model in a combined block adjustment with photogrammetric data, but the method that is most promising is the method of "anything functions on the fly." But there are pitfalls that one must be aware of. GPS is easy and available for photogrammetric operators.

