Technical Session Summaries (TS)

COMMISSIONS III/IV/VII
Working Groups III/3, IV/2, VII/2

Session TS-01 - **Thematic Information Extraction from Digital Images**
August 4, 1992, 08:30-10:00
Session Reporter: Dr. Toni Schenk (USA)
Chairman: ***Dr. Toni Schenk*** *(USA)*

Nanno J. Mulder (Netherlands) - **Thematic Information Extraction and Data Fusion, Knowledge Engineering Approach to Integral Use Data from Diverse Sources**
(Invited Paper)

Key points were: (1) Data fusion = old problem, (2) a proper model must be found to solve data fusion problem, and (3) technical developments of data fusion at ITC.

To solve the data fusion problem proper constraints must be introduced. The approach is to define a search space and to use reference mechanism to constrain it. Backward chaining allows to select data which are relevant to hypothesis evaluation.

Roberto Steffensen (Canada) - **GEOCLASS, A New Approach to the Thematic Classification of Multispectral Imagery**

Key points were: (1) Multispectral mapping, (2) signature concept, and (3) considers spatial relationship of pixels.

In the approach taken by GEOCLASS system, the spatial relationship of pixels is exploited. Thus, a major disadvantage of conventional methods is eliminated. The author demonstrated the method with some examples from agricultural scenes.

Bernd-Siegfried Schulz (Germany), - **Fully Automated, High-Resolution Classification of Remotely Sensed Digital Multispectral Recordings**

Key points were: (1) Working Group III/3 program original goals have work for presentation, (2) analysis of existing methods and procedures selecting training area, and (3) evaluation of rules for aggregating training areas before and after classifications.

After analyzing existing methods for selecting training areas the author concludes: it is feasible to select aggregate and discriminate training areas automatically and it is feasible to discriminate classes with high reliability (high reclassification accuracy of training areas, no mis-classifications).

Dieter Fritsch (Germany) - **Semantic Models for Top-Down Image Data Identification**

Key points were: (1) Image understanding, (2) bottom-up approach (data driven), and (3) top-down approach, symbolic scene description algorithmic model, object oriented model.

Image understanding is presented as a bottom-up and top-down approach. The author agrees that object oriented languages should be used in the top-down approach, because of their properties to express spatial relationships.

COMMISSION IV, VII
Working Group IV/1, VII/2

Session TS-02 - **Map Production Using Digital Procedures**
August 4, 1992, 08:30-10:00
Session Reporter: Minoru Akiyama (Japan)
Chairman: ***Minoru Akiyama*** *(Japan)*

Jee-Cheng Wu (China-Taipei) - **Experience in Digital Photogrammetric Mapping**

In order to create 1:1,000 digital geographic data of Taiwan, standard procedure of stereo model digitizing and definition of coding system which is hierarchically structured for geographic entities were established.

Minoru Akiyama (Japan) - **Current Status of Digital Cartographic Data Preparation in Japan**

The achievement of the digital cartographic data preparation in Japan was introduced. There are four scale ranges of data for different applications. Small and medium scale data have already completed all of Japan, while large and very large scale data are ongoing.

Jukka Artimo (Finland) - **The Digital Mapping Process of the Basic Map of Finland 1:10,000/1:20,000**

Finland has produced digital map in three stages. In stage 1, fairly drawn maps were digitized. In stage 2 up to this year, digital data have been obtained from stereo models through analytical plotters. In stage 3 starting now is planned to be of digital map publishing.

Ammatzia Peled (Israel), R. Adler, J. Forrai - **New Photogrammetric Data Acquisition - Data Base for Digital Mapping and GIS**

National Digital Mapping Data Bases are aiming to serve National GIS/LIS infrastructure as well as to produce standard map series in digital way. Wide variety of data sources as existing maps, aerial photography of 1:70,000 and 1:40,000, satellite images of SPOT and LANDSAT and Russian space photographs are used.

Some problems existed in comprehending different accuracy data sources, and to meet different demand of GIS and map production.

COMMISSION V
Working Group V/1

Session TS-03 - **Metric Machine Vision Systems**
August 4, 1992, 08:30-10:00
Session Reporter: Dr. S. F. El-Hakim (Canada)
Chairman: ***Dr. Sabry F. El-Hakim*** *(Canada)*

Henrik Haggrén (Finland) - **Digital Close-Range Photogrammetric Systems, New Developments and Perspectives** *(Invited Paper)*

Key points were: (1) Review of present system, (2) examples of applications in industry, and (3) achievable accuracy, calibration and evaluation.

The paper summarizes the status of digital real-time close-range photogrammetry with emphasis on the MAPVISION system. The outlook for the future and areas where improvements are required have also been presented.

Hans-Gerd Maas (Switzerland) - **High-speed Solid State Camera Systems for Digital Photogrammetry**

Key points were: (1) The review of available storage media for images, (2) the review of available cameras for high-speed image capture, and (3) proposed a typical complete system for high-speed photogrammetry.

The paper gives an overview of digital photogrammetric systems, and its various components, suitable for applications requiring high-speed (faster than 30 images per second) image capture.

Ivar Maalen-Johansen (Norway) - **Close-Range Videometry - Design and Calibration of a Mono-Camera System for Dynamic Purposes**

Key points were: (1) A specially designed miniature camera system (single camera with mirrors), (2) mathematical model for distortion, and (3) the accuracy and precision results.

A specially designed miniature camera system with mirrors and only one camera, have been presented. The mirror design gives the stereo effect in a small volume. The calibration procedure and mathematical model which attempts to correct for the various distortions resulting from this arrangement was presented. The system is designed for studying the condition of cow-teats during an automated milking process.

Weiyang Zhou (USA) - R. Brock, J. Thorpe, P. Hopkins - **A Digital Photogrammetric System for Three-Dimensional Deformation Measurement**

Key points were: (1) System for surface deformation measurement, (2) matching method on dots, and (3) the self-calibration procedure.

A digital close-range photogrammetric system designed for target measurement was described. The targets are placed on object surface to measure its deformation. A matching procedure which takes advantage of the various sizes of the targets has been presented.

COMMISSION I
Working Group I/1

Session TS-04 - **Standards and Specifications in Aerial and Space Photography**
August 4, 1992, 10:30-12:00
Session Reporter: Anders Boberg (Sweden)
Chairman: ***Dr. Hartmut Ziemann*** *(Sweden)*

The President of ISPRS Commission I, Mr. Marcio Barbosa, introduced Dr. Hartmut Ziemann as Session Chairman. Unfortunately, one paper was deleted from the presentation list, and one author did not show up. However, this allowed more time to be devoted to the remaining three papers.

Dr. Hartmut Ziemann (Sweden) - **Thoughts on Standard-Related Activities in ISPRS Commission I**
(Invited Paper)

Key points were: (1) A technical or procedural standard may act as a marketing tool, and is therefore in many fields desirable, (2) the ISPRS Recommended Procedures for Calibration of Photogrammetric Cameras should be transferred into an International ISO Standard, and (3) ISPRS should establish closer contacts with international bodies with relation to standardization.

The need for closer international cooperation on the field of standardization of procedures related to image acquisition and processing was stressed. Suggestions for resolutions and other actions were given, being to a large extent on line with what is currently discussed in the General Assembly.

Comment:

Professor Torlegård confirmed that Council has recommended the General Assembly to incorporate standardization matters into the Statutes and Bylaws of ISPRS.

Sergei S. Nekhin (Russia), V. G. Afremov, V. B. Ilin, I. Yu Afanasiev, N. M. Babashkin - **Evaluation of Aerial Photographs Taken by Forward Motion Compensation Cameras**

Two aerial cameras of different types, each with two different black and white film types, were test flown over a 2 km X 2.4 km large test area. The test area was targeted with 340 signals of the Maltese cross type. Improvements in resolution when using forward motion compensation were shown. Apparently, high-contrast targets were used, and the films were developed to rather high gamma- values (1.8-2.3).

Kennert Torlegård (Sweden) - **Test-Field and Self-Calibration of Fiducial Marks**

Key point was test-field camera self-calibration should include the fiducial coordinates as unknowns.

To the collinearity equations, including interior and exterior orientation parameters and distortion corrections, equations for fictitious observations of eight fiducial marks were added. For linearization, the

structure of the matrices as well as possible singular cases were explained.

By a simulation study, possible accuracy improvements were shown, and the effects of different a priori weights were discussed. Corner fiducials showed lower accuracy than mid-side fiducials.

COMMISSION II
Working Group II/5

Session TS-05: **Integrated Photogrammetric Systems**
August 4, 1992, 10:30-12:00
Session Reporter: Dr. Atef Elassal (USA)
Chairman: ***Dr. Atef Elassal*** *(USA)*

This session was attended by over 400 delegates.

Branko Makarovič (Netherlands) - **Integrated Photogrammetric Systems: Status and Outlook**
(Invited Paper)

Characteristics of high performance and low cost systems were presented.

Q: R. A. Saleh

Does the distinction between high performance versus low cost system hold in view of lowering of cost of computing power, RAM and storage capabilities?

A: B. Makarovič

High performance system not only needs high computing power but also other components, such as high resolution images and handling capability.

To convert low cost to high performance system, almost all components will need to be replaced. This is not at all cost effective. In order to have high performance systems, it is preferred to develop it as required. An intermediate solution may be justifiable to upgrade low cost system into a high performance system.

Wolfgang Faig (Canada), J. Olaleye - **Integration of the Kern DSR-11 Analytical Plotter into a GIS**

Standalone and integrated operational systems were discussed. The various components, the photogrammetric workstation, GIS/LIS/ Data Base Management System, Data Base and User interaction were inter-related in a configuration.

Comments:

Paul Newby on the importance to purchasers, users, mapping organizations, of the vendors providing the facility for the integration of their photogrammetric systems with the existing digital mapping on geographic information systems. The vendors should please note the importance of this aspect and not just try to sell complete systems which do not fit into the purchaser's history.

Luis Cogan (Switzerland), L. Hinsken - **The Concept of a Photogrammetric Workstation Outlined by the Example of the LEICA SD2000**

A photogrammetric workstation constitutes: controller integrating the various components i.e., host, stereoviewer, frame buffer (digital image processing), film and CCD camera input with user interaction.

Q: Jim Case

What is the cost effectiveness of digital/softcopy systems versus classical analytical plotter systems?

A: L. Cogan

Digital systems tend to become cost effective in the future with the lowering of cost of digital system components.

Otto Kölbl (Switzerland) - **Popularization of Photogrammetry**

Key points were: (1) Photographic and geometric importance in photogrammetry for environmental concerns, and (2) integration of spatial data with GIS.

Q: Wolfgang Förstner

How do you automatically detect breaklines before you do matching and how long will it take until each family buys such a system?

A: O. Kölbl

This aspect is for research. DTMs may be used to obtain potential breaklines in the first phase. These are then verified in the matching process and accepted or rejected.

Families will not buy such a system until price of GIS corresponds to the price of the word processor.

Lewis A. Lapine (USA) - **Introducing New Technology - - A Manager's Prospective**

Key points were introduction of new technology and strategies of implementation which were as follows: developmental stage; test and evaluation for acceptance; implement and train; fine tuning and production streamlining.

Q: Ismael Colomina

How do you solve the problem of loosing lock on satellite?

A: L. Lapine

The satellites are chosen to be higher than 15 degrees above the horizon, and during a mission the aircraft is not banked greater than 15 degrees. This avoids the loss of lock on a satellite.

COMMISSION VII
Working Group VII/4

Session TS-06 - **Applications of GIS/Image Analysis in Non-Renewable Resources**
August 4, 1992, 10:30-12:00
Session Reporter: Dr. Wijn Langeraar
Chairman: ***Dr. Tsehaie Woldai*** *(Netherlands)*

Vernon Singhroy (Canada), C. Bowie, P. Barnett, F. Kenny - **Lithologic and Quaternary Mapping in Glaciated Vegetated Areas Using SAR and TM Images**

The key points were: (1) Remote sensing and especially image processing have proved valuable in arid to semi arid environments, (2) little work is done in tropical regions or vegetated areas of the world, and (3)

radar can assist in overcoming much of these problems.

Much of the research done using satellite remote sensing has proven successful in arid to semi arid environments where vegetation is almost absent. The work focuses on vegetated areas as well as glaciated and using radar for lithologic and quaternary mapping and emphasizes the possibility existing. The use of airborne SAR data in combination with TM proved valuable, especially if the SAR was taken with a 45° incidence angle.

Carsten Jurgens (Germany) - **Soil Erosion Assessment and Simulation by Means of SGEOS and Ancillary Digital Data**

Key points were: (1) Using remote sensing to solve universal soil equation, and (2) using GIS to graphically present a soil erosion susceptibility map.

Using the universal soil equation a number of parameters were solved by using remote sensing and image processing. The study area is north of Saarburg, Germany (4 km X 4 km). The land use parameters in the equation was extracted by a supervised land use classification. By taking the three principal components of 12 band data sets (90% of the information). During classification very few pixels were wrongly classified but only two-thirds of the area could be classified.

Slope and slope length were automatically determined using DTM. All other parameters in the universal soil equation were derived from existing maps or fieldwork. The result is a soil erosion susceptibility map which was arrived at using a GIS.

Important in the research was that geocoding must be done precisely. Predictable result of the map was the vineyards were the most susceptible to soil erosion (steep and long slope).

H. van der Meer Mohr (Netherlands), T. Woldai, P. van Dijk - **Monitoring Environmental Pollution in a Coal Mining District, Montalban Area, Spain**

Key points were: (1) Coal mining, and the pollution resulting from it, is a major hazard facing the area today, (2) satellite data are excellent tools used in detecting such environmental hazard areas, and (3) image processing techniques must opt for a better enhancement method to extract valuable information from the remotely sensed data.

Selective image processing techniques have been used in identifying and monitoring environmental pollution in a coal mining district in Montalban, Spain. the optimal index factor developed by Chavez assisted in selecting the best images with optimum information. The latter data was treated with various methods of enhancement procedures in order to extract mine polluted area which proved successful.

Adel F. Abdel-Kader (Egypt), M. A. Essawy, S. E. Smith - **Landsat and SPOT Investigations in Sinai Peninsula, Egypt**

Key points were: (1) Geological and geomorphological information on Sinai and selected areas of Sinai using remote sensing, and (2) evaluate the capabilities and inherent characteristics of Landsat TM and SPOT to solve specific geologic problems.

Geological investigation using Landsat TM and SPOT was done for Sinai, Egypt. Four major lineament trends were recognized. The most prominent being the 15°-20° trend. The latter controls the mineral deposits in the area mainly iron and manganese. IHS gave a better discrimination of the deposit. Ratioing was also tried.

Correlation was done on petroleum occurrences using the same procedure. The major trends control the occurrences of paleo-alluvial fans which occur during rifting.

COMMISSION V
Working Group V/2

Session TS-07 - **Calibration and Evaluation of Close-Range Sensors--Session I**
August 4, 1992, 13:30-15:00
Session Reporter: Dr. John G. Fryer (Australia)
*Chairman: **Dr. John G. Fryer** (Australia)*

Horst A. Beyer (Switzerland) - **Advances in Characterization and Calibration of Digital Imaging Systems** *(Invited Paper)*

Key points were: (1) Understanding the imaging system, (2) locating errors in CCD systems, and (3) calibrating CCD systems.

An overall summary of the entire calibration of a CCD system. All aspects from lighting to target sizes to lenses and sensors, etc. were reviewed with respect to error sources and calibration techniques.

G. Strunz (Germany), Christian Heipke, M. Stephani, R. Lenz - **Photogrammetric Calibration and Point Determination Using a Digital CCD Camera**

Key points were: (1) Use of digital CCD camera, (2) improvement in accuracy using piezo-controlled chip movement, and (3) target location by template matching and contour-polygons.

The development of a high resolution CCD camera from a more basic one using piezo-controlled movement of the chip was explained. The calibration and performance of this camera system was described. Different algorithms for the location of images were used.

Stuart Robson (United Kingdom) - **Film Deformation in Non-Metric Cameras Under Weak Geometric Conditions — an Uncorrected Disaster?**

Key points were: (1) Influences of unmodeled image coordinates on final object coordinates, (2) film unflatness, and (3) film deformation corrections.

Results of simulated photogrammetric surveys using a Hasselblad camera with a 100-point reseau were presented. Variations caused by changing film types and film backs were discussed. The "local bilinear" method of image correction was shown to be the best interior

orientation method. Errors in final coordinates were related to the film unflatness.

Ingolf Hådem (Norway), K. Åmdal - **High Precision Calibration of a Close Range Photogrammetry Systems**

Key points were: (1) Dimensional control in industry, and (2) calibration of a test field by various methods.

Variations in the numbers of control points, camera types and calibration methods were made in a series of tests. The use of "given" distance for calibration was not advised due to possible errors arising from ill-conditioning--much better to use control points which were well-distributed.

COMMISSION III
Working Group III/1

Session TS-08 - **Geographic Information Theory**
August 6, 1992, 08:30-10:00
Session Reporter: Dr. Martien Molenaar (Netherlands)
Chairman: ***Dr. Martien Molenaar*** *(Netherlands)*

Martien Molenaar (Netherlands), R. Groot - **Geo-Information Theory: Why and What** *(Invited Paper)*

Key points were: (1) The introduction of (geo-) information systems confront organizations with the need to redefine their mission and their structure to fulfil this mission, (2) the formulation of a business, an information technology and an organization strategy requires a frame work based on a geo-information theory, (3) such a theory should give a linguist approach to geo-information, interrelating its syntactic, semantic and uncertainty aspects, and (4) this theory could serve as a framework for developing geo-data models and the related processing models.

Y. Benard (Canada) - **Spatial Data Modelling: The Module-R Formalism and CASE Technology** *(Invited Paper)*

Key points were: (1) We need a good geo-information theory so we can describe consistently the geographic world from a human perspective, not a machine perspective, (2) we need a standard formalism (language) to do so, and (3) we need software tools to do this efficiently, including translation to a computer language.

Efficiency goes through an "automated" (as much as possible) workflow, so it is easier and faster to go back and forth (since we never build the "perfect" design the first time!). A lot of work in this direction already exists in the information technology community (i.e. software and systems engineering), let's not reinvent the wheel but benefit from their experience.

M. Isdale (Canada), Y. C. Lee - **An Object-Oriented Modelling Framework for Geographic Information**

Key points were: (1) Object-oriented concepts are useful, (2) a prototype was developed, and (3) the prototype is extensible.

The object-orientated paradigm provides useful spatial modelling concepts. A prototype was implemented using Eiffel. the implementation provides basic tools for a user to enhance the framework.

Allan J. Brimicombe (Hong Kong) - **Responsibility, Uncertainty & Fitness-for-Use: Implications for Geo-Information Theory**

Key points were: (1) Current approaches to uncertainty have serious shortcomings; narrow consideration of accuracy, binary consideration of accuracy and use of global measures; (2) data must be proactive about its uncertainty at the level of the object; and (3) a model is put forward as an organizational framework for progress in uncertainty research in GIS.

A model has been suggested in order to guide and give perspective to research efforts in the area of error and uncertainty in GIS. It assumes that observation of uncertainty, its propagation in analysis and its visualization by the user may not necessarily use the same metric and may involve verbalizations. The user can assess fitness-for-use for a particular context and by running sensitivity analysis, establish requirements for improvement or updating of the base data. An example of how to use the model was presented.

Li Deren (China), Gong Jianya - **A Unified Data Structure to Represent Vector and Raster Data in GIS**

The key points were: (1) Unified data structure to represent vector and raster data, (2) it is based on linear quadtree, and (3) it supports object-oriented data models.

The presentation gives a new data structure - unified data structure for an integration system with GIS and RS. This data structure is based on linear quadtree. In order to improve the representation precision of raster. This data structure can have the advantages of raster data and vector data. It can be used to carry out topology query and set operation. On the other hand, it supports object-oriented data model.

Gong Jianya (China), Li Deren - **Object Oriented Data Models in GIS**

Key points were: (1) An object-oriented approach, (2) unified data structure, and (3) integration system including geometric and attribute data.

The presentation gives a review of object-oriented data model. the authors proposed a view-point: object-oriented data model is suitable for geometric data and attribute data. The object-oriented geometric data model is like topology model and the object-oriented attribute data model is also better than relational data model. By using this data model, it is easy to establish a integration system with geometric data, attribute data and RS data.

COMMISSIONS VII
Working Group VII/1

Session TS-09 - **Spectral Signatures**
August 4, 1992, 13:30-15:00
Session Reporter: Dr. Gérard Guyot (France)
Chairman: ***Dr. Gérard Guyot*** *(France)*

Gérard Guyot (France), Xing-Fa Gu - **Intercomparison of Multisensor Satellite Images** *(Invited Paper)*

Key points were: (1) Radiometric errors introduced when using sensors having different passbands, and (2) significant differences between BRDFs in XS-2 and XS-3.

Problems were introduced by differences in passband positions between SPOT and TM, particularly in the visible directional differences between XS-2 and XS-3 even through little vegetation. A cross comparison of TM-4 with XS-3 with directional and spectral effects show significant differences.

Paul J. Curran (United Kingdom) - **Estimating Foliar Chemical Concentrations with the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS)**

Key points were: (1) Imaging spectrometry data may be able to be used in models for the carbon cycle, (2) some results of airborne work have shown good agreement with laboratory measurements of lignin, and (3) ability to decompose spectra and use stepwise regression is important.

Surveyed mainly U. S. activities in foliar chemical concentrations using imaging spectrometry.

Richard Escadafal (France), A. R. Huete - **Soil Optical Properties and Environmental Applications of Remote Sensing**

Key points were: (1) Interest in soil spectra-normalized to 900 mm helps differentiate soil types, (2) AVIRIS, TM, SPOT and AVHRR can be used to detect soil color, and (3) first derivative of reflectance helps differentiate spectral shapes.

NDV1 does not work well with AVHRR broad bands. Soils are not a grey background. Spectral features allow differentiation of soil types. There is a need to account for spectral signatures in mixels. In the future there will be modeling of soil spectral features for establishing digital data bases.

Xing-Fa Gu (France) - **Analyse et Correction des Effects de la FTM sur les Images de SPOT-HRV**

Key points were: (1) Correction for MTF effect shows artificial target can be made much clearer; (2) differences are between 30 and 40 (for example less than 50% occurs about 13% of the time), and (3) showed improvement of merging pan and XS after MTF correction.

Output of sensor must be corrected for MTF and atmospheric adjacency effect to improve image clarity and radiometric fidelity of imagery.

Jan G.P.W. Clevers (Netherlands), B.A.M. Bouman, C. Büker, H.J.C. van Leeuwen - **A Conceptual Framework for Estimating Crop Growth Using Optical Remote Sensing Data**

Key points were: (1) Relate LAI and LAD is a possibility. Improved accuracy of estimating crop growth; (2) use red edge index from AVIRIS chlorophyll-optical properties prospect relates LAI to chlorophyll content, and (3) LAI and NDVI% show good agreement with SAIL and experimental results.

Use RS for improving crop growth modeling. Initiation and calibration of growth model using RS. Data from MAC Europe '91 campaign, Flevoland test site (Netherlands), and Sample and Universal CROp growth Simulator (SUCROS). Use leaf color, angle and LAI from RS monitoring LAI and LAD using "2 look concept" using CAESAR.

COMMISSION VII
Working Group VII/3

Session TS-10 - **Renewable Resource Inventory and Monitoring with Remote Sensing/GIS - Session I**
August 5, 1992, 08:30-10:00
Session Reporter: Galen F. Hart (USA)
Chairman: ***Dr. Gabor Remetey-Füllöp*** *(Hungary)*

Paul T. Tueller (USA), A. C. Yuan, C. C. Geddes - **Feature Extraction From Landsat TM Pixels - An Example From Shrub Dominated Rangelands**

Key points were: (1) Rangelands are spectrally complex and basic spectral characteristics are not well known, (2) all pixels are "mixed" and it is of importance to identify the key components that constitute the pixel, and (3) pixel component modeling is used to "estimate" the important range variables.

The approach gave satisfactory results, except for plant litter. The best relationships were provided by normalized indices - the NDVI (TM band 4 minus TM band 3 divided by the sum of the bands) and a modified version of the NDVI provided good results.

Tania M. Sausen (Brazil), E. E. Wangui - **Landsat Imagery and GIS Application in Studying Consequences of Deforestation on the Environment: Case Study Vale do Paraiba do Sul**

Deforestation of tropical rain forests has attracted worldwide attention. A consistent source to temporally study the magnitude of the situation is Landsat data. Landsat TM data from 1984, 1988 and 1989 were combined in a GIS to create an environmental degradation map of the Vale do Paraiba. Products like this can be valuable to decision makers for current and future actions.

COMMISSION I
Working Group I/2

Session TS-11 - **Sensors and Platforms for Remote Data Acquisition - Session I**

August 5, 1992, 08:30-10:00
Session Reporter: Dr. Christian Heipke (Germany)
*Chairman: **Dr. Decio C. Ceballos** (Brazil)*

Philip N. Slater (US) - **Ways of Radiometrical Calibration of Sensors in the Solar-reflective Range Using On-board Solar Diffusers & Ground Sites as References** *(Invited Paper)*

Key points were: (1) Categories of optical remote sensing sensors, (2) preflight calibration, and (3) inflight calibration.

Radiometric accuracy of various sensors differs between 1-10% of the grey values. Inflight calibration is much more accurate than preflight calibration. Ultrastable radiometers should be used as reference. Many independent calibration methods should be used to achieve optimal results. At least one sun-reference method should be used.

Jörg Albertz (Germany), H. Ebner, C. Heipke, G. Neukum, F. Scholten - **The Camera Experiments HRSC and WAOSS on the Mars 94 Mission**

Key points were: (1) Two digital 3-line CCD cameras on a Russian satellite to planet MARS, (2) high resolution stereoscopic views (10 micron pixel size on the ground), and (3) evaluation of imagery using photogrammetry, cartography, shape from shading, spectrometry and photogeology.

Main objective of the mission was as follows: generation of digital terrain models from stereoscopic image data, mapping of morphological features, production of orthoimages and orthoimage maps and improvement of the geodetic control network of Mars. Time Schedule is for launch in November 1994 and begin imaging Mars in October 1995.

Douglas J. King (Canada) - **Development and Application of an Airborne Multispectral Digital Frame Camera Sensor**

Key points were: (1) Low cost airborne remote sensors, (2) off-the-shelf components only, and (3) digital CCD camera.

A low cost airborne digital CCD camera was presented. Color images can be acquired sequentially using a color wheel. Applications are foreseen in planning, disaster monitoring and forestry. Mapping applications will be limited due to the small field of view.

Torbjörn Westin (Sweden) - **Interior Orientation of SPOT Imagery**

Key points were: (1) Improvement of geometric accuracy of SPOT, (2) radial and tangential distortion, and (3) errors due to misalignment of 4-linear CCD arrays per "virtual" CCD line.

The distortion of SPOT due to the misalignment of the four separate 1778-point CCD arrays and due to distortions of the optics is corrected for using multiple imagery. The errors found are in the order of 0.2 pixels (less than or equal to 2 microns). Empirical investigations confirm the results.

Ying Chen (USA) - **A Rigorous Calibration Method for Digital Cameras**

Key points were: (1) Critical aspect in digital photogrammetry is the accuracy of the image acquisition device; (2) general calibration method for line and area CCD cameras; and (3) RMS errors after calibration in the range of 0.1 pixel.

A mode for the calibration of digital cameras is presented. Radial, tangential distortion and linear CCD movement errors are introduced and solved for sequentially. Promising results from the calibration of three different sensors are presented.

COMMISSIONS III & V
Working Group II/1

Session TS-12 - **Advances in Development of Analytical Stereoplotters**
August 5, 1992, 08:30-10:00
Session Reporter: Daniel S. Andrews (USA)
*Chairman: **Morris L. McKenzie** (USA)*

Morris L. McKenzie (USA) - **Advances in the Development of Analytical Stereoplotters. Working Group II/1 Report for 1988 - 1992** *(Invited Paper)*

Key points were: (1) DVP was illustrated; (2) the new Intergraph analytical stereoplotter was mentioned and noted that it was on display in Exhibits; and (3) these instruments and others were described as to their role in the development of the technology.

The speaker outlined the main objectives of WGII/1. The planned workshop was cancelled. A "procurement package" was submitted. Four reports were prepared and issued, and are available free upon written request. The new WGII/1 name proposed is "Real Time Mapping Technologies."

Ludwig Hock (Germany), E. Dorrer - **Real Time Processing of MOMS-02 Linear Array Imagery for Analytical Stereo Restitution**

Key points were: (1) MOMS-02 sensor will be carried on second German spacelab mission call "D2". The launch date (18-02-93), global coverage, and orbital parameters were outlined; (2) objective is to investigate stereo restitution of analog imagery; and (3) computational factors were discussed. Continual visual stereo perception is a characteristic of the system.

The MOMS-02 sensor will have 4.5 meters resolution and a 37-km swath. The linear array imagery is intended for stereo restitution using Zeiss Planicomp P2 analytical instruments. A reference scale of 1:50,000 was indicated. Future - integration will be into PHOCUS environment for data collection.

Eugene L. Marley (USA) - **Progress in Point Marking for Aerial Triangulation**

Key points were: (1) New instrument was developed which permits aerotriangulation data collection on an analytical stereoplotter (OMI) without modification; (2)

test done before delivery to U. S. Government. Report was published. The most recent product is a laser device that differs from earlier models; and (3) it is adaptable to analytical stereoplotters without modification, at a reasonable price. It was privately developed.

Dr. Helava's vision resulted in this product. Zeiss Jena patented a laser point marker in 1970s. A laser device vaporizes the emulsion and delivers a clean mark at 60 or 90 micrometers. It has been extensively tested and the developers are satisfied that the system will support softcopy operations. It also complements GPS operations in photogrammetry.

Q: K. Jacobson

Process - will it disturb the model in the plotter. A photo-point image rather than artificial point is better?

A: E. Marley

"confidence" of marked point is better.

Q: R. Saleh

Assumption is that the digital image has 15 micrometer resolution threshold. Point marking can do better than this. So we would lose accuracy of identifications of points by going to a digital environment?

A: E. Marley

The question will be passed on to Dr. Helava.

Q: D. Andrews

What is the cost and availability?

A: E. Marley

Not priced, but will be on market soon with a cost comparable to the PUG-4.

Michael H. Elfick (Australia) - **A CCD Eyepiece for Analytical Instruments**

Key points were: (1) There is a need for improved pointing, impersonal observations, and reduced operator effort; (2) uses include fiducial measurements, reseau point measurement calibrations, and performance checks; and (3) procedures include self calibration of cameras, problems include illumination, noise (dirt, etc. in field of view), and frame grabber control.

The hardware and concept for a CCD eyepiece have been developed. Observation times and accuracy are being measured and are being improved during tests. The device appears reasonably effective.

A. Chapuis (Switzerland), Wilfried Muller - **A New Method of Calibration for Analytical Photogrammetric Workstations**

Key points were: (1) Origin and source of instrument errors are outlined. In the past, mechanical means and affine transformations were used to reduce these errors. (2) Leica DSR design was described. Large, expensive solution. Later instruments such as SD2000 and SD3000 are smaller and use better methods to reduce error. Correction grid and DSRCAL are used operationally. and (3) CCD cameras used in factory calibrations.

Newer instruments have better method of calibration and error reduction than the old. CCD cameras are used for factory calibration. They have numerous advantages over old methods, and auto-measurements are used for measuring marks and cross detection. Correction grids are generated. Errors were outlined. Calibration accepted if errors are within factory tolerance, which is very small. Hysteresis effects (moving mechanical parts) are present in all mechanical instruments and factory tests must be passed. Sequence of measurements was described for SD2000. Effects of temperature changes were characterized.

Q: M. McKenzie

Nonperpendicularity of X and Y axes. How bad before this is judged to be a problem?

A: A. Chapuis

An affine transformation is used anyway. 1 or 2 degrees is OK.

COMMISSIONS III/V

Session TS-13 - **Computer Vision and Computer Graphics**

August 5, 1992, 10:30-12:00

Session Reporter: M. Kempa (Germany)

Chairman: ***Dr. Bernhard P. Wrobel*** *(Germany)*

Reinhard Koch (Germany) - **Model-Based 3D Scene Analysis from Stereoscopic Image Sequences**

Key points were: (1) 3D scene analysis with stereoscopic image frequencies, and (2) scene reconstruction.

An approach for the modelling of complex 3D scenes such as outdoor street views from a sequence of stereoscopic image pairs was presented. Starting with conventional stereoscopic correspondence analysis, a 3D model scene with 3D surface geometry is generated. Not only the scene but also the surface texture is stored within the model. The 3D model permits the detection and correction of geometric errors by comparison of synthesized images with real input images through analysis by synthesis techniques. 3D camera motion can be directly estimated from the image sequence. Experiments with a model of a single house have been presented.

Olivier D. Faugeras (France) - **Three Dimensional Vision and Mobile Robots** *(Invited Paper)*

Key points were: (1) Image sequence analysis, (2) Kalman-filter for motion extraction, and (3) fusion of consecutive stereo frames.

Image sequences are analyzed for guidance of a mobile robot, first with respect to a single camera image sequence and then with stereo images. In both cases corresponding line segments have been used as measurements with noise. Consecutive frames have been linked together by Kalman-filtering, thereby estimating the state vectors and the covariance matrix. The Kalman approach is based on the assumption of locally constant velocity. Many examples from indoor scenes have been presented.

Peter Durisch (Switzerland) - **Photogrammetry and Computer Graphics for Visual impact Analysis in Architecture**

Key points were: (1) Image synthesis, (2) ray-tracing, and (3) visual impact analysis.

A method is presented to produce realistic computer generated color images for the judgement of aesthetic properties of planned buildings. They are embedded into the existing environment by a computer montage in 3 dimensions. During interactive preprocessing, a 3D description of the existing is created; geometrical data, atmospheric parameters and illumination parameters are retrieved from digital site photographs. The final image, combining the planned building and the environment, is represented by the site photographs and rendered by an extended ray-tracing algorithm. This was demonstrated by several examples.

John S. Powers (USA) - **An Information Theoric Image Visualization System**

Key points were: (1) Entropy, (2) image processing based on information theory, and (3) evaluating satellite imagery.

A system has been described which enables digital, multispectral imagery to be viewed via the metrics of information theory. Such images possess utility by revealing subtle environmental structures in satellite imagery and the ability to reveal distortions of the image acquisition process.

COMMISSION IV
WORKING GROUP IV/3

Session TS-14 - **Progress in Map Revision Processes**
August 5, 1992, 10:30-12:00
Session Reporter: Dr. O. Kölbl (Switzerland)
Chairman: ***Paul R. T. Newby*** *(United Kingdom)*

Ivan Katzarsky (Bulgaria), S. Postadjian - **Bulgarian Experience in Devising Automated Technology for Large-Scale Mapping**

Key points were: (1) Digital mapping, (2) modernization of analog plotters, and (3) national data base.

Bulgaria conceived a procedure for digital plotting in large scales. The procedure is based on analog plotters such as the stereo metrographics and makes use of the IBM compatible PC's produced in Bulgaria. The system seems to give satisfaction in production. The main purpose of the system is map revision.

Graeme Wilkinson (Italy) - **A Study on the Automatic Revision of the European Community's CORINE Land Cover Database Using Satellite Data**

Key points were: (1) Land use mapping, (2) comparison of automatic feature extraction with visual interpretation, and (3) satellite imagery.

CORINE is a land cover database conceived for the whole Europe and is currently finished for Portugal, Luxembourg and parts of other countries. It is established by photo interpretation and consists of 44 classes. Under favorable conditions 25 classes could be updated automatically from SPOT data but important classes are misinterpreted such as complex cultivated areas or construction sites.

Audience Discussion:

A lively discussion ensued on the problems of establishing and maintaining a sensible land cover classification for areas as large and diverse as the whole of the European Community. The early work is admitted to have been rather subjective which poses problems for update, especially where more experienced interpretation and automatic change detection indicates a different classification but minimal changes on the ground. The author remains optimistic on the project and the promise of automated change dectection.

Rune Solberg (Norway), J. Tallhaug - **Semi-Automatic Revision of Topographic Maps from Satellite Imagery**
(Presented by Oystein B. Dick)

Key points were: (1) map revision by SPOT images, and (2) supervised detection of roads.

The aim is the conception of a prototype computer system for map revision in scales of 1:50,000 using SPOT data. The work presented concentrated on the detection of old roads in SPOT images guided by existing maps. The map content was digitized and the road information extracted. This approach allowed for recognition of most of the corresponding roads in SPOT images, but manual control and editing is clearly necessary.

Bo Malmstrom (Sweden), A. G. Engberg - **Evaluation of SPOT Data for Topographic Map Revision at the National Land Survey of Sweden**

Key points were: (1) Map revision in forest areas, and (2) use of SPOT images in comparison with high altitude aerial photographs.

The study concentrated on the revision of topographic maps by SPOT images and high altitude photographs in heavily forested areas. Both images gives an accuracy of 65-75%; serious problems arise for the threshold tree size of 1.5m as specified for maps. The handling of urban areas appears to be more problematic.

A. Van Voorden (Netherlands), M. Van Persie - **Accuracy of Superimposition**

Key points were: (1) Mono superimposition; (2) accuracy in central field of view of 6-10μm, and (3) accuracy at the periphery 60-150μm due to calibration errors.

The study analyzed the precision of image superimposition in analytical stereoplotters using mono systems. Three systems were used but their type was not communicated. The precision in the central area of the field-of-view was found between 5-10μm whereas at the periphery discrepancies between 60-150μm were found. A better instrument calibration should allow for a great reduction of these errors.

COMMISSION V
WORKING GROUP V/4

Session TS-15 - **Industrial Measurement Applications**
August 5, 1992, 10:30-12:00
Session Reporter: Dr. Heinz Ruether (South Africa)
Chairman: ***Dr. Heinz Ruether*** *(South Africa)*

Horst A. Beyer (Switzerland) - **Automated Dimensional Inspection with Real-Time Photogrammetry**

Key points were: (1) Real-time (RT) photogrammetry is viable for industrial inspection; (2) automated RT systems must be robust and accurate; and (3) accuracy enhanced through on-line, self-calibration of cameras.

A practical implementation of a near real-time digital photogrammetry system was discussed. An experiment was performed to show that RT photogrammetry was a viable technique for the automatic measurement of car bodies subject to deformation through crash testing. Low-cost, off-the-shelf CCD cameras were employed in a multi-camera, multi-station geometry to yield object point positioning accuracies of better than 1mm. Image mensuration accuracies of 1/20th of a pixel were demonstrated within an industrial environment. Problems of targeting, lighting and stability were alluded to.

Anne Legac (France) - **Three-Dimensional Measurements by Hybrid Methods (Photogrammetry and Theodolites)**

Key points were: (1) Close-range photogrammetry and digital theodolites can be used together to form a hybrid measurement system for industry; and (2) integration of photogrammetry and theodolites into a single measurement network and mathematical models for object point triangulation must accommodate observation data from different measurement systems.

An account of the use of close-range photogrammetry and digital theodolites to form a hybrid 3-D measurement system was given. It was shown that there are many industrial measurement tasks that are more suited to the hybrid approach. Examples covering an Arianne rocket, the TGV brain, a turbine blade, and a large radiotelescope were presented. These tasks required very high accuracy and involved a high density of object target points. The importance of using interchangeable and/or adaptable targeting was stressed, as was the need to realize the potential and limitations of each of the measurement tools forming the hybrid system.

Andrew R. Marshall (Australia) - **Photogrammetric Methods for the Inflight Verification of Attitude Sensor Accuracy**

Key points were: (1) Dynamic photogrammetry was employed for the measurement of helicopter attitude, in flight; (2) the use of synchronized metric cameras was discussed; and (3) photogrammetry provided a means to calibrate an on-board INS attitude sensor.

The use of synchronized cameras for the measurement of in-flight orientation of a helicopter by photogrammetric means was described. Two CRC metric cameras, with synchronization via an infrared triggering system, were employed to monitor the positions of approximately 20 targets on the underside of a helicopter flying at an altitude of 100m over a test area. From the photogrammetric data it was possible to determine helicopter heading, pitch and roll angles and thus to provide a dynamic calibration of the on-board INS attitude sensor to an accuracy of better than 0.5°. Various aspects of the project were touched upon, from targeting to the synchronization and timing problem, to the mathematical model and network geometry limitations.

V. Uffenkamp (Germany), K. Güther, J. Peipe - **Photogrammetric On-Line Quality Control in a Furniture Factory**

Key points were: (1) On-line, digital photogrammetry is utilized for QC inspection in an industrial environment; (2) the system is being designed to measure 0.1-0.2mm accuracy of various sizes of kitchen panels, and (3) edge detection techniques are utilized to extract corner and edge measurements.

The use of an on-line, digital photogrammetric system for the QC inspection of kitchen furniture panels was reported. The system comprises a single reseau-scanning camera (RSC) which images the four corner areas of the finished chipboard furniture panels. Through edge-detection techniques, both the corner points and the sides are measured, thus providing a dimensional check of the panel. This function is performed in a few seconds to 0.1-0.2 mm accuracy. Through a rectification process, the measurement data is compared against a control field. Special considerations are given to lighting and edge pitting problems.

COMMISSIONS II/III
Intercommission Working Group II/III

Session TS-16 - **Design and Algorithmic Aspects of Digital Systems**
August 5, 1992, 15:30-17:00
Session Reporter: W. Kornus (Germany)
Chairman: ***Dr. Heinrich Ebner*** *(Germany)*

Heinrich Ebner (Germany), I. Dowman, C. Heipke - **Design and Algorithmic Aspects of Digital Photogrammetric Systems, Intercommission Working Group II/III Report to Commissions II and III**
(Invited Paper)

Key points were: (1) What is a digital photogrammetric system? (2) Summary of the activities of the working group, and (3) main results.

H. Ebner first gave a definition of a digital photogrammetric workstation and outlined its functionality, performance and practical use. Next he summarized the activities of the intercommission

working group II/III. There were three meetings in the last two years in London (Feb. '90), Boulder (Mar. '91) and Munich (Sep. '91). All contributions have been published. H. Ebner finally summarized the main results of these meetings and formulated some proposals for the further development of digital photogrammetric workstations.

Franz Leberl (USA) - **Design Alternatives for Digital Photogrammetric Systems** *(Invited Paper)*

Key points were: (1) Changes in the photogrammetric mapping process, and (2) design issues of a photogrammetric system.

F. Leberl first discussed the overall mapping process and the forces which change that process. The main change issues he focussed on, were: a) GIS, b) control points, c) visualization and animation, and d) sensing. He then began to speak on the design issues of a photogrammetric workstation: a) number of computers per uses, b) standards, c) data quantities, d) display monitors, e) pointing, f) transfer data rates, g) comparison between orthophoto systems and stereo systems, h) stereo viewing, and i) operation systems. He concluded that the technology and application drives are outside of photogrammetry and in the GIS-domain.

Edward M. Mikhail (USA) - **Quality of Photogrammetric Products From Digitized Frame Photography**

Key points were: (1) Data evaluation on an analytical stereoplotter, (2) data evaluation on a digital photogrammetric system, and (3) comparison and analysis of the results.

Prof. Mikhail reported on results of data evaluation issues, both on a DSR analytical stereoplotter and an HAI digital photogrammetric workstation. The results were separately analyzed and compared for the interior, relative and absolute orientation process and the generation of digital elevation data, spot heights and orthoplotter. He concluded that the quality of cartographic products, derived by a digital photogrammetric system is good and the productivity is quite high. However more extensive testing is required to draw firm and general conclusions.

John E. Farrow (United Kingdom), K. J. Murray - **Digital Photogrammetry -- Options and Opportunities**

Key points were: (1) Use of digital photogrammetry within the Ordnance Survey, (2) options, available from the use of this technology, and (3) possible market opportunities.

J. E. Farrow first gave some background information on the Ordnance Survey policy. Then he came to speak of digital photogrammetry. He outlined the different options, which arise from the use of this technology. Input, output, hardware and software aspects were discussed. Next he reported on some trials with a digital photgrammetric system at the Ordnance Survey. Finally possible market opportunities were explored.

Eckhard Siebe (Germany), B. Pollak, J. Schiewe - **A Digital Photogrammetric Workstation for the Evaluation of Space Data**

Key points were: (1) MOMS-02/D2 project, (2) plotter configuration - hardware, and (3) plotter configuration - software.

E. Siebe first gave some general information about the MOMS-02/D2 project. Within this project a digital photogrammetric workstation is developed at the University of Hannover. He outlined the hardware and software requirements and showed the actual configuration based on a SOM4/370 and an accelerated bound VX. Tasks and planned functions of the digital plotter were described.

COMMISSION V
Working Group V/5

Session TS-17 - **Architectural and Archeological Photogrammetry**
August 5, 1992, 15:30-17:00
Session Reporter: Ross W. Dallas (United Kingdom)
Chairman: ***Ross W. Dallas*** *(United Kingdom)*

Manfred Fellbaum (Germany) - **Low Cost Surveying Systems in Architectural Photogrammetry**
(Invited Paper)

Key points were: (1) Equipment suitable for architectural photogrammetry, and (2) review of systems (3) cost effective solutions.

A very useful review of low cost systems, all of which could be applied in architectural photogrammetry.

M. A. R. Cooper (United Kingdom), S. Robson, R. M. Littleworth - **The Tomb of Christ, Jerusalem; Analytical Photogrammetry and 3D Computer Modelling for Archaeology and Restoration**

Key points were: (1) Project in architectural photogrammetry, (2) unusual and difficult project to carry out, and (3) presentation of results interesting - CAD.

A very interesting report on the survey of a difficult site. Methodology not particularly new or original. Presentation of results through Integraph and CD-ROM.

Raffaella Brumana (Italy), G. Galeazzo - **St. Marcus' Basilica in Venice, an Application of Image Projection on a Dome**

Key points were: (1) Study of representation problems, (2) complex object - three dimensional dome, and (3) solution through CAD graphics.

The paper reported work as part of a research project in analyzing forms of representation of architecture. Particularly complex problem of interior of dome, solved by computer representation on VDU screen.

Robert Godding (Germany), G. Sacher, G. Siedler - **Multispectral Analysis of Digital Image Data in Architectural Photogrammetry**

Key points were: (1) Digital image processing, (2) application to architectural facades, and (3) results can show stone types, etc.

Value of applying DIP techniques seems potentially very valuable, but little work done. Therefore paper very valuable step in exploring this field. Work still in early stages of research, but very interesting results being obtained.

A. Georgopoulos (Greece), T. Kokkas, J. Badekas, K. Damianidis - **Recording Traditional Ships**

Key points were: (1) Recording ship hulls, (2) photogrammetric method is best, and (3) new area for WG V/5.

Although not strictly architecture or archaeology, this work is very much related, as ships as artefact are very vulnerable. Most useful review of techniques (including theodolite survey) concluded photogrammetry is the best method of recording.

COMMISSION VI
Working Groups VI/2, VI/7

Session TS-18 - **Education and Training in Photogrammetry and Remote Sensing**
August 5, 1992, 15:30 - 17:00
Session Reporter: K. Atkinson (United Kingdom)
Chairman: ***Dr. Gregory P. Ellis*** *(Australia)*

W. Schuhr (Germany), G. Konecny - **Training and Educational Aspects on Remote Sensing Image Geometry** *(Invited Paper)*

Key points were: (1) Syllabus for teaching in Photogrammetry and Remote Sensing, (2) Selected slides for training in R.S. image geometry, and (3) relationship with ISPRS Commission responsibilities.

W. Schuhr summarized the present content of Photogrammetry & Remote Sensing teaching at the University of Hannover, and explained how Remote Sensing teaching has been incorporated within the syllabus.

Kennert Torlegård (Sweden) - **Changes in Swedish Higher Education in Photogrammetry and Remote Sensing** *(Invited Paper)*

Key points were: (1) Change in structure of courses at KTH, Stockholm, (2) mathematics and science, engineering base, competence and specialization, and (3) surveying can include real estate economy and planning.

Mathematical and science base - 1st year; Surveying engineering base - 2nd year; Competence - 3rd & 4th year; MSc thesis - 5th year. Final plans may still be modified.

Keith B. Atkinson (United Kingdom), R. W. Graham, R. Hepton - **Air Survey Photography: Educational Innovation**

Key points were: (1) Unique course in air survey photography, (2) taught with academic and commercial partners, and (3) industry links to access current equipment.

In 1991 a new course in air survey photography was initiated at the University College London. Flying for navigation and photography is provided by Photo Air and Aerial Imaging Systems. Curriculum details are given in the paper.

Kevin Jones (Australia), C. Bellman, G. Ellis - **The Challenge of Providing Photogrammetric Education for the 21st Century**

Key points were: (1) Obsolete equipment, maintenance costs, course content becomes obsolete; (2) high replacement costs, and (3) challenge is to provide education which is relevant now and suitable for the future.

Lack of resources, large class size and rapid change. Solution lies in digital photogrammetry, using conventional PC's and turnkey systems. Problem solving, links with GIS and RS in modular approach, and franchised education.

R. Douglas Ramsey (USA) - **Teaching Remote Sensing Project Design & Management at the Undergraduate Level**

Key points were: (1) Geographic applications of remote sensing, and (2) examples of projects were cited and two described in detail.

The speaker summarized project based teaching of remote sensing within a first degree in geography.

COMMISSION V
Working Group V/4

Session TS-19 - **Photogrammetry and CAD/CAM: The Industrial Connection**
August 6, 1992, 08:30 - 10:00
Session Reporter: Dr. Clive S. Fraser (USA)
Chairman: ***Dr. Clive S. Fraser*** *(USA)*

David Paul Chapman (United Kingdom), A. T. Deacon, R. Kotowski, A. Hamid - **CAD Modelling of Radioactive Plant : The Role of Digital Photogrammetry in Hazardous Nuclear Environments** *(Invited Paper)*

Key Points were: (1) CAD modelling in radioactive environment, (2) role of digital photogrammetry in hazardous environments, and (3) CCD cameras mounted on geodimeter.

The role of digital photogrammetry within dangerous nuclear environments and the interaction with a 3D-CAD system was described. The presentation made it

clear that a remote system was highly advantageous for refurbishment, inspection, maintenance and decommissioning of equipment in a radioactive environment. The use of two CCD cameras, one with a wide angle lens to obtain the general coverage and the other with a long angle lens to concentrate on the area of interest, which are both mounted on a geodimeter for flexibility, was described. Convergent imagery with naturally targeted points is used and very close linking with the CAD system is implemented.

R. M. Littleworth (United Kingdom), D. M. Stirling, J. H. Chandler - **Three-Dimensional Mapping and As-Built Computer Modelling by Analytical Photogrammetry**

Key points were: (1) 3D-CAD models from analytical photogrammetry, (2) modelling of as-built structures, and (3) conventional cameras.

Some interesting examples of the use of 3D-CAD models were described and the need to produce models which satisfy the user's requirements was mentioned. The models were obtained through analytical photogrammetry using conventional cameras. The problem of transferring these models between different CAD systems was mentioned. The presentation also highlighted the fact that models derived from as-built structures may not always agree to the original specifications within the stated tolerances, due to the original specifications within the stated tolerances, due to the actual dimensions of the structure.

Francesco Angrilli (Italy), G. Bianchini, G. Fanti, M. Mozzi - **On Line Dimensional Measurements of Glass-Made Components by Means of an IR Computer Vision System**

Key points were: (1) On line dimensional measurement using CCD cameras, (2) the use of high-pass filters, and (3) infra-red computer vision system.

The measurement of glass vials during the manufacturing process using an on-line digital camera system was described. The difficulties imposed by the environment were highlighted. The system configuration was mentioned and the use of infra red and high pass filters for measuring hot objects was discussed. Some results from this system were given.

Moreno Rampollis (Italy) - **Photogrammetric Survey of a Large Offshore Platform During a Dynamic Phase**

Key points were: (1) Use of conventional photogrammetry to measure large object, and (2) dynamic monitoring.

The use of conventional photogrammetry to measure the deformations of a moving offshore platform was described. The measurements take place in the dockyard with two measuring epochs during the movement of the structure. It was concluded that photogrammetry was a suitable technique for achieving the requirements for such surveys.

COMMISSIONS II, VII
Working Groups II/2, VII/2

Session TS-20 -**Systems for Integration of GIS and Remote Sensing**
August 6, 1992, 08:30 - 10:00
Session Reporter: David R. Steiner (Germany)
Chairman: ***Dr. Manfred Ehlers*** *(Germany)*

Approximately 250 persons attended this session.

Jeffrey L. Star (USA), J. E. Estes - **Systems for the Integration of Remote Sensing and GIS** *(Invited Paper)*

Key points were: (1) Processing requirements for Remote Sensing and GIS are different; (2) processing capabilities are increasing rapidly. At the same time physical size and price are decreasing. (3) There are three levels of integration: 0 - separate and distinct hardware and software; 1 - common hardware, separate software; 2 - total integration (Does not exist).

There are large costs in the Level 0 which may outweigh any advantages. There are more advantages to Level 1, while the costs remain the same. The costs of Levels 0 and 1 become the advantages of Level 2. Level 2 costs include increased complexity in software development and the need for suitable, common data structures.

Nickolas L. Faust (USA) - **Geographic Information Systems and Remote Sensing Future Computing Environment - An Update** *(Invited Paper)*

Key points were: (1) The need to make sense of huge amounts of available spatial data will require advanced processing capabilities; (2) this processing capability is becoming available to more and more users in the form of parallel processing; (3) "Network Processing" is an important technology for increasing processing capability.

Rapid increases in processing and capabilities are facilitating the development of tools for the integration and processing of remotely sensed and GIS data.

Tapani T. Sarjakoski (Finland), J. Lammi - **Requirements of a Stereo Workstation for GIS Environment**

Key points were: (1) Stereo workstations offer some advantages over the use of orthoimages in GIS applications (i.e., no DEM required); (2) In addition to being sufficiently powerful, the workstation should be personal, low cost, have a single interface with a uniform design, and be easy to use; and (3) stereo workstations will be used by end users of various capabilities for a multitude of applications.

Stereo workstations should be based on multipurpose workstations with minimal hardware extensions. The system should be modular and standardized but customizable for a variety of users and applications.

Gerhard Koenig (Germany), J. Storl, F. Wewel - **A Digital Stereophotogrammetric System in a GIS Environment**

Key points were: (1) Development of a multi-platform, networked photogrammetric systems (ADSS); (2) the system uses transputers to parallelize data processing; (3) the system uses tools provided by ARC/INFO to integrate digital photos with GIS data.

The Technical University of Berlin has developed an integrated photogrammetric/GIS system to use photographic data for building and updating GIS databases.

COMMISSION VI
Working Groups VI/1, VI/2, VI/3, VI/4, VI/7

Session TS-21 - **History, Terminology, Economics and Standards of Photogrammetry and Remote Sensing**
August 4, 1992, 13:30 - 15:00
Session Reporter: Dr. John Badekas (Greece)
Chairman: ***Dr. John Badekas*** *(Greece)*

Hans-Peter Böhr (Germany), A. Schwender - **Was Heisst Hier - Fernerkundung? - Translation of Technical - Scientific Concepts**

Key point centered on the various approaches for creating/translating words and terms.

A universal terminology should evolve, independent of linguistic or national bias.

Hand-Peter Böhr (Germany), G. Lindig - **ISPRS Multilingual Dictionary - General Status and Progress of German Language Group**

The key point raised is that there are three official ISPRS languages and 16 primary world languages. It is hoped that the ISPRS multilingual dictionary can be produced in the 16 world languages. Gradual but good progress has been made in this project.

Sanjib K. Ghosh (Canada) - **History of Photogrammetry - Analytical Methods and Instruments**

He reported that he has completed Chapter 6 of the proposed book on History of Photogrammetry.

Li Deren (China) - **From Photogrammetry to Iconic Informatics - on the Historical Development of Photogrammetry and Remote Sensing** *(Invited Paper)*

Key points were: (1) Changes in science and technology, environment, user need to our discipline, progress in discipline; (2) structural changes in photogrammetry - New Photogrammetry(?); and (3) integration of remote sensing with photogrammetry and with GIS.

Iconic informatics is a new term coined for combining geosciences, remote sensing and information technology.

Zbigniew Sitek (Poland) - **Report of WG VI/1 Activity (1988-92) - Report of the Editorial Board for Volume III The History of Photogrammetry**

He reported that progress remains incomplete. Contribution or cooperation from contributing authors appears to be delayed or lacking.

Karlheinz Güthner (Germany), J. Peipe - **PC Assisted Translation of Photogrammetric Papers**

Key points were: (1) Data flow: text input, recognition, translation, layout, target language; (2) hardware configurations; and (3) software, word processing, translation programs, dictionary priorities.

COMMISSIONS VII, I
Intercommission Working Group VII/I

Session TS-22 - **Tropical Forest and Land Use Monitoring**
August 6, 1992, 10:30-12:00
Session Reporter: Bob Ryerson (Canada)
Chairman: ***Dr. Leo Sayn-Wittgenstein*** *(Canada)*

Z. D. Kalensky (United Nations) - **FAO Remote Sensing Activities in Environmental Monitoring and Forest Cover Assessment in Developing Countries** *(Invited Paper)*

Key points were: (1) Remote sensing is a large and very important center in the FAO since it serves all of FAO, (2) remote sensing is important since there is no alternate survey technology for forest monitoring, and (3) GIS has multiplied the benefits of remote sensing.

The FAO remote sensing group has several components: technology transfer, field projects support and environmental monitoring. Two projects were described: Africa Real Time Environmental Monitoring Information System (ARTEMIS) and the Tropical Forest Action Plan. The latter provides a strategy for sustainable management of forest resources tailored to individual countries. There are four components: forest resources and land use; forest based industry development; fuel wood and energy and conservation.

Advantages and constraints of various remote sensing systems were reviewed. The importance of real time monitoring as part of an early warning system was emphasized.

G. Sicco Smit (Netherlands) - **"A Good, a Better or the Best Remote Sensing Application System" for Tropical Rain Forest Survey in the Amazon Region**

Key points were: (1) The tools of remote sensing are aerial photos and satellite images, (2) additional information used is from a data base or geoinformation system, and (3) ground data is essential to bring the data sets together to derive an accurate result.

Sherry Chen (Brazil) - **The Role of NOAA-AVHRR Data in Vegetation Monitoring of the Amazon Region**

Key points were: (1) Spectral similarities exist between savannah and deforested areas, and (2) using AVHRR data and maximum likelihood classification, you will underestimate deforested areas because of misclassification of boundary pixels

The work reported was on forest deforestation using Landsat TM and real time forest fire monitoring using NOAA imagery. Advantages and disadvantages were discussed, including costs, data, availability, spatial resolution, etc. NOAA Channel 3 was the best single NOAA Channel for identifying development. Fire fronts are visible on the thermal imagery.

Frederick Campbell (Canada), F. J. Ahern, R. K. Raney - **Canada's Tropical Forestry Initiative in Latin America - An Airborne SAR Program**

Key points were: (1) Canada's airborne radar system acquired C band SAR imagery in Costa Rica, Venezuela, Brazil and Guyana in April 1992; (2) forested and nonforested areas could be clearly distinguished based on texture and shape. Some forest typing could be done; and (3) A variety of management related information could be obtained.

A large dataset has been provided to cooperators in all of the countries in this Canada-ESA funded venture. Preliminary results are encouraging. Based on work using ERS-1 and Radarsat simulations in Canada, it would appear that ERS-1 imagery cannot be routinely used to monitor cut-over areas. The success of the Radarsat simulations compared to ERS-1 has been attributed to difference in incidence angles.

COMMISSION III

Session TS-23 - **Progress in Photogrammetric Data Analysis : New Theories and Algorithms**
August 6, 1992, 10:30-12:00
Session Reporter: Dr. Li Deren (China)
Chairman: ***Dr. Li Deren*** *(China)*

Kurt Kubik (Australia) - **Photogrammetric Restitution Based on Linear Features** *(Invited Paper)*

Key points were: (1) Photogrammetric resolution, and (2) industrial metrology.

The problem of relative and absolute orientation, and restitution is discussed, when only lines are available on the object, instead of points. The minimum number of lines required for these operations is discussed, and the applications of the method is given.

Gerhard Brandstätter (Austria) - **Notes on the Direct Projective Transformation of General Stereo Pairs into the Rigorous Normal Case by Image Correlation**

Key points were: (1) Projective transformation, (2) normal case, and (3) image correlation.

The normal case is defined by means of rotational parameters. Therefrom results a simple structure of the matrix of correlation, so that all five parameters of relative orientation can easily be derived from the coordinates of the epipole and the third column of the correlation matrix. Error propagation is discussed and an application to a stereo pair is shown.

Fritz Ackermann (Germany) - **Operational Rules and Accuracy Models for GPS Aerotriangulation**
(Invited Paper)

Key points were: (1) Additional terms allow for datum transformation and GPS drift correction in combined block adjustment, provided singularities are avoided by use of some four control points and cross-strips; (2) GPS-AT is of high precision, operationally simple and most economic; and (3) empirical results confirm the theoretical accuracy expectation and show that the method is ready for practical application.

Relative kinematic camera positioning by differential phase observations is precise in the order of 5 cm or better. Parameters for datum transformation and potential drift errors take all flight restrictions away. For their determination a few (4) ground control points and cross strips are necessary.

The theoretical accuracy of combined GPS block adjustment has been extensively studied for various control and parameter scenarios. The results prove the general high accuracy level of GPS blocks and show in detail the influence of ground control and GPS accuracy on the blocks. GPS is applicable to the full scale range of photogrammetric mapping.

Some empirical results of test blocks and pilot blocks confirm the theoretical accuracy expectation. They also demonstrate that GPS supported aerial triangulation is operational and ready for practical application.

Egon Dorrer (Germany) - **Investigations into the Recovery of MOMS-02 Three-Line Camera Orientation by Means of Knowledge-Based Image Processing**

Key points were: (1) Three-line camera, (2) orientation, and (3) image processing.

The paper summarizes a preliminary study on determining changes in orientation of spaceborne MOMS-02 imagery caused by singular time limited disturbances both of position and attitude. A principal way of solving this problem is shown, where two distinct differences are considered. Due to the premature state of the investigation no results are shown.

COMMISSION IV
Working Group IV/7

Session TS-24 - **Global Land Cover Mapping and Global DEM**
August 6, 1992, 10:30-12:00
Session Reporter: Dr. Ryutaro Tateishi (Japan)
Chairman: ***Dr. Ryutaro Tateishi*** *(Japan)*

Koji Kajiwara (Japan), R. Tateishi - **Problems of NOAA GVI Data for Global Land Cover Monitoring**

Key Point was a clarification of problems inherent in NOAA GVI data.

The authors pointed out that NOAA GVI data have several critical problems for global land cover monitoring. They are atmospheric effects by the change of solar zenith angle, sampling problem, effects by wide scan angle and defect of maximum vegetation index composite method.

M. Wolf (United Kingdom), D. J. Wingham - **A Global Inventory of Digital Topographic Data**

Key point was about a worldwide survey of DEM from 352 organizations.

The author presented the result of a survey on digital topographic data provided by 352 worldwide organizations. The result includes data source, scale, cost, etc. He concluded that currently the best digital topographic data which covers the whole earth surface is ETOPO 5 with a 5 minute grid spacing.

Piotr Laskowski (USA) - **An Ideal Map Projection for Global GIS Output**

Key point was a proposal for a new map projection with less distortions which is more suitable to the output of global data.

The author proposed a new map projection, "Tri-Optimal World Projection" for the output of global data. It has minimum error properties which simultaneously minimize the equal-area, conformal, and equidistant distortions.

Isabelle Veillet (France) - **Accuracy of SPOT Triangulation with Very Few or No Ground Control Points**

Key point was obtaining a relative accuracy of 25m in XYZ over a 200 km x 200 km area from SPOT data.

The author investigated the accuracy of 3D coordinates obtained from SPOT images without GCP by block adjustment. She reported the accuracy by standard deviation (relative accuracy) and RMS (absolute accuracy). The result was within 25 meters relative accuracy in XYZ for a 200 km x 200 km test area.

COMMISSION V
Associate Group

Session TS-25 - **Robot Vision and Navigation**
August 6, 1992, 13:30-15:00
Session Reporter: Dr. Reimar Lenz (Germany)
Chairman: ***Dr. Reimar Lenz*** *(Germany)*

Christian Hock (Germany), E. D. Dickmanns - **Intelligent Navigation for Autonomous Robots Using Dynamic Vision** *(Invited Paper)*

Key points were: (1) 4D - modelling, and (2) inclusion of dynamic behavior.

An operational system for guidance of autonomous vehicles was explained and shown.

Kenneth Edmundson (USA), K. Novak - **On-Line Triangulation for Autonomous Vehicle Navigation**

Key points were: (1) Stereo camera, and (2) multisensor integration.

A GPS guided vehicle with a stereo camera setup was shown to be operational.

Th. Kersten (Switzerland), Armin Gruen - **Sequential Estimation in Robot Vision**

Key points were: (1) Givens Transformation, and (2) accuracy of consumer cameras.

The Givens Transformation is found to be far superior to simultaneous estimation. Also, with a consumer CCD-camera, an accuracy of one tenth of a pixel was obtained.

Nassir Navab (France), Zhengyou Zhang - **Fusion of Visual Data Through Dynamic Stereo-Motion Cooperation**

Key points were: (1) Stereo matching, (2) temporal matching, and (3) ego-motion estimation.

COMMISSIONS II, IV
Working Groups II/3, IV/4

Session TS-26 - **Accuracy and Quality Standards of Photogrammetric Data**
August 6, 1992, 13:30-15:00
Session Reporter: M. M. Radwan (Netherlands)
Chairman: ***Jon Kure*** *(Netherlands)*

Jon Kure (Netherlands), M. M. Radwan - **Final Report of WG IV/4 : Standards for Photogrammetric Procedures** *(Invited Paper)*

The paper gives guidelines for the establishment and verification of quality standards of photogrammetrically collected data. Elements considered: positional accuracy, attribute accuracy, data history, logical consistency, data security, data decay. Accuracy issues were considered at various phases: data collection, data storage and processing, data presentation. (Several tables of quality values were given.) Various error sources and their contribution to accuracy were discussed. Measures of attribute accuracy were proposed. The paper presents the advantages of giving true data quality standards for mapping managers and map users.

Hiroshi Murakami (Japan), R. A. Welch - **Automatic Feature Extraction for Map Revision**

Key points were: (1) Map data provided the initial threshold values for image segmentation; (2) expert system approach permitted control of the iterations required for feature extraction and the refinement of threshold values; (3) two to four times smaller pixel resolution was required to achieve machine feature extractions comparable to those of human interpreters.

Gary Ducher (France), I. Dowman - **An OEEPE Test on Orthophoto and Stereo-Orthophoto Accuracy**

Key points were: (1) If the DEM is derived from the same photography as the orthophoto, the orthophoto may be enlarged by up to five times; (2) if the DEM can be derived from smaller scale photography then considerable savings in cost can be made; (3) the scale of the original photograph to be rectified is the most critical factor; and (4) the scale of the DTM has the least impact.

Corne P. J. M. Van Elzakker (Netherlands), B. Ramlal, J. Drummond -**The Visualisation of the Quality of GIS Generated Information**

The presentation aims to show the integration of known cartographic theory with studies in the GIS provision information qualities statistics carried out at ITC. Three aspects were considered: lineage, position and attribute qualities. The presentation of quality information uses the "display" capabilities to permit the visualisation of these quality statistics. Cartographic theory provides means and visual variables to visualize qualitative, ordered or quantitative information. Examples given show how lineage, position and attribute qualities can be visualized (case study).

Ole Jacobi (Denmark) - **Updating Cartographic Data Bases - Merging Old and New Data**

To place new objects in an existing database, the same reference system must be used and a least square adjustment of the new and old observations must be carried out. If old information are kept fixed, the geometric quality of the database will deteriorate in the successive update.

With respect to generalization: it is a problem in integrating minute survey of objects with a course survey of objects in the same database. This is due to lack of mathematical theory to describe generalization.

When objects in the database are variable in accuracy and varying levels of details, it is important to assign "quality" codes to objects and to indicate how measurements are made.

COMMISSION VII
Working Group VII/5

Session TS-27 - **Ocean and Coastal Zone Monitoring with Remote Sensing**
August 6, 1992, 13:30-15:00
Session Reporter: Dr. K. A. Ulbricht (Germany)
Chairman: ***Dr. Klaus A. Ulbricht*** *(Germany)*

Adel F. Abdel-Kader (Egypt), A. S. Ayoub - **Environmental Assessment of Hurghada Coastal Zone, Red Sea by Thematic Mapper Data** *(Invited Paper)*

The development of the Egyptian Red Sea coast has been under heated debate. A multi-million dollar tourist industry conflicts with planned oil operations. The objective of this study is to assess by use of Landsat-TM, the coastal sensitive environments of the Hurghada area. An approach of combined digital image processing and manual image interpretation was adopted to assess, identify and map subjectively shoreline characteristics, land use and land cover as an first step toward the development of an Environmental Sensitivity Index. The most environmentally sensitive areas were found to be mainly coral reefs, beaches and rare plant species.

Sima Bagheri (USA) - **Water Quality Modeling of Nearshore Waters Using Integrated Remotely Sensed Data and In Situ Measurements**

It is the objective of this study to use integrated remotely sensed data acquired by Landsat-5 Thematic Mapper and Airborne Multispectral Video Camera with in-situ surface water sampling for water quality investigation in New Jersey nearshore waters. Statistical analyses were performed to establish predictable relationships between multiplatforms remote sensing detected signals and in-situ concentration of phytoplankton pigments/total suspended sediments. These analyses are prerequisites for using remote sensing to effectively evaluate, monitor and manage the water quality in New Jersey nearshore waters.

Alexander M. Chekalyuk (Russia), M. Yu Gorbunov - **Laser Remote Sensing of Phytoplankton Photosynthetic Activity In-Situ**

New techniques and special double-pulse LIDAR system for measurements of horizontal distributions of phytoplankton photosynthetic activity were described. By using these techniques it is possible to carry out rapid remote monitoring of the sea surface from on board a moving platform (vessel, helicopter, aircraft) with a high spatial resolution (up to 100 m). Photosynthesis efficiency is estimated by the value of the relative yield of chlorophyll-a variable fluorescence. The results of laboratory experiments and examples of applications in oceanography investigations were presented.

COMMISSION VII
Working Group VII/7

Session TS-28 - **Applications of Expert Systems and Artificial Intelligence in Environmental Management**
August 7, 1992, 08:00 - 10:00
Session Reporter: Dr. D. G. Goodenough (Canada)
Chairman: ***Dr. David G. Goodenough*** *(Canada)*

Manfred Sties (Germany), K. Segl - **Experiments with Statistical Classifiers**

Key points were: (1) Modified classification algorithm to get confidence values for each pixel after classification; (2) the confidence values can be used in a reasoning process to post-process the classified image; and (3) post processing based in confidence values improves the classification.

Traditional Maximum Likelihood Classification is not satisfying, because no confidence values for the pixels are

produced. A modified classification algorithm has been developed. It is based on the distance between classes. It results in a ranking of the classification results for each pixel. A resulting set of images is produced: Best (highest ranked class), 2nd best, 3rd best and so on. Each image is accompanied by a "confidence image". Postprocessing is carried out by reasoning on these confidence values, using a moving 3 x 3 matrix. Visual interpretation of the result shows that some misclassifications are removed.

M. I. Heard (UK), P. M. Mather, C. A. Higgins - **GERES: A Prototype Expert System for the Geometric Rectification of Remotely-Sensed Images**

Key points were: (1) An expert system with a graphical user interface; (2) two modes: novice and expert; (3) user driven, i.e., the user supplies points and the expert system gives advice; and (4) background geometric registration of images requires expert knowledge.

The expert system is developed in C and PROLOG. It is a highly modular system. Reasoning is performed by backward chaining. It does transformation functions, analyzes the spatial distribution of the ground control points and it explains and justifies the decisions. Currently, research is carried out to do automated ground control point detection.

Andrew Finegan (Australia) - **A Methodology to Design an Expert System for Remote Sensing Technology Management**

Key points were: (1) Method for information/expert knowledge gathering, and (2) soft system methodology.

A methodology was presented describing how to gather information for an expert system. It is based on "soft system methodology". It aims at solving problems of technology management and technology transfer.

Yasunori Terayama (Japan), Y. Ueda, K. Arai, M. Matsumoto - **A Comparative Study on the Methods for Estimation of Mixing Ratio Within a Pixel**

Key point was a comparison between three methods for estimation of mixing ratio within a pixel using simulated data.

The study compared three methods: (a) Least squares method with a generalized inverse matrix; (b) Maximum Likelihood Method; and (c) Least squares method minimizing the estimated mixing ratio. The comparisons were carried out using simulated data. The Maximum Likelihood Method gave the best result.

COMMISSIONS II, III, V
Working Groups II/5, V/3, IC II/III

Session TS-29 - **Algorithms and Software Concepts for Digital Photogrammetric Workstations**
August 7, 1992, 08:30 - 10:00
Session Reporter: H. Mayer (Germany)
Chairman: ***Dr. Heinrich Ebner*** *(Germany)*

Toni Schenk (USA) - **Algorithms and Software Concepts for Digital Photogrammetric Work Stations**
(Invited Paper)

Key points were: (1) Surface reconstruction, (2) perceptual organization, and (3) object recognition.

The presentation was confined to concepts and methods of machine vision that can be used for close-range photogrammetry. A short introduction into the paradigm of computer vision was given. It was shown that there are different goals and approaches for surface reconstruction in machine vision and in photogrammetry. An introduction into perceptual organization was given. For the object recognition problem the "feature matching with geometric constraints" was shown as an example. In the conclusions the importance of approaching the problem on a theoretical level and of improving education was emphasized.

Branko Makarovič (Netherlands) - **Considerations on Image Matching -An Engineering Perspective**

Key points were: (1) Image matching, (2) input technique - output differentiation, and (3) engineering perspective.

A differentiation of image matching according to input, matching techniques and output was made. For the input the importance of geometric constraints and conditions as well as of image entities was shown. For the matching techniques different types of strategies (involving image analysis, feature extraction and least squares fit) as well as the corresponding adaptive controls were presented.

Beate Müller (Germany), M. Hahn - **Parallel Processing - The Example of Automatic Relative Orientation**

Key points were: (1) Parallel processing, (2) automatic relative orientation, and (3) theoretical investigation and practical test.

General remarks on parallel processing were made. The process of automatic relative orientation by means of building up image pyramids, feature extraction, matching and orientation and the derivation of displacement fields was described and an example was presented. Results of the analysis of the different subprocesses of the automatic relative orientation according to their parallelization capabilities were shown.

Eberhard Gulch (Sweden) - **A Knowledge Based Approach to Reconstruct Buildings in Digital Aerial Imagery**

Key points were: (1) Object reconstruction, (2) knowledge based approach, and (3) building reconstruction in multiple digital aerial images.

The reconstruction of buildings in multiple aerial images was presented: A segmentation results in line and area features.These features are projected into the object space. The result is parsed with alternation between the line and region features and a consistency check is made in the object space. Here any discontinuities are removed, missing lines are introduced and the resulting closed polygons are interpreted. Empirical tests on

manual (optimal) and automatic (non-optimal) segmented features were presented. Thereby it was found that the quality of the automatic interpretation is the major bottleneck of the recognition.

Lee R. Warren (USA) - **Digital Production System**

Key points were: (1) All-digital production system, (2) digital stereo workstation, and (3) productivity and management effectiveness improvement.

The two steps of the all-digital production system for mapping, charting and geodesy of the armed forces was presented: Mark 85 improved the hardcopy production, production methods, and data management of the former mapping system. It also provided initial softcopy production capabilities. Mark 85 is already delivered and operational.

Mark 90 gives end-to-end softcopy production capability. It improves production management, production programming, scheduling and resource management. It uses a stereo workstation for feature and elevation extraction. A knowledge based system supports these tasks. Mark 90 will be delivered this year.

COMMISSIONS VI
Working Group VI/6

Session TS-30 - **On-Line Literature Retrieval**
† In Memorium Jürgen Hothmer †
August 7, 1992, 08:30-10:00
Session Reporter: Dr. J. H. ten Haken (Netherlands)
Chairman: ***Dr. J. H. ten Haken*** *(Netherlands)*

The chairman opened the session with a word of welcome to the audience. He then delivered a testimonial in honor of Prof. Dr. Ing. Jügen Hothmer, the past Editor of the **ISPRS Journal**, former President of ISPRS Commission VI and former chairman of the Working Group for Literature Retrieval Systems. The audience was then invited to observe a moment of silence in remembrance.

Irene Mader (Italy), C. H. Latarche - **The European Remote Sensing and Photogrammetry (ERSAP) Database** *(Invited Paper)*

Key points were: (1) Remote sensing and photogrammetry database, (2) international cooperation, and (3) complementary to existing services in the on line field.

The presentation gives a review of the developments in the past which led to the present situation as for available on line databases. The project described is based on cooperation between the ESA and the GDTA in Toulouse, France and should lead to a new database which will give good coverage of European literature in the field of photogrammetry and remote sensing. It will be complementary to the existing databases in this field. The project will become open to other European organizations to join it.

Vasudha Satalkar (India), R. Nagarajan, L. S. Joshi - **PC Based Information Retrieval System for Remote Sensing Literature and Data**
(Presented by Kam Rao)

Key points were: (1) Storage and retrieval, and (2) use of a PC, (3) development.

At the Center of Studies in Resources, Engineering, IIT, Bombay, a PC based information system is being developed for literature and data products in the area of remote sensing. The hardware and software requirements, the organization and the expectations are discussed.

Gene Thorley (USA) - **The Federal Geographic Data Committee: Developing a National Geographic Information Resource**

Key points were: (1) National geographic information resource, (2) organization, and (3) acquisition of data.

An outline is given on how in the Federal Geographic Data Committee a national geographic information source is being developed. The collection and input of data are discussed.

J. H. ten Haken (Netherlands) - **Data Bases in the Field of Aerospace and Related Fields**

Key points were: (1) Data bases, and (2) aerospace and related subject fields, (3) application of remote sensing.

A review is given of those data bases which are relevant for the retrieval of literature in the field of aerospace and the related subject fields geodesy, cartography and geoinformation systems. A distinction is made between the theoretical side and the application side of aerospace.

David A. Tait (United Kingdom) - ***ISPRS Journal* — Review and Preview**

Key points were: (1) Subscribers, (2) contents, and (3) further developments.

A presentation is given on the subscribers and their geographical distribution of the *ISPRS Journal*. Further, a review of the contents in the period 1985 - 1991. An outline is given aboout future developments with the special announcement that the news section in the *Journal* will be extended.

COMMISSION I
Working Group Special Topic

Session TS-31 - **Future Remote Sensing Missions and Early Results of New Systems**
August 7, 1992, 10:30-12:00
Session Reporter: Sherry Chou Chen (Brazil)
Chairman: ***Dr. Placidino M. Fagundes*** *(Brazil)*

There were approximately 100 persons in attendance.

Paulo Roberto M. Serra (Brazil), C. E. Santana - **The Brazilian Space Program** *(Invited Paper)*

Key points were: (1) The Brazilian complete space program, (2) the Sino-Brazil space cooperation program started in 1988, and (3) all sensor and satellites detail.

The Brazilian Space Program was presented in this paper. There are two space programs currently ongoing, the Brazilian Complete Space Program (MECB) and the cooperative Sino-Brazilian program CBERS (China Brazil Earth Resource Satellite). The first two MECB satellites are for environmental data collection and the third and fourth are for remote sensing. Expected launch date is the end of 1992. CBERS will be launched in the end of 1994 by a Chinese launcher C2-4 carrying a payload of approximately 1,400 kg.

Alfred Setzer (Germany) - **ERS-1 Europe's First Remote Sensing Satellite**

Key points were: (1) Preliminary results of ERS-1 applications on different natural resource studies, and (2) ERS-1/2 instrument summary was given.

Dr. Setzer's speech concentrated on the presentation of first mission results. Interesting images showed different applications (wind speed, glacial development, naval route investigations, etc.) One participant asked if ERS-1 is not oversold for land applications since the original C-band is designed for ocean application.

Bill P. Clark (USA) - **Technology Trends in Spaceborne Remote Sensing Instruments**

Key points were: (1) Survey methods, (2) generic instrument types, and (3) seven-level definition for technology readiness

Trends for the future satellites are presented such as multifunction systems with some degree of autonomous operation and on-board decision-making.

F. Lanzl (Germany) - **The MEOSS Mission**

Key points were: (1) Three line stereo method, along track, (2) photogrammetric adjustment, and (3) DEM generation.

As joint project between ISRO and DLR a combined mission of the DLR instrument MEOSS for stereo recording and the ISRO multispectral camera LISS-I will be flown in 1993. This long term mission offers for the first time the possibility to combine three line stereo data and multispectral data.

Hiroshi Akao (Japan), M. Kudoh, Y. Nemoto, M. Fukushima, M. Isoda, T. Higuchi, T. Takenouchi, H. Michioka - **The Development of Short Wavelength Infrared (SWIR) Subsystem for ASTER**

Key point was the SWIR subsystem for ASTER on EOS was developed for rock and soil studies in Japan.

SWIR has six bands with spatial resolution of 30m and swath of 60km. Major applications are for rocks, soils, snow, ice, cloud, vegetation and volcano studies. Shows the superiority of SWIR vs. TM and HIRIS on NE ratio especially around 1.3μm. The development of key SWIR components have been successfully performed.

COMMISSIONS V, II, III
Working Groups V/3, III/2, IC II/III

Session TS-32 - **Image Analysis and Synthesis in On-Line Applications**

August 7, 1992, 10:30-12:00
Session Reporter: Dr. Dieter Fritsch (Germany)
*Chairman: **Dr. Dieter Fritsch** (Germany)*

Kevin Bowyer (USA), D. W. Eggert, C.Dyer - **Aspect Graphs: State-of-the-Art and Applications in Digital Photogrammetry** *(Invited Paper)*

Key points were: (1) The "Aspect Graph" data structure summarizes the basic different views of an object; (2) algorithms exist to compute the aspect graph for a broad range of possible object geometries; and (3) scale space considerations can be incorporated in the aspect graph framework.

Research related to aspect graphs has been a very active area of computer vision in recent years. The conceptual framework and basic results of this body of work were summarized.

Ulf Hönisch (Germany) - **Verification of Graphical Primitives in Gradient Direction Images**

Key points were: (1) Model verification with proof routes are an alternative approach to avoid the investigation of the image pixel by pixel in the same time expensive manner; (2) proof routines are primitive based and allow model based local verification of well known CGD models; and (3) may be other levels and operations are important in a top down than in a bottom up approach and must cross usual boarders between intermediate results.

Michael Schmid (Germany) - **Recognition of Partially Occluded Moving Objects**

Key points were: (1) 3-D modelling of objects, scenes, dynamic model, (2) underlying methods from control theory and knowledge based techniques, and (3) hypotheses generation, testing for verification or rejection.

The handling of this means the detection and tracking due to partial occlusion of two independently moving 3-D objects on motorways, including horizontal and vertical curvatures, has been demonstrated in a simulation loop with simulated image processing in real-time (<760μms) by combining methods from control theory for recursive estimation and knowledge based techniques for hypotheses testing.

Karsten Jacobsen (Germany) - **Surface Determination with an Accuracy of Few Microns**

Key points were: (1) Geometric conditions of macro photogrammetry, (2) comparison of use of photos vs. CCD images, and (3) necessary configuration of CCD cameras for object determination with an accuracy of few microns.

The surface determination for manufacturing is currently done with profiling instruments. A

photogrammetric solution can overcome its disadvantages. Photographic cameras have been used for on line solutions. CCD cameras are limited because they require special geometric conditions for object reconstruction.

COMMISSION IV
Working Group IV/5

Session TS-33 - **Applications of Geographic Information Systems**
August 7, 1992, 10:30-12:00
Session Reporter: Dr. Marguerite Remillard (USA)
*Chairman: **Dr. Roy A. Welch** (USA)*

Kohei Cho (Japan), M. Yoshimura, S. Takeuchi, K. Kamada, S. Murai, C. Otsuka - **Computer Assisted Information Extraction From Satellite Images for Updating National Land Use Information Data Base in Japan**

Key points were: (1) A cost effective and efficient method of updating land cover information in Japan was required. Formerly, manual interpretation of aerial photographs for mapping land use and land cover was utilized; (2) although automatic thematic classification of satellite image data was proposed, the classification accuracy of 70 to 80 percent was not acceptable; and (3) therefore an improved method of satellite image classification was developed that includes the input of human interpreters, decision free classification, pre and post image data processing and the identification of change areas to streamline the update process.

A cost effective and efficient method of updating land use information in Japan using satellite image data and GIS was developed.

Crista S. Carroll (USA), S. A. Morain, D. Hinrichsen - **Spatial Modeling and Monitoring of Biodiversity Using Biophysical Land Units (BLU)**

Key points were: (1) The BLU model, GIS and remote sensing techniques were used to monitor biodiversity in New Mexico by the United States Bureau of Land Management and the University of New Mexico; (2) BLU classification is based on the ecological responses of an area and includes information on vegetation cover, terrain characteristics, soils and hydrography that is derived from satellite image data, maps and on-site measurements; and (3) advantages of the BLU model over typical vegetation classifications are a) identified patches tend to be more homogeneous; b) the system is hierarchical in scale, attribute detail and time frame; and c) the recognition and quantification of biodiversity is made possible.

The BLU model of classifying the landscape and monitoring biodiversity based on characteristics influencing ecological response (e.g; vegetation, terrain, soils and hydrography) derived from satellite, map and site data was utilized to manage federal lands in New Mexico, USA.

K. Hirata (Japan), Hidemi Kashima - **Utilization of GIS for Road Management**

Key points were: (1) A GIS (ARC/INFO) was used to link small scale and large scale databases for road facility management in Japan; and (2) the PC-based GIS system permits high speed operations to determine functions and costs, program expandabilty and operation in an office environment.

The ARC/INFO GIS system was used to link large and small scale databases for use in road facility management in Japan.

I. Osamu (Japan), U. Kohei, Y. Myint - **A Study of Facility Management System in the Computer Aided Design Using 3 Dimensional Data Base**

Key points were: (1) Constraints existed in the previous method of urban facility management in Japan that included a) difficulty in updating and maintaining data bases; b) considerable costs required for data input; c) difficult customization and d) limited capability to handle 3-D data; and (2) a digital mapping system for facility management was developed that uses software packages such as AUTOCAD, MAPCAD and the R-Base data base management system.

A PC based and engineer-oriented GIS system was adopted in Japan that allows efficient digital mapping, a standardized relational data base management system that supports SQL queries and scanner data input for facility management of urban landscapes.

W. Schuhr (Germany), G. Konecny - **Progress in GIS Change Detection Ability**

Key points were: (1) Polynomials are still being used for the geometric correction of satellite image data although they do not account for the third dimension and error propagation can lead to misregistration of GIS data layers and incorrect conclusions when conducting change analyses; and (2) improved "strong geometric projection" equations were presented that account for the third dimension and are suitable for use with satellite and airborne radar or optical image data.

Improved geometric correction equations were presented and used to orient strips of airborne radar data, to create a digital mosaic and calculate a DEM of the terrain.

COMMISSION IV
Working Group IV/7

Session TS-34 - **Generalization and Visualization of Digital Elevation Models**
August 7, 1992, 13:30-15:00
Session Reporter: Carlos Eduardo Nery (Brazil)
*Chairman: **Dr. Luiz A. Vieira Dias** (Brazil)*

K. Tempfli (Netherlands), M. Pilouk - **A Digital Image Processing Approach to Creating DTM's from Digitized Contours** *(Invited Paper)*

Key points were: (1) Digital terrain models (DTM) from contour lines, (2) automated skeleton extraction,

and (3) application in engineering, geosciences, etc.

The main objective was to obtain DTM's from contour lines. To avoid the error due to automatic determination of contour lines interpolated from the existing ones, "skeleton lines" are automatically generated. The practical results are much better. The precision was determined in the examples shown.

Pat S. Chaves, Jr. (USA) - **Use of "Local" Shape-From-Shading to Enhance an Existing Digital Elevation Model**

Key points were: (1) Digital elevation models (DEM), (2) image processing, and (3) edge detection.

The objective was to present a series of filters to determine the relief forms, from the shade on satellite images. The data thus obtained was added to an existing DEM, to improve its geometric accuracy. A few examples were shown.

Laszlo Molnar (Austria) - **Principles for a New Edition of the Digital Elevation Modelling System SCOP**

Key points were: (1) Digital elevation models (DEM), (2) graphics management, and (3) system integration (graphics and data bases)

Development of a new computer system (SCOP), in order to model terrains through surface classes determination. Use is made of an object oriented technique.

John C. Trinder (Australia), C. Angleraud, K. Becek - **Generalization and Visualization of Digital Elevation Models**

Key points were: (1) Digital elevation models (DEM), (2) image matching, and (3) triangular irregular network (TIN).

The objective of the paper was to obtain DEM's from SPOT satellite images. The method was based on the determination of the same terrain feature on different satellite images of the same area, from the knowledge of the satellite parameters.

H. Ebner (Germany), G. Aumann - **Generation of High Fidelity Digital Terrain Models from Contours**

Key points were: (1) Digital terrain models (DTM), (2) skeleton lines, and (3) geomorphological terrain features.

The objective was the determination of high fidelity DTM's from known contour lines. From the contour lines, skeleton lines are produced, and from these a better DTM is generated.

COMMISSION III, V
Working Group III/2, V/3

Session TS-35 - **Object Reconstruction and Location by Image Analysis**

August 7, 1992, 13:30-15:00

Session Reporter: Dr. Henrik Haggren (Finland)

Chairman: ***Dr. Wolfgang Förstner*** *(Germany)*

Christian Heipke (Germany) - **Integration of Digital Image Matching and Multi-Image Shape from Shading**

Key point was integration of the shape-from-shading to multi-image matching function.

The author described two alternatives for surface reconstruction: digital image matching and shape-from-shading. Both methods are based on the image information produced by the illumination. The basic difference is that the shape-from-shading fails if the features are at high frequency, whereas matching fails with low frequencies. The author presented how these will be used complementarily rather than alternatively. He showed with two examples of synthetic image pairs how the surface reconstructions were successfully completed; first in the case both the matching and the shape-from-shading techniques were used as integrated.

Q: R. Koch

When fusing SFS and matching is applied separately, matching gives 3D (depth) measures where SFS gives only orientation. The depth is lost (differentiation!). How are the boundary conditions between both methods applied?

A: C. Heipke

SFS needs boundary conditions. The best would be simultaneous evaluation.

Q: U. Rauhala

Regarding computational aspects, is array algebra of GLSM directly applicable to SFS.

A: C. Heipke

GLSM alone with 2-ray models already yield robust solutions.

Q: R. Lenz

SFS depends on absolute grey values. Couldn't you, in regions with at least slight gradients, do image matching based on individual grey values?

A: C. Heipke

In principal yes, but this was not investigated.

Q: Yong-Jian Zheng

Can one segment an image into regions so that each of them is made of the same material.

A: C. Heipke

In principal yes, but this was not investigated.

Ofer Zilberstein (Israel) - **Relational Matching for Stereopsis**

Key point was correspondence finding using relational tree structure for homolog image profiles.

The author discussed the correspondence problem within 1-D feature based matching along homolog epipolar lines. The correspondence was solved by producing first relational tree structures relating to hierarchical - (global and local) - peaks in the gray value functions of both left and right images. The relational nodes were then mapped mutually using a cost function where the cost was the number at lost nodes during the mapping. After the best left node to right node correspondence was found, the feature points were defined in the object space. The work was exemplified with a pair of images at 128 pixel scan lines and at 60% overlapping, but was also applied for 1:4000 scale images

of size 4K x 4K.

Q: M. Molenaar

The method has been presented for trees. Do you also have solutions for more general graph structures?

A: O. Zilberstein

Yes. 2-D.

Q: M. Molenaar

Do you apply heuristic search strategies to speed up the search for an optimal match.

A: O. Zilberstein

Yes, we will.

Anja M. I. Wilkin (Finland) - **Robust 3-D Object Representation by Linear Features**

Key point was - Combination of robust estimation and least squares intersection at linear features for multi-image networks.

The author first overviewed robust estimation techniques to be applied for 3-D object reconstruction. She used the RANSAC (Random Sampling Consensus) principle for outliers detection combined with least squares intersection of linear features - (so far only straight lines) - into the object space. She showed some simulation results of a four camera setup, where the intersections recovered close to theoretical expectations in the case. The outliers were uniformly distributed. The examples were at 8.3, 25, 49 and 69% rate of outliers, and the outliers were relocated in each case successfully. In cases where the outliers were of constant size (distance to the line) the coincidence between the simulations and statistical expectations decreased as the distance of outliers increased.

Q: M. Hahn

As far as I know from robust estimation, each robust technique is able to cope with symmetrical outlier distribution. The superiority of RANSAC to other techniques lies in the fact that it can handle asymmetric error distribution. Is this your experience also?

A: A. Wilkin

Yes, it should, but here we had the simulations only with symmetric distances.

Q: R. Munjy

With this approach, two photographs will give you unique solution? How did you obtain your accuracy results?

A: A. Wilkin

With more than two images, the solution is the best fit according to least squares. Here we had four images.

Alexander P. Gracian (United Kingdom), P. Challenor, J.-P. Muller, M. A. Srokosz - **Automated 3-D Spatial Measurement of Short Gravity-Capillary Waves**

Key point was - Sea surface reconstruction for calibration of ground truth for ERS-1 SAR images.

The author presented practical results of automated stereomatching in reconstruction at water surfaces in order to determine spatial and spectral behavior of gravity capillary waves. The surface model was based on 60 mm film images taken on a support which acted as the 3-D on-site control framework as well. Additionally, the wave spectra was measured with wave staffs. The anticipated applications were a) The determination of wind stress, or of damping effects of slicks. b) The research on spatial statistical fractal nature of sea surface, and c) The use of surface microtopography in relation to ERS-1 SAR images to rain effects, and to ERS-1 backscatter returns.

Q: C. Heipke

Were the matching results improved manually before further processing?

A: A. Gracian

No.

COMMISSION VII
Working Group VII/7

Session TS-36 - **Knowledge Based Techniques for Data Fusion**

August 7, 1992, 13:30-15:00

Session Reporter: Katarina Johnsson (Canada)

Chairman: ***Dr. David G. Goodenough*** *(Canada)*

Katarina Johnsson (Canada), D. G. Goodenough, C. Kushigbor - **An Expert System Interface for the GRASS Geographic Information System** *(Invited Paper)*

Key points were: (1) Prolog predicates as interface, (2) RESHELL expert system shell, and (3) make GIS functions available in expert systems.

An interface is being developed to run GRASS GIS functions from within expert systems developed in RESHELL. Examples of simplifications for the user using the RESHELL-GRASS interface. The expert systems are designed in a highly modular fashion, using an object oriented structure for knowledge storage.

Stephen J. Ford (USA), D. M. McKeown - **Information Fusion of Multispectral Imagery for Cartographic Feature Extraction**

Key points were: (1) Merging of classified image data with segmented images and disparity maps that show object elevation; and (2) applying image understanding algorithms to scene analysis in urban/suburban environments.

Pan (single images and stereo images) are used together with classified multispectral data. High resolution aerial images are used (MEIS and Daedalus) 1.5 m resolution or higher needed for urban areas. Stereo images provide elevation information on buildings for example. This can be displayed as brightness in 2-D or in 3-D. A Segmented panchromatic image is merged with a classified color image => homogeneous regions and well defined borders.

Alfred Mehlbreuer (Netherlands), I. Molina - **Multistage Pattern Recognition for Digital Landscape Modelling**

Key points were: (1) Description of a program for creation of a digital landscape model of Europe, and (2) digital classification and semiautomatic systems.

The presentation describes the current project CORINE - Coordinated Info on the Environment - for the European Community. It also describes some preliminary research carried out at ITC for a 2nd generation land information system for Europe, mainly based on digital methods for information extraction from maps and satellite images.

Anton K. Kaifel (Germany), F. Löher - **Backpercolation Training of Neural Networks for Agricultural Land Use Classification with Landsat TM Data**

Key points were: (1) Three neural network algorithms were compared; and (2) the backpercolation algorithm (Jurik, 1990) performed best.

Procedure: a) Extraction of training data, b) Training of neural network, c) Classification; d) Relaxation of classified image data, and e) Validation. Expected classification accuracy: up to 90%.

Andrew K. Skidmore (Australia) - **Classification of Spatial Data Using a Hybrid Neural Network-Expert System**

Key points were: (1) Hybrid system => Use advantages of both neural network and expert system; (2) the expert system supplies prior probabilities that are used as weights on the neurons.

Advantages are that it is a self learning system. It is possible to formalize prior knowledge to use for neuron weighting.

COMMISSION VII
Working Group VII/1

Session TS-37 - **Applications from Active and Passive Microwave Sensing**
August 10, 1992, 13:30-15:00
Session Reporter: Dr. Gérard Guyot (France)
Chairman: ***Dr. Gérard Guyot*** *(France)*

Pat S. Chavez, Jr. (USA) - **Generation of Spatial Variability Index (SVI) Images: SLAR Examples**
(Invited Paper)

Key points were: (1) Use of not only local, but also intermediate and regional spatial information in remotely sensed image data; (2) compute an SVI (Spatial Variability Index) and SAI (Spatial Amplitude Image), and (3) gives "uni-band and "multi-band" users the option to process and analyze their data using "multi-band/image" tools.

Sune R. J. Axelsson (Sweden) - **Geometric Optics Modelling of the Polarized Back-Scattering from a Vegetative Layer with Rough Ground Surface Boundary**

Key points were: (1) A model is presented for predictions of the backscattering from vegetation using geometric optic approximations; and (2) this approach might be useful in the mm-wave band and the optical region of the spectrum.

By taking into account the two-bounce reflection effects, the cross-polarization effects are predicted as well.

K. S. Rao (USA), N. Chauhan, W. L Teng, J. R. Wang, E. T. Engman - **An Approach to Mapping Soil Moisture with Multifrequency Polarimetric SAR Data**

Key points were: (1) Use of multifrequency and multipolarization data, (2) study on the topographic effects, and (3) mapping of soil moisture from SAR data.

Multiangular, multifrequency and multipolarization SAR images enable establishment of a soil moisture map.

COMMISSION III
Working Group III/2

Session TS-38 - **Image Understanding in Photogrammetry and Remote Sensing**
August 10, 1992, 08:30-10:00
Session Reporters: Stephan Ruwiedel & Wolfgang Förstner
Chairman: ***Dr. Wolfgang Förstner*** *(Germany)*

Andres Huertas (USA), K. Price - **Using Perceptual Grouping to Detect Objects in Aerial Images**
(Invited Paper)

Key points were: (1) Perceptual grouping is essential for interpreting aerial images; (2) perceptual Grouping is a multilevel process; and (3) future work is concentrated on grouping fields.

Q: B. L. Deekshatulu

How do you get the antiparallels from the edge images?

A: A. Huertas

We first approximate the edge contours by piecewise linear segments. These are described by their end points, orientation and contrast. The list of lines is then sorted by angle. For any given line, we then look for those having opposing contrast, the desired separation and the line angle tolerance.

Q: C. Heipke

What is the role of human interaction during the extraction process? What kind of input parameters do you need to provide for the system?

A: A. Huertas

The systems described are completely automatic and require no human interaction or intervention. The only required parameter is the resolution of the image. Other parameters such as sun angles (when using shadows), minimum and maximum object sizes, are given by the operator if desired.

Q: M. Hahn

Do you exploit and in which way do you exploit stereoinformation within perceptual grouping?

A: A. Huertas

Our most recent system to detect buildings uses stereo matching at the junction level (L-and T-junctions) to aid in the process of constructing U-structures and finally rectangles.

Zheng Wang (USA) - **Image Understanding in Photogrammetry and Remote Sensing**

Key points were: (1) A feature based matching approach is used to reconstruct surfaces over urban areas; (2) the surface analysis consists of the three parts: hump detection, grouping of 3-D edges, classification of 3-D edges; and (3) the result of the matching process is improved substantially using this technique and can be used to recognize buildings.

Monika Sester (Germany) - **Automatic Model Acquisition by Learning**

Key points were: (1) Interpreting images of natural scenes requires generic object models; (2) the models can be automatically generated from given classified examples; and (3) the derived models describe the objects structure and its statistical properties.

Q: M. Sties

Is it possible to apply this procedure also on nonrectangular shaped parcels?

A: M. Sester

The parcel structure (at least in Germany) shows that individual parcels are of simple form, namely rectangles or polygonal areas. These can be covered by the procedure.

Q: A. Huertas

How are the initial probabilities determined?

A: M. Sester

They are derived from the examples. A collection of examples have to be examined in order to compute them. How many examples? 1000? - No, I think approximately 100.

John Stokes (Sweden) - **Parsing Segmented Digital Images**

Key points were: (1) Interpretation of large-scale aerial images here consists of two steps: segmentation and parsing; (2) the parser which generates the underlying structure of the segmentation result, requires perfect data; and (3) segmentation still is the bottleneck for image analysis.

Q: K. Schutte

Image processing will always give errors. Does this observation not lead to the logical decision that approximation should take place in parsing?

A: J. Stokes

No, this is at your own will. We have chosen to view segmentation in terms of modeled primitives as an approximation, while the parse of this segmentation is true or false.

Q: W. Förstner

Could you think of error correcting parsing, where the errors you expect from the segmentation are modeled explicitly?

A: J. Stokes

Yes, this is in fact done by the procedures used in the consistency check. A typical example is a missing line displaying two neighboring plane segments as one non-plane segment. Such an error is easily traced and corrected in an inline procedure.

Q: A. Huertas

Your system uses segments. Edge detectors are known to give inaccurate edges near junctions. How does the system deal with this? Second, is there a danger of the rules becoming too fine grained?

A: J. Stokes

We don't use edge detectors. Model-guided boundaries take care of this problem. With strong enough requirements on the boundaries, inaccurate junction designs are avoided. As to the second question, the only rules occurring classify line segments as vertical, horizontal or sloping. The criteria for vertical or horizontal are quite simple. The interpretation of sloping lines depends on what they connect to, i.e., a limited set of possibilities, so I see no danger here.

Yong-Jian Zheng (Germany) - **Feature Extraction: A Neural Network Oriented Approach**

Key points were: (1) The laws of perceptual grouping are used as criteria during the feature extraction; (2) a neural network aggregates pixels into regions following the grouping criteria; and (3) a line is estimated from the aggregated line region yielding a quality description of the line.

COMMISSIONS IV, III, VII
Working Groups IV/5, III/1, VII/2

Session TS-39 - **Visualization of GIS Output Sensing**
August 10, 1992, 08:30-10:00
Session Reporter: Thomas R. Jordan (USA)
*Chairman: **Dr. Roy A. Welch** (USA)*

Roy Welch (USA) - **Integration of GIS and 3-D Image Processing on Personal Computers** *(Invited Paper)*

Key points were: (1) Standard 386/486 PC's with Super VGA displays can be employed to derive planimetric, thematic and topographic map data from digital images for input to a GIS; (2) image data must be rectified using ground control to bring it into registery with the other layers in the GIS. A common coordinate system is required to permit the rectified images to underpin the GIS; and (3) photogrammetric accuracy is determined by the image quality, base-to-height ratio of the stereo dataset (0.5-1.0), pixel size or scan density (30 - 50 μm spot size), and the quality of the ground control.

Personal computer technology has made image processing, photogrammetry and GIS capabilities more widely available to the user community. The utilization of photogrammetric 3-D mapping techniques with scanned aerial photographs permits the development of digital orthophotos for use as an image backdrop for GIS operations and analysis. This results in an overall improvement of capability.

Eugene Derenyi (Canada), M. Halim, R. Pollock, T. Y. Shih, C. K. Xian - **Design and Implementation of GIS Based Digital Image Processing System**

Key points were: (1) There is a rapidly increasing

demand by GIS users for digital images as a source of data. This requires an integration of handling raster and vector data sets; (2) few existing GIS systems are designed to manipulate raster and vector data in a uniform system. It is, however, possible to successfully retrofit an existing GIS with image handling capabilities; and (3) the CARIS system was extended to permit monoscopic digital mapping operations from multi channel/multilayer image datasets.

The CARIS GIS system was successfully retrofitted to accommodate digital mapping, image processing and GIS operations within a single environment. This capability provides a solution to the changing needs of the GIS user community and permits the use of digital images as a primary data source. Future needs will include facilities for stereo mapping and knowledge-based analysis integrating both vector and raster data in a single operation.

Chung S. Han (Netherlands), H. J. W. van der Vegt - **Photogrammetry & GIS for Coastal Defence**

Key points were: (1) The survey department RWS is tasked with maintaining up to date maps and beach profiles of the barrier islands which shelter the significant portion of the Netherlands that lies below sea level; (2) current technology cannot keep up with the demand. Therefore, they are moving towards an all digital photogrammetric workstation for aerotriangulation compilation and automatic DTM generation; and (3) accuracy of the all-digital solution is quite comparable to conventional analog and analytical techniques. Work can be completed in a fraction of the time previously required.

Digital photogrammetry provides a faster, more flexible approach to mapping coastal areas than conventional mapping methods. The improved throughput allows the survey department to satisfy customer needs in a more timely manner while maintaining accuracy standards. Managers and analysts can use DTM's from several years to determine changes and trends, identify problem areas and develop solutions or recommendations.

B. Robertson (Canada), Hans W. Wehn - **On the Use of the Object Oriented Paradigm for Multisensor Geocoding**

Key points were: (1) Digital image data must be accurately geocoded before it may be used to collect data for a GIS; (2) an object-oriented modeling approach permits geocoding techniques based on specific sensor characteristics (a priori knowledge) and relationships to the ground and aircraft (a posteri knowledge), and (3) new sensors can be added or existing sensor models modified by manipulating small objects in the geocoding model.

Digital image data of all sorts (satellite, aircraft, radar) can best be geocoded using all a priori knowledge about the specific sensor in an object oriented manner. Rigorous application of the sensor models can result in a 10 times reduction in the number of ground control points required to geocode an image. The object oriented approach is easier to implement and modify than conventional polynominal models.

INTERCOMMISSION WORKING GROUP VI/III AND COMMISSION II/VI NEWSLETTER

Session TS-40 - **Computerized Teaching**
August 10, 1992, 10:30-12:00
Session Reporter: Dr. Andreas Georgopoulos (Greece)
Chairman: ***Dr. Andreas Georgopoulos*** *(Greece)*

Joachim K. Höhle (Denmark) - **Rechnergestützte Ausbildung und Übung in Photogrammetrie und Landinformationssystemen** *(Invited Paper)*

Key points were: (1) Recognition of great potential of computers in education at all levels; (2) description of all types of learning programs; and (3) detailed description of LISDEMO software developed at Aalborg University in Denmark.

The author has presented the various systems/programs developed for personal computers at Aalborg University. The applied strategies and the tools used have been explained. Details of three different software packages and the experience with them in education has also been presented.

Demetre P. Argialas (Greece), O. W. Mintzer - **The Potential of Hypermedia to Photointerpretation Education and Training**

Key points were: (1) Analysis of "Photointerpretation" and of "Knowledge interpretation", (2) explanation - usage of hypermedia in education, and (3) comments on authoring a hypermedia system and system design - link with expert system.

The presenter of the paper examined how educators teaching photointerpretation could use hypermedia technology for more effective presentation and teaching. Hypermedia systems could also help to build less ambiguous decision support systems and knowledge bases and thus make expert interpretation systems more intuitive.

Oystein B. Dick (Norway) - **Use of PC-ERDAS in Satellite Mapping/GIS Education**

Key points were: (1) Description of satellite mapping course and hardware system in agricultural University of Norway, and (2) demonstration of educational software used.

The two PC-based ERDAS systems described play an important role in the coursework of the satellite mapping curriculum. The training combines digital image processing, classification, geometric corrections, stereo photogrammetry, digital mosaics, etc. of all kinds of satellite data.

T. Oshima (Japan), Mitsunori Yoshimura - **Education Based on Computer Operation for Remote Sensing and GIS Beginners' Training**

Key points were: (1) Advancements in computer industry - popularization of the computer, => hence development of educational system; (2) description of the system itself and its background; and (3) presentation of applications of the system in educational areas.

The authors described how beginners become familiar with remote sensing, raster GIS and their integration. Moreover, the vector/raster conversion and combined analysis with remote sensing may also be clarified and understood through the software produced.

Reiner Schwebel (Germany) - **Training Concept for Software-Oriented Products**

Key points were: (1) Determination of the training concept for the Zeiss products; and (2) description of the training system for the various users and for the various levels.

The learning functions of the Zeiss software for training of the users is thoroughly described. By means of courses and individual training, systems and application specialists convey practice-oriented knowledge for the system to operators, system managers and programmers.

COMMISSIONS III, VII
Working Groups III/4, VII/7

Session TS-41 - **Knowledge Based Systems**
August 10, 1992, 10:30-12:00
Session Reporter: Dr. Tapani Sarjakoski (Finland)
*Chairman: **Dr. Nanno J. Mulder** (Netherlands)*

David G. Goodenough (Canada) - **SEIDAM, System of Experts for Intelligent Data Management** *(Invited Paper)*

Key points were: (1) Progress of the SEIDAM project; (2) integration of information by using expert system technology; and (3) neural network technology as a tool to support integration.

The presentation described the objective and contents of the Canadian SEIDAM (System of Experts for Intelligent Data Management) project. SEIDAM integrates data from multiple satellites, aircraft, field data, geographical information systems, and environmental and forest models in order to respond to queries about the forests. SEIDAM builds on the sheri technology. SEDAM will use neural networks for spatial knowledge acquisition. SEIDAM is aimed at the data management problems facing remote sensing over the next decade when more than 60 sensors will be generating imagery over the globe. SEIDAM presently includes 50 expert systems. Machine learning will be used to expedite the creation of knowledge and new expert systems.

L. Tiina T. Kilpeläinen (Finland) - **Multiple Representations and Knowledge-Based Generalization of Topographical Data**

Key points were: (1) Trend from cartographic generalization towards conceptual and data level generalization; (2) multiple representation as a way to overcome the problems of generalization; and (3) use of attribute data of geo-objects to facilitate generalization.

The presentation described an initial part of a research project on multiple representation and knowledge based generalization of topographical data. The project is currently under way at the Finnish Geodetic Institute. The objective of the presentation was to identify the main problems in the domain of generalization and to suggest alternatives for solving these. The connection between multiple representation and generalization was clearly pointed out. The generalization was divided into the phases of data generalization and visualization. Object oriented Prolog++ was introduced as a hybrid tool for implementation. The way toward more complete modeling, including 3-D aspects, was seen as a future trend.

Ralf Bill (Germany) - **On the Acquisition, Representation and Application of Knowledge in Geo-Information Systems**

Key points were: (1) How to acquire knowledge from users; (2) how to represent knowledge in computers; and (3) how to make the knowledge applicable for users.

The presentation reviewed the concepts of knowledge acquisition, representation and application with respect to their usage in geoinformation systems (GIS). The presentation started with some definitions on data, information and knowledge. The knowledge representation formats were treated in detail. It was claimed that the procedural design of a GIS needs to be replaced with the inference mechanism of an expert system. Heuristic approaches and use of fuzzy knowledge representation techniques were seen as important in GIS.

Jan Heikkilä (Finland) - **Representing Uncertain Knowledge with Bayesian Belief Networks**

(Presented by Anita Laiho due to author's illness.)

Key points were: (1) Need for representing uncertainty in image understanding; (2)Bayesian Belief Networks (BBN) with sound theoretical basis; and (3) computational complexity of BBN.

The presentation reviewed the use of BBN for representing uncertain knowledge. A motivation for the work was derived from the research in image understanding in which the problem of the ambiguity of interpretations exists on all levels of hierarchy. The presentation introduced the concept of BBN and advocated it because of its sound foundation in probability theory. Image segmentation was used as an example. The problems related to the computational

complexity were introduced and parallel computing was suggested as a future solution. An updating algorithm was proposed as a practical solution for the computational problem.

COMMISSION V
Working Group V/3, V/5

Session TS-42 - **Image Analysis and Image Synthesis in Architectural Photogrammetry**
August 10, 1992, 10:30-12:00
Session Reporter: Dr. Landolf Mauelshagen (Germany)
Chairman: ***Dr. Landolf Mauelshagen*** *(Germany)*

Detlev Woytowicz (Germany) - **Digital Orthophoto Using Multi Image Matching**

Key points were: (1) Fundamental principles, (2) performing multi-image matching, and (3) first applications: test field, mosaic floor (Cathedral in Sienna, Italy)

The method of digital multi-image matching including the cancellation of just covered regions (existing information of the whole object) is presented by first results in architectural photogrammetry.

Kurt Novak (USA), K. L. Edmundson, P. Johnson - **Spatial Reconstruction and Modeling of the Sundagger Site in Chaco Canyon**

Key points were: (1) Photogrammetric reconstruction, (2) generation of spatial surface model, and (3) shadow castings (shading, ray tracing) on a spiral and their changes.

This most interesting astronomic observatory used by native Americans has been captured by five different photographic image sets (no metric calibration, not sufficient control). The creation of a comprehensive, full 3-dimensional model of the laboratory and its surroundings (integration of two photo-sets) is visualized by a sophisticated surface modelling program, which allows shading and ray tracing. Special computer animations are applied.

R. Carlucci (Italy), M. Barbarella, M. Fiani, S. Paradisi - **Photogrammetric Structured Data Acquisition and Compression Aimed to Static Calculation by Finite Elements Methods - Experience on the Colosseo, Rome, Italy**

Key points were: (1) General approach to photogrammetry, (2) 3-D data acquisition, and (3) data thinning for recording system and algorithm.

The photogrammetric recording of the outer walls of the famous Colosseo is a basic documentation for analysis and research aiming at preservation. Topologically defined data structures from the stereoplotter are organized to a computer graphic rendering with data extraction to define a geometry for the input in a computation with finite element method.

L. Tang (Germany), M. Stephani - **Object Modelling and Visualization in Architecture**

Key points were: (1) Integrated system composed of photogrammetric recording, data acquisition and preparation, object modelling, visualization, data management and analysis; and (2) application at the Dome of the Rock in Jerusalem.

A complete documentation of an architectural object covers the geometric modelling (e.g. photogrammetric restitution) and the pictorial information (e.g. conventional photographs). Both aspects can be combined in one procedure using surface modelling techniques and digital photogrammetric tools. Different practical approaches for modelling and visualization and their applicability are demonstrated.

André Streilein (Switzerland), H. Beyer, T. Kersten - **Digital Photogrammetric Techniques for Architectural Design**

Key points were: (1) Processing steps in digital architectural photogrammetry, (2) data acquisition and measurement techniques, and (3) photogrammetric analysis.

Digital systems should provide a sensor resolution comparable to traditional film-based systems. Using CCD cameras geometric and semantic information from architecture can be integrated directly into Computer Aided Architectural Design (CAAD). Three dimensional geometric and topological descriptions and features of the objects worked out through semi-automatic measurements are compared with results of a still-video camera and a film-based medium format camera.

INTERCOMMISSION WORKING GROUP II/I

Session TS-43 - **Advances in Space Photography and Its Use**
August 10, 1992, 13:30-15:00
Session Reporter: Dr. K. Jacobsen (Germany)
Chairman: ***Dr. Karlheinz Marek*** *(Germany)*

Karlheinz Marek (Germany), V. V. Kiselev - **Weltraumphotographie--stand und Entwicklung-stendenzen** *(Invited Paper)*

Key points were: (1) Development of the Sowjet-Russian/CIR space photographic systems, (2) overview of the camera systems used, and (3) future development of higher spatial resolution in space photographs.

The operational Sowjet-Russian/CIR space systems are equipped with photographic cameras. The newest camera, the MK4 has a ground resolution of 8-10m/lp and can be used in the same manner as the KFA-1000 photographs for mapping in the scale range of 1:25,000 to 1:50,000. In the future photographs with an increased ground resolution of 1m/lp may be available. A test with a 3m focal length camera with 1m/lp resolution provided a photographic scale of 1:70,000. These images formerly only used for military purposes may compete with aerial photos.

Karsten Jacobsen (Germany) - **Advantages and Disadvantages of Different Space Images for Mapping**

Key points were: (1) Geometric potential of space images for mapping, (2) comparison of different space images for mapping, and (3) map update based on space images.

Several photographic or digital images taken from space with different sensors are available. Complete topographic map coverage of the world can be obtained by the use of space images. Similarly, the same procedure can be used for map updating. The geometric potential of images taken with the MC, the LFC, the KFA 1000 and the MK4 is sufficient for mapping at a scale of 1:50,000. However, all features cannot be completely extracted for 1:50,000 mapping. The different systems are compared.

Eberhart Pelz (Germany), K. Fritsche, D. Hertel - **Erfahrungen zur Standardisierung Photographischer Weltraumaufnahmen für die Informationsgewinnung über Waldëkosysteme**

Key points were: (1) Examination of the film used in the KFA-1000, and (2) investigations for standardized photographic processing.

Quantitative spectral measurements based on film material are difficult. In addition to the problems of transfer from the object to the camera, the spectral information available in the film depends upon the optics, the film, film processing, age of the film, the charge and in the case of the KFA-1000, also upon the copy process. It also depends upon the location in the film (radial distance), i.e., a) Quantitative statements are only possible for image areas with equal vignetting; b) radiometric differences must exceed the values determined by the camera to be detected; and c) for quantitative analysis only the center point of the image should be used.

COMMISSION V
WORKING GROUP V/1

Session TS-44 - **Machine Vision Systems for Industrial Photogrammetry**
August 10, 1992, 13:30-15:00
Session Reporter: Dr. Kam Wong (USA)
*Chairman: **Dr. Kam Wong** (USA)*

Peter C. Gustafson (USA), H. B. Handley - **A Video-Based Industrial Measurement System**

Key points were: (1) Videk 1,000 x 1,000 CCD camera, (2) desired accuracy of 1/50 pixel for antenna calibration, and (3) ± 1/25 pixel accuracy achieved, equating to 1/30,000 to 1/70,000.

John Turner (United Kingdom), D. Yule, J. Zanre - **A Real Time Photogrammetry System for Underwater and Industrial Applications**
(Presented by Peter Z. Moon)

Key points were: (1) Noncontact measurement in off-shore platforms, and (2) video camera and 386-PC with Windows-3 software and 1242 x 1152 pixels.

Sabry F. El-Hakim (Canada), D. Westmore - **A Knowledge-Based Edge/Object Measurement Technique**

Key points were: (1) Edge detection and objective recognition in dimensional measurement, and (2) for quality inspection and reverse engineering.

Ph Hartl (Germany), M. Ionnides, G. Pritschow, A. Wehr - **4-D Laser Scanning Followed by Internal Computer Model Generation**

Key points were: (1) Incorporation of measurement system into the industrial production loop, (2) laser scanning has many advantages compared with other measurement systems, (3) scanning time for 200 x 200 pixels is 20 seconds with a range accuracy of ± 0.15 mm, and (4) the 4th dimension refers to intensity.

Brigitte Husen (Germany), U. Benter - **Precise Tool Measurement Using Digital Photogrammetry**

Key points were: (1) Geometric thickness of drilling and milling tools, (2) PC-based CCD system, and (3) 0.1 to 0.2 pixel edge detection accuracy.

An accuracy of 3 mm for well-defined edges.

COMMISSION VII
WORKING GROUP VII/2

Session TS-45 - **Applications of Integrated GIS/Image Analysis Systems**
August 10, 1992, 08:30-10:00
Session Reporter: Dr. Douglas King (Canada)
*Chairman: **Dr. Pamela I. Sallaway** (Canada)*

Marquerite Remillard (USA), R. Welch - **Integrated Image Processing/GIS Techniques for Monitoring Aquatic Resources**

Key points were: (1) Used a combination of data types (remote sensing, aerial photography, GPS, photogrammetric information) plus GIS to develop integrated aquatic resources databases; (2) can combine historical and current data/knowledge to determine trends in aquatic resources and develop predictive models; and (3) continued development based on low cost platforms/data (eg. PCs) will allow many resource managers to develop their own models and assist in ecologically-based decision making.

Three examples of aquatic data base and analysis were presented.

CIR photos from past 20 years were used to identify emergent/submergent vegetation in a reservoir. Polygons were field checked and digitized into a GIS. Combined with other layers such as bathymetry, sedimentation, nutrient measurements, etc. to determine relations with vegetation. Found depth and sediments most related to vegetation development. Used this relationship to predict where new vegetation might develop.

To determine areas of high potential erosion as nonpoint sources of sediments to the rivers flowing into the reservoir, used SPOT, USGS topo soils maps and precipitation maps to produce factors used in the Universal Soil loss equation. Identified problem areas for management actions.

Mapped ecophysical changes to an island offshore of Georgia using color aerial photography, DEM and previous maps. Determined that logging and burning in uplands were not significantly degrading marshland productivity in lowlands.

Fabrizio Jemma (Italy) - **Remote Sensing and GIS Contribution for an Environmental Planning Proposal**

Key points were: (1) Environmental data not well integrated into the planning and monitoring infrastructure in Italy; (2) need to develop models relating resources, uses and management concerns; and (3) their model has been successfully developed to determine trends in ground water susceptibility to pollution and water supply given continued urban/industrial development.

Presented model concept showing relations between resources, uses and management. Collected data at several levels of detail regarding land use/land cover, actual pollution, population, etc. Developed model based on monitoring of landuse changes with SPOT or Landsat TM which predicts potential pollution. Discussed some difficulties in classification of satellite data in urban/rural area typical of Italy.

Douglas M. Muchoney (USA), D. H. Grossman - **Ecological Inventory and Classification Using Integrated Remote Sensing/GIS Analysis**

Key points were: (1) Native conservancy is concerned with preservation of biodiversity and ecologically significant areas; (2) development of a rapid ecological assessment program is underway; and (3) need good knowledge of diverse ecophysical variables in order to plan for and implement protection.

Presented methods used to combine vegetation, topography, soils and geology in Jamaica and to aid in site selection and characterization of potential parks. Used Landsat to classify vegetation (unsupervised with GPS based field checking and then supervised). Integrated topography to drape landcover. Integrated soils and geology with above to produce maps of 36 combined ecophysical classes for use in planning and monitoring of protection areas.

COMMISSION V
WORKING GROUP V/6

Session TS-46 - **Biological Surface Measurements**
August 12, 1992, 08:30-10:00
Session Reporter: Dr. Thomas Leemann (Switzerland)
Chairman: ***Dr. Thomas Leemann*** *(Switzerland)*

Laurence P. Adams (South Africa), A. Tregidga - **Precise Biological Surface Measurements in Some Medical and Dental Studies**

Key points were: (1) Non contact, highly accurate measurements of the topology of biological structures become important to medical doctors, (2) biostereometrics in South Africa, and (3) measurements using a reflex microscope or stereo video technology.

Paper shows some unique non-contact measurement and mapping techniques for a variety of biological organisms or parts thereof. Three examples document the wide range of use of this procedure. Examples shown are the screw of the rat portal vein, quantification of wear of denture teeth, human head movement.

Ying Ke (USA), K. W. Wong, M. Slaughter, R. Gretebeck - **A Computer Vision System for Mapping Human Bodies**

Key points were: (1) Highly automatic mapping of an entire human body, and (2) study growth pattern, link between body fat and cardiovascular diseases (=> large number of experiments).

The paper shows the promising capability of computer vision systems in biostereometry to quantify human body surface and body volume. Data is obtained by a three (Tester Four) triple camera arrangement and appropriate processing. The computer vision approach allows for a very highly automated reconstruction process and produces results in short time frames.

Harvey L. Mitchell (Australia) - **An Approach to Digital Photogrammetry for Body Surface Measurement**

Key point was: (1) Near real time, close range digital photogrammetric system for parts of the human body (part of the face), (2) fully automated, low cost, high accuracy and easy to use, and (3) soft tissue measurement (facial reconstruction, etc.).

Emphasis was given to the hardware and software which make up a precise, simple, easy-to-use system to map human soft tissues. Input stems from 2-D photo images. Surface analysis of the face is given as an example for medical doctors to quantify soft tissue changes after surgery.

D. Woytowicz (Germany), W. Wester-Ebbinghaus, H. Gäbel, Th. Hallbauer, G. Schumpe - **Photogrammetric Measurement of the Human Back Shape and Its Relations to the Spine**

Key points were: (1) Surface of human back shape in relation to the geometric behavior of the spine; under occupation, (2) study with 30 helicopter pilots with and without back pain.

The study tries to link the surface shape of the human back with the geometric behavior of the spine. To that extent 30 helicopter pilots were orthopedically examined, 22 of them then measured by photogrammetry. As a result it can be shown that the specific geometry of the sitting posture of a helipilot while working leads to a static-motoric pattern in normal life.

L. Baratin (Switzerland), V. Achilli, G. Bonetti, I. Marini **Stereophotogrammetry: A Possible Employment in the Dental Field**

Key points were: (1) Stereophotogrammetric Measurement of the volumetric changes caused by the application of the rapid palatal expansion appliance, and (2) transversal hypoplasias of the upper jaw.

The rapid palatal expansion is used as an orthopedic measure to correct transversal hypoplasias of the upper jaw. Stereophotogrammetry is used to quantify the volumetric changes as well as the local movements.

COMMISSIONS IV, VII
Working Groups IV/2, VII/2

Session TS-47 - **Experience with Digital Elevation Models**
August 12, 1992, 08:30-10:00
Session Reporter: Carlos E. Nery (Brazil)
*Chairman: **Dr. Luiz A. V. Dias** (Brazil)*

Fritz Ackermann, W. Schneider - **Experience with Automatic DEM Generation** *(Invited Paper)*

Key points were: (1) Digital elevation models (DEM), (2) image correlation, and (3) robust fitting

Development of a system that relates stereo images and produces DEM's. Prof. Ackermann is very experienced in this area and his models obtain very high accuracy.

Kohei Arai (Japan), Y. Terayama, H. Watanabe, T. Tagawa, J. Komai - **A Consideration of Attitude Jitter on Digital Elevation Model (DEM) Estimation with EOS-AM1/ASTER**

Key points were: (1) Digital elevation models (DEM), (2) image processing, and (3) Fast Fourier Transform (FFT).

The objective of the paper was to assess the influence of satellite movements to obtain DEM data. The sensor used was the ASTER, aboard a Japanese satellite.

Philippe Munier (France), J.-C. Rivereau, S. LeBlanc - **Map Production and Updating Using SPOT Data and SPOT Data Derived Products**

Key points were: (1) Digital elevation models (DEM), (2) map production, and (3) geocoding, mosaicing.

The author presented the several present products SPOT Image produces and future proposals. Special emphasis was placed on the generation of DEM's from SPOT data.

A. Soumare (Nigeria), L. Cuilhe - **Produits Cartographiques à Partir d'Images Spatiales: Quelles Perspectives pour L'Afrique?**

Key points were: (1) Problems on producing maps in Africa, (2) impact of modern cartography, and (3) problems with inadequate human resources.

The paper presented the authors' view of the problems Africa is suffering now with respect to map production and revision. He suggests a better cooperation between the countries and support from international organizations like the United Nations.

Liang-Chien Chen (China-Taipei), J.-Y. Rau, L.-H. Lee - **Recursive Surface Reconstruction Using SPOT Stereo Images**

Key points were: (1) Stereo images, (2) digital elevation models interpolation, DEM interpolation, and (3) epipolar.

The main objective of the paper was to show that it is possible to improve DEM from SPOT images, in a recursive way.

COMMISSIONS III, VII
Working Groups III/3, VII/2

Session TS-48 - **Simultaneous Interpretation of Different Digital Recordings**
August 12, 1992, 08:30-10:00
Session Reporter: E. Pross (Germany)
*Chairman: **Dr. Bernd-Siegfried Schulz** (Germany)*

Wolfgang Förstner (Germany), T. Löcherbach - **Fusing Informtion in Remote Sensing** *(Invited Paper)*

Key points were: (1) Modelling in mapping, (2) automatic image interpretation, and (3) fundamental paper in theoretical modelling.

Pat S. Chavez, Jr. (USA), J. A. Anderson, S. C. Sides - **Removal of Topographic Effects from Satellite Images WITHOUT the Use of a DEM**

Key points were: (1) Functionality of topographic effects, (2) comparison of special filterings, and (3) practical results

Question on the dependence of resolution and classification result; in the test area non-significant.

Jean-Paul Rasson (Belgium), V. Granville, F. Orban-Ferauge - **The Non-Stationary Poisson Process: A Fully Non-Parametric Model for a New Approach of Supervised Classification in Remote Sensing**

Key points were: (1) Definition of classification function "added intensities" (A1-Classification), (2) compare A1 and ML-Classification, and (3) practical and theoretical results were presented.

P. Blonda (Italy), G. Pasquariello - **Multitemporal Remote Sensing Data Classification Using Neural Network**

Key points were: (1) Supervised learning by neural network classification, (2) using Jeffries-Matusita-Distance.

Practical results for single TM-images, multitemporal TM-images, and single TM-images including DEM. Question on number of hidden layers and on convergence time (stability after 1000 - 1600 iterations).

Claudio Conese (Italy), F. Maselli, T. de Filippis -
A New Method for the Integration of Landsat TM and SPOT Panchromatic Data

Key point was - Combination of Principle Components Analysis (PCA) and high pass filtering (HPF).

Practical results obtained in a 5x5 km^2 test area in Italy. Question on including neighborhood in PCA and on georeference with bilinear convolution in control points.

COMMISSIONS II, III, V
Working Groups II/5, III/2, III/4, V/1, IC II/III

Session TS-49 - **Tomorrow's Digital Systems**
August 12, 1992, 10:30-12:00
Session Reporter: John Farrow (United Kingdom)
*Chairman: **Dr. Ian Dowman** (United Kingdom)*

Tapani T. Sarjakoski (Finland) - **Suitability of the Sharp JX-600 Desktop Scanner for the Digitization of Aerial Color Photographs**

Key points were: (1) A low cost, $10,000, product capable of producing images with a precision of 1/5 pixel or 8μm, sufficient for most photogrammetric tasks, (2) the calibration should be regularly performed and the photogrammetric software must be able to apply the error model, and (3) image sharpness falls off towards the edge and therefore images should be constrained to the center of the 9" x 9" area.

In discussion it was emphasized that the use depended on the application, but in general 1/2 pixel was necessary to determine the geometry of an object and therefore the scanner met this. The calibration process uses a simple pixel line fitting process to determine the grid intersections to approximately 1/10 pixel. It was not thought necessary to use a more complex harmonic analysis as the simple approach adopted was satisfactory and could be applied to other similarly constructed scanners.

S. B. Miller (Switzerland), J. E. Thiede, A. S. Walker -
A Line of High Performance Digital Photogrammetric Workstations - The Synergy of General Dynamics, Helava Associates, and Leica

Key points were: (1) The powerful alliance of GD, HAI and Leica has been formed to give each a wider market penetration, joint bids for large projects, joint development on user products confirmed by recent formal signed agreement; (2) partnership now offers the complete range of digital photogrammetric capabilities from scanner through orthoimage to feature extraction from either mono or stereo digital images are supporting a range of industry vector processing packages.

In discussion the importance of the role of marketing of these new commercial digital workstations was stressed. The potential for competition from the non-traditional photogrammetric system suppliers is much higher and therefore effective marketing is considered vital, and new market sectors will need to be sought.

Thomas Luhmann (Switzerland), R. Loser -
The Programmable Optical 3-D Measuring System POM--Applications and Performance

Key points were: (1) The system is designed to perform inspection and quality assurance in the industrial sector where structures need to be measured to monitor conformance with design tolerances; (2) multiple camera views, generated by the moving object, enable known geometric shapes to be detected from partial or distorted areas in the various views; and (3) a preliminary teaching procedure is used to indicate the type of object/shape to be measured and from then on the activity is automatic.

Urho A. Rauhala (USA) - **Nonlinear Array Algebra in Digital Photogrammetry**

Key points were: (1) Using the Nonlinear Array Algebra technique some significant effects from 2nd and higher order terms within some non-linear image modelling problems can now be treated in a significantly slower complexity time than hitherto, (2) the technique will have particular impact in multi-image problems; and (3) iterative convergence can be achieved from even poor initial values.

Rauhala compressed a very technical and theoretical paper within his allotted 15 minutes, attempting to cover his methodology for treating multiple digital images. He presented claims of impressive improvement in computer processing speeds over standard least squares matching technique.

General Discussion — **"Tomorrow's Digital Systems"**

Q:

Will there be any revolutionary breakthroughs, or will it be a slow evolution from the present state?

A:

More automation to support vector feature extraction will come, but slowly. Work is still needed to permit scanning of images directly from the negative roll films.

Q:

Will the newer, more reasonably priced scanners have hardware or software calibration facilities?

A:

Both. In general hardware will become more robust.

Q:

Do you agree that scan resolutions need to be at the 5 micron level to match analytical stereoplotter capability in order that the radiometric information currently used by the operator will not be lost?

A:

We do not need the extreme. Larger pixels are sufficient in practical applications. Theoretically, 5 microns is sufficient, but in commercial practice this is rarely needed and 30-40 microns will suffice, with 15-25 microns as a reasonable objective.

Q:

Will users accept the new Digital Soft Copy Analytical Stereoplotter?

A:

Non-photogrammetrists can now use the photogrammetric tool which shifts the whole measurement process from the current supplier to the end user, if at a reasonable price. User photogrammetric input to GIS data bases will be possible.

Both DTM and orthophoto can be done on the same workstation as feature extraction. The near future will bring automation tools for feature extraction to maximize productivity. Ways to couple geometry with semantic information will help the process of enabling users to extract their own data requirements.

COMMISSIONS IV
Working Group IV/6

Session TS-50 - **Planetary Mapping**
August 12, 1992, 10:30-12:00
Session Reporter: Dr. Sherman S. C. Wu (USA)
Chairman: ***Dr. Sherman S. C. Wu*** *(USA)*

Tammy Dickinson (USA), M. B. Duke - **Extraterrestrial Mapping and the Space Exploration Initiative**
(Invited Paper)

The Space Exploration Initiative (SEI) is intended for robotic surveys and mapping of the moon and Mars so that intelligent site selections can be made for future manned exploration and scientific expeditions to their surfaces. There will be two small orbiters of the moon with sensors to survey the surface materials and their chemistry as well as map the entire surface. Various kinds of maps will be generated such as: topographic, local and geologic maps which will be used in analysis to select sites for surface investigations. Small robotic vehicles and instruments will be the first surface investigators. Mars exploration will begin with the Mars observer which will remain in orbit about Mars for 1 Mars year (2 Earth years). It will survey and map the surface of the planet in the same manner used for the moon. Site selections and surface explorations also would be carried out in the same manner.

Frederick J. Doyle (USA), M. Davies, M. Milan, G. Neukum - **Cameras for Extraterrestrial Mapping**
(Invited Paper)

The key point was that past experience in mapping the moon and Mars has helped guide us in selecting the best camera system for future planetary mapping.

By concentrating on the moon and Mars we know that a good mapping plan requires determination of the planets spin axis orientation and the gravity field. Then a network of ground control points can be produced for global image maps and topography (1km pixels and 100m DEM) as well as for regional maps (5-10m DEM) and landing site maps (0.5 to 1m DEM) Image requirements for science is limited in scale by resolution of the human eye which is about 5 pixels/mm. Therefore image scale for a global image would be 1:5mil and a landing site image would be 1:5000.

Only orbiters would be used for systematic coverage with system capabilities to do stereo for topography and multispectral for science. The sensor should be electrooptical because it is small and lightweight and has a high dynamic range. None of the existing space camera systems flying or to be flown such as Gallileo, Mars 94, Mars Observer, or Cassini is suitable for the mapping requirements. The system should have 2 focal lengths (1000mm and 200mm) with a focal plane array of 4000 x 4000 elements to be used for both stereo and multispectral. There should be on board processing with a wide band data link. Images should be put on CD-ROM for PC-based stereo workstations.

J.-Peter Muller (United Kingdom), A. C. Cook, T. Day, J. Iliffe - **Global Topographic Mapping System of Mars**
(Invited Paper)

Key points were: (1) An automated digital mapping system is developed; (2) using existing planetary control network and Viking Orbiter image data; and (3) a global topographic map of Mars could be derived.

This system uses a program called EXODUS which is an acronym for Extraterrestrial Orbital DEMS for Understanding Surfaces. It is used in the Mars Information System (MIS) to automate the selection of images to be used in stereo. Control point selection is automated and the terrain model is automatically generated. The terrain model is still not quite free of error but should be exemplary for Mars 94 and 96.

John C. Curlander (USA) - **Magellan SAR Processor Design and Performance**

The Magellan imaging SAR system has several times better resolution than its predecessors, the U.S. Pioneer Venus and Russian Venera. The orbit is highly elliptical so that imaging takes place in that portion of the orbit near the planet surface then turns the same large imaging antenna towards Earth in the outer part of the orbit for data transmission. Magellan is acquiring 10 times more data than Seasat or Sir-C acquired. The processor is handling an average of 90 orbits per week at 150m resolution. There have been no processor failures in 2 1/3 cycles of Venus surface coverage. They expect the project to run through March '93 and then be decommissioned.

Franz W. Leberl (USA), K. E. Maurice - **Stereo-Mapping of Planet Venus from Magellan SAR Images: A Status Report**

Magellan has now imaged more than 90% of the planet Venus with 75m pixels. Altimetry data used to

assist development of DEM's is misleading when used for determining small crater depths. The crater will be too shallow by a factor of 2 because the altimeter footprint is too large for the crater size. Good stereo has recently been achieved by combining the third cycle with the first cycle near the North Pole. The look direction is east at look angles off nadir of 45 degrees and 25 degrees. The DEMs can be compiled using automatic correlation but they have found that there is a difference of 100m between manual and automatic compilation.

Timothy Day (UK), J.-P. Muller, A. Cook -**Automated Digital Topographic Mapping Techniques for Mars**

Key points were: (1) Discuss techniques of stereo match (Otto Chau); (2) using Viking orbiter images of Mars for implementation; and (3) DEM and perspective views as well as contours can be produced.

Mr. Day is using the Otto Chau Stereo Matcher to compile DEMs using Mars imagery.

COMMISSIONS VII
Working Group VII/3

Session TS-51 - **Renewable Resources Inventory and Monitoring with Remote Sensing/GIS--Session II**
August 12, 1992, 10:30-12:00
Session Reporter: Dr. Randall Thomas (Denmark)
Chairman: ***Dr. Randall Thomas*** *(Denmark)*

Gabor Remetey-Fülöpp (Hungary), P. Winkler - **Monitoring Renewable Natural Resources--A Joint Proposal of the Eastern-Central European Countries** *(Invited Paper)*

Key points were: (1) The Central-East European countries need good resource inventories for future planning and management; (2) there is an urgent need to build up remote sensing and GIS/LIS capabilities; and (3) there is a need for good fundamental map data.

The paper outlines a proposal and recommendation to develop a regional (ECE countries) remote sensing and GIS infrastructure to provide the necessary training and capabilities to develop resource inventories and maps. The paper outlines current capabilities in Poland, Check and Slovak Republics, Bulgaria, Romania and Hungary. The paper also outlines what resources and inputs would be needed to develop this infrastructure.

Mona El Kady (Egypt), C. B. Mack - **Remote Sensing for Crop Inventory of Egypt's Old Agricultural Lands**

Key points were: (1) Old agricultural lands are more complex because the plots are smaller, more crops and 2-3 crops/year with a variety of planting dates; (2) Landsat data is not good enough for old agricultural lands and aerial photos are needed; and (3) end user must determine the detail needed. Then once known, one can select the source of data.

Old agricultural lands (6000 years old) in Egypt pose a difficult problem for developing reliable land use maps because the plots are very small, 2-3 crops per year are planted at a variety of times, and there is intercropping. The only way this can be done is to scan-digitize color IR air photos into a GIS. Then they develop about 10 land use classes. Satellite data is useful for large scale, general inventories but not for the old agricultural lands.

Henrik Österlund (Sweden), È. Rosenqvist, A. Engberg - **Remote Sensing for Forest Management--The Swedish ISY Contribution Projects**

Key points were: (1) Sweden's contribution to ISY is partly through its activities in the World Forest Watch; (2) eight projects related to forestry and education have been undertaken, and (3) there is a large emphasis on education in these programs.

Sweden's ISY contribution to the World Forest Watch has been manifested in 8 projects: a) A GIS/Remote Sensing Workstation for updating and revising forest maps, b) change detection in forest stands, c) forest management planning with aid of GIS and integrated satellite data, d) forest decline monitoring using Landsat TM, digital forest maps and elevation models, e) development of a Swedish Forest Information Atlas, f) monitoring tropical forests (in Thailand) with high resolution satellite data, g) a study on deforestation in African drylands (Sudan) by assessing changes in woody vegetation, h) developing a program for education of educators from Africa, SE Asia, and South America.

Erkki O. Tomppo (Finland), Matti Katila - **Multi-Source National Forest Inventory of Finland**

Key points were: (1) National forest inventory in Finland is an important management source of information; (2) change-growth and mortality can be estimated more accurately using a remote sensing method; and (3) remote sensing method (MSI) agrees very closely with the field inventory (FI) method.

Older (survey) inventory methods based on a sampling scheme took 10 years to complete the entire country. A method based on satellite data has been shown to be very successful in providing not only general area statistics of forest types (pine, spruce, birch and other) but also types of wood (saw, pulp and waste) as well as volume and growth and mortality estimates. The remote sensing methods provide information comparable to the FI method in 3-5 year cycles rather than 10 years. It is also very cost effective.

Edward M. Makhanya (South Africa), M. Townsend - **Mapping Rural Land Use in Selected Subsistence Farming Areas of South Africa, Using Remote Sensing Products**

Key points are (a) Currently a lack of reliable land use data in subsistence farming areas of South Africa; (2)

Landsat MSS data was not of sufficiently high resolution to allow crop identification in subsistence farming areas; and (3) SPOT data appears to provide the detail necessary to classify agricultural crops.

South Africa has two different types of farming - large scale commercial farms and small plot subsistence farms. For land use planning and management there is a need for reliable land use data in the subsistence farming areas. Landsat MSS data were used in an attempt to classify the land use - but this did not compare well to field surveys and aerial photography. However, SPOT data appears to provide the necessary spatial resolution.

COMMISSION V
Working Group V/6

Session TS-52 - **Human Motion and Posture Analysis**
August 12, 1992, 15:30-17:00
Session Reporter: Dr. Peter Niederer (Switzerland)
Chairman: ***Dr. Peter Niederer*** *(Switzerland)*

Jürg U. Baumann (Switzerland), D. Sheffer, A. Schaer, G. Meier - **Photogrammetry in Medical Gait Analysis**
(Invited Paper)

Key points were: (1) Functional analysis of neuromuscular disorders of motion; (2) 2 mm spatial resolution necessary (and sufficient), and (3) rapid data-acquisition including photogrammetry is necessary.

Gait analysis permits a medical assessment of disorders of locomotion in combination with clinical data (knee injuries, neuromuscular disorder, artificial joints). Photogrammetry is of use for the determination of mechanical body parameters such as moments of inertia and geometrical data, important for motion analysis. The later includes a calculation of forces, torques, velocities, acceleration, etc.

Hirofumi Chikatsu (Japan), M. Turuoka, S. Murai - **Sports Dynamics of Carl Lewis Through 100m Race Using Video Imagery**

The key point was about problems in sports video imaging, i.e. nonmetric photogrammetry and feature extraction.

A single-view TV sequence (taken for commercial TV reporting) is calibrated and evaluated to reconstruct the motion of Carl Lewis during a 100M race.

H. Rüther (South Africa), G. van der Vlugt - **A Real-Time Photogrammetric System for Patient Positioning in Proton Therapy**

Key point was - In this project, photogrammetry is not only used for measurement purposes, but also for positioning.

Patient has to be brought into a proper position for proton therapy. For this purpose photogrammetry is utilized. Tumor information is taken from CT, or MR, respectively. Eight standard CCD TV cameras are used. Patient is automatically monitored during treatment.

Winfried Kinzel (Germany), E. D. Dickmanns - **Moving Humans Recognition Using Spatio-Temporal Models**

The aim of this study is recognition of humans in view of facilitating automated road vehicles. A mathematical motion model for describing human motion is used. This model is fitted to actual images, in particular, motions of humans taken by TV (CCD).

COMMISSION VII
Working Group VII/6

Session TS-53 - **Monitoring Change in Urban Areas with GIS/Image Analysis**
August 12, 1992, 15:30-17:00
Session Reporter: Dr. Bruce C. Forster (Australia)
Chairman: ***Dr. Bruce C. Forster*** *(Australia)*

Bruce C. Forster (Australia), Chen Xing - **Urban Spatial Attributes from Satellite Remote Sensing Using End Member Analysis and Variability Measures**
(Invited Paper)

Key points were: (1) Spatial variability is an important measure for predicting housing density and house size; (2) vegetation has a modifying influence on spatial variability; and (3) further work on urban models, particularly in non-westerned cities, is required.

The problem of mixels in urban environments was discussed with regard to measures for disaggregating pixel response. A number of methods of end member analysis were reviewed. The results of a research study over Sydney, Australia using SPOT and Landsat TM data, showed coefficient of variability to be a strong measure for predicting housing density and house size in low to medium density residential areas.

Chor P. Lo (USA) - **A GIS Approach to Population Estimation in a Complex Urban Environment Using SPOT Multispectral Images**

Key points were: (1) A combination of remote sensing and GIS can be used to predict population; (2) high density multistory urban areas are difficult to predict on a single site basis; and (3) regional measures of population can however be reliably predicted.

A study of Hong Kong using satellite remotely sensed data and a simple GIS can be used to predict population. At the individual block level, predictions can have substantial error, but over larger areas quite reliable predictions can be derived.

Christopher J. Webster (United Kingdom), I. J. Bracken **Exploring the Discriminating Power of Texture in Urban Image Analysis**

Key points were: (1) Texture is a strong measure of urban characteristics; (2) not all texture measures are equally successful; and (3) Fourier transform indicating block structure are a reliable measure of urban density.

A number of texture measures were analyzed for remotely sensed data acquired over cities in the Middle-east and Britain. Conclusions were reached on the most appropriate texture measures. Fourier analysis of linear and block variability allowed high prediction of urban density characteristics.

J. R. dos Santos (Canada), Ana L. R. Carrara, C. Foresti **Analysis of Vegetation Indices in Urban Areas from Landsat TM and HRV-SPOT Orbital Data**

Key points were: (1) Vegetation indices are a useful variable in the analysis of urban areas; (2) vegetation indices can be used as a basis for classifying urban areas; and (3) high correlations between actual and measured values were obtained.

Urban environments in Brazil were studied using a classification index to determine the proportion of vegetation to synthetic built materials. These indices were used as a basis for classifying the urban area. The method was shown to be highly predictive of actual conditions.

Prof. M. Ridd (USA) - **Global Urban Eco-system Models**

Key points were: (1) Urban areas have a major influence on the Earth's environment; (2) urban areas can be usefully analyzed using satellite remote sensing; and (3) vegetation - impervious, soil surface analyses is a useful method for analyzing urban areas.

A global view of the impact of urban areas on the Earth's environment was presented. Although urban areas occupy only 5% of the Earth's surface, they are a critical factor in modifying the environment. Using satellite remote sensing and a vegetation impervious, soil surfaces triangle, most urban surfaces can be mapped as a proportion of these surface types. Thus one could provide a standard methodology for global analysis of cities.

COMMISSION I
Working Group I/4

Session TS-54 - **Sensor Orientation and Navigation**
August 12, 1992, 15:30-17:00
Session Reporter: Dr. José Luiz Aguirre (Brazil)
Chairman: ***Prof. Placidino M. Fagundes*** *(Brazil)*

Approximately 50 persons attended this session.

Larry A. Hothem (USA), E. J. Cyran - **Airborne Global Positional System Control for the National Aerial Photography Program** *(Invited Paper)*

The presentation addressed the use of GPS for the control of 7.5 minute quadrangles of USA's national systematic mapping, carried out by the USGS. The paper describes the reference points (four first-order stations), the employed cameras, aircraft and GPS antenna, and gives a overview of the GPS post-processing software packages. A summary of the operations, results and accuracies achieved was presented.

Keren Li (Germany) - **Ergebnisse über drei GPS-gestützte Testflüge und Vergleiche—Testflight, Results**

The presentation covered the testflight results for three areas which employed kinematic GPS, as an

experiment conducted by the University of Hannover. The parameters employed, the equipment on board and on the ground, and the primary results were presented, emphasizing the sub-decimeter accuracies obtained. The paper also addressed aerotriangulations done with the data obtained with GPS, and the results of the corresponding block adjustments. The aerotriangulation allowed a significant improvement over the previous results.

Tobias Heuchel (Germany), P. Friess - **Experience with GPS-Supported Aerial Triangulation**

The paper emphasizes the advantages of using GPS to support aerotriangulations. Relative kinematic positioning was discussed and the mathematical formulations briefly presented. The determination of ambiguities was shown to be possible with a block-adjustment aerotriangulation. The supporting configuration of ground control points was presented, as well as the equipment employed in two different projects, one in the Guinea Bissau and other in the US. Theoretical considerations about the attainable precision were covered.

Karsten Jacobsen (Germany) - **Handling of Disturbed Kinematic GPS-Data in Block Adjustment**

The presentation addressed the situation where systematic errors occur during the data takes and have to be corrected by aerotriangulation. An interpolation of projection centers was shown to help minimize the errors. Three test areas were employed to elevate the procedure, with different overlap and sidelap figures. Block adjustment and aerotriangulation results showed that the results are better with larger overlaps.

COMMISSION V
WORKING GROUP V/2

Session TS-55 - **Calibration and Evaluation of Close-Range Sensors - Session II**
August 13, 1992, 08:30-10:00
Session Reporter: Volker Uffenkamp (Germany)
Chairman: ***Dr. W. Wester-Ebbinghaus*** *(Germany)*

Ralf Goldschmidt (Germany), W. Borchardt, U. Richter **Criterions of Selecting Opto-Electronic Components of Systems Intended for Contactless and True to Geometry Measurement** *(Invited Paper)*

Key points were: (1) Digital sensor, (2) sensor geometry, (3) frame grabber.

The author gave an overview how opto-electronical components can be tested to assure that they are appropriate for measurement, testing and automation tasks. For example, CCDs and frame grabbers have been

investigated for linearity errors, lateral pixel sensitivity and pixel geometry as well as testing the realization of the pixel imaging on frame grabbers.

Wolfgang Riechmann (Germany) - **The Accuracy of the Reseau-Scanning Camera (RSC) in Comparison with Theodolite and Photogrammetric Systems**

Key points were: (1) Reseau scanning camera, (2) close-range photogrammetry, and (3) on-line and digital object recording.

Riechmann gave an introduction of the main components and principle of the digital middle format Rollei Reseau Scanning Camera (RSC). He presented the results of a test field measurement carried out with the RSC, a Rolleiflex 6008, a large format Rollei LFC camera and a Kern SPACE theodolite. A comparison shows that with the RSC, a level of accuracy could be reached which up to now appeared to be reserved for analog middle format cameras.

Anthony G. Wiley (USA), K. W. Wong - **Geometric Calibration of Zoom Lenses for Computer Vision Metrology**

Key points were: (1) Zoom lenses, (2) geometric calibration, and (3) computer vision.

As zoom lenses are quite useful in computer vision applications, the author reported about investigations for modeling changes of interior orientation and the distortion characteristics that occur during changes in the focal length setting. The results of the study show that the average residual error remains between 0.2 and 0.4 pixel throughout the range of focal settings of a A2.5 - 75mm zoom lens.

John C. Fryer (Australia) - **Recent Developments in Camera Calibration for Close-Range Applications**

Key points were: (1) Small format, (2) camera calibration, (3) lens distortion, and (4) film unflatness.

A review of calibration techniques for small format cameras was presented, giving comments and hints on each parameter of the camera and lens calibration model. A comparison of lens distortion techniques shows that the actual values of parameters may appear to differ without an alteration to the object point coordinates. The relevance of the offset of the principal point, the film sketch and film unflatness, as well as the role and methods of the interior orientation, were discussed.

COMMISSION III, VII
WORKING GROUP III/4, VII/7

Session TS-56 - **Knowledge Engineering, Applications, and Systems**
August 13, 1992, 08:30-10:00
Session Reporter: Tiina Kilpeläinen (Finland)
*Chairman: **Dr. Tapani Sarjakoski** (Finland)*

K. Schutte (Netherlands), N. J. Mulder - **Knowledge Engineering in RS and Knowledge Based Systems in GIS**

Key points were: (1) Model based knowledge engineering is applied to hypothesis generated town a 3D GIS; (2) the use of remote sensing data as evidence for updating of the 3D GIS; and (3) bottom-up evidence reasoning reduces the search - three for the acceptable hypothesis.

The representation described how model based reasoning can be applied to the analysis of remote sensing images. The essential part of the work was a connection to a 3D GIS. The presented method was based on the idea solving the inverse problem for which hypothesis about buildings are derived from the 3D GIS data base and these hypotheses are then accepted or rejected on the basis of image analysis.

Two error measures were proposed: run-length and arbitrary order moments comparison. The following problems were discussed: Search techniques, numeric parameter estimation and convergence properties. The connections to the object oriented programming paradigm were emphasized. The practical feasibility of the method was addressed as a future research topic.

Norbert Haala (Germany), G. Vosselman - **Recognition of Road and River Patterns by Relational Matching**

Key points were: (1) Relational matching methods, (2) search techniques for efficiency, and (3) integration of knowledge with mutual information.

The paper described the relational matching method for matching of relational descriptions of images and maps. The work was motivated by the task of automatic exterior orientation of images. The structural descriptions of the images are obtained by thresholding selected channels of color images and subsequent thinning of the linear structures. A search method was used to match the derived relational image descriptions with hand made descriptions of the landmarks. Results show that search time is influenced by the number of image and landmark priorities, number of similar objects or object parts and segmentational error.

Eugene Derenyi (Canada), D. Fraser, R. Pollock, M. Halim - **Knowledge Based Image Classification in a GIS**

Key points were: (1) Knowledge based image analysis, (2) overview of the CARIS GIS software, and (3) integration of knowledge based image classification methods into the CARIS system.

The presentation discussed the inclusion of GIS based nonspectral information into the image analysis process viewed as knowledge based image classification. Such a-priori knowledge is proposed to be best utilized in a hybrid GIS. The integration of knowledge based image classification methods were discussed in the context of Canadian CARIS GIS software. An example of agricultural map classification and map area estimation was discussed.

COMMISSION II
WORKING GROUP II/4

Session TS-57 - **Systems and Instrumentation for Microwave Data Processing**
August 13, 1992, 15:30-17:00
Session Reporter: Wolfgang Noack (Germany)
Chairman: ***Dr. Horst Weichelt*** *(Germany)*

A. Shutko (Germany), H. Weichelt, E. Reutov, T. Jackson, T. Schmugge, C. Swift, P. Pampaloni, S. Paloscia, G. I. K. Rao, K. Schmidt - **Progress and Problems in Microwave Radiometric Remote Sensing of Soil Moisture (Instruments and Application)** *(Invited Paper)*

Key points were: (1) Main parameters that effect microwave radiation from soil and vegetation; (2) introduction of the main instrumentation; and (3) showing results of measurements of radiation from different types of vegetation.

The authors are showing the methodological and system aspects using a dual channel (2 μm/22 μm wavelength) airborne microwave radiometer system.

Wolfgang Noack (Germany) - **DLR's Operational and Planned SAR Processing Systems** *(Invited Paper)*

Key points were: (1) The operational ERS-1 SAR processor and the processing and archiving facility of DLR; (2) the schedule of the current and planned SAR satellites forms the background for DLR's future developments; and (3) introduction of detailed system aspects of the ERS-1 and X-SAR processors.

Major upgrades and developments of processor systems need to be done for the processing of data from polar orbiting earth observing missions. Recent developments in the computer industry with respect to compute power and mass data storage capabilities are indicating that affordable systems will be available in time. In the next year a new precision processor running on work station will be developed and offered to interested users.

C. Y. Chang (USA), J. Curlander - **SIR-C Ground Data System and Processing Algorithm Design**

Key points were: (1) The end-to-end data flow of the SIR-C ground data system; (2) the characteristics of the radar and data products; and (3) the algorithms used for survey and precision products.

The development of the GPL SIR-C ground data system bearing in mind the problems for SAR processing with a low altitude and unstable flying shuttle is a quite comprehensive task to be completed in October 1993.

H. Wakabayashi (Japan), M. Shimada, T. Kikuchi, H. Aiba, H. Nohmi - **The SAR Processing System of NASDA EOC**

Key points were: (1) Features of the parallel processing system in use for processing of SAR and optical data; (2) processing capabilities for the generation of leveled SAR products; and (3) image samples of G-ERS and a blade diagram of the processor.

The presentation showed a detailed view of the SPR processor of NASDA, which is operational for G-ERS as well as high quality products. These will be an upgrade of the system which is aimed at doubling throughput.

Einar-Arne Herland (Finland), Seppo Vaatainen - **A Processor-Based SAR Image Geocoding System**

Key points were: (1) The image geocoding system uses processor parameters, digital elevation models and state vectors as input; (2) the used satellite edit propagator and its performance; and (3) target location calculation procedure.

The algorithm has proven its quality with ENS-1 data. However, the quality of the used digital elevation model data was not sufficient for automatic processing and manual adjustment was necessary.

Johannes Raggam (Austria), D. Strobl, A. Almer - **Multisensor Mapping Using SAR in Conjunction with Optical Data**

Key points were: (1) Procedures for stereo mapping using combined optical and SAR data; (2) mapping principles and processing steps; and (3) results of imaging multispectral SPOT/Landsat/DC8 image data.

In general, the proposed algorithm has proven to be suitable for stereo mapping. However, interactive operation is required. Problems have been shown up with respect to geometric and radiometric accuracies of the different sensor types used.

COMMISSION VII

Session TS-58 - **Remote Sensing Data Requirements in the 1990'S**
August 13, 1992, 10:30-12:00
Session Reporter: Frank Hegyi (Canada)
Chairman: ***Frank Hegyi*** *(Canada)*

Robert N. Colwell (USA) - **Four Decades of Progress in Photographic Interpretation Since the Founding of Commission VII** *(Invited Paper)*

Key points were: (1) History of photointerpretation, photogrammetry and Commission VII; (2) overview of platforms, sensors, type of data and their application; and (3) constantly changing technology and the challenge to use current techniques for the inventory and monitoring of natural resources.

The author provided an excellent overview of four decades of progress in photographic interpretation. He was the co-founder and first president of Commission VII. The presentation was well received by approximately 50 participants. Future challenges include the "multi" concept, high resolution, increased spectral resolution and the use of GIS together with RS data.

COMMISSION I
WORKING GROUP I/3

Session TS-59 - **Sensors and Platforms for Remote Data Acquisition — Session II**
August 13, 1992, 10:30-12:00
Session Reporter: Volker Uffenkamp (Germany)
Chairman: ***Dr. John Curlander*** *(USA)*

John Curlander (USA) - **Recent Developments in the Use of Synthetic Aperture Radar for Remote Sensing** *(Invited Paper)*

Key points were: (1) Advancements in SAR can be used to measure surface topography; (2) superior technique to stero more accurate techniques; and (3) polarity is a valuable classification tool to make measurements of forest density.

New uses of SAR are being studied that extend use of SAR to variety of scientific and mapping applications.

E. Velton (Germany), P. Ammendola, M. Canevari, M. Wahl - **X-SAR, A Spaceborne Synthetic Aperture Radar Instrument**

Key points were: (1) Mission of X-band (Germany) and L-, C-bands (USA) will be flown in October 1993 on the space shuttle; (2) advanced system, never flown 3 frequency, quad-polarized systems in space, large increase in technology; and (3) very good performance relative to ERS-1, TWT design with 12m slotted waveguide antennae.

Very interesting new program for scientists since it will produce SAR data sets with multiple channels (9) all collected simultaneously. These designs are now being advanced for next big SAR program X-EOS.

R. Reuike (Germany), Dieter Oertel, R. Sandau, T. Terzibaschian, M. Scheele - **A Flexible Digital Wide-Angle Opotoelectronic Stereo Scanner**

Key points were: (1) Advanced design with 3-line imaging arrangement with over 5,000 imaging pixels; (2) stereo results from 3 lines - one nadir pointing, one looking ahead, one looking behind; and (3) system will be used in Mars 94 experiment to produce topographic maps of surface.

Airborne prototype has been developed for wide angle stereo scanner which will be flown on Mars 94 mission. System has been tested over sites in Germany and is performing well.

Anthony Freeman (USA) - **Radiometric Calibration of SAR Image Data**

Key points were: (1) Maturation in SAR field has led to operational calibration of instruments such as JPL a/c SAR; (2) to perform calibration properly, one must know terrain variation in image; and (3) radar system can be designed with internal calibration devices to measure transfer function.

Very clear overview of techniques to calibrate synthetic aperture radars. Equations and results were presented as well as calibrated images shown.

Benoit Rivard (Canada), P. Thomas, D. Pollex, A. Hollinger, J. Miller, R. Dick - **Calibration Results for the Field Portable Thermal Infrared Spectrometer (THIRSPEC)**

Key points were: (1) Operational portable (back-pack) infrared radiometer is now being used in the field for geology studies; (2) system has built in calibration mode that does not require liquid nitrogen; and (3) correction technique involves replacing measured sample with known reference samples to derive the correction factor.

Portable infrared spectrometer has beem developed to perform measurements of rock samples. System has been proven to be well calibrated and is now being used operationally.

COMMISSION II
WORKING GROUP II/2

Session TS-60 - **Systems for Image Interpretation, Analysis and Display of Remotely Sensed Data**
August 13, 1992, 10:30-12:00
Session Reporter: D. R. Steiner (Germany)
Chairman: ***Dr. Manfred Ehlers*** *(Germany)*

There were about 100 attendees to this session.

Manfred Ehlers (Germany), D. R. Steiner - **A New Evolving Paradigm in the Systems Aspects for Processing of Remotely Sensed Data** *(Invited Paper)*

Key points were: (1) Summary of the activities of WGII/2; (2) observations concerning technology as a driving force in the development of integrated systems for processing geoinformation; (3) distinctions between the disciplines of photogrammetry, remote sensing and GIS are blurring; and (4) requirements for hybrid geoinformation processing workstations based on general purpose hardware.

Advances in hardware and software development are leading to the development of integrated systems for the processing of geoinformation. The increased capabilities of modern workstations are providing a catalyst for the development of such systems.

Joachim Wiesel (Germany) - **Benchmarking Image Processing Systems**

Key points were: (1) Software developers and end users need benchmarks to make decisions concerning performance of processing systems; (2) two types of benchmarks are production (application specific and not portable) and synthetic (generic and portable); and (3) Ikonstone is a public domain, synthetic benchmark for assessing the performance of image processing systems.

Ikonstone has been developed to provide a way of benchmarking most image processing systems running on a wide variety of platforms. The software will be made available via FTP at the completion of its development cycle.

Ian Dowman (United Kingdom) - **Triangulation of SPOT Data: Results from the OEEPE Test**

Key points were: (1) OEEPE conducted a test to determine requirements and accuracy of triangulation of strips of SPOT data; (2) seven research organizations used the same imagery to independently test various control configurations; and (3) control data was obtained by measurement from hard copy and digital data.

The test indicated that the accuracy obtained is similar for triangulated strips as for single images. It was noted that height accuracy was better than XY. Hard copy measurement provided better results than digital for this test.

David Allison (United Kingdom), J. P. Muller - **An Automated System for Sub-Pixel Correction and Geocoding of Multispectral and Multilook Aerial Imagery**

Key points were: (1) A project to monitor land use at a high spatial resolution (5m) using aerial data required an automated and highly accurate technique for image registration; (2) conventional registration methods are not accurate due to complex distortions and displacements; and (3) a multi-step, automated procedure was used to produce registration results to an accuracy of less than one pixel.

A useful technique for obtaining highly accurate registration of multi-sensor, multi-resolution imagery was presented. This technique is highly automated and is well suited for localized change detection.

B. Guindon (Canada), T. A. Fisher, F. E. Guertin - **The Evolution of Operational Satellite Image Geocoding in Canada**

Key points were: (1) The evolution of geocoding systems in operational use in Canada since 1976; (2) development of each system was driven by technical limitations of predecessors as well as availability of new image data sources; and (3) the need for improved control and DEM corrections, extended product lines and extended operating modes will drive future development.

The development of geocoding systems in Canada has been an evolutionary process which builds on the success of previous systems and is driven by increased demands on the technology and advances in image acquisition.

R. Muller (Germany), P. Reinartz, G. Kritikos, M. Schroeder - **Image Processing in a Network Environment**

Key points were: (1) XDIBIAS is an image processing system based on over 20 years experience at DLR; and (2) the system features operation in a network environment, modular software structure, ease of use, a programmer's interface for extensibility, and a high degree of portability.

The DLR has developed an image processing system which is designed to run in a networked environment. The system runs under X-Windows, is modular, extensible and easy to use.

COMMISSION IV
WORKING GROUP IV/2

Session TS-61 - **Mapping from Space**
August 13, 1992, 13:30-15:00
Session Reporter: Alain Baudoin (France)
Chairman: ***Alain Baudoin*** *(France)*

Gottfried Konecny (Germany), W. Schuhr - **Mapping Potential of Remote Sensing Sensors** *(Invited Paper)*

Key points were: (1) Photographic cameras used in space have good technical capabilities for mapping but the number of space missions with them is very low; (2) SPOT and MOMS can be used for 1:100K mapping or for 1:50K with some limitations; and (3) radar can be used for 1:250K mapping.

W. Schuhr presented his paper which described three different types of sensors: photographic cameras, scanners and SAR, which can be used from space to map the earth's surface. The advantages and disadvantages of these tools were presented showing that, at the present time, none of them is perfect for medium scale topographic mapping. But with some improvements, space could be used very efficiently for mapping.

H. Ebner (Germany), W. Kornus, T. Ohlhof - **A Simulation Study on Point Determination for the MOMS-02/D2 Space Project Using an Extended Functional Model**

Key points were: (1) In 1993 MOMS will have 5m resolution and along track capabilities; and (2) the use of three images (fore, aft and vertical) should improve the accuracy of point determination.

MOMS-02/D2 mission was described with its instrument payload, having five lenses and stereoscopic capabilities (vertical, fore and aft). A third order polynomial model is used to describe image geometry. Simulations were performed in order to assess the quality of point determination using simultaneously three images, GCPs and a DEM. It is expected that MOMS will provide DEM with 5m accuracy.

Christian Heipke (Germany), W. Kornus, G. Strunz, R. Thiemann, I Colomina - **Automatic Photogrammetric Processing of Spot Imagery for Point Determination, DTM Generation and Orthoprojection**

Key point was that automatic stereo matching of SPOT images could provide high quality products: ortho images and DEM (dz = 10m).

A method for stereo matching using SPOT images was described. Some GCPs are used as "seed" points to calculate orientation parameters modelled with a third order polynomial. Two test areas were studied in Germany and Spain. Results showed that an accuracy of about 15m in planimetry and 6m in altimetry is achievable for GCPs, and about 10m for DEM.

Alain Baudoin (France) - **Les Amélioration du Système SPOT à l'horizon de l'an 2000**

Key points were: (1) SPOT SKG will have 5m

resolution and improved stereo; (2) existing products will continue to be available but improved products are expected to increase the market for SPOT imagery; and (3) definition of mission requirements is made taking into account users' requests.

The SPOT system already insures the availability of high resolution images until the year 2000. CNES, the French space agency, is studying improvements of SPOT after SPOT 4. SPOT 5 and SPOT 6 should have a higher resolution (5m) and along track stereoscopic capabilities, which should increase the SPOT market, especially for cartography and vegetation studies. The mission requirements of the system are considered in order to satisfy the users' needs. The use of a SAR is also studied for a separate mission. SPOT radar could compliment the optical SPOT family.

Frank Pattyn (Belgium) - **Topographic Mapping with SPOT in Polar Regions**

Key points were (1) SPOT could be used for topographic maps in polar regions; (2) stereo matching is better using a priori information; and (3) multispectral (with NIR) is better than panchromatic for this purpose.

Automatic matching of stereo pairs is possible with the half of a priori information: maximum parallax, geometric constraints, and detection of snow and shadows. Statistics on the correlation coefficient are used for matching acceptance. A result was presented; with 28 GCPs the planimetric accuracy is between 10 and 20 m and the altimetric accuracy about 15m, which is compatible with 1:100,000 scale map requirements.

COMMISSION VII
WORKING GROUP VII/5

Session TS-62 - **Atmospheric Remote Sensing**
August 13, 1992, 13:30-15:00
Session Reporter: Dr. K. A. Ulbricht (Germany)
*Chairman: **Dr. Klaus A. Ulbricht** (Germany)*

P. A. Brivio (Italy) - **Multisensor and Multitemporal Satellite Data for Runoff Forecast in High Alpine Environment** *(Invited Paper)*

Accumulation and ablation of snow control the hydrological environment of high mountain river basins. Multisensor and multitemporal satellite data enables monitoring of seasonal changes in snow cover for evaluation of its contribution to runoff. Nine Landsat 4 and 5 multi spectral scanner and thematic mapper images in a hydrological year were analyzed by digital image processing. Supervised maximum likelihood classification was used for estimating areal distribution and seasonal changes in snow cover over the upper Cordevole river basin located in the high environment of eastern Italian Alps. Digital elevation model, slope, aspect and exposition maps were used in the analysis. The seasonal snow cover was integrated with meteorological and hydrological data to develop a runoff forecast model for the basin. Performance evaluation of the model indicates Coefficient of Determination and Volume Deviation as 0.85 and +0.96% respectively comparable with results of World Meteorological Organization.

Uta Heinzmann (Switzerland) - **Cloud Classification on the Basis of NOAA-APT Data Using a Fuzzy Logic Approach**

A lot has been published on cloud classification on the basis of satellite data; but unfortunately, there seems to be a tendency to concentrate on the method of classification itself instead of going further and asking for the underlying processes. Time series of cloud data are required for this purpose, and classifications developed on single series requiring high spatial and spectral resolutions cannot be applied to hundreds of scenes in an operational way. For this reason a method based on NOAA-APT, DTM and landuse data was applied to a time series of one year (365 scenes). This data provided a basis for modeling with data for the REKLP (Region Klima Project).

Claude R. Dugway (Canada) - **Estimating Evapotranspiration Within the Colorado Alpine Tundra with Landsat Thematic Mapper**

Evapotranspiration (ET) is a key element in climate related studies on all spatial and temporal scales. Recent studies have shown that ET can be estimated with some degree of precision from meteorological satellites, over flat terrain, using semi-empirical and analytical models. However, no method has been proposed in order to derive this parameter in mountainous terrain by combining remotely sensed imagery with ancillary data. This is explained in part by the difficulties in estimating the relevant parameters which control ET rates, i.e. radiation balance, wind speed, aerodynamic resistance. Several models for deriving ET at both local and regional scales were reviewed. Using Landsat TM imagery and digital terrain data, an approach was proposed for estimating ET in a high relief environment. Preliminary results in the alpine tundra of Niwot Ridge (Colorado, USA) suggest possible solutions using remotely sensed data.

Andrey A. Ioltukhovski (Russia) - **Atmospheric Correction of Angular Measurements Above an Inhomogeneous and Non-Labertian Surface**

The inverse problem of identifying spectral reflection coefficient of the surface, optical thickness and atmospheric transmission function based on spectral measurements of the upward radiation in different directions was addressed. The optical transfer operator was used for modeling radiation transfer in inhomogeneous atmosphere with an inhomogeneous and a non-lambertian underlying surface.

COMMISSION V
WORKING GROUP V/3

Session TS-63 - **Algorithmic Aspects in Close-Range Image Analysis**
August 13, 1992, 13:30-15:00
Session Reporter: Dr. Dieter Fritsch (Germany)
Chairman: ***Dr. Dieter Fritsch*** *(Germany)*

Peter Axelsson (Sweden) - **Real-Time Photogrammetric Systems — Who are the Developers?** *(Invited Paper)*

Key points were: (1) Least squares will not solve everything, (2) direct solutions in combination with robust techniques, and (3) combine machine vision and photogrammetric tradition.

The motivation of the paper is based on two questions: (1) Are there any traces of a photogrammetric tradition still visible? (2) Are there fundamental differences depending on the scientific background?

Different aspects of a real time photogrammetric system are investigated. It is found that the traditional least squares estimation is not always sufficient but must be completed with e.g. direct solutions and robust estimation techniques.

J. Chen (United Kingsom), T. A. Clarke - **The Automatic Recognition, Location and Labelling of Targets in Digital Photogrammetric Engineering Measurement**

Key points were: (1) Recognition of targets placed on objects can be achieved using binary techniques; (2) centroid algorithms can provide subpixel location of targets in grey scale; and (3) an affine transformation is used to do consistent labeling.

Armin Gruen (Switzerland), D. Stallmann - **High Accuracy Dimensional Measurement Using Non-Targeted Object Features**

Key points were: (1) Edge detection without targets; (2) object reconstruction by means of edges; and (3) system set up for edge detection and object reconstruction.

This paper gave an overview of high accuracy dimensional measurement with non-targeted object factors. An accuracy of 1:25,000 was reached by means of least space matching of edge parts.

Simon X. Godber (United Kingdom), M. Robison, M. Evans - **Stereoscopic Vision Using Line Scan Sensors**

Key points were: (1) Look at alternative vision systems; (2) line scans can be used in vision systems; and (3) potential application in security/robot vision systems.

COMMISSION V

Session TS-64 - **Experts and Expert Systems**
August 14, 1992, 8:30-10:00
Session Reporter: Dr. E. P. Baltsavias (Switzerland)
Chairman: ***Dr. Emmanuel P. Baltsavias*** *(Switzerland)*

Mark R. Shortis (Australia) - C. L. Ogleby, F. J. Leahy **Expert Witness Testimony Based on Photogrammetric Evidence**

Key points were: (1) Photogrammetrist must demonstrate to court that he has expertise - qualifications must be verified; (2) usually single-photo photogrammetry is required; and (3) photogrammetrist, as an expert in court, must be prepared to answer loaded and unreasonable questions and to address non-contentious issues.

Scott O. Mason (Switzerland), V. Kepuska - **On the Representation of Close-Range Network Design Knowledge**

Key points were: (1) An expert system is being built to perform the task of photogrammetric network design; (2) rules shown as suitable representation for the heuristics and rules-of-thumb in network design; (3) frames as a suitable representation for structural knowledge in network design.

Adeyinka A. Bammeke (United Kingdom), R.A. Baldwin **Designing and Planning Close-Range Photogrammetric Networks: Is an Expert System Approach Feasible?**

Key points were: (1) Prima-facie case established for building an expert system for network design; (2) emphasized need for simple accuracy predictor to support design for initial imaging geometry; (3) prototype built to handle simple planar-faced objects.

J. Jansa (Australia), J. C. Trinder - **A Knowledge Based System for Close Range Digital Photogrammetry**

Key points were: (1) Knowledge base not completed - should be used for the analysis of measurement results; and (2) using binary coded structure light for the derivation of object shape for which feature-based techniques are unsuitable.

INTERCOMMISSION WORKING GROUP VII/I

Session TS-65 - **Environmental Monitoring Applications**
August 14, 1992, 08:30-10:00
Session Reporter: Frank Hegyi (Canada)
Chairman: ***Frank Hegyi*** *(Canada)*

R. Ryerson (Canada), B. Bruce - **Canada's Technology Transfer Approach for Environmental Monitoring**

Technology transfer is divided into three key phases. The first is the enabling phase in which policy support, mandate and management is set out. The second is the empowerment phase during which information is obtained, education on training is undertaken and infrastructure established. The implementation phase is based on demonstrations, applications, integration and research and development. The remainder of the presentation discussed three sources of risk: acceptability, feasibility and availability.

Farouk El-Baz (USA) - **Remote Sensing of Environmental Effects of the Gulf War**

The key point was RS satellite imagery can help monitor the impacts of the Gulf war.

There has been significant environmental damage as a result of the Gulf war - including surface damage, oil spills and fires. Impacts of oil spills on coastal resources, land surface disturbance, and atmospheric disturbances were reviewed. In many instances, long term impacts are not known. The oil fires appear to have had a short term effect, while the spills' impacts may last for several decades. The real long term impact may well come from erosion which has created new sand dunes, whose effects may last for several centuries.

Christopher Stohr (USA), R. S. Lunetta, T. D. Frank **Collection and Interpretation of Color Infrared and Thermal Infrared Imagery of Landfill Covers**

Key points were: (1) Thermal IR imagery can be used for monitoring drainage from land fills; (2) color infrared imagery can be used to monitor impacts on vegetation of leachates and depressions on the surface; and (3) imagery can be used to monitor the whole site at one time, leading to identification of minor problems before they become major problems.

COMMISSION II
WORKING GROUP II/3

Session TS-66 - **Receipt, Preprocessing and Archiving of Large Volumes of Data in Remote Sensing**
August 14, 1992, 08:30-10:00
Session Reporter: Fred C. Billingsley (USA)
Chairman: ***Fred C. Billingsley*** *(USA)*

Ralph J. Thompson (USA) - **Land Science Data Management for the Earth Observing System an Architecture for Archive Management**

Key points were: (1) AVHRR multi-coverage at 10 gigabytes per day; (2) gridded data sets from DMA global CD's will be put together into a Landsat Pathfinder data set to provide a retrospective high quality data set; and (3) a major problem/effort in archiving has been getting agreements between centers to produce a multi-center seamless system.

A network of Centers will be established to handle/ archive the vast quantities of data which will be acquired by the Global Change Research Program in the late '90s. This system is being prototyped at the EROS Data Center. This system will assemble and make available a high quantity of data from the present worldwide Landsat data, and is also collecting complete coverage of all land masses from the AVHRR. These are being collected now to provide a baseline for future global studies, and the system will provide valuable experience in data management which will result in more intelligence in future system designs.

Bill P. Clark (USA) - **A Survey of Digital and Optical Small Media for Storage of Landsat Data**

Key points were: (1) CD ROM, (2) WORMS and write many - read many, and (3) digital cartridges.

The current status of several media were presented. CDROM formats are being standardized using an ISO 9660 basis. Systems are becoming cheap enough for small users. Mastering costs expected to drop to the $1000 range, thus allowing experimenters and other small users to generate CD ROMS. Write Once - Read Many (WORM) and write many - read many disks are still too expensive for small users. Magnetic tape cartridges such as Exobyte are becoming cheap enough to be applicable in major data distribution.

Athula Mandanayake (United Kingdom), K. Tildsley, A. Newton, J.-P. Muller - **Automatic Mosaicking of Satellite Images Using Global Re-Navigation**

Key points were: (1) A sequence of operations for using tie points to mosaic images from AVHRR GAC images; and (2) back calculations for recovering the apparent spacecraft position and altitude.

A system for mosaicking images from satellite such as AVHRR, using automatic selection of tie points between images, and renavigating over the mosaic. Fixed ground points may also be used if available. Images are then resampled into the desired output space. These may then be radiometrically blended and assembled into further mosaics.

COMMISSION V
WORKING GROUP V/3

Session TS-67 - **Surface Monitoring**
August 14, 1992, 10:30-12:00
Session Reporter: Dr. J.-P. Muller (United Kingdom)
Chairman: ***Dr. J.-P. Muller*** *(United Kingdom)*

Donald M. Stirling (United Kingdom), J. H. Chandler, J. S. Clark - **Monitoring One of Europe's Largest Retaining Walls Using Oblique Aerial Photography**

Key points were: (1) No distortion (<3.5mm) detected, and (2) helicopter platform provided excellent flexibility.

A helicopter was used as a platform and the camera was held by a London bus conductor harness. Targets were placed on retaining walls. Manual photogrammetric measurements were processed using an in-house self-calibrating bundle adjustment. Without control, a nearby power station cooling tower could be measured to an accuracy of 0.5m.

Rudiger Kotowski (Germany), J. Peipe - **Optimizing the Photogrammetric Network to Record Mozart's Pianoforte**

Key points were: (1) Simultaneous camera calibration object coordinates <40mm, (2) no use was yet demonstrated, and (3) bundle triangulation cornerstone.

The relationship between geometrical shape and acoustics of Mozart's Pianoforte in Salzburg was studied based on constructed replicas from 20 instruments of the late 18th Century. Used normal case convergent photographs. Bundle adjustment must be <0.08mm. Point determination required accuracy ±50mm. Partially free adjustment. Vertical aerial photography (6) approach did not achieve required accuracy. (720-340μm) lack of 7 gaps. With convergent photography (16) 30-40μm, with both (20-30μm). 1:100,000 scale measurements. Zeiss Planicomp was used for measurements. Graphical display (with points) in 3D.

Hans-Gerd Maas (Switzerland) - **Robust Automatic Surface Reconstruction with Structured Light**

Key point was method can deal with discontinuities and occlusions.

Objects with insufficient surface texture. Multi grid projection of Moiré grid and coded light sequence (not accurate). A passive regular spaced dot pattern was projected. The center of gravity method was used for point segmentation and for epipolar line disparity limitation. Ambiguity was resolved through the use of a third camera and then a fourth camera. Ray traced visualization. Examples shown for bust, toy car, wing tip.

Faustin A. S. Banda (United Kingdom), J-P. Muller, S. N. Bhatia M. Buckhary - **Automatic Generation of Facial DEMs**

Key point was multi level Otto-Chau matcher with automated seedpoints.

Plastic cranio-facial surgery application area. Texture (grid & point) projected on face. Four CCD Pulnix cameras - side view has analog cameras for comparison. Automated seedpoints extracted using Foerstner interest operator. Multi facet Delauney triangulation used to prune matched points. Canny operator used to detect vertical line projections.

COMMISSION IV, III
WORKING GROUP IV/1, III/1, IV/5

Session TS-68 - **Digital Mapping and Geographic Information Systems**
August 14, 1992, 10:30-12:00
Session Reporter: Dr. Ryosuke Shibasaki (Japan)
*Chairman: **Dr. Ryosuke Shibasaki** (Japan)*

Ryosuke Shibasaki (Japan), H. Shaobo - **A Digital Urban Space Model — A Three Dimensional Modeling Technique of Urban Space in a GIS Environment** *(Invited Paper)*

Key points were: (1) Digital representation model for urban objects, (2) surface representation is useful for that purpose, and (3) case study to demonstrate the usefulness of Digital Urban Space Model (DVSM).

Surface representation based on TIN's is not restricted to a 2.5-D surface. By dividing a 3-D surface into several 2.5-D surfaces, a 3-D surface can be represented. This was a local project to support planning of a redevelopment project. There is no quantitative data on the cost of 3-D data base development. It depends on the level of detail of the representation.

J. Raul Ramirez (USA), E. Fernandez-Falcon, R. Schmidley - **Integration of Scanning and GPS Data by DTM Means**

Key points were: (1) Digitizing vector map with use of auxiliary data such as GPS data; (2) not only the digitization of existing maps but also the update of maps can be conducted using GPS data; (3) GPS data acquired by GPS Van; and (4) the cost effectiveness is good.

The accuracy satisfies national standards. GPS survey with Van is not expensive because the surveying time is rather short.

Karl Kraus (Austria) - **Analysis of Geographical Data and Visualization of Their Quality**

Key points were: (1) Estimation of the positional uncertainty of contour lines and the theoretical framework for the estimation, (2) visualization of the uncertainties, and (3) data quality must be also provided to GIS users.

It is indeed important ISPRS business to provide geographic data with information on its quality.

Lars Schylberg (Sweden) - **Cartographic Amalgamation of Area Objects**

Key points were: (1) Generalization of an area object by a new algorithm based on grow and shrink, and (2) good for interactive system environment.

Generalization for an area object is based on the uncertainties of the object. Originally, far area objects derived from RS data.