TECHNICAL SESSIONS
(COMMISSIONS I – VII)

COMMISSION I
Working Group I/1

Session 1101 - **Image Data Quality Control and**
Standardization
July 11, 1996, 10:45-12:15
Session Reporter: **Anders Boberg** *(Sweden)*
Chairman: **Anders Boberg** *(Sweden)*

Hartmut Ziemann (Germany) - HIGHLIGHT-PAPER:
Standard-related Activities within ISPRS TC I

This highlight paper stressed the importance of active liaison with ISO Technical Commissions of direct interest for ISPRS activities, especially concerning primary data acquisition. As there are many ISO commissions and sub-groups, and as several standards of immediate interest for ISPRS, e.g. concerning film speed determination, are under revision, it is of value that someone takes on to follow this work. It is being discussed to transfer this issue to Commission VI or to a joint WG I/VI. Also within CEOS and CIE work of this kind is carried out, concerning earth observation satellite data and colour issues, respectively. The case of colour, standardization of nomenclature is of high priority.

The recommendations of Prof. Ziemann have been formalized in a draft resolution from ISPRS WG I/1. The commission president, Prof. Mussio, expressed his great appreciation for Prof. Ziemann's work in this area.

Zheng Wang (USA) - **Digital Image Dodging in Digital Orthoimage Production**

Mr. Wang presented a practical solution to the problem of non-uniform density and contrasts over the image area of digital orthophotos. Non-uniformity causes severe problems when mosaicking digital orthophotos. the process is based upon equalization of intensity histograms from different parts of the image, resulting in linear contrast adjustments over the image area. Although not theoretically based, the method may solve an important problem for orthophoto users.

Responding to questions, it was pointed out that the two areas to be used for histogram determination should represent extreme areas in regard to global density variations within the image, and that it is not necessary to choose areas located in the overlapping area of neighboring image. To achieve density adjustments within the entire image, interpolations between the determined histograms are carried out. Work on colour image is done based on histograms determined with red, green and blue filters; no colour transformations are carried out.

Roland Schlienger (Switzerland), H. Schade, P. Fricker, A. Rohrbach - **Increased Image Quality Resulting from New Technologies in Aerial Cameras**

The paper, originally planned for presentation by Mr. Roland Schlienger, stressed recent advancements in aerial camera and lens design, giving improved results expressed as distortion and resolution. Although the authors represent the Leica company, some examples were shown also from other manufacturers. Concerning Leica lenses, average distortion for the 15/4 UAgS was claimed to be less than 2 micrometers (although, in response to a question, it might be somewhat higher locally), while area weighted average resolution (AWAR) exceeds 120 lp/mm at aperture 4 for high-contrast targets (and, in response to a question, should exceed 100 lp/mm all over the image area). Even light fall-off has been reduced to some 35% at 140 mm radius at aperture 4. FMC and AMC devices were reported to function well.

Questions (by A. Boberg and O. Andersen) concerned distortion, resolution, modulation transfer function (MTF) respectively AWAM, and image motion compensation; the following answers were given:
- radial lens distortion (for four semi-diagonals) can be given as function of radial distance; the stated ± 2 µm are the average radial distortion; data on tangential distortion is not available at present
- the Leica calibration equipment is at present undergoing modifications which will enable the determination of MTF data which can then be published; the reporting could be similar as done in the past in the reporting of resolution and its area weighted average (AWAR)
- as angular accelerations can be high in turbulent conditions at low altitude, frequent updating of the gyrostabilized mount is necessary; motor control, however presents certain problems today

It was further pointed out that the use of camera calibration data in most analytical plotters is limited, and that manufacturers should provide the possibility to also correct for asymmetric radial and tangential distortion.

COMMISSION I
Working Group I/2

Session 1201 - **Navigation and High Resolution**
Sensors
July 10, 1996, 8:45-10:15
Session Reporter: **Roman Arbiol** *(Spain)*
Chairman: **Petros Patias** *(Greece)*

Yanming Feng (Australia), K. Kubik, S. Han - **A Long-Range Dynamic GPS System and Positioning Results**

On-The-Fly integer ambiguity for long-range dynamic or kinematic GPS positioning is difficult to achieve. The paper documents a dynamic GPS processing prototype system that achieves decimeter-level accuracy in real time and 1 ppm accuracy off-line in three dimensions over the range of a few hundred kilometers without OTF ambiguity resolution.

Q: Which is the main improvement using this approach?
A: Stability.

Kazuyoshi Takahashi (Japan), M. Ono - **Extraction of Precise Attitude by Means of Image Navigation Channel Data of AVNIR**

A method for precise geometrical correction of a spaceborne sensor is proposed. The AVNIR, present in the satellite ADEOS, will have an additional CCD array channel to be used for attitude determination, using correlation.

Q: Is any other navigation sensor planned for the ADEOS platform?
A: Yes, an IMU, but its data capture frequency will be too low.

Helmut Rüdenauer (Germany) - **The Low Cost Remote Sensing System „LARSS" for Environmental Monitoring and Photogrammetric Applications**

The paper presents the development of a sensor platform for light fixed wing aircrafts. The different possibilities of the platform are described. Then a low cost Color Line Scanner is presented. The aim of the complete system is to make airborne photography, photogrammetry and remote sensing available to users which could not afford these techniques before.

Alessandro Capra (Italy), F. Radicioni, L. Vittuari - **Kinematic GPS Profiles and Navigation in Antarctica**

Three kinematic GPS applications in Antarctica are presented and analyzed from the point of view of feasibility and accuracy obtainable in different situations, the problems presented and the adopted solutions. Long range applications will obtain poor accuracy. Results can be improved with supplementary processing.

Takayuki Aoki (Japan), T. Koizumi, Y. Shirai - **Fundamental Study on Inertial Surveying**

An inertial surveying system has been developed. It is composed by a vibration gyro and an accelerometer. Using this system an experimental surveying is carried out. A test has been prepared to obtain the camera orientation without ground control points. Surveying applications could probably improve their results using this data.

Q: Has any time drift been observed during the experiment?
A: No, test procedure seams too fast to observe it.

COMMISSION I
Working Group I/3

Session 1301 - **Developments in Optical Digital Sensors**
July 12, 1996, 13:30-15:00
Session Reporter: **Hans-Gerd Maas** *(Switzerland)*
Chairman: **Rainer Sandau** *(Germany)*

Beate M. Csatho (USA), R. H. Thomas, A. F. Schenk, W. B. Krabill - **Remote Sensing of Polar Regions Using Laser Altimetry**

The application of laser altimetry for the determination of surface elevation changes on ice in NASA's program for polar regions was shown. It was also given an overview on NASA's altimeter system on Moon, Mars and Earth, and the derivation of range, reflectivity and surface roughness parameters using simulated wavefronts were shown.

Rainer Sandau (Germany), A. Eckardt - **The Stereo Camera Family WAOSS/WAAC for Spaceborne and Airborne Applications**

An overview on the WAOSS/WAAC space- and airborne stereo cameras was given and application examples were presented with datasets over Berlin and an airborne dataset over an open mining area.

WAOSS (Wide-Angle Optoelectronic Stereo Scanner) is a stereo camera for the synoptical observation of the dynamics on the surface of Mars and in its atmosphere. It has been launched in November 1996.

WAAC is a spin-off of WAOSS for airborne terrestrial applications. WAAC is also miniaturised (5 kg, 15 W) and controlled by only 1 PC which also handles the GPS, INS and Gyro data.

Kerry McIntosh (Australia) - **A Calibration Procedure for CCD Array Cameras**

A procedure was presented for the calibration of solid state sensor cameras in close range photogrammetry, based on already established techniques.

Michael Kaplinsky (USA), J. Li, N. J. McCaffery, E. S. H. Hou, W. F. Kosonocky - **Experimental Multi-Wavelength Imaging Pyrometer for Remote Sensing of Temperature Profiles on Surfaces with Unknown Emissivity**

Key points were: (1) Presented Multi-Wavelength Imaging Pyrometer (M-WIP) is capable of simultaneous real-time temperature measurements of targets with unknown emissivity. (2) In order to perform these measurements the spectral radiance of the target is detected at several wavelengths by an IR camera equipped with an assembly of narrow-band IR filters; the temperature and emissivity of the target are then determined simultaneously from the least-squares fit of the theoretical model of IR camera output to the experimental data. (3) An experimental M-WIP system is implemented with 320x122-element PtSi IR-CCD imager with an assembly of 7 narrow band striped IR filters in the range from 1797 nm through 4512 nm. (4) Initial M-WIP measurements demonstrated temperature resolution of ±1 °C for blackbody target in the temperature range from 600°C to 900°C. Temperature resolution of ±4°C was demonstrated for the blackbody source viewed through the double-polished silicon wafer with unknown spectral transmissivity in the temperature range from 500°C to 950°C.

Carlo Marino (Italy), Rosa M. Cavalli, R. Bianchi, S. Pignatti - **Airborne Imaging Spectrometry: A New Approach to Environmental Problems**

An airborne hyperspectral imager with 102 channels in the visible, near-infrared and infrared range was presented. The performance of the instrument was demonstrated by a number of application examples in environmental monitoring.

COMMISSION I
Working Group I/3

Session 1302 - **Calibration of Optical Digital Sensors**
July 17, 1996, 13:30-15:00
Session Reporter: **Rainer Sandau** *(Germany)*
Chairman: **Hans-Gerd Maas** *(Switzerland)*

Wolfgang Kornus (Germany), M. Lehner, F. Blechinger, E. Putz - **Geometric Calibration of the Stereoscopic CCD-Linescanner MOMS-2P**

For a large camera system like the German MOMS-2P 3-line stereoscopic and multispectral pushbroom scanner consisting of 5 optics, both laboratory calibration and in-flight geometric calibration are required to get 0.1 pixel accuracy. Plans for in-flight calibration include the semi-automatic determination of ground truth from available orthoimages and DEM via multi-scale image matching. Simulations show that the accuracy goal for the geometric calibration can be met.

Q (V. Jovanovic - USA): Are changes in camera geometric parameters in regard to temperature considered?
A (M. Lehner - Germany): Could perhaps for some extent be attributed to temperature effects during long calibration session (4 sets of data in normal and reversal position).

Q (H.-G. Maas - Switzerland): How often is that in-flight calibration necessary?
A (M. Lehner): Not too often.

Qassim A. Abdullah (USA) - **Evaluation of Digital Cameras for Photogrammetric Mapping**

Key points were: (1) The introduction of industrial digital cameras for aerial mapping. (2) Shortcomings of present digital cameras. (3) Industrial standard for digital cameras.

A metric high resolution digital camera will not only be the camera for the future but it will also revolutionise the mapping industry in two ways:

a) Cost saving through the elimination of the cost of film and film processing by providing the digital media and by eliminating the cost of film scanning which will be used for further digital processing.

b) It will provide timely data since the data can be processed in the softplotter as soon as the airline lands on the ground, thereby eliminating the relatively long waste on the photo laboratory processing, and then the scheduling for film scanning.

Q (H.-G. Maas - Switzerland): Are the lens distortions included in the calibration procedures?
A (Q. A. Abdullah - USA): Yes, to some extend.
Remark by Thomas Delaney (USA, Kodak): Will be improved in next camera.
Q (H.-G. Maas - Switzerland): Is the 10-s-imaging cycle due to the Frame Grabber speed or the Hard Disk speed?
A (Q. A. Abdullah - USA): It's the Frame Grabber. Next camera will be equipped with a 1-2 seconds Frame Grabber.

Anko Börner (Germany) - **The Optimisation of the Stereo Angle of CCD-Line-Scanners**

Key points were: (1) There is no reliable investigation for the optimal value of the stereo angle for CCD-line-scanners up to now. (2) A few counteracting processes are responsible for the formation of such an optimal value.
(3) The use of simulation technique should be the only way to get a satisfying result. (4) A stereo-angle between 15° and 20° enables the 3D-reconstruction with the optimal result for all investigated cases.

Q (H. P. - Australia): For the relationship between the stereo-angle and image matching and surface reconstruction sensibility and optimal configuration: What you have shown are simulated experiment results. I think that there probably exists a way of unified theoretical analysis. For example, we may assume t here is a minimum bounding hemisphere covering the object surface and then work out the theoretical analysis.
A (A. Börner - Germany): That may be possible.

COMMISSION I
Working Group I/5

Session 1501 - **Quality Analysis of Photoscanners**
July 15, 1996, 8:45-10:15
Session Reporter: **Otto Kölbl** *(Switzerland)*
Chairman: **Ralf Bill** *(Germany)*

No session report received!

Emmanuel Baltsavias (Switzerland), B. Waegli – **Quality Analysis and Calibration of DTP Scanners**

Sergio Dequal (Italy), F. Rinaudo, A. Lingua – **Matching Techniques and Algorithms for Some Basic Photogrammetric Procedures in the Low Cost Digital Photogrammetric Systems**

Karsten Jacobsen (Germany), U. Bolte, H. Wehrmann – **Geometric and Radiometric Analysis of a Photogrammetric Image Scanner**

Gertrud Roth (Germany) – **Quality Features of a State-of-the-Art High-Performance Photogrammetric Scanning System: PHODIS SC**

Raimund Seywald (Austria) - **On the Automated Assessment of Geometric Accuracy Scanner Performance** (Micro-abstract of author)

A system is presented to investigate the geometric accuracy of scanners. Evaluation procedures and algorithms are described to analyse various types of scanners. Evaluation can be based on a test target which allows both, manual visual analysis as well as automated algorithmic evaluation. An assessment of quality has to differentiate between local and global geometric accuracy. Experimental evaluation results were obtained with scanners using different scanning principles. Further the requirements of a reliable geometric accuracy test target are discussed.

COMMISSION I
Working Group I/6

Session 1601 - **Acquisition, Pre-processing and Archiving of Satellite Data**
July 16, 1996, 11:15-12:15
Session Reporter: Louis - Francois Guerre (France)
Chairman: **Dan Klang** *(Sweden)*

Hiroyuki Wakabayashi (Japan), Y. Osawa, K. Toda, T. Hamazaki, R. Kuramasu - **A SAR System on ALOS**

The presentation focused on the ALOS mission concept, the satellite system features and the SAR instruments characteristics.

The ALOS satellite is dedicated to regional observation using high resolution sensors and is scheduled to be launched in 2002. It is a follow-on of the JERS-1 mission, having both microwave and optical sensors. The microwave SAR sensor, called PALSAR, is an L land antenna with a resolution in (x,y) of 10 m. The optical sensors are the PRISM instrument with an along track stereo capability, a resolution of 2,5 m and height accuracy of 5 m, and the AVNIR-2 instrument.

The presentation has covered mainly the description of the SAR instrument, describing all the technical characteristics. Among the main important characteristics, the system will have a fine mode, a SCAN SAR mode and a Low Data Rate mode.

The principal mission of ALOS will concern cartography, and environmental and hazard monitoring.

Keiji Osaki (Japan) - **Preliminary new Satellite Data Retrieval System on World Wide Web Server**

The presentation focused on the description of a preliminary satellite data retrieval system constructed on a WWW server.

The main key points of the presentation were the concept and advantage of such system, the methodology used, the flow of the retrieval process, the time performance of the retrieval after tests on various network sites and computer systems.

Unless existing satellite data retrieval tools, the retrieval system presented here has been directly built on a WWW server with the creation of dedicated page with HTML. This WWW server could be linked with RDBMS to improve the retrieval.

Different pages allow the enquiry description, the display of a certain number of thumbnail images (quicklook), the display of whole images by selecting the corresponding thumbnail image and the possibility to place an order through an order form.

The time performance test has shown time response of less than 40 seconds (for the display of 12 thumbnails on the same page) on spark station (not linked to the internal network) or less than 10 seconds on systems linked to the internal network.

This system is presented as a progress in an effective feature extraction of raw satellite data by thumbnail images, which could be available to various clients on the WWW.

Taejung Kim (Korea), I. Lee, S. D. Choi - **A New Low Cost Direct Archiving and Pre-processing System for KITSAT-3 Image Data**

The presentation focused mainly on the description of the series of small experimental satellites called KITSAT and on some descriptions of the ground segment characteristics. The concept behind the KITSAT satellite systems is the design of small satellites with many advantages like the low cost of the system, the short period of development, the decrease of the risks, the possibility to respond faster to the user needs, the lower data rate which implies a cheaper cost of the ground receiving stations.

Among the disadvantages, we could find a reduced power supply, a not so performant attitude accuracy, a lower resolution, a low data rate or productivity.

KITSAT-3 is the follow-on of 2 small satellites (KITSAT-1 and 2 already launched in 92 and 93) but with improved characteristics (swath of 59 x 59 km², 3 band R, G, NIR, resolution of 17 m, altitude of 870 km, image size of 32 MB, telemetry flow of 3 MBPS (X band), weight 100 kg, power 100 W, size 45 x 45 x 60 cm, 3 axes stabilised, pointing accuracy of 0.5, attitude stability of 0.014 deg/s, on board solid state mass memory devices).

These characteristics allow the development of simple ground receiving stations with low cost, easy development and use of commercial hardware technology.

In particular, heavy systems like High Density Tape Recorder (HDTR) with associated heavy development on high speed computation could be replaced by commercial PC with dedicated software for synchronisation and direct archiving recorder. The presentation has shown some block diagrams of the system.

Joe Thurgood (USA) - **Requirements of Future Processing and Archiving Facilities**

This presentation focused on the description of the evolution of the photogrammetric domain and stated the

big improvement brought by the newly coming high resolution satellites. It has then presented the satellite and operation infrastructure of Space Imaging to serve the user requests.

The evolution of the mapping products has seen the transition (from 1975 to 1995) from drafted cartographic products (line maps, hard copy, contour maps) to computer assisted files (line maps, contour maps and digital terrain models, orthophotos) and later to data source for GIS and software applications (feature extraction point/line/areas, topology, data base integration, digital terrain, ...).

The tools have also drastically evolved and it took almost 30 years (from 1957 to 1985) for the users to accept analytical technology. It took also more than 30 years (from 1965 to 1996) for the users to accept digital technology.

This second wave of change has transformed a lot the way of working and thinking of the user.

Now, a new type of change will happen with the coming of high resolution satellites such as the one developed by Space Imaging. The spacecraft of Space Imaging to be launched by the end of 97, is a 817 kg satellite, with on board GPS for satellite localisation, a resolution up to 1 m images, with a 26 degrees from nadir incidence angle.

An operational infrastructure will be implemented to respond to the users' needs and requests and in order to improve the planning of the satellite, the production of the products. Photogrammetric needs will be covered with the production of images at 1/2400 scale with ground control points and 1/24000 without ground control points.

COMMISSION I
Poster Sessions

Poster Session 10P1 - **Primary Data Acquisition**
July 10, 1996, 12:30-14:30
Session Reporter: **Gianfranco Forlani** *(Italy)*
Chairman: **Luigi Mussio** *(Italy)*

All 7 papers were application oriented, covering either aerial and satellite applications.

Three of them concentrated on space (satellite) data acquisition (analogue space cameras) and data distribution to users. More specifically, two questions were addressed, in order to extend the flexibility of systems:

- the realisation of a data formatter which is conceived as to be system independent, and can be updated to accommodate new sensors output; this should allow accepting of new satellite sensors input without implying the development of a new data formatter;

- the design and implementation of a module for automatic identification of truncated and wrong messages in DCP messages collected by ground receiving stations. In the prospect of an increased traffic on the receiving stations this should help data handling.

As far as data distribution and user access to data is concerned, a new development in electronic catalogues

has been presented including, in addition to the WWW capabilities, the possibilities offered by the Java network software, which potentially greatly expand the range of data manipulation for the user, overcoming limits due to HTML protocol and network bandwidth.

In image quality assessment, a transportable target set was presented, which allows testing the resolution of the actual images, together with a method for automatic measurement of the resolution of the actual images, together with a method for automatic measurement of the resolution through profile analysis.

The coupling of a CCD and a thermal camera, to allow registration of visual information on thermal images has been presented, to exploit the characteristics of both sensors.

Finally, a successful example of photogrammetric survey by using a navigation system based on DGPS showed that accuracies around 1 m can be achieved even on long baselines (around 200 km).

Risto Kuittinen (Finland), E. Ahokas, P. Jarvelin - **Transportable Test-Bar Targets and Microdensitometer Measurements - A Method to Control the Quality of Aerial Imagery**
Transportable polyester plastic test-bar targets were made and used to test their usefulness for determining the spatial resolution of aerial photographs. Microdensitometer can be used to measure the targets and the RP of the photographs can be determined. This method is useful when the quality of arial photographs is monitored.

Victor N. Lavrov (Russia) - **Space Survey Photocameras for Cartographic Purposes**
Key points were: (1) space cartography system developed in Russia includes topographic camera TK-350, panoramic camera KVR-1000 and sensors for determination of the elements of exterior orientation of images in flight, (2) camera TK-350 provides acquisition of stereo images with accuracy 5 mkm and ratio B/H = 1.1, (3) camera KVR-1000 provides acquisition of interpretational images with ground resolution 2 m in 160 km swath, (4) space cartography system allows production of topographic maps of scale down to 1:50 000, digital and thematic maps as well as orthophotoplans of scale down to 1:10 000.

As a result of conversion of military technologies, the materials obtained by TK-350 and KVR-1000 cameras are available to foreign customers in form of both archive data and new ordered survey.

Andrzej Lubecki (Poland), B. Wiecek - **Thermal-Visual Digital System in the Image of Area Phenomena**
Thermal-vision digital system (TVDS) was worked out on the basis of a thermal scanner of AGEMA LWB 880 and vision camera CCD. The scanner obtains data in spectrum range 8-12 μm and the camera CCD in the range 0,4-0,9μm. The aim of the system is to register digital data on surface temperatures distribution and their measurements on the examined objects. Generated

thermal and visual images are stored in the computer memory IBM notebook type and processed on one monitor in parallel. The system can work on different stands: in a laboratory, in a car while driving or in a plane during a flight. TVDS may register thermal images, visual images or both of them: a) as single images, b) as films with given time intervals between registration of particular records, c) in real-time. The registered digital images undergo elaboration taking into account surrounding temperature, emission coefficient and registration distance (atmospheric conditions). The elaboration of thermograms can be carried out in TVDS or outside it. There is a possibility of elaborations in different forms: qualitative or quantitative ones. Graphic images have got a screen form which can be a layer of a vector map. TVDS is an open system and therefore it can be equipped with necessary additional applications.

Hideyo Yokotsuka (Japan), T. Sakata, H. Shimoda, S. Sobue, M. Sekigucci - **Development of Highspeed Programmable Formatter for Earth Observation Satellite Downlink Data Formatting**

The format process of earth observation satellite downlink data is usually performed with custom made hardware, which is designed for a satellite or a sensor. Our programmable formatter system can take various sensor synchronisation by only setting the parameter in programmable synchronised hardware.

Maria de Fatima Mattiello-Francisco (Brazil), R. C. Gatto, S. N. Itami, W. Yamaguti - **Data Format Analysis Using Automation Approach**

Finite state automaton modelling by been used in the Mission Centre Software in order to perform recognition and error analysis of different formats of Data Collection Platform messages.

With that modelling it is possible to detect truncated and spurious data in the message blocks received in the Mission Centre.

Livio Pinto (Italy), M. Cory, G. Banchini - **Aerial Photographic Coverage of Ireland with GPS in 12 Days**

In 1995 the Ordnance Survey of Ireland commissioned Compagnia Generale Ripreseaeree (CGR) with aerial photography of Ireland to support its small scale mapping programme and the production of orthophotos for validating farmers claims under the EEC programme.

The photography specified was B/W at a scale 1:40 000. The aerial photography was successfully completed within 12 days: approximately 4000 photos were taken in 77 strips. Thanks to carrier phase and C/A code GPS data recorded during the flight by on board GPS and at 3 GPS base stations on the ground, it was possible to calculate the path of each strip with a RMSE of ± 1m despite the fact that the distance between the airborne GPS and the ground stations varied between 0 and 200 km. The aerial triangulation results of a small strip performed by the Ordnance Survey has validated the Kinematic GPS positioning accuracy.

COMMISSION I

All 6 papers were evaluation oriented, covering either aerial and satellite applications:
- Determination of the geometric characteristics of a digital camera by self calibration
- Photorealistic textured 3D city models derived from images acquired by vehicle based 3 line CCD camera
- Analysis and correction of geometric deformations of digital images using a low-cost scanner
- Sufficient area condition of an object for a SPOT detector
- Robust estimators with very high breakdown point have proved to be effective in the photogrammetric outlier detection
- DEM generation of stereo images irreversibly compressed on a satellite.

Markus Maresch (Austria), P. Duracher - **The Geometric Design of a Vehicle Based 3 Line CCD Camera System for Data Acquisition of 3D City Models**

This paper presents the geometric design of a new approach for an automatic vehicle based recording of building facades. It is based on the use of 3 partially inclined and vertical linear CCD arrays as the primary data sources. Other sensors support the retrieval of the exterior orientation. This mobile camera is used for data acquisition of the geometric model of building facades and the recording of high resolution photo texture. The requirements and constraints for this system and the theoretical background for the effect of motion disturbance due to sensor motion are discussed, and lead to the arguments for the development of the proposed system. We show recordings from a line sensor and discuss preliminary results in automatic motion detection. Methods for the creation of normalised images are explained. The major advantages of the proposed system of conventional area imaging technologies are the possibility of continuous recording, high resolution images, acceptable amount of data and the fulfilled requirements for the data acquisition of photo-realistic textured city models. Our approach offers an inexpensive data acquisition method for generation photo-realistic textured city models and provides good raw data for reconstruction of a geometric model of a building's facade.

Adam Boron (Poland) - **Calibration of Digital Images Produced with the Use of UMAX 1200 SE Scanner**

As a result of the analysis of geometric deformations of digital images acquired using low-cost scanner UMAX 1200 SE, the correction method is proposed which

reduced scanning geometric errors from $m_p = \pm 5$ pixels to $m_p = \pm 0,15$ pixels.

Fang Cheng (Germany), P. Hartl - **The Sufficient Area Condition of an Object for a SPOT-Detector**

Some objects can not be found or identified on a SPOT-image due to their too small areas. An object on the ground must be large enough so that it can be detected vertically by a SPOT-detector and recorded as a complete pixel in a SPOT-image. This condition, defined as the sufficient area condition of an object for a SPOT-detector, has been not studied yet. In this paper the condition is theoretically analysed and quantitatively calculated. The results are as follows:

1) The area of an object on the ground must include an ellipse, whose long axis e_1 is in the direction with the greatest ground slope ε and equal to $2R/\cos \varepsilon$, and whose short axis e_2 is horizontal and equal to $2R$.

2) If the ground is smooth ($\varepsilon = 0$), the ellipse becomes a circle with the radius R.

Here R is the diagonal length of a SPOT-image's pixel: $10 \div$ m or $20 \div$ m.

The above conclusions may be applied to other satellite images, if they are similar to SPOT-images in the aspects of imagery principle and pixel form.

Here it should be particularly pointed out that an object, which can be surely identified or which can become at least an identifiable pixel on a SPOT-image, should meet not only the sufficient area condition, but also another condition: there should be a considerable difference in spectral responsivity between the object and the other objects around it. This difference-condition should be studied in the future.

Luigi Mussio (Italy), T. Bellone, B. Crippa - **Robust Procedures for Data Pre-Processing, Testing and Archiving**

Robust estimation techniques are essentially downweighting methods and, among them, redescending estimators are the most promising ones, as their breakdown point is often very high. A method, recently proposed by Rousseeuw and Leroy, is here presented and applications to outliers identification in photogrammetry are discussed.

Kiyonari Fukue (Japan), R. Matsuoka, Y. Kawata, H. Shimoda, T. Sakata, K. Ohta - **DEM Generation from Stereo Images Compressed Irreversibly on a Satellite**

In order to reduce downlinking data volume from the satellite to a receiving station, on-board lossy data compression is planned to apply to data acquired by sensor AVNIR-2 on ALOS satellite which will be launched on 2002. In this report, influences of lossy data compression for terrain elevation measurement are discussed based on several simulation experiments.

Three kinds of data compression methods, i.e. block coding, DCT (discrete cosine transformation) and vector quantisation, were evaluated in the case of ¼ data compression ratio. The ground surface texture of simulated stereo pairs were created from an aerial photograph. PSFs (point spread function) of atmosphere were also considered in the simulation of acquired image. The terrain elevation measured by using area correlation matching method and least square method as the first and second matching stage, respectively.

These experiments showed that, in contrast with our forecast, data compression and turbid atmospheric condition did not increase elevation measurement error. DCT and Vector quantisation decreased measurement error under the condition of turbid atmosphere. Block coding showed low measurement error under the both atmospheric conditions. As a conclusion of this study, on-board data compression can be adopted without the increase of elevation measurement error and block coding is the best method as an on-board data compression from the view point of stability for atmospheric condition.

COMMISSION II
Working Group II/1

Rongxing Li (Canada), M. A. Chapman, L. Qian, Y. Xin, C. Tao - **Mobile Mapping for 3D GIS Data Acquisition**

Key points were: (1) A developed prototype system was presented which aims at 3D GIS data acquisition using mobile mapping technologies. (2) The mapping platform, named VISAT, is a vehicle equipped with GPS, INS, CCD cameras and a computer. In the present configuration up to eight cameras can be used. (3) The integrated acquisition of all sensors provides highly accurate absolute orientation data for georeferencing the images. (4) Digital close range photogrammetric measurements are carried out for extraction of objects from multiple images with a reasonable 3D accuracy. The main efforts for further developments concentrate on automation of feature extraction. Matching tools, line feature and road boundary extraction are under development.

Q: What type of inertial system is used ?
A: For the highly accurate determination of the exterior orientation a high quality Liton strap-down system is used.

Michael Hahn (Germany), D. Stallmann, C. Stätter, F. Müller - **The DPA Sensor System for Topographic and Thematic Mapping**

Key points were: (1) The Digital Photogrammetric Assembly (DPA) is an integrated airborne sensor system for real-time data collection. The field of application is in high resolution topographic and thematic mapping. (2) The camera module consists of three panchromatic line arrays for stereo imaging and four line arrays for multispectral imaging. INS and GPS is integrated for georeferencing the line imagery. (3) The rectification of the georeferenced images eliminates the effect of high frequent rotational motion which has had a negative impact on stereo processing. (4) The primary goal of the development is extraction of objects. Currently the focus is on roads, buildings and other man-made objects. For solving this task multispectral analysis is taken into account as the second important source additionally to the stereo image data.

Guangping He (USA) - **Design of a Mobile Mapping System for GIS Data Collection**

Key points were: (1) The mobile mapping system, named GPSVision, consists of three major components: a Trimble GPS receiver, a Liton LN-200 inertial navigation system and two colour CCD cameras. The system is open for integrating many different kinds of GPS receivers or cameras. (2) A PC-computer provides for the overall control, storage, display and operator interaction

during data acquisition. (3) Positioning by GPS-INS integration with a Kalman-Filter and calibration of the entire system is necessary for precise 3D data collection. By calibration the lens distortion, the relative orientation parameters and the offset between the stereo vision system and the GPS/INS system are determined. (4) A similar concept is under development for the Saab TopEye system which is used on a helicopter platform. In this system a laser range finder is integrated which was found to be very efficient for various applications, e.g. in power line survey.

Q1(M. Hahn - Germany): Which sensors are currently used in the TopEye system?
A: GPS/INS for positioning, video cameras and laser range finder for imaging.

Q2(Th. Kersten – Switzerland): What about the basic processing system of TopEye ?
A: The developments for processing the range data aim at DTM data collection. In this contexts special tasks have to be solved, for example the detection of power lines. Because the power lines are line structures which are higher than the DTM it is not difficult to solve these measurements automatically.

Veljko M. Jovanovic (USA), M. M. Smyth, J. Zong - **Autonomous and Continuous Georectification of Multi-Angle Imaging Spectro-Radiometer (MISR) Imagery**

Key points were: (1) The purpose of MISR is to study the ecology and climate of the Earth. MISR is part of an Earth Observing System EOS payload to be launched in 1998. (2) The MISR consists of nine push-broom cameras with viewing angles between ± 70.5 deg. The IFOV is 250 m/275 m (cross-track) and between 250 m and 707 m (along-track). (3) The geometrical processing concept is to transform the physical MISR image to a virtual image in which the terrain-projected radiance represents nine digital maps of the spectral bands. (4) The geometric processing algorithm for georectification includes band-to-band registration and recursive image-to-image registration. The transformation to the ground requires a DEM to be given. A global DEM of sufficient resolution is available for MISR's internal use.

Martin Nix (Switzerland) - **A Mobile Office for the Surveyor**

Key points were: (1) The mobile office aims at GIS data acquisition in which the total station technology is integrated in an office environment. (2) The recent advances in technology indicate that mobile office solutions have the potential to substitute office work. The following technology for a mobile office is available: a penpad computer, a total station, a telemetry link and a software solution with the potential to replace desktop processing with on-line processing of survey data. (3) Recent improvements of total stations make use of penpads. The trend is to finish processing in the field even if more complex products like DEMs are generated. (4) The mobile office is operated by only one person thus

there is no need any more for an operator of the total station.

COMMISSION II
Working Group II/2

Session 2201 - **Integrating Vector and Raster Data in GIS**
July 15, 1996, 8:45-10:15
Session Reporter: **Gordon Plunkett** *(Canada)*
Chairman: **Manfred Ehlers** *(Germany)*

Thomas Blaschke (Austria) - **GIS Techniques and Hybrid Parametric/Non-Parametric Image Classifications: A Case Study Showing the Potential for Signature Training and Accuracy Assessment**

Key points were: (1) Parallelepiped classification of Landsat TM data do not give good results, especially in mountainous areas due to shadows. (2) Signature training using conventional signature training can be improved by specifying various shapes in feature space using vector drawing. (3) Results were disappointing using this technique as the classification accuracy improved by only one percent.

Jun Chen (P. Republic of China), Y. Le - **Defining and Representing Temporal Objects for Describing the Spatio-Temporal Process of Land Subdivision**

Key points were: (1) The spatio-temporal process of land subdivision and the possibility of describing the process with a space-time composite model was discussed.
(2) Temporal objects were introduced and defined for representing the spatio-temporal process of land subdivision. (3) An indexing method was developed to chain along the time axis the new parcels and their parents. (4) It was found that the evolving spatial topology was mixed with temporal topology during the land subdivision process. (5) New concepts and methods need to be developed for describing and representing spatio-temporal topology.

V. I. Malov (Ukraine), S. Oleynik, V. Gajda, G. A. Zotov - **Digital Photogrammetric Station "Delta"**

Key points were: (1) The digital photogrammetric system was developed for the National Mapping Agency of the Ukraine. (2) It consists of hardware, system software and applications software. (3) The system is based on the PC computer and includes a high resolution scanner.
(4) The semi-automated process can take stereo pairs and produce a DTM.

Steffen Kuntz (Germany), C. Streck, C. Kessler - **Earth Observation for Identification of Natural Disasters "EOFIND"**

Key points were: (1) "EOFIND" was a proof-of-concept study by the Centre for Earth Observation of the European Commission. (2) The study evaluated the feasibility of using Earth Observation data for disaster management and was intended to reduce the reluctance of NGO's to using space technology. (3) The study, which was completed in February 1996, concerned the user requirements of scientific, commercial and disaster management organisation. (4) Case studies of forest fire, storm damage assessment and flooded areas were examined. (5) Findings of the study included: users don't understand remote sensing or information technology; users consider EO products as useful, EO data does not satisfy all users requirements.

Chengming Li (P. Republic of China), J. Chen - **Describing Spatial Relation Based on Voronoi Diagram in Discrete Space**

Key points were: (1) This paper describes the methods of generating raster voronoi diagrams in discrete space.
(2) The process consists of constructing the voronoi diagram of a spatial object and inspecting the neighbourhood of the object. (3) An E-R diagram is developed to describe the topologic relationships. (4) The process make the calculation of topological operators very easy.

COMMISSION II
Working Group II/2

Session 2202 - **Hardware and Software Aspects of GIS**
July 17, 1996, 15:30-17:00
Session Reporter: **Manfred Ehlers** *(Germany)*
Chairman: **Gordon Plunkett** *(Canada)*

Manfred Ehlers (Germany), J. Albrecht, H. Brösamle - **VGIS: A Graphical Front-End for User-Orientated Analytical GIS Operations**

Key points were: (1) Current GIS are powerful tools but far too complex for users who only need GIS as toolboxes. (2) There is a need for a universal set of GIS operations that are independent of the underlying GIS or the data structure. (3) It could be shown that 20 universal GIS operations are sufficient to cover almost all of today's GIS (analytical) functionality. (4) These 20 universal GIS operations were implemented in a Virtual GIS (VGIS) shell which consists of a graphical user interface (GUI), a flow chart generator and a flow chart interpreter that triggers the commands for the underlying GIS. The GIS is completely hidden from the user. (5) A prototype implementation proved the validity of the project: GRASS and Arc/Info are currently incorporated in the VGIS project. Future plans call for compliance of VGIS with the Open GIS (OGIS) data model and interface services to prove the independence of the universal GIS operations from the system used and the data structure.

Morakot Pilouk (The Netherlands) - **Systems for Integrated Geoinformation: Stages of Evolution**

Key points were: (1) There is a need for integration of data from multiple sources. (2) This requires the development of integrated GIS, especially in the field of 3D data processing. (3) Based on an analysis of existing GISs, criteria were developed to form stages for an evolutionary approach for completely integrated systems (subsystems; functional integration; client/server environment; structural integration). The work is still in a conceptual phase.

Yoichi Oyama (Japan) - **Semi-Automatic Digital Photogrammetric System on PC**

Key points were: (1) The historic development of digital photogrammetry went from "special purpose hardware" in the 1960-1980 time frame via "experimental workstations" (1980-88) to "practical use workstations" (1988-93) and now to "PC based" systems. (2) The "Pyramid Stereo" system was presented: PC; Scanner; Printer. (3) The software encompasses components for: scanning, orientation, rectification, image pyramid construction, stereo matching, DGM generation, and orthoimage creations. (4) Results for a stereopair analysis were presented.

Joachim Wiesel (Germany), W. Hagg, R. Kramer, A. Koschel, R. Nikolai - **A Client/Server Map Visualisation Component for an Environmental Information System Based on WWW**

Key points were: (1) An Environmental Information System (EIS) with a client/server architecture based on WWW technology was developed for a State Environmental Protection Agency. (2) Use was made of the advantages offered by public domain software, especially WWW, Inter- and Intranet services for access & display of environmental databases. (3) Other public domain software includes NCGIA http, GRASS, TCL 4.1, GNUPLOT, ORACLE and others. (4) Emphasis was given to the technical aspects of the architecture with focus on map and data visualisation. (5) Examples of the WWW interface and map display were presented. Future developments will include Java services to shift the processing burden more to the client level.

Gordon Plunkett (Canada), Y. C. Lee - **Industry Trends for PC Based GIS**

Key points were: (1) Technology is advancing at rapid pace for PCs (Windows 95, GUI, memory, mass storage devices). (2) This now allows complex GIS to be implemented in a PC based environment. Implementation strategies and requirements were presented. (3) Advantages of desktop GIS project elements include: low costs; ease of migration; inclusion of desktop mapping systems; simplicity of installation, operation and maintenance; equal performance of high-end PCs and low-end workstations. (4) A set of recommendations for PC based GIS specifications were presented.

COMMISSION II
Working Group II/3

Session 2301 - **Distributed Information Systems for Interoperability**
July 12, 1996, 8:45-10:15
Session Reporter: **Bishr Yaser** *(The Netherlands)*
Chairman: **Ekow J. Otoo** *(Canada)*

Jeffery Eidenshink (USA), L. R. Oleson - **Network Distribution Techniques of the Global 1-km AVHRR Data Set**

Key points were: (1) The main objective of the project was to provide geoinformation users management and distribution of 1-km AVHRR raw and processed data. (2) The data set was very large. It is measured by terra bytes. (3) The data set was a) raw data: 5 channels 10 bits AVHRR since April 1992 & Pole to Pole data segments and b) vegetation index composite data channels 1-5 were stored as 16 bit. The rest of the channels was stored as 8 bit.

The methodology of this project emphasised first on developing compression techniques in order the reduce the storage capacity requirements. HTML browsing facility was provided to users in order to navigate the archive. The archive is accessed by a robot (Robo Archive) in order to download the data.

During the discussion the author indicated that the compression algorithms, which were developed, are available on request. He also indicated that the time span required to transfer the data is depending on the available communication lines. This would imply that it is required to increase the band width of communication lines.

Herwig Rehatschek (Austria) - **A Concept for a Network-Based Distributed Image Data Archive**

Key points were: (1) The sparsed and spatially distributed receiving stations of satellites an Magellan Mission to Venus, made it difficult for users to know which data exists where. (2) There does not exist an easy GUI for searching data archives. (3) Overseas connectivity is shown.

A system has been developed which provides a) power search capabilities, b) browsing interface with easy GUI, c) platform independent connectivity, d) accounting and networking security capabilities and e) remote data processing.

A robo archive was provided. A mechanism for informing the central server about any archive which performed update operations was developed. ATM network was used which has a very large bandwidth and allows the integration of data, voice and video. Currently the author is busy in developing and setting up an SQL server.

During the discussion the author mentioned that ATM network is not implemented overseas. Hence overseas connections are still limited.

Michael Kofler (Austria), H. Rehatschek, M. Gruber - **A Database for a 3D GIS for Urban Environments Supporting Photo-Realistic Visualisation**

Key points were: (1) It was required to investigate the visualisation of simulation of exhaust and heat spread in urban areas. (2) The data which had to be restored was geometry, texture, attribute. (3) It was required to develop fast visualisation techniques.

Relational data model was selected over object oriented because the earlier has easy to use GUI and better performance speed. The 3D Rectangle-trees were used to store and visualise the data. The author concluded that object oriented has better modelling constructs over relational model but it is slower. The author is planning to implement the same concept in a distributed DB environment.

Ekow J. Otoo (Canada) - **An Architecture for Interoperability in Large Volume Spatial Object Repositories**

Key points were: (1) The author presented a project for designing and developing a system architecture for providing data browsing, search and retrieval mechanisms of spatial information which is stored in spatially distributed databases. (2) The browsing was achieved by developing metadata browsers. The meta-database is called the master database.

COMMISSION II
Working Group II/3

Session 2302 - **Technology for Very Large Databases**
July 10, 1996, 11:15-12:15
Session Reporter: **M. Radwan** *(The Netherlands)*
Chairman: **Mosaad Allam** *(Canada)*

Mosaad Allam (Canada), E. J. Otoo, C. Chaly - **Federated Multi-Database Infrastructure for GIS Interoperability - The Delta-X Project**

Key points were: (1) Several databases were created in Canada over the last 20 years (topography, DTM, legal survey, aerial photos, etc.), existing in several organisations (Government, private). These databases are dispersed and heterogeneous (different platforms, data models, format, etc.). The need to develop an infrastructure to facilitate access to information in these dispersed databases was highlighted. (2) In 1988 the Delta X project was launched, in order to federate these heterogeneous databases, achieve interoperability among them and provide access to their contents. (3) The Delta X project goals are: a) Meta View/GIS spatial browser, configured over Internet as a client/server model to run, b) security controlled data access and system and c) handle on-line data requests and perform data conversion. The data can be provided in different formats (standards for data exchange as well as formats of several commercial GIS systems). (4) Further developments and enhancements are in progress as well as the commercialisation of the system.

Markus Törmä (Finland) - **Self-Organising Neural Networks in Feature Extraction**

Key points were: (1) The objective is to decrease the volume of RS data. The methods used are based on feature selection (where only important if relevant channels are selected) and feature extractions (where original channels are transformed to lower dimensional channels). The objective is to reduce redundancy while preserving relevant information. (2) The feature extraction method used is based on Karhunen-Löwe transformation and is compared to transformation made by Kohonen self-organising feature map (Neural Network). (3) Several experiments were carried out to compare performance and classification errors taking different datasets.

Loey Knapp (USA), J. Turek, P. Andrews, C. Elvidge - **Image Navigation for Emergency Response (INFER): Application to Wildland Fires**

Key points were: (1) The objective is to provide up to date, relevant information (including historic ones), efficient algorithms for search and retrieval of information from database, an information communication infra-structure and a smart user interface. (2) The INFER project, a subproject under the G7 Global Emergency Management Information Network Initiative (GEMINI), is a collaborative research comprising IBM, USDA & the Canadian Forest Service Research. (3) The basic features: a) Content-based search: (contrast to straight metadata search) is based on a set of algorithms which are implemented at the time of the query and perform search on texture, shape and pattern (classification), b) Several functionalities are provided to perform visualisation and extraction of features dynamically in the image data, c) Apply compression techniques to reduce data storage, d) Access is provided via the Internet. (4) Several application Scenarios were presented.

COMMISSION II
Working Group II/4

Session 2401 - **Processing of SAR Data**
July 11, 1996, 13:30-15:00
Session Reporter: **Gordon Plunkett** *(Canada)*
Chairman: **Gordon Plunkett** *(Canada)*

Regine Bolter (Austria), M. Gelautz, F. W. Leberl - **SAR Speckle Simulation**

Key points were: (1) Simulated SAR images are an important tool for testing and evaluating SAR image processing algorithms, (2) Background theory was presented and several methods of producing simulated SAR images were introduced, (3) The implementation methodology selected for further discussion was to produce a noise free artificial terrain image, multiply it with a simulated speckle file and produce the final image by blurring, (4) Several examples of simulated images were given and statistically biased images were concluded to give the best results for this application.

Yonghong Huang (The Netherlands), J. L. van Genderen - **Evaluation of Several Speckle Filtering Techniques for ERS-1&2 Imagery**

Key points were: (1) A discussion of several speckle filtering techniques such as Box, Median, Lee, Frost, Kuan, Enhanced Lee, Enhanced Frost and Gamma Map was presented. (2) Some quantitative and qualitative evaluations were given. (3) Conclusions included that higher order statistics would give better results and that the Gamma Map filter gives the best results for visual interpretation. (4) Adaptive filter window sizes will give better results for less homogeneous images.

Hannes Raggam (Austria), A. Bauer, W. Hummelbrunner - **Automatic Tie-Pointing in Overlapping SAR Images**

Key points were: (1) A methodology for the automated detection of tie-points in overlapping SAR images is required for image mosaicking purposes (the example used here was for geocoding ERS- 1 SAR images). (2) Points of interest are determined in a reference scene and then the corresponding points are attempted to be found in the respective search scene by means of image matching techniques. (3) The resulting points may be useful for SAR image co-registration or SAR block processing tasks.

Wilhelm Hagg (Germany), M. Sties - **The EPOS Speckle Filter: A Comparison with some Well-Known Speckle Reduction Techniques**

Key points were: (1) An objective comparison criterion for speckle filters is not available for two reasons: a) the algorithms are adaptive to the image contents and b) the distortions of the image contents are related to the smoothing capability of the filter. (2) For the presented comparison method the smoothing capability of all filters was adjusted to a similar value. (3) A synthetic image with several geometric primitives at different contrast levels was used enabling an exhaustive overview of the filters performance with regard to the image contents. (4) The RMS-error was calculated within selected image regions as a quality measure. (5) The results show that algorithms using a geometric approach such as the EPOS, Geometric and the Refined Lee filter give the best overall performance. (6) For high contrast levels the EPOS filter performs best of all geometric primitives observed.

Eliane Alves da Silva (Brazil) - **Cartographic Alternatives in the Amazon**

Key points were: (1) To present the main aspects of cartographic alternatives in the Amazon-Brazil. (2) These are: airborne or spaceborne SAR mapping (due to humid climate conditions and cloud cover) and geodetic surveys using GPS. (3) The Amazon region needs cartographic data that will provide databases for area management and study. (4) The mapping projects will indicate where the landscape needs better environmental control which will assist in mitigating social problems. (5) The SIVAM Project - The Amazon Vigilance System is assisting in the sustainable development in this region.

COMMISSION II
Working Group II/4

Session 2402 - **Real-Time Systems and Applications of SAR Data**
July 17, 1996, 8:45-10:15
Session Reporter: **Michael A. Chapman** *(Canada)*
Chairman: **Michael A. Chapman** *(Canada)*

Joao Moreira (Germany) - **Design of an Airborne Interferometric SAR for High Precision DEM Generation**

Work on a new interferometric radar (SAR) system for the generation of high precision DEMs was presented along with the background mathematical models.

Q: 0.5 m SAR accuracy for 0,5 m DEM accuracy?
A: 0.5 m DEM accuracy is needed!

Gerrit Huurneman (The Netherlands), R. Gens, L. Broekema - **Thematic Information Extraction in a Neural Network Classification of Multi-Sensor Data Including Microwave Phase Information**

The results of a neural network classifier for classifying multi-sensor data were presented. Non standard image sets were used for the classification.

Masatoshi Mori (Japan), T. Yokoyama, N. Yamamoto - **Speckle Filtering for JERS-1/SAR Imagery**

Several mathematical models for radar speckle reduction were presented. The results were somewhat inconclusive as to which model would be best for various data sets.

Rüdiger Gens (The Netherlands), B. Van Veen - **Analysis of the Geometric Parameters of SAR Interferometry for Spaceborne Systems**

The analysis of required geometric characteristics of a SAR Spaceborne System for interferometry was presented. Data fusion possibilities were also discussed.

Q: Is it possible to include different data sets with the INSAR data?
A: This is possible but not yet considered.

Mark Upton (U. K.), J.-P. Muller - **SAR Differential Interferometry Processing System for Volcano Monitoring**

The results of radar based were presented. Results showed a strong agreement with surveying results but did not agree with other recently published results.

COMMISSION II
Working Group II/5

Session 2501 - **Technologies in Integrated Production Systems**
July 15, 1996, 10:45-12:15
Session Reporter: **M. M. Radwan** *(The Netherlands)*
Chairman: **George Y. G. Lee** *(USA)*

George Y. G. Lee (USA), D. C. Hooper - **Building a Production System to Support the National Digital Orthophoto Program: An Integration Challenge**

Key points were: (1) The goal is to complete the USA coverage by the year 2001, including 10 years programme for maintenance of data. The lack of budgetary and production work through contracts with private industry. (2) Design of multidata paths that allow the integration of data from different agencies, different sources and different methods. Lack of accepted standards however prolonged the development cycle. (3) Change from centralised archive to a decentralised database for all USGS's data holdings.

Cetin Cömert (Turkey), G. Baner - **Determining an Interchange Standard for the National Spatial Data Infrastructure of Turkey**

Key points were: (1) The availability of a National Spatial Data Infrastructure (NSDI), with its political/institutional, technical and management components, will improve accessibility and use of spatial data and enable nation-wide data sharing. (2) A spatial data interchange standard is needed, although a long-term operation. Existing standards (DIGEST, etc.) are not always satisfactory. A feature-based standard is needed, which allows the selection of required feature classes. (3) An evaluation criteria is developed to examine existing standards. The standard which will be found as the most appropriate one, will represent a starting point, subject to adaptation according to needs in GIS market in Turkey.

Martin Braess (Germany) - **Extracting Spatial Information from Digital Video Images Using Multiple Stereo Frames**

Key points were: (1) Use of mobile mapping system in order to map man-made features along highway. (2) A feature-based matching algorithm for the reconstruction of 3D scene geometry was proposed, based on matching of straight line segments. (3) The proposed method in corporate feature attributes (to determine the similarity of features to be matched, e. g. line parameters), relation between features (corresponding features in different images are likely to have the same relations), and geometric constraints (e. g. Coplanarity). (4) The final matching is performed in steps (using tree search).

Jerzy Saczuk (Poland) - **Desktop Mapping and GIS System DIGIMAP - GeoSET**

Key points were: (1) The system has been developed in Warsaw and has 100 (non-photogrammetric) and 30 (photogrammetric) installations in Poland. (2) The system is developed to assist digital mapping with use of analogue stereo-plotters, accept data from field surveys and digitised maps. It has links to relational databases for LIS/GIS activities. (3) The system works in Windows environment; it allows vector/raster merging.

John Parker (USA), M. Madani - **Integration for Digital Photogrammetry Production Systems**

Key points were: (1) The concept of separating data acquisition operative (stereo restitution and feature extraction) from application operations, allow easy integration of data from different sources as well as different photogrammetric systems. (2) Digital photo-grammetric system needs for smart file format conversions compression/decompression techniques, efficient handling of large data storage and smart ergonomic design. (3) Developments are going towards the automation of DTM and digital orthophoto production and the development of methods to assist and automate aerial triangulation. (4) Future developments will show more automatic feature extraction capabilities.

Karel Charvat (Czech Republic), V. Cervenka, A. Limpouch, F. Pivnicka - **Technology for Digital Vector Land-use Map Preparation Based on Remote Sensing Data**

Key points were: (1) The system is developed to produce Land-use maps in the Czech Republic. (2) The paper describes the various steps involved (Colour Composite, data compression using Neural Network technique, image georeference coding, non-supervised classification, classified image geocoding, field inter-pretation). (3) The used system TOPOL-GIS includes vector/raster manipulation, various raster functionalities, spectral analysis, orthophoto production, map-output.

COMMISSION II
Working Group II/5

Session 2502 - **Developments in Photogrammetric Systems**
Session dedicated to the memory of Uki Helava
July 16, 1996, 13:30-15:00
Session Reporter: **Michael Chapman** *(Canada)*
Chairman: **Mosaad Allam** *(Canada)*

Clifford Greve (USA), S. E. Webster - **Integrated Photogrammetric Systems at Science Applications International Corporation**

Joining of remote sensing, image processing and photogrammetric groups.

Josef Braun (Germany), L. Tang, R. Debitsch – **PHODIS AT - An Automated System for Aerotriangulation**

PHODIS AT, the system for automated aerotriangulation, is composed of the automated block preparation, fully automated tie point measurement and semi-automated control point measurement. Components of PHODIS AT are described and results from the photogrammetric practice are presented. It is shown that the digital aerotriangulation can be much more economic compared to the analytical aerotriangulation.

Alex Dam (USA), A. S. Walker - **Recent Developments in Digital Photogrammetric Systems from Leica-Helava**

Product development is primarily customer driven, but the engineers/scientists vision influence it significantly. Recent demands for improvements in the scanning automation has resulted in a new generation of roll-film scanners. Helava's new scanner, the DSW300, will be profiled in a historical perspective of scanning products. Helava's Digital Photogrammetric Workstation (DPW) has also been reported on.

Alain Chapuis (Switzerland) - **Performance Improvement for the Triangulation Process on LEICA Analytical Workstations by Sequential Adjustment used for Continuous Quality Control and Digital Point Transfer**

Leica modernised the orientation and triangulation software in order to increase the performance of the SD-line and respond to the change of user's demands for more quality control and modern graphical interface. A full integrated on line bundle triangulation module with statistical blunder detection is reducing drastically the time for detection and elimination of blunders. ORIMA (ORIentation MAnagement software) was developed by Dr. Ludger Hinsken, Development & Consulting, in close collaboration with Leica.

Scott B. Miller (USA), F. B. Paderes, A. S. Walker - **Automation in Digital Photogrammetric Systems**

The current and near future status of automation in LEICA-Helava products is presented, specially the advanced treatment of blunder detection, generation of DTMs, adaptive automatic elevation extraction, orthophoto production and mosaicking, and semi-automatic vector extraction (with tools for building refinement, for boundaries of homogeneous areas, for trails and centrelines, and road and boundary edges, etc.).

COMMISSION II

Session 2001 - **Developments in Digital Photogrammetric Workstations (IWG II/III)**
July 11, 1996, 8:45-10:15
Session Reporter: **Josep L. Colomer** *(Spain)*
Chairman: **Ian Dowman** *(U. K.)*

A. Stewart Walker (USA), G. Petrie - **Digital Photogrammetric Workstations 1992-96**

Straightforward account of the recent development and current status of DPWs, from a practical point of view. Little coverage of close range photogrammetry. Progress has been impressive, adoption is widespread and a competition market-place brings the customer a fine choice of products at low prices. DPWs will become the workhorse faster than analytical plotters, which took 20 years from invention to significant commercial sale. Yet the rather low level of automation is somewhat disappointing and surprising: improvement in this area is initial to the future of DPWs. Nevertheless, DPWs represent a radical shift in photogrammetric technology and, in turn, to the deliverables which users of DPWs are able to offer to their clients.

In the discussion the issue of PC based systems becoming more widely used was brought up. The speaker did agree and, nevertheless, pointed out that manufacturers have to make sure that DPW software will run an the user's platform of choice. Answering a further question he remarked that project management aspects are not yet well supported by DPW software. He also pointed out that, though the number of photogrammetric enterprises currently running digital point transfer systems is small, we will see digital aerial triangulation all around in two years.

Armin Grün (Switzerland) - **Digital Photogrammetric Stations Revisited**

In the civilian market segment Digital Photogrammetric Stations are around for about one decade - as university-based solutions first, later as commercial products. In some countries the digital systems have already outnumbered the analytical plotters. This is an indication of the remarkable changes which digital technology has triggered even outside research laboratories. This paper provides for a critical review of the state-of-the-art of current Digital Stations. It

comments on the achievements in system development and investigates to what extend the original expectations, demands and predictions have been fulfilled.

In the discussion, Prof. Grün was asked whether the user friendliness issue could be solved before automation. According to the speaker's answer, those are different problems.

Jianqing Zhang (P. Republic China), Z. Zhang, W. Shen, Z. Wang - **VirtuoZo Digital Photogrammetry System and its Theoretic Foundation and Key Algorithm**

During the past 16 years, VirtuoZo, a Digital Photogrammetry System was successfully developed at Wuhan Technical University of Surveying and Mapping in P. R. China. The main functions and the theoretical foundation of VirtuoZo are introduced. Specially the matching algorithms and the algorithms for improving the effectiveness of VirtuoZo are introduced. Some of the applications of VirtuoZo are outlined, too.

Nobuhiko Mori (Japan), S. Murai - **Stereoscopic Image Processing Using a Digital Photogrammetric System**

Key points were: (1) A digital photogrammetric system has been applied to stereoscopic image analysis. (2) Updated precise DEMs of any place can be extracted easily from digital stereoscopic images by the system. (3) Stereoscopic image analysis can be carried out with the system using stereoscopic image processing programs developed on the system. (4) Some experiments have already been done in some application fields and the usefulness of the system has been confirmed.

Giancarlo Capanni (Italy), F. Flamigni - **Siscam Softcopy Photogrammetric Workstation**

Systems for digital photogrammetry developed in the last years in the company; systems concepts and applications.

COMMISSION II

Session 2002 - **Integration of Photogrammetric Systems into Production (IWG II/III)**
July 18, 1996, 8:45-10:15
Session Reporter: **Wolfgang Schickler** *(USA)*
Chairman: **John Thorpe** *(USA)*

Kurt Kubik (Australia), P. Harvey - **Experimental Study of Optimal Digital Mapping Parameters**

Key points were: Quality of digital photogrammetric mapping taking the following aspects into account (1) image scale and flying height, (2) pixel size and (3) image compression. The author presented a comparison of analytical photogrammetric versus automatic digital DTM extraction, in order to evaluate optimal performance parameters for digital photogrammetric mapping. He pointed out that the

achievable height accuracy was 1 pixel for pixel sizes up to 25 microns. He found that the compression error (JPEG) increases linearly with the compression rate and that a compression up to a factor 8 was insignificant to the result. Compared to the other factors the cost gain by compression was not important.

Gary Brown (USA) - **The Future of Softcopy in Photogrammetric Mapping Firms**

Key points were: The implementation and use of current and future new digital technologies in the production environment of photogrammetric mapping firms. The author pointed out that a strong client requirement now includes digital imagery as well as digital vector data. The current technologies in digital photogrammetry support automated production of orthophotography well, but automated vector extraction is not yet ready for production, and that there is a strong need for standards for data files as well as for digital imagery. His opinion is that near future softcopy advancements will be split between vector acquisition and additional automated processes that need less operator interaction.

Q (J. L. Colomer - Spain): What is the return of investment period that you are using for calculating the costs?
A (G. Brown - USA): It is difficult to say because of the technological changes. You are constantly adding more disk, memory, etc. I would be happy if I could answer 3 years, but it is probably 5.

Frantisek Pivnicka (Czech Republic) V. Cervenka, K. Charvat, A. Limpouch - **Cost-Effective Digital Photogrammetry**

Key points were: (1) A low cost digital photogrammetric system in (2) a PC/Windows environment was presented. The system combines different photogrammetric tasks like (3) orthophoto rectification, (4) automatic DEM generation, (5) stereo plotting and editing and (6) GIS functionalities in just one package. The author pointed out the advantage of directly compiling into a GIS system.

Peter Kempa (Germany) E. Siebe - **Controlling and Updating of 3D - Urban Data within a Digital Photogrammetric Workstation**

Key points were: (1) Data controlling, (2) quality check and (3) data updating for 3D - urban data consisting of (4) DEM and (5) 3D - city models.

Mannesmann Mobilfunk has been outsourced the mapping of 12 major cities in Germany for cellular network planning. The quality of the data had to be checked regarding the following aspects: Completeness, consistency, position accuracy, height accuracy and level of detail. The principle of the quality check they used was a super imposition of the 3D data into orthophotos and a manual inspection and verification on a digital photogrammetric workstation. The accuracy has been tested by a comparison of the data with randomly

selected and manually measured samples. The problem of data updating has not been addressed so far.

Q1(P. Newby – U. K.): Do you see a place here for quality system standards (ISO 9000) which claim to reduce costs while improving quality management? Has ISO 9000 penetrated the telecommunication business, or the mapping business in Germany?

A (P. Kempa - Germany): Yes, we see this as a very important and helpful development in which we are very interested.

Q2(P. Newby): So you see ISO 9000 as directly helpful to you, not just something to be implemented as a result of market pressure to do so?

A (P. Kempa): Yes, definitely helpful to us.

Jussi Lammi (Finland) - **3-D Modeling of Buildings from Digital Aerial Imagery**
Key points were: (1) Automated 3D-building extraction. The buildings were modelled by a (2) boundary representation of a (3) solid model. The presented principle is a interactive reconstruction of the building model based on building primitives, and an automatic (4) multi-image matching using a (5) least squares matching method in object space.

Q1(M. Lemmens – The Netherlands):What are the criteria you use to define the search space and what is the step size?

A (J. Lammi - Finland):You should have to have some approximation, but theoretically it is not necessary. Search space and step size are typically dependent on the imagery used.

Q2(M. Molenaar – The Netherlands):The topologic model for the representation of 3D objects you showed were based on graphs with a planar topology. Is this a serious restriction or could you also work in situations where the graph is not planar, but where it has a 3D topology?

A (J. Lammi): Yes, it is a restriction.

Q3(J. Thorpe - USA):Is the interactive measurement done in 2D or 3D?

A (J. Lammi): In 2D.

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The most important posters were:

Christoph Dörstel (Germany), T. Ohlhof - **Processing and Display of Three-line Imagery at a Digital Photogrammetric Workstation**
The orientation procedure, requirements for stereo viewing and image point measurement, and the implementation into the digital stereoplotter ZEISS PHODIS ST have been explained.

Paolo Zatelli (Italy) - **A Portable Software System for a Digital Photogrammetric Station**
At the University of Trento a portable photogrammetric system has been built using standard programming techniques. The system includes digital sensor calibration for close-range applications, all classical photogrammetric operations of an analytical plotter with some of the tasks automated.

Florin Savopol (Canada), M. Boulianne, C. Nolette - **Production d'images synthétiques de haute résolution pour la stéréorestitution photogrammétrique**
An accurate digital photogrammetric system for terrestrial applications has been set up which uses images of higher resolution than those achieved from CCD cameras: A synthesised image is calculated from a series of video images captured by a camera sweep, both vertically and horizontally, from a fixed point.

Andreas Georgopoulos (Greece), E. Tounas - **Towards an Operational Digital Video Photogrammetric System for 3D Measurements**
The paper deals with the development of a low-cost digital system for accurate 3D measurements, using stereoscopic video frame sequences.

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Franz Hochstöger (Austria) - **Software for Managing Country-Wide Digital Elevation Data**

Development of effective storage and management of large volumes of digital elevation data from variety of sources. This procedure is particularly suitable for data archives and for DTM applications. It can be used with both, original and derived data. The system is designed to serve wide range of users, it is included in the known scop system. - Very good study in high priority area.

Relin Zhang (P. Republic of China) - **The Contribution of Information Theory to Development of Mapping Theory of Digitised Aerial Photographs**

Proposed more efficient data structure for digitised datasets from scanned aerial photographs by applying information theory. Specifically, it involves optimisation of coding and data compression. When testing the results, it was found that the loss of information was almost insignificant. - Very good paper contributing to increased effectiveness of datasets structures.

Shue-chia Wang (China-Taipei), S.-H. Chiu, C.-C. Tsai - **Dynamic Window Size Least Squares Matching for Aerial Triangulation Point Measurement**

Description of a new procedure for aerial triangulation based on digitising nine (9) tie areas, each of 4 mm x 4 mm in size, rather than digitising the whole image. Dynamic window size is used for automatic matching of tie points within each 4 mm x 4 mm tie area.

The significance of this work is great reduction of volume of data to be processed, requiring only standard PC computation power.

Very good study with potential to result in significant savings.

Gordon Plunkett (Canada) - **Metadata Requirement for GIS: A Canadian Experience**

Report on Canadian approach to development of metadata standard. Description of metadata information flow, system structure and identifiers. References to existing metadata standards were included.

This presentation addressed a top priority topic. Its successful solution should result in improved access to geospatial data.

This presentation is rated as #1 of the presentations in this poster session.

Graham Freeman (Canada), M. Abbasi - **Stereo Image Registration Based on Uniform Patches**

Automated image registration based on matching uniform patches in stereo-pairs success ranges between 67% (points correctly matched). This procedure facilitates an automation of height determination and orthophoto production, requiring matching image stereo-pairs.

Very good study with considerable practical impact.

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Antonio Maria Garcia Tommaselli (Brazil), M.H. Shimabukuro, P.A.P. Scalco, F.M.A. Nogueira – **Implementation of a Photogrammetric Range System**

Susumu Hattori (Japan), A. Okamoto, T. Ono, H. Hasegawa – **Development of a Digital Image-Based Plotter and its Application to Ground Displacement Measurement in the KOBE Earthquake**

Graham Freeman (Australia), M. Abbasi-Dezfouli – **Stereo-Image Registration Based on Uniform Patches**

Willie O'Sullivan (Switzerland), Th. Kersten – **Project SWISSPHOTO – Digital Orthophotos for the Entire Area of Switzerland**

Raad A. Saleh (USA), Fr. Scarpace – **Investigation of Aerial Triangulation and Surface Generation Using a Softcopy Photogrammetric System**

Bock-Mo Yeu (Korea), H. Kwon, S.-G. Lee, D.-B. Shin – **Statistical Test for Evaluation of the Accuracy of Digital Maps for Geo-Spatial Information System**

Gleb A. Zotov (Russia), S.S. Nekhin, S. Oleynik, L.B. Ilyin – **Digital Point Transfer for Aerotriangulation by Analytic Plotter**

Dragan Mihajlovic (Yugoslavia), Z. Cvijetinovic – **A PC-Based Solution for Computer Aided Photogrammetric Mapping on Analog Stereoplotters**

Douglas Smith (U.K.), M. Smith – **Operational Experiences of Digital Photogrammetric Systems**

Thomas Läbe (Germany), K.H. Ellenbeck – **3D-Wireframe Models as Ground Control Points for the Automatic Exterior Orientation**

Nikolay A. Rosental (Russia), A.L. Logutko – **Air Mass Motion Remote Control System**

Constantin Nitu (Romania), C.-D. Nitu – **Errors and Tolerances in the Mapping, Photogrammetry, RS and GIS Integration**

Regina Tokarczyk (Poland) – **Photogrammetric Set for Architectonic Evaluation on Video Stereo Digitizer**

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Working Group III/1

Session 3101 - **Integrated Orientation of GPS, INS and Imaging Sensors**
July 15, 1996, 15:30-17:00
Session Reporter: **Martin Smith** *(U. K.)*
Chairman: **Ismael Colomina** *(Spain)*

Michael Cramer (Germany), J. Skaloud, K. P. Schwarz - **Exterior Orientation by Direct Measurement of Camera Position and Attitude**

The performance of an airborne data acquisition system consisting of receivers of the Global Positioning System (GPS) and a strapdown Inertial Navigation System (INS) together with an aerial camera is assessed using data of 1: 6 000 large scale photogrammetric test. Multiple flight lines were flown over a well controlled photogrammetric test field allowing the assessment of position and attitude repeatability, as well as the analysis of the gyro drift.

After a brief description of the essential features of the sensor integration design, its practical implementation is described and the error budget is discussed. To assess the feasibility of using independently determined attitude and position parameters from GPS/INS for the exterior orientation of the photographs, the independent models were directly georeferenced. Primary results indicate that aerotriangulation at a photo scale of 1: 6 000 using independent exterior orientation directly obtained from an integrated GPS/INS can be done with an accuracy of 0.3 m.

Q (N. El-Sheimy - Canada): How do you fix the attitude between the camera and INS?
A: This is calibrated at the start of the photography.

Erik Lithopoulos (Canada), B. Reid, B. Sherzinger - **The Position and Orientation System (POS) for Survey Applications**

This presentation describes the Position and Orientation System (POS), a commercial off-the shelve product. POS integrates inertial sensors with GPS to provide position and attitude measurements.

The presentation will describe the system and its uses in a range of commercial applications with emphasis in the airborne.

Q1 (J. Skaloud - Canada): You claim that you can get 1-2 min arc in inner alignment in-flight, can you give the technical details?
A: No.

Q2 (N. El-Sheimy - Canada): How long does it take to perform the inner alignment?
A: 20-30 seconds for the gyroresolution to be less than 1:10 000 of a degree.

Q3 (I. Colomina - Spain): What INS do you use?
A: Litton LR-86 (modified).

Martin Smith (U. K.), C. Joy - **Advances in GPS-Assisted Helicopter Photogrammetry and its Application to High Precision Highway Profiling**

An efficient road network is essential for a country's economic activity. Around ten years ago, photarc surveys limited decided to address the problem of using traditional terrestrial survey techniques to provide essential highway profiles. A non-contact photogrammetric system was developed using a Zeiss UMK 10/1318 camera 'cradled' out of a bell 206 helicopter. Single model analytical analysis is used to give road spot heights to RMSE ± 0.005 m.

Despite the ability of the system to provide clients with cost effective profiles, the requirement for full ground control along the hard shoulder is undesirable both for financial and safety reasons.

This paper presents the most recent developments at the Institute of Engineering Surveying and Space Geodesy of the University Nottingham, including system developments and bundle estimation analysis. Details of current work and future plans are also given.

Clive S. Fraser (Australia), J. Shao - **Exterior Orientation Determination of MOMS-02 Three-Line Imagery: Experiences with the Australian Testfield Data**

The paper discusses the establishment of the Australian ground truth testfield for MOMS-02 imagery obtained in the 1993 D2 mission. As well as detailing photogrammetric and GPS-survey aspects, the paper also discusses the exterior orientation determination of the testfield imagery and the triangulation accuracy obtained for ground points. The mathematical model at triangulation is reviewed and experimental results are summarised.

Heinrich Ebner (Germany), T. Ohlhof, E. Puth - **Orientation of MOMS-02/D2 and MOMS-2P Imagery**

This paper deals with the orientation of 3-line imagery taken during the MOMS-02/D2 experiment in spring 1993. The combined adjustment of the complete image, ground control, orbit and attitude information is supplemented by a rigorous dynamical modelling of the spacecraft motion to take orbital constraints into account.

About 14,000 conjugate points were processed in one imaging sequence (430 x 37 km²), together with the epoch state vector, attitude data and 12 GPS-ground control points. The results were close to the limits and even poorer without the control points because of the missing absolute attitude control data. Good accuracies can be obtained with a few precise control points or with a block of cross-overlapping strips.

Q: What is the impact of the star camera not working?
A: It is not very important as it is on another part of the platform and we would need to know the relationship between the two sensors, which we do not have.

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Session 3102 - **Theoretical Aspects of Sensor Orientation**
July 18, 1996, 8:45-10:15
Session Reporter: **Johannes Kilian** *(Germany)*
Chairman: **James Lucas** *(USA)*

Timm Ohlhof (Germany) - **Local, Regional and Global Point Determination Using Three-Line Imagery and Orbital Constraints**

The emphasis of that paper is point determination using spaceborne 3-line imagery and orbital constraints. In order to properly utilise the image information contained in conjugate point co-ordinates and the orbit information contained in tracking data, both data types have to be evaluated in a combined adjustment process. To this end, the conventional bundle block adjustment algorithm is supplemented by a rigorous dynamical modelling of the satellite motion to take orbital constraints into account.

The efficiency of the new bundle adjustment approach integrating orbital constraints has been proved with simulated Mars96 HRSC/WAOSS data and practical MOMS-02/D2 data.

Q (J. Lucas - USA): Multiple sensors to determine the attitude are involved in the presented system. Is there a backup possibility, if one sensor fails?
A: Yes, there is the redundancy of the attitude sensors, especially gyros, there is no redundancy in the cameras.

Gerald Forkert (Austria) - **Image Orientation Exclusively Based on Free-Form Tie Curves**

Recent developments in the field of digital image processing encourage to use line information for image orientation and object reconstruction instead of or in addition to traditional methods based on distinct points. In this paper image orientation exclusively based on free-form tie curves shall be demonstrated working on a car as real-world test object. Photographs were taken from around the car and scanned in order to obtain digital images. Edges extracted from those digital images provided the input data for bundle block adjustment for the determination of both, the orientational parameters of the images as well as the spatial shape of the tie curves. The results show, that an accuracy in the order of the uncertainty of definition of the object lines could be achieved.

Q (T. Ohlhof - Germany): Did you have applied your form-free curve method on aerial or satellite images as well?
A: Yes, there is a diploma thesis on applying form-free curves on aerial images; investigations on satellite images are also in hand; no concrete results yet.

Peter Axelsson (Sweden) - **Outlier Detection in Relative Orientation - Removing of Adding Observations**

Comparison of strategies for outlier detection (1) removing bad observations, (2) adding good observations or (3) finding a balance between good and bad points using MDL. Results show that repeated solutions based on minimal number of observations, i.e. "bootstrap"-methods, can handle large fractions of outliers. MDL is found to be a good criteria when removing outliers.

Q (M. Hussain - USA): Are there any distinct patterns in the errors of the x or y co-ordinates?
A: No.

Gerhard Brandstätter (Austria) - **On Critical Configurations of Projective Stereo Correlation**

The report deals with critical point configurations of projective image correlation. Projective images are non-metric, the co-ordinates are affine and they refer to an „interior co-ordinate system" of the model space. For this pre-assumptions the critical case is formulated and possibilities of discovering it are developed.

Johannes Kilian (Germany) - **Capture and Evaluation of Airborne Laser Scanner Data**

Using an airborne laser sensor system for the direct 3D data capture has a big potential for 3D surface reconstruction. After a short introduction to the system hardware and the fields of application a few topics of the evaluation process are highlighted. Especially the calibration procedure and the 3D building reconstruction using height and intensity data are presented. Therefore airborne laser sensor systems are very useful and high precise 3D data capture with big perspectives deriving further products like a DEM even in forest areas and in 3D building reconstruction.

Q (M. Hussain): Any experiences in how many control points are needed?
A: No, not real experiments, just two pilot projects.

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Session 3201 - **Experience with Systems for
Automatic Aerial Triangulation**
July 17, 1996, 10:45-12:15
Session Reporter: **Jean-Francois Rolle** *(Switzerland)*
Chairman: **Otto Kölbl** *(Switzerland)*

No report received!

Toni Schenk (USA), B. M. Csatho, R. Thomas, W. Krabill
– HIGHLIGHT PAPER: **Digital Aerial Triangulation**

Thomas Kersten (Switzerland), W. O'Sullivan –
**Experiences with the Helava Automated Triangulation
System**

Peter Krzystek (Germany), T. Heuchel, U. Hirtel – **An
Integral Approach to Automatic Aerial Triangulation
and Automatic DEM Generation**

Mostafa Madani (USA) – **Digital Aerial Triangulation -
The Operational Comparison**

Juha Jaakkola, T. Sarjakoski – **OEEPE Research
Project: Aeriotriangulation Using Digitized Images.
Final Results**

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Session 3202 - **Model Based Feature Extraction**
July 11, 1996, 11:15-12:15
Session Reporter: **R. Nevatia** *(USA)*
Chairman: **R. Nevatia** *(USA)*

No report received!

Pascal Fua (USA) – **Model-Based Optimization:
Accurate and Consistent Site Modelling**

Carsten Steger (Germany) – **Extracting Lines Using
Differential Geometry and Gaussian Smoothing**

Olof Henricsson (Switzerland), F. Bignone, W. Willuhn,
F. Ade, O. Kübler, E. Balsavias, S. Mason, A. Grün –
**Project Amobe: Strategies, Current Status, and Future
Work**

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Session 3203 - **Automatic Orientation Procedures**
July 15, 1996, 8:45-10:15
Session Reporter: **Tapani Sarjakoski** *(Finland)*
Chairman: **Tapani Sarjakoski** *(Finland)*

Christian Heipke (Germany) - **Automation in Interior,
Relative and Absolute Orientation**
The presentation reviewed recent developments and
the state of the art in automatic image orientation. It was
shown that interior and relative orientation can be and
have been cast into autonomous modules, and are also
commercially available. It was pointed out that relative
orientation is also a core of automatic aerial triangulation.
The situation is somewhat different for automatic absolute
orientation. Although encouraging research results and
developments towards automatic systems exist, semi-
automated measurement possibilities are still needed in
digital photogrammetric workstations.

Q1 (I. Dowman – U.K.): Is point/feature distribution a con-
cern for automatic relative and/or absolute orientation,
and if so, what strategies can be employed to
overcome the problem?
A (C. Heipke - Germany): According to my experience
there is no problem in automatic relative orientation.
As for automatic absolute the distribution is dictated
by the control information which must be available
from external sources.

Q2 (M. Roux - France): Can one use feature based
matching based on conjugate points for multi-temporal
and multi-source matching?
A (C. Heipke): I haven't worked on this kind of matching
problems myself, but expect difficulties in using points
only due to the more dissimilar grey value distribution
in the images. I suggest using relational matching
schemes for such applications.

Heinz Rüther (South Africa), N. v. d. Merwe - **An Image
Matching Scheme Using a Hybrid Feature- and Area
Based Approach**
The presentation introduced a hybrid image matching
scheme that combines aspects of feature based matching
and area based matching. The two stages of the
matching scheme take into account firstly the local
structure of a feature, and secondly the spatial relation
between a feature and its neighbours. The technique
makes it possible to carry out a fully automatic relative
orientation without any prior knowledge of orientation
parameter estimates.

Chris McGlone (USA) - **Bundle Adjustment with
Geometric Constraints for Hypothesis Evaluation**
The paper described the use of a bundle adjustment
with geometric constraints to evaluate feature matches

and geometric assumptions, based on the used of reliability statistics available from adjustment computations. The combinatoric problems inherent in the method can be avoided bye early editing of the hypotheses and by utilising evaluations of minimal redundant geometric subsets. The use of these methods in full-sized systems will require the computations to be optimised as much as possible.

Christian Drewniok (Germany), K. Rohr - Automatic Exterior Orientation of Aerial Images in Urban Environment

The topic of the presentation was automatic orientation of aerial images based on the use of manhole covers as landmarks. Detection of manhole covers was performed via least squares estimation using templates. The size of the round templates was determined in a so called learning phase. The approach offers the opportunity to automate the orientation process in urban environments, presuming that the approximate image scale and the approximate location of acquisition can be derived from the flight plan.

Yan Lue (USA) - Towards a Higher Level of Automation for SoftPlotter

The presentation reported the approach used in SoftPlotter by Vision International for automatic interior orientation and automatic tie point selection. For automatic interior orientation extensible database of the templates for fiducials are used. Automatic tie point selection is based on various configuration patterns that are available in the system.

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Session 3204 - **Segmentation and Classification**
July 12, 1996, 11:15-12:15
Session Reporter: **Uwe Weidner** *(Germany)*
Chairman: **Eberhard Gülch** *(Germany)*

Wolfgang Eckstein (Germany) - Segmentation and Texture Analysis

Key points were: (1) Segmentation is central for aerial image analysis tasks. It is recommended to use multiple data sources, if available, especially colour images and digital elevation models (DEM). (2) It is recommended to select the appropriate resolution, depending on the task (scale space analysis). (3) From the bunch of available segmentation methods the appropriate one should be selected, depending on the task. There exists no operational system to make this choice. It is recommended to perform trial and error with existing methods instead of implementing and testing similar ones.

Francisco Cortijo (Spain), N. P. de la Blanca - Image Classification Using Non-Parametric Classifiers and Contextual Information

Key points were: (1) A combination of pixel-based spectral classification of "Landsat MSS" data is proposed with contextual classification taking the neighbourhood into account. (2) The pixel-based classification yields and initial state which can be substantially improved by a following contextual classification. (3) A number of combinations have been empirically tested and the usage of "Cart", "LVQ-1" spectral classifiers in combination with the "ICM" contextual classifier is recommended.

Olaf Hellwich (Germany), H. Mayer, G. Winkler - Detection of Linear Structures in Synthetic Aperture Radar (SAR) Scenes

Key points were: (1) A Bayesian method is applied to detect curvilinear structures in SAR imagery (synthetic aperture radar). (2) Due to the noise characteristics of SAR data this is a very difficult task. (3) Markov random fields are used to support the detection of neighbouring lines from already detected lines, based on a local model for continuity of lines.

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Session 3205 - **Matching Techniques**
July 10, 1996, 10:45-12:15
Session Reporter: **Wolfgang Förstner** *(Germany)*
Chairman: **Wolfgang Förstner** *(Germany)*

Ramarkant Nevatia (USA) - HIGHLIGHT-PAPER: Matching in 2D and 3D

Key points were: (1) Matching is central to many image analysis tasks. A large number of factors affect the choice of a matching strategy for a given task. (2) The registration of images to maps is of increasing importance. Major problems are the choice of suitable representation levels and the non-perfect site models. Colour coded quality measures for the matching support the human operator in the task of change detection. (3) The matching problem is not solved, but many options are available and successfully applied to some classes of problems. It is recommended to use the highest level of abstraction possible for the matching and an as early as possible transition to 3D. A combination of matching and segmentation/grouping is expected to reduce the complexity of both tasks.

Heping Pan (Australia) - Uniform Full-Information Image Matching Using Complex Conjugate Wavelet Pyramid

Key points were: (1) Wavelets allow a closed form solution for the top-down matching of two stereo images. The estimation of the five parameters for the relative orientation and of the two focal lengths is based on the assumption of a single bounded surface. (2) A spiral

parallax propagation is applied on the top level of the multi-resolution approach, followed by conventional hierarchical parallax propagation on the lower levels. (3) The family of symmetric complex wavelets is regarded best for discrete matching tasks.

Tapani Sarjakoski (Finland), J. Lammi - **Least Squares Matching by Search**

Key points were: (1) Search is a basic technique in AI and can solve any non-linear system. Search allows a direct solution of global least squares matching with multiple images, requiring no linearisation like conventional least squares matching. (2) Least squares matching by search is much less sensitive to approximate values compared to the conventional approach and requires only higher computational efforts. (3) The basic formulation for the height determination of a point is easily extendible to the matching of points, lines and surfaces. Alternative efficient search strategies are to be applied.

Ian Dowman (U.K.), A. Morgado, V. Vohra - **Automatic Registration of Images with Maps using Polygonal Features**

Key points were: (1) Distinct polygonal features, extracted from DD5 satellite imagery are matched in 2D to map data using chain code and dynamic programming. A dense network of matched points is generated for the registration process. (2) So far the vectorization of rasterbased map data and the selection of four control point pairs require user interaction. (3) Perspective distortions of the buildings due to the look angle and object orientation result in systematic displacements, that have to be eliminated. With highly redundant number of matched points a certain degree of generalisation of the map data can be handled.

Bjarke M. Pedersen (Denmark) - **Automated Measurement of Ground Control Objects in Large Scale Aerial Photographs**

Key points were: (1) Large natural control objects or areas instead of few conventional control points are used. Grey level templates generated from vectorized map data are used for the matching. (2) Two major assumptions are used: a) It is necessary to derive closed polygons from the unstructured map data and b) the approximate orientation parameters must be available. (3) The matching process is based on search from coarse to fine yielding sub-pixel accuracy. A final robust bundle adjustment can detect blunders caused e.g. by many similar looking nearby objects.

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Session 3206 - **DGM Generation and Analysis**
July 11, 1996, 13:30-15:00
Session Reporter: **Michael Hahn** *(Germany)*
Chairman: **Michael Hahn** *(Germany)*

Franz W. Leberl (Austria), M. Gruber, W. Kellerer-Pirklbauer, A. Pinz, P. Uray, G. Paar - **Surface Reconstruction**

Key points were: (1) Surface reconstruction should deal with the topographic surface and with the objects on the earth surface. Thus it is more difficult than DTM reconstruction. (2) The classical focus on stereoscopy has recently been broadened to include structured light and laser ranging, interferometry with radar sensors, but also single image approaches, shape-from-shading and tactile profiling in close range. (3) The strong improvements in surface visualisation contributed to a wider understanding of modelling surface properties other than surface geometry.

Hans-Gerd Maas (Switzerland) - **Automatic DEM Generation by Multi-Image Feature Based Matching**

Key points were: (1) A multiple image feature based solution for matching was developed by adaptation of a 3D flow measure process. (2) The given orientation is used to calculate epipolar lines of pairwise image combinations. Constraint search along epipolar lines leads to candidate point pairs which are further evaluated by taking other image combinations into account. (3) Even a lot of points have been extracted in an image only a relatively small number of multi-image point correspondences have been found experimentally in a scene which was captured by 6 images. The DTM generation process has shown that only a very small number the matched points have been outliers.

Q1 (M. Hahn - Germany): What is the reason for the discrepancy between the number of extracted and matched points? Is it instability of the point extraction?

A: Yes, I think this is a general problem and unfortunately instability of the point features must be observed. I tested several interest operators and found that there is almost no difference between them with respect to the success rate of establishing point correspondences.

Q2 (L. Tang - Germany): What was the size of the images in your experiments ? Was it 15 000 pixels in row and column?

A: The first example was a scanned aerial image block with 6 000 x 6 000 pixels for each digital image. In the second experiment a DCS camera was used with an image size of 1 500 x 1 000 pixels.

Bernhard Wrobel (Germany), J.-R. Tsay, R. Schneider - **Wavelets Based Object Surface Reconstruction by Fast Vision**

Key points were: (1) FAST Vision reconstructs two surfaces: One is the terrain surface which is represented by bilinear facets, the other one is the radiometric surface for which now Daubechies wavelets are applied. (2) The advantage of the orthogonal wavelet surface is the C1 continuity which stabilises the FAST Vision approach considerably. (3) Experimentally a very high resolution of 2 x 2 grey value pixels for a height facet was used which has given an empirical accuracy of the reconstructed surface of 0.2 to 0.6 pixels.

Q1 (M. Hahn - Germany): Differs the wavelet approach from classical pyramidal processing ?
A: The image pyramids are still used. The major difference is the improved radiometric surface representation.

Q2 (M. Hahn): Would it be useful to use wavelets for the geometric surface also ?
A: Because no orthogonal representation for Z(X,Y) is possible there would be no advantage.

Q3 (U. Rauhala - USA): Is the approach very time-consuming ?
A: This depends very much on the regularisation window size which can be large if low contrast regions occur.

Bernd Giese (Germany), J. Oberst, R. Kirk, W. Zeitler - **The Topography of Asteroid Ida: A Comparison between Photogrammetric and Shape-from-Shading Image Analysis**

Key points were: (1) 57 images have been taken from asteroid Ida by the Galileo spacecraft during the flight in August 1993. (2) A Comparison was performed between a DTM stereo solution and a shape from shading solution. (3) Whilst photogrammetry resolves large and medium scale features, photoclinometry successfully resolves small scale features. (4) A considerable limitation of the experimental investigation was the lack of ground truth. (5) The experiment has shown that ideally both methods should be combined to optimise the overall result.

Uwe Weidner (Germany) - **An Approach to Building Extraction from Digital Surface Models**

Key points were: (1) The Surface Model of an urban area contains geometric information about the terrain surface as well as buildings and other objects. (2) Selection and reconstruction of building models are based on parametric and prismatic building models using the Minimum Description Length principle. (3) Even though the 2.5 D surface model covers object shape more explicit than, e.g., an aerial image pair, the quality of building extraction is directly related to the quality of the surface modelling approach. (4) First experiments using a DEM generated by image matching have been successful. Extensions are planned in which GIS data are taken into account as another source of 2D prior information.

Session 3301 - **3D Object Reconstruction**
July 12, 1996, 8:45-10:15
Session Reporter: **Karl-Heinrich Anders** *(Germany)*
Chairman: **Monika Sester** *(Germany)*

G. Sagerer (Germany), F. Kummert, G. Söcher - **Semantic Models and Object Reconstruction in Computer Vision**

Key points were: (1) Hybrid approach combining semantic network with statistical and numerical learning techniques: a) explicit knowledge is stored in semantic network and b) implicit knowledge is gained by neural network or statistical learning procedures, (2) for prototypical application (simple 3D objects) object recognition and 3D reconstruction is demonstrated.

Q1 (M. Sester - Germany): Did you consider to use structural learning techniques in order to get an explicit knowledge representation instead of knowledge "hidden" in the nodes and weights of the neural net (NN)?
A: No, up to now NN is the only learning technique used.

Q2 (W. Förstner - Germany): Did you make tests with overlapping parts?
A: Not yet tried - test data used has no overlapping parts.

Franz Rottensteiner (Austria) - **3D Object Reconstruction by Object Space Matching**

Key points were: (1) Topographic surface reconstruction with feature based matching, (2) Generation of corresponding hypothesis based on region adjacency graph, (3) Integration of bundle block software to provide geometrical constraints for hypothesis.

Q1: Which kind of features are used ?
A: Interest points derived with Förstner interest operator.

Q2 (H. P. Pan - Australia): Do you have any examples ?
A: No, presentation was just a concept which will be realised in the near future.

Deren Li (P. Republic of China), X. Wang - **Relational Structure Description and Matching Algorithm for 3D Objects**

Key points were: (1) Use CAD-models for object reconstruction, (2) 3D objects are described in relational data structure, (3) Multi constraints used to cut down the search space.

Q (M. Sester – Germany): Do you assume that the orientation of the objects is known ?
A: Orientation is unknown, is also derived in matching process

Norbert Haala (Germany), K.-H. Anders - **Fusion of 2D GIS and Image Data for 3D Building Reconstruction**

Key points were: (1) using additional information supports 3D building reconstruction to great extent: a) use of range data and b) use of (2D) GIS-data, (2) "Interpretation" of GIS-data is needed to get 3D building hypothesis from 2D building ground plans, (3) Verification of hypothesised buildings in stereo images.

Q1 (J. Thorpe - USA): It is very important to use existing GIS data to reconstruct spatial objects. This approach shows an excellent way how it can be achieved. Question to Förstner about state of the art in automatic building reconstruction.

A (W. Förstner - Germany): At the moment no automatic system is available. Good and promising approaches are a) to use GIS data and b) semi-automatic approaches.

C1 (M. Molenaar – The Netherlands): GIS is important as prior information, especially to derive aggregation hierarchies in order to extract different aspects of the data and also relations between the objects - which are a very important cue to get context information.

C2 (N. Haala - Germany): This is also our focus, especially the work of the co-author K.-H. Anders, to automatically derive more prior information from the GIS.

Q2 (D. Li - China): What happens if the buildings do not exist in the database ?

A: Procedure is primarily used for 3D building reconstruction - thus only those buildings are found and reconstructed which are in the database.

C3 (S. Mason – South Africa): Different aspects of automatic building reconstruction can be discerned, because form and type of buildings differ considerably in different countries, e.g. in South Africa there are regions where houses are build up or cut down within a few days. Another aspect to consider is: In areas of high unem-ployment there are the slums or the similar.

C4 (H. Mayer - Germany): Use GIS as hypothesis since it is only valid for a certain instance in time - and might be out of date.

W. Förstner: announces the Workshop on "City Models" to be held in Bonn, Germany in October1996.

C5 (UK): There is a great need for automation of 3D reconstruction of 2D GIS building data sets. There is such a huge number of objects that can only be handled reasonably by automatic procedures.

COMMISSION III
Working Group III/3

Session 3302 - **Image Analysis and Image Understanding**
July 11, 1996, 8:45-10:15
Session Reporter: **Toni Schenk** *(USA)*
Chairman: **Toni Schenk** *(USA)*

No report received!

Helmut Mayer (Germany) – **Abstraction and Scale-Space Events in Image Understanding**

Yury V. Visilter (Russia), A. A. Stepanov, S. Y. Zheltov – **Events-Based Image Analysis for Machine Vision and Digital Photogrammetry**

Franz Quint (Germany), St. Landes – **Colour Aerial Image Segmentation Using a Bayesian Homogeneity Predicate and Map Knowledge**

Ruedi Boesch (Switzerland) – **Detection and Extraction of Complex Map Symbols**

Bernd Neumann (Germany) – **Reasoning Strategies in Scene**

COMMISSION III
Working Group III/3 and ICWG III/IV

Session 3303 - **Landscape Modelling and Road Extraction**
July 10, 1996, 13:30-15:00
Session Reporter: **Oliver Jamet** *(France)*
Chairman: **Oliver Jamet** *(France)*

George Vosselman (The Netherlands) - **Uncertainty in GIS Supported Road Extraction**

Key points were: (1) Map updating through automatic image interpretation needs a merging of various information; handling uncertainty in such a process is a necessity. (2) Uncertainty sources are: a) the GIS itself, the extraction process through the inherent discrepancy between a topographic model and reality and b) the extraction process through the incompleteness of the chosen models at the level of primitive description as well as at the level of the scene description. (3) The benefits of uncertainty of modelling will be show not only in the possibility of predicting the quality of the final result, but also in the control of the process itself; this is illustrated by an example of road updating, where primary decisions can be reconsidered in case of low certainty result.

Q (O. Jamet - France): Do you think a complete model of the scene is necessary to achieve full automation, or can some of the discrepancies between the model and reality be handled efficiently by stochastic decision making processes?

A (G. Vosselman – The Netherlands): A complete model isn't reachable. For certain sources of noise, you might do that.

Ralf Tönjes (Germany) - **Knowledge Based Modelling of Landscapes**

Key points were: (1) 3D modelling of landscape by simple superimposition of a photograph upon a DTM leads to unrealistic views: semantics of the objects present in the scene have to be taken into account. (2) An interpretation scheme base on semantic Networks is proposed to extract roads and forest borders from the images. (3) These objects allow a separate computation of 3D meshes from a DTM generated by correlation: thus, continuity constraints are imposed on the roads while discontinuities are preserved at the border of the forests.

Q (M. Sester - Germany): Your semantic networks do not include relations between objects, don't they?

A (R. Tönjes - Germany): Up to now, no geometrical relation is used in the process (which handles only construction relations).

Albert Baumgartner (Germany), C. Steger, C. Wiedemann, H. Mayer, W. Eckstein, H. Ebner - **Update of Roads in GIS from Aerial Imagery: Verification and Multi-Resolution Extraction**

Key points were: (1) Updating can be decomposed into two phases: verification of the database and extraction of new features; the application presented concerns the road network. (2) Verification is processed by a GIS driven search of parallel borders; it leads to a classification into three classes: verified, inaccurate and rejected. (3) The extraction step is conducted independently from the GIS data but makes use of a more complete multi resolution road network model; roads should respond to the extraction at low and high resolution. (4) The road model used can be described as a set of submodels (partial models) which use depends on the context; additional control is achieved by removing the non rural areas from the region of interset (mask from a texture analysis at low resolution).

Q (O. Jamet - France): Up to now, the verification and the extraction phases are independent. Do you plan to merge these two processes?

A (A. Baumgartner - Germany): Certainly we do. The easiest way is to „overlap" the two results so as to select the results of the extraction that represent new roads.

John C. Trinder (Australia), H. Li - **Extraction of Man-Made Features by 3D Active Contour Models**

Key points were: (1) We are engaged in this research on semi-automatic road extraction because we aim at an operational method. (2) Classical active contour models (or snakes) are used on a single image to compute a refined position from a rough manual plotting; the process works on satellite imagery as well as on high resolution one (with an energy function taking the two borders into account). (3) The method is extended to 3D in a multi image process by computing the curve in object and image space. (4) The assessment of the method shows a relative accuracy of 0.5 to 1.0 pixels for input distant of less than 5 pixels of the searched position, and of 1.0 to 1.5 pixels for input distant of more than 7 pixels; 3D models seem to cause more problems than 2D ones; nevertheless the absolute accuracy is comparable with manual plotting.

Q1 (W. Förstner - Germany): You talked about the difficulty
   to meet operational designers interested in implementing this kind of tool. Is it related to the computational time requested for the method?

A (J. C. Trinder - Australia): Once the preprocessing is done (gradient computing and energy function building), the processing time in interactive mode isn't too heavy (2 seconds for an average curve on an average workstation).

Q2 (O. Jamet - France): Did you compare the plotting time in semi-automatic and in manual mode?

A (J. C. Trinder): We didn't proceed to a formal comparison, but it appears to us that the operator should save time in areas where the network is much curved.

Q3 (O. Jamet): In the 3D process, you compute the internal energy from the derivatives of the 3D curve. Wouldn't it be wiser to compute a separate energy for the Z derivatives that could be weighted differently?

A (J. C. Trinder): We didn't make many tries on the weighting. It's a possibility.

Michel Roux (France), J. Lopez-Krahe, H. Maitre - **Automatic Digital Terrain Model Generation Using Aerial Images and Maps**

Key points were: (1) The aim of this application is to produce a DTM in a dense urban area, the methodology is the following: Extract roads on the map, derive the altitudes of the crossroads from a DTM computed by automatic correlation, interpolate the final DTM from the cross roads' altitudes. (2) Problems are raised by: a) the inaccuracy of the extracted network (due to the map positional accuracy and to the processing that can displace the segments of a few pixels) and b) the robustness of the estimation of the altitude of the crossroads. (3) The proposed solutions are a) to look for altitude minima among the extrema of the altitude histogram computed in a wide neighbourhood of each crossroad and b) to verify the crossroad by checking the coherence of the altitude along the connected road axis. (4) This technique shows an average absolute error of 2.1 m compared to reference altitude data computed from the map; regions with few crossroads still cause problems.

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Session 3304 - **Topographic Feature Extraction**
July 19, 1996, 10:45-12:15
Session Reporter: **Jan Peter Muller** *(U.K.)*
Chairman: **Jan-Peter Muller** *(U.K.)*

No report received!

Eberhard Gülch (Germany) – **Deformable Models as a Photogrammetric Measurement Tool-Potential and Problems**

Andreas Busch (Germany) – **A Common Framework for the Extraction of Lines and Edges**

Armin Grün (Switzerland), H. Li – **Linear Feature Extraction with LSB-Snakes from Multiple Images**

Franz Quint (Germany), M. Sties – **Evaluating Model Fidelity in an Aerial Image Analysis System**

Scott Mason (South Africa) – **3D Building Reconstruction Using Composites of Surface Primitives: Concept**

COMMISSION III

Session 3001 - **Multi-Scale Problems and Uncertainty (IWG III/IV)**
July 18, 1996, 15:30-17:00
Session Reporter: **Ryosuke Shibasaki** *(Japan)*
Chairman: **Ryosuke Shibasaki** *(Japan)*

Martien Molenaar (The Netherlands) - **Multi-Scale Approaches for Geodata**
Key points are: (1) For data acquisition of geo-objects the definition of these objects should be understood in their semantic context. (2) The scale range of which these definitions are valid is part of their context. (3) Therefore, linking scale levels, aggregation procedures should be possible in geo-databases. (4) Four strategies, class-driven, geometry-driven, functional and structural generalizations.

Q1 (Th. Leemann - Switzerland): 4 methods of aggregation of objects are mutually exclusive or combinable?
A: In applications, people use various combinations of aggregations. It is better for us to be aware of what kinds of aggregations they used or they would like to use. This classification of the aggregation methods are very helpful in selecting or designing aggregation methods.
Q2: Results of generalisation should be stored or made when needed?
A: It may be wise to store the results. It would depend on the frequency of use.

Yaser Bishr (The Netherlands) - **A Hierarchical Spatial Canonical Data Model - Towards Federating Heterogeneous GIS's**
Key point is: A model for loading real world semantics on database objects for the purpose of federating heterogeneous and distributed GIS. The emphasis is on the defining semantics and how they could be loaded and formalised.

Q1 (R. Shibasaki - Japan): The underlying idea of this paper is embedding the metadata into GIS databases to translate different semantics of heterogeneous GIS system. Considering a very wide variety of geo-objects, is it possible to translate the different semantics?
A: When query is occurred, the metadata of highest level server (the global server) was searched. Based on the metadata, appropriate database was selected. Each class of data in the GIS database metadata exist which is necessary to translate the query. In conclusion, a deep hierarchy of the metadata will be used for translating the query into the different semantics.

Q2 (O. Jamet - France): To what extent can you handle the queries in the user language? Doesn't it cause any problems when the contents of the different databases are quite different, e.g. in case of multi-scale databases?
A: We have two levels of users: Identified ones and unknown ones. There are standard queries for identified users. Others can browse the metadata.

Zhi-Lin Li (Hongkong) - **Transformation of Spatial Representation in Scale Dimension: A New Paradigm for Digital Generalization of Spatial Data**
Key point is: A new viewpoint for multi-scale representation in GIS environment. Geomorphological operations are the basic tool-kit for that environment.

Q1 (Th. Leemann - Switzerland): In the example, only a single object is used. If many objects are used, what will happen? Will there be any discrepancies between those objects?
A: Many objects can be processed. Results are good.

Q2 (Th. Leemann): Several themes, classes may compete in aggregation.
A: The model demonstrated here is the lowest level. Higher level of knowledge will be necessary.

Xiao-Yong Chen (Japan) - **Spatial Relations Between Sets**

Key point is: An integrating theory of spatial relations between sets. With the theory, spatial relations are defined in terms of the intersection of the boundaries, interiors and exteriors of two dynamically generated sets based on the Hausdorff metric.

Q1 (R. Shibasaki - Japan): Is it possible to apply the theory in the paper to the identification of intersection between two line features with positional uncertainties?
A: In case of vector data, cross section point can be calculated. In case of raster data, logical overlay operations can be used.

Q2 (J. Chen - P. R. of China): The theory in this paper handle only spatial relations. GIS requires more.
A: In extending 2D object to 3D, simple extension is not possible without any rigorous theoretical background. There is a need to develop a new theory to help us extending 2D to 3D or 4D.

C (M. Molenaar - The Netherlands): Problem in GIS is mainly the semantics. When the geometry is complete, this theory can handle the relations of spatial objects. The problem is how to assign the geometry to each object. To tackle with this and other problems, rule-based descriptions will be necessary, and it would be helpful to analyse what kinds of uncertainties exist and to identify what tools can be used.

Q3 (T. Cheng - The Netherlands): Why do you call your relations dynamic?
A: The relations can be changed according to the value of the distance. This is not static, but dynamic.

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Session 3002 - **Automated Feature Extraction on Digital Photogrammetric Systems (IWG II/III)**
July 12, 1996, 15:30-17:00
Session Reporter: **Azubuike G. Nwosu** *(Switzerland)*
Chairman: **Josep L. Colomer** *(Spain)*

Oliver Jamet (France) - HIGHLIGHT-PAPER: **Automated Feature Extraction on Digital Photogrammetric Systems**

This paper on automated feature extraction explained that tools are not available on commercial systems because of low reliability and other limitations imposed by cost of hardware and data. Robustness relies strongly on image quality and proper modelling.

Wolfgang Schickler (USA), Z. Poth - **The Automatic Interior Orientation and its Daily Use**

The system on automated interior orientation (available on ZEISS - PHODIS stereoplotter) was presented. This system has three main tasks: to locate fiducials, identify the 8 possible poses and finally to calculate the transformation between image and the fiducial system. The algorithm involves resampling, hierarchical localisation, pose recognition-binarization, and a refinement of measurement. To achieve these tasks, the system takes less than 20 seconds, with a RMSE < 0.2 pixels.

Liang Tang (Germany), Z. Poth, T. Ohlhof, C. Heipke, J. Batscheider - **Automatic Relative Orientation - Realization and Operational Tests**

The ZEISS approach to automated relative orientation was presented. This utilises a coarse-to-fine matching approach relying on image pyramids. Feature-based matching is used with higher pyramids to get conjugate points, and least-square matching techniques are used for precise point matching and tracking. Time depends mainly on scale of imagery, and in most cases it takes 1 to 3 minutes on a Silicon Graphics Indy-R4400 (150 MHz). About 100 points are used and precision is between 0.2 and 0.4 pixels.

The few failure cases have been found to occur due to large scale differences between stereo conjugates, to overlaps less than 40% and to very large relative kappa rotations.

Frank Scholten (Germany) - **Automated Generation of Coloured Orthoimages and Image Mosaics Using HRSC and WAOSS Image Data of the Mars96 Mission**

Systems for automated generation of orthoimages and image-mosaics from the two main sensor systems of the MARS96 (HRSC and WAOSS) were presented. Orthoimaging will be based on the indirect-method ray-tracing and rely mainly on orbit information improved by photogrammetric bundle adjustment and DTMs generated utilising multiple images. Radiometric aspects of mosaicking will be automatic without any interaction. Derived image maps will range in scale from 1/50,000 to 1/500,000. Input could be in any map projection system.

HRSC has 9-CCDs with 5184 detectors each mounted in the 3-line format. It has a 12-meter resolution at nadir, a 18.9 degree stereo and a swath of 62 km.

WAOSS has 3-CCDs mounted in the 3-line format. It has a 100-meter resolution, a 25.3 degree stereo and a swath of 520 km.

Michael Hahn (Germany), M. Kiefner, A. Quednau, E. Hinz - **Semi-Automatic Measurement of Signalized Ground Control Points at Digital Photogrammetric Workstations**

An experiment in the measurement of signalised points in digital imagery was presented. This system relies on the initial position of each signal (occupying an area of 1 m x 1 m) in a certain image and an approximate transformation in others. Many possible signal templates (or formats) are available as input in the system. Weighted area-based-least-squares matching is used to remove inhomogeneous areas of the imaged signal. This

utilises multi-image template matching. The system has a success rate of 99%.

Session 3003 - **Integrating Photogrammetric Techniques with Scene Analysis and Machine Vision (IWG II/III)**
July 10, 1996, 15:30-17:00
Session Reporter: **Jefferey A. Shufelt** *(USA)*
Chairman: **Chris McGlone** *(USA)*

Edward Mikhail (USA), H. F. Barakat, K. Weerawong - **Feature-Based Photogrammetric and Invariance Techniques for Object Reconstruction**

Computer vision and photogrammetry have several shared goals: camera calibration, camera position and orientation determination, image transfer, and object reconstruction. Photogrammetric methods maintain accuracy as data quality degrades; most invariant methods work well when data is near-perfect, but breakdown rapidly with error. There are several distinguishing factors between invariance in computer vision and classical photogrammetric methods: invariance eliminates physical parameters and uses linear, non-redundant solutions, whereas photogrammetric methods retain physical parameters and use non-linear, redundant solutions.

Q: You mentioned the use of invariant methods for the Generation of approximations. Are there other applications for invariants in photogrammetric methods?
A: Invariants for point transfer between images could lead to a less roundabout approach than the traditional photogrammetric method.

Hakan Wiman (Sweden), P. Axelsson - **Finding 3D-Structures in Multiple Aerial Images Using Lines and Regions**

Key points are: (1) Automated 3D mapping of buildings using aerial photographs; currently only roofs can be extracted. (2) Specifically designed to treat multiple images in an effective way. (3) Does not treat the problem of localising the building, only makes a 3D description given that there is one building in the image patches.

The task was subdivided into four sub-tasks, none of which use any image-to-image processing, instead deriving object space measures from each image independently. Analysis is then performed in object space, using all evidence simultaneously. The system assumes that 3D surfaces are rectangular.

Q1:How can this approach be extended to non-rectangular shapes?
A: Intersect 3D planes to get other non-rectangular lines.

Q2:The edges are extracted from 2D images. What if you used matching and then obtained edges from the matched models?

A: Such an approach is possible, but it wasn't attempted here.

Thierry Quiguer (France) - **Rectangular Building 3D Reconstruction in Urban Zones**

This paper presents a low-cost interactive algorithm which assists in reconstructing rectangular buildings. The method was designed to be interactive to avoid classical detection problems. One building corner is manually positioned, and the remainder of the building is reconstructed automatically. The best two lines through the corner are found, and then the parallelogram is closed, minimising a homogeneity/gradient cost function. Normalised correlation is used for the 3D reconstruction of the building.

Q1:Will the same technique work for other types of roofs, such as peak roof buildings?
A: Work has focused on complete end-to-end system first, rather than exploring other types of building models.

Q2:Why use a homogeneous ground intensity constraint? This seems likely to be violated.
A: This can be violated. Using multiple images helps.

Felicitas Lang (Germany), W. Förstner - **Surface Reconstruction of Man-Made Objects using Polymorphic Mid-Level Features and Generic Scene Knowledge**

This paper combines several approaches to achieve surface reconstruction of man-made objects, including a hierarchically structured scene model, described by geometric and thematic aspects. The method is a multi-image approach, in which a point is selected for correspondence. Surfaces are reconstructed by composition of object parts, and matching is done by using Aggregates. This approach allows generic models for object parts, which are subjected to a global consistency check to ensure the quality of the final reconstruction.

Q1: Where do the probabilities for Bayesian analysis come from?
A: Currently, they are obtained empirically; it is possible to obtain them theoretically.

Q2:Are there any restrictions on vertices in terms of inter-sections passing through them?
A: We use polymorphic feature extraction, and labels on features. A graph is constructed for the whole image.

Q3:How do you select the first point for a match?
A: We use a cost function.

Urho A. Rauhala (USA) - **ELSM and GLSR Techniques of Array Algebra in Shape Matching and Merge of Multiple DEMs**

A system concept for "DEM image" triangulation is introduced. Under this concept, geometric terrain and feature reconstruction with automated edit are performed

using two array algebra techniques: Entity Least Squares Matching (ELSM) and Global Least Squares Rectification (GLSR). IFSAR and GMRM technologies today can produce, fully automatically, raw DEMs with a post at every image pixel. Their refined orientation, merge and robust automated edit techniques require the overlap of at least 2-4 "DEM images" in the fashion of traditional image triangulation. An array algebra formulation of the resulting tie point mensuration, and real-time solution of the orientation parameters, achieved a speed of over 10,000 4-way DEM tie points/second using ELSM. The resulting solution of orientation and image variant self-calibration is back-substituted to the point variant feature DEM reconstruction of GLSR in the merged output space. The array algebra solution of least squares finite elements achieved speeds of over 100,000 merged posts/second. The fill-in of missing data is automated, as well as blunder elimination near posts of several input values.

Q: How does array algebra relate to sparse grid methods?
A: Kronecker algebras lie behind both techniques.

COMMISSION III

Session 3004 - **Data Structures for 3D-GIS (IWG III/IV)**
July 16, 1996, 8:45-10:15
Session Reporter: **Bishr Yaser** *(The Netherlands)*
Chairman: **Klaus Tempfli** *(The Netherlands)*

Dieter Fritsch (Germany) - **Three-Dimensional Geographic Information Systems - Status and Prospects**

The author gave an overview on data models for integration of DTM and GIS and for 3D GIS and elaborated on a relational structure for the 2.5D approach. He emphasised that 3D GIS requires a 3D query language. The proposed Geo-SQL is built around three categories of operators: a) measurement functions, b) spatial predicates, and c) an object generating language. In his opinion a uniform database scheme will not be necessary in the future by using client-server and distributed database concepts. E.g., height data server A can be separated from planimetry B and the link could be provided in a virtual database.

Q: (M. Molenaar – The Netherlands): What about the gap between data acquisition and 3D data modelling?
A: (D. Fritsch - Germany): The development should go in two directions: (1) elaborating a closed geometric data model and (2) pursuing integrating 2.5D information and DTM.

Norbert Pfeifer (Austria), H. Pottmann - **Surface Models on the Basis of a Triangular Mesh Surface Reconstruction**

The author presented an approach for constructing a smooth surface from a TIN structure. As the surface has no shape restrictions, caves, bridges, bodies, etc. can be

modelled. The triangles are used to define surface patches that interpolate the vertices and the tangent planes of adjacent patches. Examples were shown.

Q (K. Tempfli – The Netherlands): How can breaklines be accommodated?
A (N. Pfeifer - Austria): This can be easily done by providing the surface normal only at the two end points of the respective triangle edge and not all along it.

Shaobo Huang (Japan), R. Shibasaki - **Spatio-Temporal Interpolation of Class Variables by Integrating Observational Data Behavioural Models with Genetic Algorithms**

Interpolating nominal variable data should not only include their spatial distribution but also their behaviour. The knowledge about the behaviour is acquired from the available temporal knowledge and data. Genetic algorithms are used to maximise the likelihood in interpolation. The method was employed to generate the vegetation cover data set in simulating long-term global vegetation changes.

Q: (M. Molenaar - The Netherlands): What about the model that was used for temporal change? Is it restrictive?
A: (Sh. Huang - Japan): Any model can, in general, be used in the genetic algorithm as long as it produces 'survival patterns'.

Tao Cheng (The Netherlands) - **Coupling GIS and Environmental Modelling: The Implications for Spatio-Temporal Data Modelling**

The author in her paper elaborated spatio-temporal data modelling for coupling environmental models with GIS. The model is organised along three levels of data modelling. Ms Cheng raised several questions during the presentation which should be considered in solving such a problem. These included application orientation versus a user oriented perspective, how the objects should be constructed at the conceptual level, and should we use tight or loos coupling at the logical level.

COMMISSION III

Session 3005 - **Image Sequence Analysis: Algorithmic Aspects (IWG V/III)**
July 10, 1996, 13:30-15:00
Session Reporter: **Emmanuel Baltsavias** *(Switzerland)*
Chairman: **Emmanuel Baltsavias** *(Switzerland)*

No report received!

Klaus-Peter Schwarz (Germany),N. El-Sheimy – **Kinematic Multi-Sensor Systems for Close-Range Digital Imaging**

Ilkka Niini (Finland) – **Orthogonal 3-D Reconstruction from Video Images**

Lionel Dorffner (Austria) – **A New Approach for Spatial Measurement of Dynamical Processes**

Rongxing Li (Canada), M.A. Chapman, W. Zou – **Optimal Acquisition of 3D Object Coordinates from Stereoscopic Image Sequences**

COMMISSION III

Poster Session 30P1 - **Progress in Integrated Sensor Orientation**
July 18, 1996, 10:30-12:30
Session Reporter: N. N.
*Chairman: **Friedrich Ackermann** (Germany)*

No report received!

Holger Schade (Switzerland) – **On the use of Modern GPS Receiver Technology and Inertial Sensors for Photogrammetric Applications**

Johannes Kilian (Germany), N. Haala, M. Englich – **Capture and Evaluation of Airborne Laser Scanner Data**

Kandiah Jeyapalan (USA) – **Airborne GPS**

Karsten Jacobsen (Germany), M. Schmitz – **A New Approach of Combined Block Adjustment Using GPS-Satellite Constellation**

Manfred Fellbaum (Germany) – **PROMPT – A New Bundle Adjustment Program Using Combined Parameter Estimation**

Garry N. Newsam (Australia), D.Q. Huynh, M.J. Brooks, H. Pan – **Recovering Unknown Focal Lengths in Self-Calibration: An Essentially Linear Algorithm and Degenerate Configurations**

Hamid Ebadi (Canada), M. Chapman – **GPS Controlled Strip Triangulation Using Geometric Constraints of Man Made Structures**

Erwin Kruck (Germany),G. Wübbena, A. Bagge – **Advanced Combined Bundle Block Adjustment with Kinematic GPS Data**
Ralf Reulke (Germany), A. Börner, M. Scheele, Th. Terzibaschian – **Stereo Processing with Attitude-Disturbed Image Data**

Mohamed Ettarid (Morocco) – **Variance Decomposition and its Application in Photogrammetry**

Mushtaq Hussain (USA), R. Munjy – **The Impact of Multiple Antenna and Gyro Camera Mount on GPS-Photogrammetry**

Eamon Barrett (USA) – **View-Based Invariant Methods for Creating Synthetic Images of 3-D Scenes from Multiple Reference Images without DEMs**

J. Wu (China-Taipei), C. Chang, D.C. Lin – **Positional Accuracy by Radargrammetry with Airborne SAR Imagery**

COMMISSION III

Poster Session 30P2 - **Sensor Orientation: Theory and Systems**
July 18, 1996, 13:00-15:00
Session Reporter: N. N.
*Chairman: **Ian Dowman** (U. K.)*

No report received!

Atsushi Okamoto (Japan), S. Hattori, H. Hasegawa, T. Ono – **Orientation and Free Network Theory of Satellite CCD Line-Scanner Imagery**

Azubuike G. Nwosu (Switzerland), A. Meid – **The Leica System for Orientation of Linear Sensor Imagery**

Francelina A. Neto (Portugal) – **Conjugate Points in the Orientation of Across and Along Track Stereomodels**

Wanpeng Zhang (Germany), B. Giese, J. Oberst, R. Jaumann – **Methods of the Bundle Block Adjustment of Planetary Image Data**

Jie Shan (Germany) – **Object Reconstruction without Interior Orientation**

Mohammed El-Shafei Abdel-Latif (Egypt), A.M. Elsonbaty – **Using Homogenous Co-ordinates to Solve the Problems of Determining the Orientation Parameters of Non-metric Cameras and the Reconstruction of Space Models**

Tetsu Ono (Japan), A. Okamoto, S. Hattori, H. Hasegawa – **Fundamental Analytics of Satellite CCD Camera Imagery Using Affine Transformation**
Jörg Albertz (Germany), M. Breuer – **Geometric Correction of Airborne Line Scanner Imagery**

Fergal Shevlin (Ireland) – **Scanner Resection Using Trajectory Data**

Impyeong Lee (Korea South), T. Kim, S.D. Choi – **Systematic Correction Mechanism of Geometric Distortions in the KITSAT-1 CCD Earth Images**

Francis Klumb (Switzerland), M. Price – **Monitoring Large Bodies with Micrometric Precision**

COMMISSION III

Poster Session 30P3 - **Topographic Feature Extraction**
July 15, 1996, 10:30-12:30
Session Reporter: **Norbert Haala** *(Germany)*
Chairman: **Monika Sester** *(Germany)*

No report received!

Peggy Agouris (USA), A. Stefanidis – **Scale Difference Considerations in Conjugate Feature Matching**

Michael Gruber (Austria), M. Pasko – **Fusion of 2-D GIS Data and Aerial Images for 3-D Building Reconstruction**

Uwe Stilla (Gremany), Kl. Jurkiewicz – **Structural 3-D Analysis of Urban Scenes from Aerial Images**

Yi-Hsing Tseng (China-Tapei) – **Orienting Digital Stereopairs by Matching Fourier Descriptors**

Arpad Barsi (Hungary) – **Thematic Classification of a LANDSAT Image Using Neural Networks**

Guoqing Zhou (P.R. of China) – **Recognising Primitives Using Aspect-Interpretation Model Matching in Both CAD and LP-Based Measurement System**

Gianfranco Forlani (Italy), E. Malinverni, C. Nardinocchi – **Using Perceptual Grouping for Road Recognition**

Yuji Tsujiko (Japan), F. Kawamura, S.B. Jayamanna – **An Edge Detector Based on Wide-Narrow Morphological Operations of Satellite Remote Sensing Images**

Mathias Lemmens (The Netherlands) – **A Survey on Boundary Delineation Methods**

Jarmo Pirhonen (Finland) – **Curve Shape Matching and Difference Detection**

Joachim Steinwendner (Austria) – **Segmentation of Optical Satellite Imagery Using Spatial Subpixel Analysis**

Borislav Marinov (Bulgaria), L. Pavlova – **Processing of Protruding Objects in Digital Images of Urban Areas**

Eugene L. Starostin (Russia), E.Y. Zueva, B.H. Barladyan, A.Y. Kargashin, E.I. Kugushev, E.L. Shapiro – **A System for Reconstruction of 3D Objects from 2D Images**

Yuong-Kyu Yang (Korea South), K.-O. Kim, I.-S. Jung, T.-K. Kim – **Landuse Discrimination via Feature Extraction Using Neural Network**

COMMISSION III

Poster Session 30P4 - **DEM and Shape from Shading**
July 15, 1996, 13:00-15:00
Session Reporter: **Rainer Kalliany** *(Austria)*
Chairman: **Rainer Kalliany** *(Austria)*

Mikael Holm (Finland), G. Denissoff, M. Paljakka, K. Juslin, S. Rautakorpi, M. Rantasuo - **Ortho-Mosaics and Digital Elevation Models from Airborne Video Imagery Using Parallel Global Object Reconstruction**

Christian Piechullek (Germany), C. Heipke - **DEM Refinement Using Multi Image Shape from Shading**

Xiuguang Zhou (Germany), E. Dorrer - **De-Shading: Integrated Approach to Photometric Model, Surface Shape and Reflectance Properties**

Dietmar Wild (Germany), P. Krzystek, M. Madani - **Automatic Breakline Detection Using an Edge Preserving Filter**

Martin Schlüter (Germany), B. Wrobel - **High Resolution Surface Reconstruction of a Landscape from Large Scale Aerial Imagery - An Extended Test**

Kohei Arai (Japan) - **DEM Estimation with Simulated Annealing Based on Surface Reconstruction Methods**

Younian Wang (Germany) - **Structural Matching and its Applications for Photogrammetric Automation**
Mushairry Mustaffar (Australia) - **Accuracy Improvement in Automated Surface Measurement**

Christian Wiedemann (Germany), L. Tang, T. Ohlhof - **A Mew Matching Approach for Three-Line Scanner Imagery**

King-Chang Lo (China-Taipei) - **Linear Features Extraction by String Matching for Automatic DEM Generation**

Robert Uebbing (Germany) - **An Automated Digital Approach for the Generation of Digital Terrain Models using HRSC and WAOSS Image Data of the Mars96 Mission**

In accordance with the motto of the session, all posters were dedicated to problems relevant for the Generation of DEM. Several approaches were shown; the most distinct differences were between image matching techniques and Shape from Shading methods. Some papers covered an approach in its entirety, up to the final Generation of DEM data. Others works were focusing on details relevant for one of the methods (e.g. looking for optimum backscatter functions to be used with shape from shading approaches).
Several papers by German authors were dedicated to the upcoming Mars96 mission. Especially here, according to a concerted dispersion of work amongst several institutes, the different approaches became apparent. Since each method has its specific merits and also drawbacks, it is obvious that a hybrid approach, combining several algorithms, is promising the best results. Various ideas in that direction could be heard during the discussions at the booths. However, currently no one can predict how difficult it will be to implement such a system and how well it actually will work. Therefore continuation of research on all issues presented at the session is necessary for further improving accuracy and reliability of automated DEM Generation.

COMMISSION III

Poster Session 30P5 - **Segmentation and Image Interpretation**
July 11, 1996, 15:00-17:00
Session Reporter: N. N.
Chairman: **Christian Heipke** *(Germany)*

No report received!

Werner Schneider (Germany) – **Remote Sensing Image Understanding Based on Physical Model Inversion**

Herbert Jahn (Germany) – **Segmentation of Remote Sensing Images with a Layered Graph Network**

Werner Schneider (Germany), M. Sester, D. Ftritsch – **Results of the Test on Image Understanding of ISPRS Working Group III/3**

Regine Brügelmann (Germany) – **Recognition of Hatched Cartographic Patterns**

Klaus-Jürgen Schilling (Germany), Th. Vögtle – **Satellite Image Analysis Using Integrated Knowledge Processing**

Kunihiko Yoshino (Japan), K. Kushida – **Estimation of A-Priori Probabilities of Landcover Categories for Bayes' Classifier**

Amnon Krupnik (Israel) – **Do it on the Ground: Increasing Reliability and Accuracy of Automatic Aerotriangulation by Matching in the Object Space**

Masanobu Yoshikawa (Japan), S. Fujimura, H. Tanaka, R. Nishii – **Decision Tree Classifier with Undetermined Notes**

Ben G.H. Gorte (The Netherlands) – **Multi-Spectral Quadtree Based Image Segmentation**

Kyong-Ok Kim (Korea South), Y.-K. Yang, T. Kim – **Shape Discrimination by Descriptors and Moments Using Neural Network**

Eija Parmes (Finland) – **Segmentation of Multidate Multispectral Satellite Imagery**

Renate Bartl (Austria), A. Pinz – **A Fusion Framework for Land Use Classification from Satellite Data**

COMMISSION III

Poster Session 30P6 - **Conceptual Aspects of GIS**
July 17, 1996, 12:30-14:30
Session Reporter: **Tao Cheng** *(The Netherlands)*
Chairman: **Martien Molenaar** *(The Netherlands)*

A. M. Tuladhar (The Netherlands) - **Spatial Cadastral Boundary Concepts and Uncertainty in Parcel-Based Information Systems**

Key points were: (1) Definition of spatial objects in cadastre. (2) Issues on boundary concepts. (3) Uncertainty in parcel-based land Information systems.

Massoud Sharif (The Netherlands), A. Zinck - **Terrain Morphology Modelling**

Key points were: (1) Terrain morphology representation and modelling. (2) Terrain morphology classification as skeleton and filling. (3) Quality assessment of terrain morphologic models. (4) Determination of an optimal model using terrain geometric primitives and expert rules. (5) The method allows promising applications in descriptive geomorphology.

Weiqi Xiao (P. R. of China), Y. Feng - **Ladex: A New Index Mechanism in Spatial Object Database System**

Key points were: (1) Advanced spatial index techniques are imperative to improve the performance of spatial object database. (2) A lattice index mechanism (Ladex) is very efficient and has many advantages over other spatial index structures, such as R+ tree. (3) The algorithms of retrieval and maintenance of Ladex is introduced. (4) Ladex is a promising index structure for GIS-based applications.

Hong-Jing Chen (P. R. of China), W.-L. Chen - **A Thinking alter a Dynamic Monitory GIS**

Key points were: (1) Analysing the dynamic changes of soil erosion of the loess plateau of China by using remote sensing information. (2) A thinking of relationship among information revolution, information technology and information sciences for geographic research based on their works.

Michael Gruber (Austria), F. W. Leberl, M. Maresch - **Requirements for Photorealistic 3D Modelling of Urban Areas**

Key points were: (1) Creation of photorealistic 3D modelling of urban area based on several source data and different techniques. (2) Most important requirements for the complete modelling of urban areas. (3) A concept of combination of different tools and workstation into one digital workstation (geo-server) is proposed to satisfy these requirements.

Eric Reiher (Canada), F. Said, Y. Li, C. Suen - **Map Symbol Recognition Using Directed Hausdorff Distance and a Neural Network Classifier**

Key points were: (1) A method for map recognition is presented to make the recognition efficient and robust. (2) It utilities the directed Hausdorff Distance as a measure of similarity for selecting possible candidates of user defined models of symbols. (3) Neural networks are then utilised to eliminate the false positives among those candidates. (4) Implementation and experiment result are presented.

Xiaoyong Chen (Japan), T. Doihara, M. Nasu - **Spatial Linear Interpolation between Sets**

Key points were: (1) A novel approach for spatial linear interpolation between sets is proposed. (2) It is based on the mathematical morphology and can be represented by a linear Minkowski combination. (3) Three kinds of models are extended from the method and can be used to interpolate the objects between concave and convex sets. (4) The principle and the efficiency of the approach are demonstrated by some practical examples for contour line linking, 2-D and 3-D spatial object interpolation.

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Poster Session 30P7 - **Triangulation and Systems**
July 19, 1996, 10:30-12:30
Session Reporter: N. N.
*Chairman: **Ismael Colomina** (Spain)*

No report received!

Eija Honkavaara (Finland), A. Högholen – **Automatic Tie Point Extraction in Aerial Triangulation**

Sulvain Airault (France), O. Jamet, Fr. Leymarie – **From Manual to Automatic Stereoplotting: Evaluation of Different Road Network Capture Processes**

Franz Wewel (Germany) – **Determination of Conjugate Points of Stereoscopic Three Line Scanner Data of Mars96 Mission**

Charles K. Toth (USA), A. Templer – **Extracting High Resolution Digital Elevation Models and Features in a Softcopy Environment**

Ahmet Bahadir Orun (Turkey), A. Ayhan – **Surface Based Object Recognition and Inspection by Photometrically Extended Bundle Adjustment Technique**

Dafer Ali Algarni (Saudi Arabia) – **Compression of Remotely Sensed Data Using JPEG**

V.K. Vohra (U.K.), I. Dowman – **Automatic Extraction of Large Buildings from High Resolution Satellite Images for Registration with a Map**

COMMISSION IV
Working Group IV/1

Session 4101 - **GIS Methods**
July 10, 1996, 8:45-10:15
Session Reporter: **Gregory J. Allord** *(USA)*
Chairman: **Lynn E. Usery** *(USA)*

Lynn E. Usery (USA) - **Membership Functions for Fuzzy Set Representation of Geographic Features**

The presentation discussed a conceptual framework for geographic feature representation which has been developed. Numerous examples of fuzzy data sets were shown. These examples included fuzzy elevation boundaries overlaying shaded relief and TM data sets.

Gregory J. Allord (USA) - **Plotter and Printer Requirements to Portray Geographic Information System Visualisation**

The presentation discussed the current status of thematic cartography relative to GIS software capabilities. Specific examples were shown detailing film recorder resolutions as applied to digital orthophotos, including maximum levels of grey and lithographic screen dots.

Rongxing Li (Canada), L. Qian, F. Dong, Y. Chen, P. Schlatter - **3D Data Structures and Applications in Geological Subsurface Modelling**

The presentation described data representations of the third dimension, including surface representations and interior representations of objects. Li also described spatial operations based on Peano Keys and datum operations based on the octree method. The conclusion referenced 3D views in a virtual reality environment.

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Session 4102 - **Remote Sensing and Photogrammetry for GIS Applications**
July 11, 1996, 15:30-17:00
Session Reporter: **Marguerite Madden Remillard** *(USA)*
Chairman: **Lynn E. Usery** *(USA)*

Werner Mayr (Germany), W. Reinhardt - **Digital Photogrammetry Joins GIS - A Powerful Combination**

An overview on digital photogrammetry, GIS and the integration of the two techniques was given.

Key points were: (1) Having digital photogrammetry and GIS operation on the same device is advantageous. (2) Automation of digital photogrammetry enables untrained GIS users to make 3D measurements directly and easily. (3) GIS should learn how to handle 3D, not just as an attribute but as a true 3D database. (4) Digital photogrammetry should be able to automatically correlate discontinuities in the land surface such as areas with trees or building.

Roy A. Welch (USA), M. Remillard - **GPS, Image Processing and GIS Techniques for Coastal Wetland Mapping Application**

Procedures for mapping the vast Everglades region of South Florida in the U.S. was described.

Key points were: (1) GPS derived control was used to rectify SPOT panchromatic satellite images and to create an image mosaic that served as a source of control for aerial photographs. (2) Georeferenced colour infrared aerial photographs were used as source information for thematic data of vegetation and land use. (3) Detailed vegetation maps are being produced at a scale of 1:15,000. (4) GPS and a laptop computer loaded with the satellite image mosaic are used in a helicopter conduct field surveys and assess the accuracy of the vegetation maps. It is expected that routine use of GPS, image processing and GIS on laptop computers will provide resource managers with full mobility in the field an lead to improvements in the thematic accuracy of resource databases.

Q (W. Peng): How many points were used to control the aerial photographs?
A (R. Welch): Generally 5 to 10 points are transferred from the satellite images to the air photos. The resulting RMSE is typically ± 5 m.

Theo Bouloucos (The Netherlands), Y. Felus, K. Tempfli - **Photogrammetry and Field Completion - An Intelligent Approach**

Special requirements of large scale urban database development was discussed. Since urban databases require high spatial resolution, have high densities of small objects per unit area and frequent changes that need updating, procedures were developed to make field data collection more efficient. Using 3D capabilities of AutoCAD and GIS functions of ARC CAD, areas of zones of uncertainty were identified such as area of shadow, relief of tall objects that might obscure features on aerial photographs. In this way, area targeted for field data collection are surveyed in a more efficient manner.

Q (L.E. Usery): Did you use a buffer distance around features to make map-derived and photo-derived comparisons?
A (Y. Felus): Yes.

Q (J. Drummond): Did you quantify the improvement of field data collection efficiency?
A (Y. Felus): No, actual experiments were not done on a regular basis. But we feel the field work efficiency was improved by 20%.

Patrick Matambanadzo (Zimbabwe) - **Photogrammetric Methods of Land Surveying, Registration and Record Keeping for Rural Land in Zimbabwe**

Cost-effective methods for surveying and database development of rural area within the Zimbabwe Land Tenure System that include communal and individual tenure and resettlement lands were presented. Aerial photographs were acquired for a pilot area in Makumbi at

a scale of 1:10,500 and enlarged to 1:5,000. Using grand survey control to rectify the aerial photos, monoplotting of heads-up digitising was performed with ARC/INFO. The RMSE of air photo rectification ranged form ± 10 to 12 m. Overall this method proved to be efficient for mapping rural areas. Future improvements will include: 1) bundle block adjustment to improve the rectification of large numbers of photographs that will be required to map the entire country and 2) the addition of non-technical considerations such as cultural factors.

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Session 4103 - **Mapping and GIS**
July 18, 1996, 10:45-12:15
Session Reporter: **Hiroshi Murakami** *(Japan)*
Chairman: **Lynn E. Usery** *(USA)*

Jack Dangermond (USA) - HIGHLIGHT-PAPER: **GIS Trends and the Utilisation of Raster Images**

GIS trends in the context of raster image utilisation were discussed. Raster images have been increasingly an important information source for GIS and the linkages between GIS and image processing technologies are now the vital part of GIS with near real-time data capture and seamless data transfer between raster and vector formats. Other GIS trends include: further hardware improvement with cheaper computers hooked up to networks, especially internet; component applications with the object oriented approach; and digital cartography with improved 3D representation, speed and quality.

Kerstin Hofmann (Germany), F. List - **A Regional GIS of the Central Andes, South America - Integration of Satellite, Geological and Geophysical Data Sets**

Hofmann's experience of developing ANDEN GIS, an integrated GIS with data of base map, geology, geophysics, images and DEM, for Central Andes region was shown. 3D Landsat TM Scenes were georeferenced and overview and edit menu developed for the use among people from different disciplines.

Jonathan Smith (USA), R. A. Welch - **Mapping Tropical Land Use from Multisensor Imagery**

Smith talked about his mapping project in Nicaragua where maps are needed for both developing economy and rich nature conservation. The study area includes both reserve area and human settlements.

Mathias Schardt (Austria) - **Mapping of Biotic and Abiotic Damages Using Satellite Remote Sensing and GIS**

Schardt talked about an experiment of damaged forest monitoring in Europe using satellite remote sensing data, focusing on the choice of appropriate remote

sensing data and harmonisation of forest damage class definition between different countries.

The use of Landsat TM data was recommended for applications because of its advantage of having mid infrared bands over other remote sensing data. Satellite remote sensing data turned out to be useful for forest health detection and the developed method successfully complemented conventional methods.

Hiroshi Murakami (Japan), K. Hirata - **Potential Nesting Site Analysis of Red-Crowned Cranes Using GIS**

Base map and existing nest location data sets were integrated in a GIS database, and a simple model developed to find potential nesting areas for the cranes.

Accuracy consideration was given to interpret the result based on the accuracies of the input data sets.

Eihan Shimizu (Japan) - **Time-Space Mapping Based on Free Net - Trilateration**

Interpolation function for coast lines was discussed. An example time-space mapping for Tokyo Metropolitan area visually demonstrated how a highway construction would influence on the accessibility in the area in terms of the shape of coast lines.

COMMISSION IV
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Session 4201 - **High Resolution Satellite Imagery for Mapping Applications**
July 11, 1996, 10:45-12:15
Session Reporter: **Marguerite Madden Remillard** *(USA)*
Chairman: **Gottfried Konecny** *(Germany)*

Frederick Doyle (USA) - HIGHLIGHT-PAPER: **Thirty Years of Mapping from Space**

The paper consisted of an excellent overview of events since 1957 that have allowed man to make maps from photographs and digital images acquired in space. In addition to a wealth of information on space mission dates, names and sensor parameters, Doyle provided unique insights based on the perspective of one who was deeply involved with the space program through his position with the U.S. Geological Survey (USGS). Doyle's presentation pointed out implications of political sensitivities not only between the United States and the former Soviet Union, but also within government agencies of the United States that had dramatic impacts on the availability of data that could be used by the civilian community for mapping purposes. He also discussed the Apollo missions of the Lunar Program, recently released information on the US Corona Reconnaissance Program, what is known about Soviet photo reconnaissance cameras and events leading up to the present-day Landsat satellite program including the US Large Format Camera and the European Metric Camera. Doyle ended his Paper by saying that he had attended every ISPRS Congress since 1956 and has seen the evolution of

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mapping from space during this time from crude hand-held photographs taken out of spacecraft windows to the sophisticated international space programs in operation today. He has seen image data resolution reduced from 80 m to 1 m and data ownership change from the government and military to civilian and commercial enterprises.

Doyle foresees tremendous potential for future mapping activities using the high resolution commercial satellite image data. He also said he is delighted to see so many young people involved in ISPRS and hopes they will be ready to take up mapping challenges that will benefit all of mankind.

Q (Z. Kalensky): You mentioned the new high resolution commercial satellites planned for the next few years. Although there are many positive aspects of these satellites, one negative aspect is the poten-tially high cost of the data and the difficulty developing countries will have in gaining access to these data. Will you comment on the availability of the high resolution data to all of the mapping community?

A (F. Doyle): The builders of the commercial satellites have never published information on the cost. They are struggling to come up with equitable arrangements that will cover their costs, provide a profit for their companies and still maintain a reasonable cost for the user that would allow world-wide access to their data. A number of agencies in the US and Europe that are designed to provide assistance to developing countries are exploring the use of grant funds to make these types of data more available. I will caution you that acquiring the data is only the beginning and the costs of exploiting the data to produce useful products also is expensive.

Gottfried Konecny (Germany) - **International Mapping from Space**

Konecny began by stating that given only one third of the Earth has been mapped at scales of 1:25,000 or larger and most of the world's maps are 20 years old or older, satellite images provide a fast and economical means for producing much needed maps. Critical factors for maps derived from satellite data include planimetric accuracy, vertical accuracy and detectability of objects. The last factor is most important and is dependent upon the spatial resolution of the data. Konecny proceeded to discuss these factors related to many of the international satellite mapping programs contributing image data for mapping applications today. He stated that while the requirements for mapping from space are well established, many studies have focused on planimetric map accuracy and future research should concentrate on the evaluation of thematic map information.

Q (L. R. A. Narayan): Can you comment on the frequency of data acquisition by the proposed high resolution commercial satellites and if it will be adequate for international mapping purposes?

A (G. Konecny): It is not possible to rely on imagery obtained by a single satellite or satellite program. In the future there will be many satellites in space acquiring image data. Data fusion will be employed routinely to meet the requirements for international mapping.

Lawrence Fritz (USA) - **Commercial Earth Observation Satellites**

This paper focused on several of the proposed commercial satellites that will be launched within the next two to three years and provide image data of high spatial resolution. Details on orbital parameters, pixel size, spectral bands and stereo coverage were discussed for Earthwatch, Inc., Space Imaging Corporation, Orbimage Corporation, GDE Systems and Resource 21.

Fritz noted that all of these programs propose rapid delivery of image data to clients, but few are disclosing any information on the cost of the data at this time. He also stated that he felt there would soon be "enough satellites to block out the sun".

Q (Wu): What will the data volume be for each frame?
A (L. W. Fritz): Data volume will be in the gigabyte range. Compression techniques will of course be used for data transfer and means for distribution via Internet are being developed.

Q (L. R. A. Narayan): You mentioned panchromatic and multi-spectral images of 1 m and 4 m spatial reso-lution acquired by Earthwatch satellites. Is it possible to merge these images onboard the satellite itself?
A (L. W. Fritz): No, not at this time, but this is only the beginning and it may be possible in the future. For example, onboard processing is predicted that will identify changes and transfer only change information. Technology can do many things for us, it is only a matter of money.

Volker Liebig (Germany) - **Earth Observation in the Information Age - Trends in Utilisation of Networks for Earth Observation Applications**

Liebig acknowledged the wealth of information that will be available to the public in the near future and the need for mechanisms for data access and dissemination. The German network system implemented by the German Space Agency (DARA) provides access to data from 16 satellite sensors and permits users to browse more than 100,000 images. He discussed the ability to set up new interfaces to other servers and provide international network connection and "one stop shopping" for mapping applications.

Q: Can anyone join this information locator system?
A: Yes, it is open to any group.

Lado Kenyi (South Africa) - **SAR Interferometry: A Comparative Analysis of DTMs**

Interferomic processing of SAR image data and the creation of DEMs for three test sites were discussed. Basic steps in the processing include co-registration of two images (to one-third of a pixel), generation of the inter-ferogram, flat terrain phase removal, fringe smoothing, phase unwrapping, ground co-ordinate

determination and DEM raster interpolation. A comparison of the resulting DEMs with reference DEMs derived from topographic maps revealed residuals of GCPs of approximately 25 m in X and Y, and 9 to 15 m in Z.

Factors affecting DEM accuracies include length baselines and vegetation cover. Kenyi concluded that comparative analysis of interferometric with derived DEMs demonstrated acceptable height errors and reasonable planimetric accuracies.

Q (Z. Kalensky): In Canada there have been many studies using Radarsat image data at the CCRS and the results are excellent. I am surprised at your comment about Radarsat.

A (L. Kenyi): I mentioned the need for the development of algorithms to establish baseline dis-tances, but did not say one should expect lower results using Radarsat.

Q: How can you handle atmospheric distortions and are they a source of serious error?

A (L. Kenyi): They are not a main source of error, but they are a source since they do introduce shifted pixels. If you use a larger baseline you can reduce this error. More research is required to correct for atmospheric distortions.

COMMISSION IV
Working Group IV/2

Session 4202 - **International Satellite Remote Sensing Programs and Data Processing Experiences**
July 12, 1996, 8:45-10:15
Session Reporter: **Thomas Jordan** *(USA)*
Chairman: **Gottfried Konecny** *(Germany)*

Roy A. Welch (USA) - **U.S. Government Satellite Remote Sensing Programs: 1995 - 2000**

In 1992, ISPRS recognised the importance of global monitoring with their AVHRR image poster of the world. Over the next 5 years more than 30 new satellite programs will be initiated by the U.S. government. These initiatives will emphasise long term coverage, low resolution imaging and continuity with existing programs. Most satellites for earth monitoring will be associated with the Mission to Planet Earth (MTPE) program, including Landsat 7 and the sensors aboard the AM-1 platform. Because of the number of satellites and the vast quantity of data that will be generated by the systems (estimated at 100 GB per day), special data processing units, such as the U.S.G.S. DAACS, will be established. The New Millenium program and Small Explorer program are experiments in new technology and promise to greatly expand the U.S. capability in earth imaging systems.

Q (Boudoin): How do the [commercial] high resolution satellites relate to the other programs?

A: The new programs are test beds for earth probes. They are trying to develop small satellite programs

intended to provide insight in the use of hyperspectral image data.

Bulusu Lakshmana Deekshatulu (India) - **India's Satellite Remote Sensing and National Information Requirements**

India's ambitious and successful satellite remote sensing program will be expanded in the next few years to include additional platforms hosting improved sensors. In addition, their receiving station can collect data from most of the current imaging satellites. This gives India a huge capability for conducting research projects on a number of subjects ranging from drought monitoring and flood studies to Urban Information Systems (UIS) and crop estimation mapping. Future requirements will dictate sensors with improved spatial and spectral resolution.

Dieter Fritsch (Germany), M. Hahn, F. Schneider, D. Stallmann, M. Kiefner - **Experiences in Processing MOMS-02 Stereo Image Data**

A study site with an extensive GPS-derived ground control network was established in Australia for use in testing the stereo mapping capabilities of MOMSO2/D2 image data. Results of tests using stereo-correlation methods indicated that co-ordinates can be derived to accuracies of 6-7 m for planimetry and 7-8 m for elevations. Looking to the future, data from the MOMS-02 camera aboard the Priroda spacecraft should provide a basis for very accurate mapping from space at scales up to 1:25,000. The results of these studies demonstrate that the MOMS concept has proved itself.

E. Dorrer remarked that they have developed an analytical solution for MOMS data and along track stereo and have received much the same accuracy figures with the Planicomp.

Emmanuel Baltsavias (Switzerland), D. Stallmann - **Geometric Potential of MOMSO2-D2 Data for Point Positioning DTM and Orthoimage Generation**

A significant amount of pre-processing was required to improve the poor image quality of the MOMS images used in this study. In addition, the control points in the Australian test field were of varying quality. In spite of these restrictions, bundle adjustment using the Kratky quadratic model for sensor geometry resulted in point positioning accuracy of 6-7 m in X, Y, and Z co-ordinates. Automated image matching produced results as accurate as the manual methods.

Diane Boardman (U.K.), I. Dowman, D. Fritsch, W. Newton, A. Chamberlain - **An Automatic Image Registration System for SPOT Data**

A method for automated point identification for registration of SPOT images was developed. Using a combination of feature extraction and intensity matching techniques, subpixel accuracy in control point identification is achieved. Future work will focus on issues such as cross sensor matching, extraction of 3D co-ordinates and DEMS and orthorectification.

Session 4203 - **Space Image Maps and Topographic Mapping**
July 13, 1996, 8:45-10:15
Session Reporter: **Marguerite Madden Remillard** *(USA)*
Chairman: **Donald Light** *(USA)*

Dan Rosenholm (Sweden) – **Applications of Space Imagery in Developing Countries**

Mr. Rosenholm discussed several very large mapping projects undertaken by the Swedish Space Corporation such as the mapping of land cover in the Philippines requiring 187 printed SPOT scenes, the production of 119 map sheets depicting forest suitability in South Sumatra and forest biomass and change detection in Malawi using Landsat TM and MSS image data. Methods used ranged from manual interpretation of hardcopy satellite images and on-screen digitising and manual interpretation to automatic thematic classification, the extraction of DEMs/contours from image data and the production of orthomaps with line overlays. Mr. Rosenholm concluded that: 1) the availability of images for large mapping projects is most critical and time and money must be budgeted to allow for the acquisition of extra images to mosaic cloud-free sections; and 2) in this changing world new and better data sources can be expected in the future for satellite mapping.

Q: Can you comment on the extraction of topography from SPOT data considering difficulties due to clouds and time differences between scenes? It seems that along-track stereo should provide much better data for topographic mapping. For example, it will be much easier to obtain two cloud-free scenes. Satellite data should then be used much more extensively in the next 10 years for topographic mapping.

A: I agree completely.

Q (Gottfried Konecny): Considering satellite images vs. aerial photographs, do you have ratios of how much faster mapping from satellite data is?

A: I would not dare to say since it depends on the individual case.

Jochen Schiewe (Germany) – **Mapping Using High-Resolution and Stereoscopic Space Imagery of MOMS-02**

Mr. Schiewe emphasised two important features of MOMS-02 image data for topographic mapping, namely, high spatial resolution (4.5 m) and along-track stereo capability resulting in maximum B/H ratios of 0.8. Geometric tests using a data set of Dubai resulted in accuracies ranging from RMSEx = +/- 3.3 to 10 m, RMSEy = +/- 4.6 to 7.6 m and RMSEz = +/- 6.1 to 13 m. In an assessment of suitability for mapping, Mr. Schiewe found horizontal accuracies adequate for mapping at scales of 1:25,000. Analyses of information content concluded that although roads and water features were readily interpreted from the data, single houses or objects

smaller than 20 square metres in size could not be identified.

Elmar Csaplovics (Germany), A. Sindhuber, U. Herbig – **High-Resolution Space Photography for Landuse Interpretation and Thematic Update of Large-Scale Orthophotos**

Russian KFA- and KWR-space-photographs – besides forthcoming MOMS-02-data – fill the gap between medium resolution satellite data (Landsat TM, SPOT) and aerial photography. Comparative analysis resulted in the following conclusio: Mapping large scale patterns of landcover and landuse change requires a temporal resolution of monitoring of one to two years and can therefore benefit from high-resolution space ortho-imagery with scales up to 1:10 000 based on panchromatic KWR-1000 or KFA-3000 data – eventually supplemented by n-IR spectral information of KFA-1000 data. Costs for data acquisition are low compared to aerial survey missions – a factor of 1:3 is realistic even when calculation costs for a multisensor KFA-1000/KFA-3000 data set. Efficiency of these data is nevertheless limited by very low height measuring accuracies.

Romuald Kaczynski (Poland) – **Satellite Image Maps of Warsaw in Scales from 1:50 000 to 1:10 000**

Key points were: (1) KFA-1000 and KVR-1000 Russian space photography has been used for Mapping of Warsaw, (2) I²S and Intergraph processing systems are compared, (3) Imagery is also extremely useful for the updating of topographic maps.

Robert Kostka (Austria), A. Scharov – **Operational Image-Based Mapping in the Franz Josef Land Archipelago**

High-resolution spaceborne photographs, radar imagery and old aerial photographs were successfully used for topological studies and photogrammetric mapping at different scales ranging from 1:600,000 to 1:15,000 in the Franz Josef Land archipelago, Russian High Arctic. Studies have shown significant changes in the region compared to the situation represented in available maps. Some contradictions in existing theories of the arctic geosciences and some surprising findings were revealed in the course of cartographic investigations.

Gordon Petrie (United Kingdom) – **Satellite Mapping in Africa**

The paper first reviews the situation regarding topographic mapping in Africa. While for some countries, the main problem is the production of new base maps, for many other African countries the main problem is the revision of existing maps which are now thoroughly out-of-date. The situation prevailing in most African national mapping agencies is then outlined and the availability of satellite photography and scanner imagery over Africa is then discussed. The results of tests of the accuracy and

the content of maps derived from satellite imagery conducted over a number of test sites having different landscape characteristics are summarised and discussed. Next some examples of topographic mapping from stereo-SPOT imagery are described, including those from Ethiopia, Djibouti and Guinea. This is followed by further examples of purely planimetic line mapping from Nigeria and image mapping from Central Sudan, using monoscopic SPOT and TM images respectively. This leads on to a further discussion of a UNDP-supported national map revision programme carried out over Uganda. The paper then goes on to make a comparison of the respective attributes of small-scale aerial photography and satellite imagery for topographic mapping in Africa and concludes with a short discussion of the likely impact of the availability of higher resolution satellite imagery which is promised for the near future.

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Session 4301 - **Map and Database Revision: Progress and Practice**
July 10, 1996, 13:30-15:00
Session Reporter: **Jon P. Mills** *(U.K.)*
Chairman: **Paul R.T. Newby** *(U.K.)*

Paul R.T. Newby (U.K.) - **Report and Review of Progress in Map and Database Revision**
Key points were: (1) Digital photogrammetry has moved from the exhibition stands into everyday practice and levels of automation are increasing. (2) On-screen plotting using orthophotos is the most cost-effective method of map database revision. (3) The benefits of stereoscopy should not be given up until a monocular DPWS is available to the surveyor in the field.

Q (M. M. Remillard): Do you envisage the use of small scale satellite imagery for map revision?
A: Yes, it will be one of the major themes for the next 4 years.

Paul Van Asperen (The Netherlands) - **Digital Updates at the Dutch Topographic Service**
Key points were: (1) The fully topological map database of the Netherlands at 1:10,000 scale (complete in 1997) is to be updated digitally. (2) By comparing the previous dataset with its updated version, charge-only information can be extracted. (3) Many more applications of change-only information are possible other than for check procedures.

Q: Do you deliver the data changes only to the customer, or do you supply an entirely new dataset?
A: For the moment we supply a fully new dataset as the customer cannot handle change-only information. We are looking at ways of providing this.

Ammatzia Peled (Israel) - **Map and Data Base Revision**
Key points were. (1) The transition from traditional to digital mapping is difficult. (2) Automatic change detection appears to be the only solution to large datasets. (3) Image processing aids map revision.

John Bossler (USA), C. K. Toth - **Feature Positioning Accuracy in Mobile Mapping: Results Obtained by the GPSVan™**
Key points were: (1) GPS, dead-reckoning and imaging systems have been integrated to create a sub-metre accurate mobile mapping system. (2)Future efforts are to be concentrated on presenting the data and integrating it with other datasets. (3) A real-time system (close to realisation) is necessary for error checking.

Q (D. R. Hocking): How fast can you travel on the railroad?
A: 30 mph is typical although 50/60 mph is possible.

Jon P. Mills (U.K.) - **Large Scale Mapping Data from Ultra-Small Format Digital "Photography"**
Key points were: (1) Imagery suited for air survey work can be successfully acquired using existing digital camera technology. (2) Planimetric orthophoto measurements from Kodak DCS200 Imagery, Differential GPS and existing large scale mapping data display similar accuracy order of magnitude. (3) Future digital cameras will be used commercially for air survey work.

Q (Newby): Given that microlights are not permitted for commercial use in some countries, will such technology be used in light aircraft?
A: Yes, as CCD chip sizes increase and download rates shorten, such cameras will be used in light aircraft.

Q (D. Light): How do you calibrate your camera geometrically?
A: We carry out a self-calibrating bundle adjustment of images taken at our 3D close-range calibration field. The images are then rectified for geometric distortions during pre-processing.

Costas Armenakis (Canada), A. M. Regan - **Map Revision Using Digital Orthophotos**
Key points were: (1) 'Old' vector data can be integrated with 'current' orthoimages for map revision. (2) High-end digital photogrammetric stations can be integrated with low-end GIS stations. (3) Simulated charge detection tests have been corned out with multi-temporal orthoimages and image differencing.

Q (D. R. Hocking): Have you moved from a cartographic to a topographic database?
A: Yes.

Q: With appropriate datum changes?
A: Yes.

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Session 4302 - **Change at the Millennium: Automated Techniques for Map and Database Revision**
July 15, 1996, 13:30-15:00
Session Reporter: **Paul R. T. Newby** *(U.K.)*
Chairman: **Paul R. T. Newby** *(U.K.)*

Peter A. Woodsford (U.K.) **- Spatial Database Update - A Key to Effective Automation**

This was a thoughtful and thought-provoking discussion of update philosophy and paradigms, with particular emphasis on the importance of maintaining database integrity through successive updates. He discussed some major current developments in database technology and the effect that these are having on the update process. He sees object orientation and database versioning as two particularly valuable techniques. He contrasted the master database and data warehouse approaches, outlined schema for merging update data and discussed the provision of change-only update to users. He noted the trends towards the use of standard rather than specialised hardware, of image backdrops and the acceptance of data transfer standards.

Q (D. R. Hocking): In the context of the master database versus the data warehouse, and assuming appropriate standards are in place, do you see the likelihood of a two-way data flow between master database and users, with value added by users being returned to the database ?

A (P. A. Woodsford): A process-centric rather than object oriented standard would be needed for this to be effective.

C/Q (J. L. Colomer): Maps are still the major product of interest to users and should not be forgotten. Do you agree that updating maps is even more complicated than updating databases ?

A (P. A. Woodsford): Yes. The database model for generating updated map output is more complicated, but object oriented databases can help to solve the problem.

Axel Englisch (Germany), C. Heipke, W. Reinhardt, M. Ebner - **On the Content of Digital Aerial Imagery for GIS Database Revision**

Englisch presented research aimed towards partial, or ultimately complete, automation for update of ATKIS and showed how such techniques can already be used for interactive road feature extraction. He also considered management aspects such as periodic or continuous revision cycles. He considers both imagery and semantic intelligence as valid information sources. He emphasised that what can be seen on an image is not necessarily sufficient even for automation of extraction of geometry, nor is semantic information even available on images.

C (M. Sester): I am not so pessimistic: I believe some semantic information as well as geometry can be extracted from images. For example classifications can be automated to some extent, just as a human operator can use the context to help to distinguish churches, farms and residential buildings.

C (P.R.T. Newby): This is the challenge to computer scientists: to prove that this contention is correct.

Q (C. Armenakis): Did you use the height information when you extracted features from your digital orthoimages ?
A (A. Englisch): No!

Karl-Heinrich Anders (Germany), D Fritsch - **Automatic Interpretation of Digital Maps for Data Revision**

Anders presented research towards automation of update of very large scale cadastral databases (ALK as opposed to ATKIS), and the use of such data to help in the revision of medium scale and even thematic maps. He asserts that data mining and computational geometry are two processes which can help in the extraction of information not explicitly stored in existing data models. He proposes the use both of existing GIS data and large scale DTMs in such ways.

Barla Gopala Krishna (India), B. Kartikeyan, K. V. Iyer, R. Mitra, P. K. Srivastava - **Digital Photogrammetric Workstation for Topographic Map Updation Using IRS-1C Stereo Imagery**

In the face of India's massive need for 1:50000 map revision, the author reported on progress towards the proposed use of this Indian satellite stereo imagery with DPWS. The steerable sensor with 70km swath width and 5.8m resolution is potentially suitable. A new DPWS is being designed from scratch for the purpose and should be ready by mid-1997. He expressed disappointment at the first test results obtained, especially for heightening accuracy. However this reporter and others well-qualified to comment consider them to be both remarkable and very encouraging, and we applaud this innovative use of remote sensing data to meet an important practical need.

Hiroshi Masaharu (Japan) - **Semi-Automatic Detection of Land Use Change from Digital Aerial Photos**

Masaharu presented various attempts to detect land use change for map revision. The use of new and old DEMs derived from digital aerial images seemed very promising. Ingenious manipulation of DEM statistics over sub-areas of different sizes added value by establishing signatures for different kinds of change. He also described road extraction through colour coding, which needs further work on noise elimination, as well as a masking and filtering process aimed at increasing the efficiency of manual change detection. He believes that best results will eventually emerge from the combination of several approaches.

Zhongchao Shi (Japan), R. Shibasaki - **Towards Automated House Detection from Digital Stereo Imagery for GIS Database Revision**

This was a report on attempts at automatic extraction of houses from complex urban scenes, and detection of changes in houses for GIS database update. Hierarchical stereo-matching is used to determine 3D disparities at ground surface level. Up to 97% success rates are claimed, another promising and impressive result.

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Session 4303 - **Graphic Revision and Digital Update**
July 18, 1996, 15:30-17:00
Session Reporter: **David A.Holland** *(U.K.)*
Chairman: **Paul R. T. Newby** *(U.K.)*

Karl A. Grabmaier (The Netherlands), K. Tempfli, R. J. Ackermann, G. Messelu - **Interpretability of Scanned Aerial Photographs**

The author described results of an assessment of the usefulness of orthophotos for interpretation of features, using different scales of photography, different pixel sizes of the input images and different pixel sizes of the output orthophotos. Results were compared with features extracted using an analytical stereoplotter, and the experiment was structured to avoid any bias due to the interpretation skills of the operators.

Results: 1) More features could be determined from 1:30,000 photos than from 1:60,000 photos. 2) Lines could be determined with more accuracy than point features. 3) Smaller pixel-sizes of the scanned images gave better results, even when the output orthophotos were of the same pixel-size.

Conclusion: Images should be scanned at a much smaller pixel size than that of the resulting orthophoto.

Fabio Crosilla (Italy), D. Visintini, A. Manzino - **Updating the Content of a GIS Database by the Robust Fusion of Different Low Cost Geometric Sources in Generalised Analytical Mixed Models**

A process of updating large scale digital mapping using low-cost digital sensors was described. Non-metric digital cameras were used to collect large-scale images (on the ground). A linear model was used to register points on the image to points in the digital map data (which were taken to be fixed). In tests using a 1:5,000 scale map, accuracies in the range 0.2 to 0.3 m were obtained.

Conclusion: The use of low-cost terrestrial digital imagery for 1:5,000 scale map update is feasible.

Q (Kr. Gajdamovicz): What is the accuracy of the GIS database?
A: 3D digital map has an accuracy of ± 45 cm in planimetry and ± 90 cm in elevation.

Q (Kr. Gajdamovicz): Do you use GPS to position the camera, and how do you perform orientation of the camera?
A: No, only the cartographic/photogrammetric tie points were used to determine the model.

Q (Newby): Can this be put to practical use, by the government mapping organisation for example?
A: We hope so! But it is in the research stage at present.

José Eduardo Juliá (Argentina) - **Photogrammetric Plotting Based Upon Digitising Tablets and a CAD System**

The author began by apologising that his talk was on analytical photogrammetry, rather than the digital photogrammetry which has been the main topic of this congress. While recognising that the future of photogrammetry is in the digital domain, at the present time such systems are too expensive for use in many developing countries, many of which do not have a national map series, even at quite small scales. The presentation went on to describe a possible solution, using only a digitising tablet (or two), an apparatus package such as AutoCAD: to produce an "image space plotter". Advantages of such a system are: it is cheap, it can be used to capture data directly into a CAD system, and it is surprisingly accurate. Test results showed accuracy of 0.2 mm, but these were mainly due to systematic error. If this systematic error could be removed, accuracies of 80 μm should be possible, or even better if a more accurate digitising tablet is used.

Conclusions: Such a system is economic and quite accurate and could be used in developing countries, especially in the production of a first map for planning purposes.

Q (K.A. Grabmaier): ITC has produced similar hardware, but after interior and relative orientation (done monoscopically) one does not need the y-co-ordinate in the second photograph, so x and y were measured in one image and the x-parallax between the two image points should provide sufficient data. Was this considered as a possibility for your system?
A: We used 'two plus two' co-ordinates, but we could use only 3, too.

Katarina Johnsson (Sweden) - **Generalisation of Image Data to GIS Polygons for Change Detection and Data Base Revision**

The presentation centred on the need to generalise raster-based data (images) when updating polygon-based GIS. The polygons of the map represent generalised areas and cannot be directly compared to pixels. As an example, forest inventory maps in Canada were described, and their update using Landsat TM images were shown. For some polygons the update was simple, since the pixels were relatively homogeneous throughout the polygon area. For other, update was much more difficult, especially if clear-cutting of forest had produced differences within the polygon boundaries (e.g. half the polygon forest, half clear-cut). Various techniques were

used to solve this problem, using mean values, modes, standard deviation, skewness and kurtosis, but the most promising technique involved the use of a fragmentation index to determine the amount of heterogeneity within a region.

Q (Newby): Could this process be fully automated?
A: Not fully, but it could be used to aid the operator when updating classifications.

Q (B. Nordahl): Could the same process be used in Scandinavia as well as in Canada?
A: There are differences, but it should be applicable since although the stand may be smaller, there is more homogeneity than in Canada. Selective logging (as opposed to clear-cutting) will add to the difficulties of classification.

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Session 4401 - **DEM Modelling Applications**
July 10, 1996, 15:30-17:00
Session Reporter: **Marguerite Madden Remillard** *(USA)*
Chairman: **Roy A. Welch** *(USA)*

Rüdiger Brand (Germany), J. Fröhlich - **A New Approach for Global DTM Modelling**
The author discussed the advantages of using spherical co-ordinates and a hierarchical procedure to calculate DEMs by analysing adjacency relationships and local averaging. This process was tested on a data set of the asteroid IDA and was shown to be applicable for planetary mapping.

Masataka Takagi (Japan), R. Shibasaki - **An Interpolation Method for Continental DEM Generation Using Small Scale Contour Maps**
This paper compared two existing DEM interpolation methods (profile and windowing) with a new method using the traditional GIS function buffering. The buffering method was shown to be the most accurate at small scales (contour intervals greater than 200 m) and is especially suitable for the generation of regional or global scale DEMs.

Roland Würländer (Germany), M. Gruber, H. Mayer - **Photorealistic Terrain Visualisation using Methods of 3D-Computer-Graphics and Digital Photogrammetry**
The author presented dramatic photorealistic terrain visualisation results using 3D computer graphics and digital photogrammetry. This technique is being used in large-scale landscape planning application. With future advances in hardware and software, interactive planning with real-time 3D modelling of natural scenes is anticipated.

Mitsuharu Tokunaga (Japan), S. Hara - **Overview of DEM Product Generated by Using ASTER Data**
The author presented an overview of DEM products generated by using data acquired by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) sensor, a joint Japan/USA project scheduled for the EOS-AMI satellite program in 1998. It is expected that relative DEM products developed without the use of ground control points will be produced in Japan at a rate of 30 scenes per day using the TDRSS On-Board Navigation System (TONS) data. Using simulated ASTER image data and TONS data, DEMS of 15 to 30 m post spacing were generated to accuracies of ± 15 to 50 m RMSE.

Jose Luis Ornelas de Anda (Mexico) - **A Shaded Relief Map of Mexico**
This paper described the production of the first DEM of Mexico derived from topographic maps and having a resolution of 500 m. Some very striking views of related products such as shaded relief images and shaded hypsographic colour images of Mexico's complex terrain were displayed. Following the presentation a large crowd gathered to view Mr. Ornela de Anda's map products including anaglyph views of stereo shaded relief maps.

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Session 4402 - **DEM and Digital Orthophoto Mapping Applications**
July 16, 1996, 13:30-15:00
Session Reporter: **Marguerite Madden Remillard** *(USA)*
Chairman: **Luiz Alberto Vieira-Dias** *(Brazil)*

John Thorpe (USA), W. Schickler – **New Automated Procedures for Creating Large Scale Digital Orthophotography in Urban Areas**
In this paper, Mr. Thorpe reported on procedures used by Analytical Surveys, Inc. in the United States to utilise aerial photographs acquired with 60 percent forward and 60 percent side overlap to produce orthoimages. The multiple viewing perspectives of the photographs provide six different possibilities for stereo viewing and internal GPS and inertial systems on-board the aircraft provide control for the photographs. Photos are then automatically scanned, automatic image control points are selected and automatic interior orientation performed. U.S. Geological Survey (USGS) DEMs available at 30-m post spacing are used in initialisation and forecasting of ground control points (GCPs). Other automatic procedures include aerotriangulation, stereocorrelation, batch processing, orthorectification and mosaicking for efficient production of orthoimages.

Q (David Hastings): With 60 percent side and forward overlap, could you forego the use of GCPs?
A: No, orientations are not good enough. We need at least one GCP and in my experience, we always have

at least one available. If we are doing elevations, we need more points anyway - about 20 to 50.

Q: Why do you use a focal length of 12 inches?
A: This is a good question. Because of the poor B/H ratio. It is difficult to map elevation s otherwise.

Wolfgang Förstner (Germany), F. Lang - 3D-City Modelling with a Digital One-Eye-Stereo System

Mr. Förstner expressed the need for 3D city models for commercial planning, architectural preservation, etc. and the desire to obtain these models by the fastest and cheapest means possible. To this end, Mr. Förstner presented a one-eye stereo system that uses a library of primitive shapes and requires interaction with the user to reconstruct complex objects from stereo digital images. The user performs high level decision operations such as model and edge selection, while the computer performs low level operations such as primitive matching. The "one-eye stereo" capability is advantageous because no special hardware is required, interaction with the image is relatively easy and it is readily accepted by non-experts.

Q (Klaus Tempfli): How do you intersect with the ground?
A: Two ways. One, you can assume the ground to be flat. Two, if you have a DTM, you can measure points around the building to intersect the ground. It is not complicated.

Q: How do you handle overhangs of the building roof?
A: This is a tricky problem and an old one in photogrammetry. Parts of buildings may also be obscured by vegetation. If it is large, 1 to 2 m, it cannot be measured. This is a problem and you need to use terrestrial images to fill in the missing building portions.

Eckhard Siebe (Germany) - 3D-Urban Data for Planning Cellular Radio Networks

Mr. Siebe noted that there is a growing need for land use, demographic and terrain data in order to establish cellular radio networks and proper placement of antennae for a tremendous number of subscribers in cities. Methods used to obtain terrain data have included terrestrial surveying, analytical photogrammetry and now the use of digital photogrammetry. A test site in Munich was examined using 1:23,000-scale black-and-white aerial photographs to determine the suitability of using digital photogrammetry. Digital techniques resulted in the production of an urban DEM depicting all buildings larger than 50 square metres in size and higher than 3 metres. Buildings were represented as boxes with flat roofs. Depicted as a shaded relief map, network planners can use the data to identify "urban canyons" along which radio signals are strongest. It was concluded that the analytical test was more precise but much more expensive since measurements were made manually. Digital photogrammetric techniques were semi-automatic and faster. Although this method fulfils the requirements, it is also less precise. Digital photogrammetry was noted as the method of the future.

Kazuhiko Akeno (Japan) - DEM Generation from Multisensor Stereopairs

Giuseppe Gentili (Italy), D. C. Twichell, B. Schwab - Integration of Orthophotographic and Sidescan Sonar Imagery: An Example from Lake Garda, Italy

Dan Klang (Sweden) - Experiences from the Transformation, Correction, Revision and Production of Topographic Orthophoto Maps of the Baltic States Using SPOT Data - The Potential of semi-automatic Data Acquisition Methods

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Session 4501 - **Mars Mapping Efforts**
July 16, 1996, 15:30-17:00
Session Reporter: **Anthony C. Cook** *(Germany)*
Chairman: **Sherman Wu** *(USA)*

Sherman Wu (USA), A. Howington-Krus - Report and Topographic Atlas of Mars

The papers presented will cover: 1) status of planetary mapping, 2) data sources techniques and current and future activities in extraterrestrial mapping and 3) development of new techniques.

The chairman then began his presentation about a book he and his co-author were working on. It consists of 6 chapters (180 pages) and is a comprehensive account of how the mapping of Mars has been accomplished to date. It covers subjects such as space missions of the past, the Mars co-ordinate system, derivation of topographic surface data, and special techniques. It also contains maps and colour pictures.

The chairman then showed some examples of cartographic products of Mars, and discussed were some of the photogrammetric techniques.

David Smith (USA), M. Zuber - Mapping the Topography of Mars

This presentation was in two parts: 1) How good was the reference frame work developed from the data from the 1970's. 2) The likely impact of the new Mars Global Surveyor (MGS) mission. The authors had re-evaluated data from the 1970's which had been used to define the Martian topographic datum. This included Radio occultation measurements, gravity and radar data (including Earth-based observations from the 1980's). The following findings were made: 1) There is an 800-700 m difference between Radar Heights and occultation heights (explained by line of sight effects and topographic heights with occultation technique). 2) It had been thought previously that the southern hemisphere of Mars was higher than the northern hemisphere - this is explained by not allowing for the offset between centre of mass and centre of figure. 3) With the reanalysed data

height errors of 1-4 km are distributed randomly across the surface.

MGS and Mars 96 missions will improve our knowledge of the topographic datum dramatically. From MGS laser altimetry, over one Mars year, a global height accuracy of the topographic data should be expected of ± 10 m. Laser and receiver will permit laser returns also from steep slopes and rough areas.

Kjra Shingareva (Russia), B. Krasnopevtseva - **Mars Mapping from Mars '96 Mission**

The Russian Mars '96 spacecraft will carry 3 mapping cameras to Mars: HRSC, WAOSS and OMEGA. The first two cameras are from Germany and will be discussed in more detail by the next paper, OMEGA is for spectral mapping in the range 0.3 - 5.2 μm. From the surveying point of view, mapping will be both regional and local. A summary was then given of the currently available Mars maps, namely how many, what scales and types, and produced by which countries. A diagram was shown illustrating the potential uses for the Mars '96 derived Mars maps. The possibility of producing a complex Mars atlas was discussed - a hard copy portfolio version where old map sheets could be removed and new ones added, and a Mars digital map orientated database which would include selectable options e.g. Mars visualisation, orbit tracks, and image coverage.

Jörg Albertz (Germany), H. Ebner, G. Neukum - **The HRSC/WAOSS Camera Experiment on the Mars96 Mission - A Photogrammetric and Cartographic View of the Project**

A Russian mission to Mars is to be launched later this year and will be placed into an eccentric polar orbit next autumn. It has two German built cameras: HRSC (High Resolution Stereo Camera) and WAOSS (Wide Angle Optoelectronic Stereo Scanner). The former can obtain nadir images as good as 10 m/pixel, and the latter will be used for global atmospheric imaging and temporal studies. Its the first time that such an experiment has been designed according to the special requirements for stereo photogrammetry and planetary mapping. The third author is principle investigator. An outline of the experiment and most important technical parameters of the cameras are given: both cameras are essentially based on 3 line scanner instruments in order to enable stereo photogrammetric analysis. The systems have already been subject to detailed calibration and testing (see next paper). For photogrammetric restitution of the image data, for generation of DTM's and orthoimages, and for the generation of other cartographic products, a comprehensive software package has been developed. A special reference system for digital data handling and cartographic purposes has been defined. Furthermore a new map series for Mars - "the Topographic Image Map MARS 1:200,000" has been designed.

Q (Sh. Wu): Could problems arise between the existing reference system used in the States on Mars-cartographic products, and the new system for Mars96 cartographic products?

A (J. Albertz): A decision was made collectively on the adoption of the new co-ordinate system of Mars by members from Europe, Russia, and the USA, who were present in the working group. Furthermore both new and old co-ordinate systems will be shown on map products to assist in the change over.

Ernst Hauber (Germany), J. Oberst, J. Flohrer, I. Sebastian, W. Zhang, C. Robinson, R. Jaumann, G. Neukum - **The High Resolution Stereo Camera HRSC for Mars 96: Results of Outdoor Tests**

The HRSC system, developed at DLR (German Aerospace Research Establishment) is a pushbroom camera with 9 CCD lines, each with 5184 active pixels. The extra channels are for photometric and colourmetric studies in addition to the 3 stereo channels. In February and March 1995 outdoor tests were made by placing the camera in a cooled vacuum chamber, with an optical window, on a rotating table. Images were scanned of a region of the Swiss Alps 40 km in a 130° panorama (compression function 8x). Geometric and radiometric calibration were conducted in a laboratory. The images underwent the same processing procedures as would be used for the Mars 96 mission, albeit the scanning geometry and scene brightness were different. The analysis of the test images showed good agreement with the calibration data, and excellent radiometric performance.

Q (O. Jamet): Do you plan to use the same compression method and same compression ratio during the Mars mission?
A: On this occasion the compression parameters were chosen to be suitable for the ground test. The Mars mission compression parameters haven't been fixed yet but are expected to be chosen according to the landscape to be imaged.

Q (O. Jamet): Doesn't compression effect correlation matching for DEM production?
A: The windowing effect of the compression algorithm doesn't effect correlation results so long as one chooses a sufficiently good level.

Jürgen Oberst (Germany), W. Zhang, M. Wählisch, A. Cook, T. Roatsch, R. Jaumann - **The Topography of Lunar Impact Basins as Determined from Recently Obtained Spacecraft Stereo Images**

This was a summary of a study on lunar topography conducted over the last two years on Galileo and Clementine spacecraft imagery. Galileo obtained images as good as 1.1 km per pixel during a flyby. Clementine obtained images in the range 125 - 400 m/pixel from polar orbit - these are global in coverage. Image search and bundle block adjustment software was used. A DEM of Mars Humboldt, obtained from Galileo stereo imagery, was shown with a grid spacing of 2.5 km - it was found to be in good agreement with Clementine laser altimetry measurements.

Although Clementine laser altimetry data has global coverage and is more accurate than the stereo matched

results in terms of height accuracy, stereo produced DEMs area. Finally, an estimate was given of the amount of material excavated during the Humboldt basin impact: 10^{15} km.

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Session 4502 - **Mapping from Images Recorded on the Magellan, Galileo and Clementine Missions**
July 17, 1996, 11:15-12:15
Session Reporter: **David Smith (USA)**
Chairman: **Sherman Wu (USA)**

Franz W. Leberl (Austria), R. Kalliany, W. Walcher - **Surface Topography Reconstruction of Venus from the Magellan Mission**
The re-construction of Venus topography from Magellan SAR data was discussed. The status of the data processing and release and work being done in preparations for stereo matching and development of a DEM was presented.

Q (J. P. Muller): Will the future see improved ephemerides to allow fullscale stereo-DEM's derived?
A: At JPL initial efforts for re-computing the ephemerides of Magellan using land marks were made but not completed. If is suggested that with the improved gravity field new orbits can be computed for Magellan with high accuracy.

Q (W. Walcher): What scale will paper maps be made from Magellan Venus data?
A (M.S. Robinson): USGS-NASA will provide full resolution maps only in digital format on CD-ROM at 75 m/pixel.

Yuri Tjuflin (Russia) - **Venus Atlas from Venera -15 and -16**
Historical development of imagery over the last 30 years for the Moon, Mars and Venus was discussed. Most interesting has been Venera 15-16 and the publication of the Venus Atlas based on these images.

Q (Welcher): At what scales do you plan to publish Venus maps (paper)?
A: At the highest available resolution of 75 m per pixel.

Mark S. Robinson (USA), A. S. McEwen - **Global Multispectral Mapping of the Moon by Clementine**
The Clementine mission, the spacecraft and instruments and some of the science results were described. A global mosaic is being compiled with an average positional accuracy of better than 500 meter. Some early science included a crustal thickness map, identification of new basins, global crustal iron abundance, identification of new regions of anorthositic crust.

Maria Zuber (USA), D. Smith - **Topographic Mapping of the Moon**
The operation of the laser altimeter on Clementine for understanding the shape and topography of the Moon was described. The 2 km lunar flattening and the centre-of-figure/centre-of-mass offset of nearly 2 km and it's implications for lunar evolution were discussed. The radii of lunar basins shown to vary with age.

Timm Ohlhof (Germany), M. Dorn, R. Brand, W. Zeitler - **Photogrammetric Processing of Digital Galileo SSI Images from Asteroid Ida**
The photogrammetric procession of Galileo SSI images of Ida and work in progress to develop a DTM for Ida was discussed. The work includes a ground control network of 96 points with an accuracy of 180 meters. Future work will include orbital constraints and improvements in Ida's rotation model.

Anthony Cook (Germany), F. Trauthan, E. Hauber, N. Bohne, K. Eichentopf - **The Solar System Information System Design and Application**
The development of a Solar System Information System (SOLIS) to assist scientists in determining the geographical extent, temporal nature, quality of planetary data, and the testing of simple hypotheses were discussed. Issues of image record size, storage format, compression and resolution were described. Example shown of image coverage over Mare Orientale illustrating resolution, stereo and phase angle information from the Clementine mission dataset of 2 million images.

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Session 4601 - **Databases for Global and Regional Environmental Studies: I**
July 11, 1996, 8:45-10:15
Session Reporter: **Andy Yaw Kwarteng (Kuwait)**
Chairman: **Ryutaro Tateishi (Japan)**

Ryutaro Tateishi (Japan) – **Global Database of Key Environmental Variables**
This paper presented four components of global change studies: 1) inventory of current conditions and trends in key environmental variables; 2) modelling relationships and interactions among environmental variables; 3) simulations and predictions; and 4) policy decisions for directing human activities towards sustainable development. Mr. Tateishi went on to describe the current status of the development of global databases including physical (DEMs, land cover, soil type), meteorological (temperature, precipitation, evapostranspiration), oceanographic (sea surface temperature, chlorophyll) and social variables (population, land use, energy consumption). In a concluding statement, Mr. Tateishi recommended that ISPRS link with other international organisations in the pursuit of

global database development such as the International Geophysical Union (IGU) and the International Cartographic Association (ICA) to avoid duplication of efforts and to co-ordinate the results of global database inventories.

David A. Hastings (USA), A. Y. Kwarteng, G. Schreier – **Challenges in Developing Integrated Global Environmental Databases: Lessons Learned from the Global Change Data Base and the Global Land One-km Base Elevation (GLOBE) Projects**

The challenges in these projects were noted as being primarily one of data quality threatened by corruption during transfer of extremely large data sets, the informal sharing of public domain databases and inconsistencies in database resolution, timing, classification systems and knowledge of all areas of the globe.

Klaus Steinnocher (Austria) – **Integration of Spectral and Spatial Classification Methods for Building a Land-Use Model of Austria**

R. Radwan (The Netherlands), A. Y. Bishr, E. Espinoza, T. Mabote – **Federating Heterogeneous DBs in a Multi Level Decision Support System for Watershed Management – A Client/Server Approach**

Yojiro Utsunomiya (Japan) – **Construction of a Thermal Inertia Mapping System (TIMS) for Hydrologic Analysis of the Earth's Surface Using Satellite and Ground Monitoring Data**

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Session 4602 - **Databases for Global and Regional Environmental Studies: II**
July 17, 1996, 8:45-10:15
Session Reporter: **Scott Madry** *(USA)*
Chairman: **Ryutaro Tateishi** *(Japan)*

No report received!

Zdenek Kalensky (Canada) – **Regional and Global Land Cover Mapping and Environmental Monitoring by Remote Sensing**

Luiz Alberto Vieira-Dias (Brazil), R. R. Rangel – **Numerical Interpolation in Flight Simulators for Microcomputers Using Digital Elevation Models**

C. M. Paresi (The Netherlands), R. Radwan – **Guide-Lines for the Development and Maintenance of a Geoinformation Utility in a Distributed Environment**

Hongliang Fang (P.R. of China) – **Strategic Alternatives to Calculate Crop Area of an Administrative Division**

Abdullah M. Al-Garni (Saudi Arabia) – **Role of Artificial Intelligence in Identifying Engineering Expansive Soils Using Satellite Imagery and Aerial Photographs**

Scott Madry (USA), R. Lozar – **The Grass Global CD-Rom Data Base and Public Domain GIS and Image Processing Software: Appropriate Tools for Global Analysis**

COMMISSION IV

Session 4001 - **Design and Implementation of 3D-GIS**
July 15, 1996, 10:45-12:15
Session Reporter: **Wanning Peng** *(The Netherlands)*
Chairman: **Martien Molenaar** *(The Netherlands)*

Klaus Tempfli (The Netherlands), M. Pilouk - **Practical Photogrammetry for 3D-GIS**

Key points were: (1) The FDS data model supports complex spatial analysis and intelligible visualisation. (2) Current systems can also be used for 3D topographic mapping, but the involved manual operations in object reconstruction and texture mapping cause considerable more work than known from 2D mapping. (3) 3D quality control is a problem asking for bringing together digital photogrammetry and advanced computer graphics. (4) Virtual reality will become reality and photogrammetry virtue.

The paper reviews a rigorous spatial concept for embarking on 3D-GIS and analyses what can be available with current photogrammetric systems to collect data for an urban 3D-GIS.

Q: Compared with 2D mapping, how much more time is needed to digitise the roofs of buildings for a 3D-GIS?
A: We have not done the comparison yet. I think it will be around 3 times.

Q: Could you repeat the advantage of a 3D-GIS over a 2.5D-GIS?
A: Of course, some applications may not need a 3D-GIS, but many applications do require a 3D-GIS.

Mathieu Koehl (France) - **The Modelling of Urban Landscape**

Key points were: (1) Definition of specific objects of urban areas. (2) Solutions for modelling of such objects. (3) Achieving a reliable geometry. Emphasis was given to the basic DTM structure and pre-existing or user defined primitives that are aggregated to become objects. To keep a reliable geometry, a hierarchical splitting up of the objects was defined and for data acquisition a range of specific tools proposed.

Q: Both presentations focused on urban environment, can the approaches be applied to other environments, such as natural environment?

A: Yes.

Qingquan Li (P. Republic of China), D. Li - **Hybrid Data Structures Based on Octree, Tetrahedral and NURBS in 3D-GIS**

Key points were: (1) Implementation of 3D hybrid data structure. (2) Presentation of a concept of 3D-GIS. Data structures in 3D-GIS were reviewed. Emphasis was given to Linear Octree (LO) and Tetrahedral Network (TEN). Three-Dimensional Run Encoding (3DRE) was developed from 2DRE for data compression in LO and a dynamic constraint method was introduced, which was used for the formation of constrained TEN. Some experiments have been completed.

Q: You mentioned that you used raster approach for constructing TEN, did you consider vector approach?

A: Raster approach has some disadvantages. We will use vector approach in the future.

Q: What are the criteria for selecting different data structures?

A: We used TEN for the inside of a body, and Octree for the outside.

Dieter Schmidt (Germany), D. Fritsch - **In Transition of 2.5D to 3D GIS**

Key points were: An algorithm has been shown that uses 2D algorithms plus 3D transformations to achieve some 3D functionality. An implementation also uses external 3D views.

Jianya Gong (USA), D. Li - **Design and Implementation of an Object-Oriented GIS software**

Key points were: The paper first discusses the object oriented (o-o) technology in several aspects of GIS, including o-o conceptual model, o-o logical model, o-o database management system, and o-o GIS. Then it introduces a new o-o GIS software - GeoStar and its implementation based on the o-o database management system and o-o programming language C++.

COMMISSION IV

Poster Session 40P1 - **Applications of GIS, Database Revision and DTMs**

July 11, 1996, 13:00-15:00
Session Reporter: **Thomas Jordan** *(USA)*
Chairman: **Lynn E. Usery** *(USA)*

Ivan Lizarazo (Columbia), M. A. Torres - **The Mapping Production in Columbia. Towards the Creation of Topographic Databases**

Since recognising that their existing map base was out-of-date in 1992, the Instituto Geografico Agustin Codazzi (IGAC) has implemented a modernisation process to convert all existing maps to digital format and implement the structure necessary to provide the foundation of a GIS. A standard mapping system including modern aerial cameras, survey equipment and analytical plotters has been installed for the purpose of producing map products at 1:2000 and 1:25,000 scale for urban and rural areas, respectively. These are also generalised for 1:100,000 scale map series. To-date, mapping for 50% of the urban areas and 40% of the rural areas has been completed.

Miroslav Roule (Czech Republic) - **Research in the Section of Cadastre of Real Estates in the Czech Republic**

In response to a 1991 Czech government decree for the establishment of a National Information System of the Czech Republic, the first phase of research and development of tools for establishment of the digital cadastre of real estates in the Czech Republic has been finished. This emphasises the development of a plan to convert the existing map base to digital format and to integrate the various Registries associated with the national cadastre. Acquisition of the various hardware and software tools required for this task was also accomplished. The next, and largest, step in the process is to make the system operational and populate the database. Follow-on research will focus on further innovations in the automation of the many tasks and better integration with the various data bases making up the national cadastre.

Frank A. van den Heuvel (The Netherlands), M. A. Salzmann - **Standards for Large Scale Photogrammetric Mapping**

Standards for the photogrammetric production process have been established during the development of a new manual for the mapping activities of the cadastral agency of The Netherlands. Chapters in this new book cover every aspect of cadastral mapping and include 1) Introduction; 2) Geometric Quality Assurance; 3) Mathematical Geodesy, 4) Connection of Point Fields; 5) Control Survey; 6) Field Surveys; 7) Photogrammetry; 8) Map Renovation and 9) Geometric Quality Evaluation. Published during the week preceding the Congress, this publication covers the current state of the art and includes specifications and recommendations for digital photogrammetry as well as for traditional methods.

Bock-Mo Yeu (South Korea), D.-J. Sohn, H.-H. Yoo, J.-H. Yom - **Application of Expert System and Image Processing Techniques for Detecting Building Changes in Geo-Spatial Databases**

A system has been developed with the goal of easing the task of building and construction permit verification using automated image analysis, feature extraction and classification techniques. An expert system approach is employed in conjunction with a GIS to compare identified

structures with the existing map base and building/construction permit records.

F. Gül Batuk (Turkey), A. Alkis - **An Application of a Pilot Project of Istanbul Urban Information System for Planning and Public Works of District Municipalities**

A pilot project was performed in which the design was made of an Urban Information System (UIS) for the district of Istanbul, Turkey. This design includes applications of public works and planning activities for a district municipality. The work of a metropolitan area were examined in great detail and the complex model for the UIS was designed and implemented on a personal computer using ARC/INFO. Specific applications were written in the ARC/INFO SML macro language. A database for a pilot area was imported from many sources, brought into a common format and tested within the scope of the project.

Zeljko Cvijetinovic (Yugoslavia), D. Mihajlovic - **Interactive DTM Data Acquisition and Verification on Computer Supported Analogue Stereo Plotters**

Most of the mapping in Yugoslavia is still performed using analogue stereoplotters. In response to a serious need to upgrade the overall mapping capabilities into the digital domain, at a minimal cost, a software package was designed for the purpose with emphasis on DTM acquisition and verification. This DTM software is tightly integrated into the MapSoft package which is the official large scale mapping software in Yugoslavia.

Celso Goncalo Dias (Junior) (Brazil) - **Vehicles Traffic Management and GIS Planning System - A Study of Detran Project - Parana State/Brazil**

A major project has been undertaken in the State of Parana, Brazil to attempt to reduce the number of traffic accidents. In this project, detailed mapping of 371 municipal districts, 74 micro traffic districts and the city of Curituba will be overlaid with the locations of all traffic accidents. This database can then be used to manage traffic flow patterns within each region or municipality.

Akos Detreköi (Hungary), G. Mélykuti, G. Szabo - **Further Development of the Hungarian DTM and Land Cover Telecommunication Data Base**

To enhance the capabilities for determining site locations for telecommunication towers, a nation-wide DTM has been created. The DTM has a grid spacing of 50 m and was created by a combination of conventional digitising of map contours and interpolation of the grid heights. Although the DTM was created in large part by the military, it is available for non-military use but must be purchased. Analysis of this DTM is helping the new and growing telecommunication industry to become better established in Hungary.

S. I. Abdel Rahman (Egypt), H. Onsi - **Application of Remote Sensing and GIS for Soil Mapping in Central Sinai, Egypt**

Using a combination of unsupervised classification and principal components analysis (PCA), a map has been made of the soils of the Central Sinai Peninusula. Five general classes of soils were identified and delineated for use in planning future agriculture in the area. In the process, the effects of vegetation cover, land use and soil erosion on spectral classification were assessed.

Ergjin Samini (Albania), A. Shehu - **Albanian Developments in Common Fields**

The political upheaval and democratic reforms of the early 1990's in Europe also affected the country of Albania and permitted that closed society to open itself to the rest of the world. Starting in 1994, a new set of cadastre maps for the Western Lowlands (1:2,500 and 1:1,000 scale) were created. These maps were based on new aerial photographs and employed modern mapping equipment and techniques for the first time. This poster presentation is significant because it is the first time a mapping specialist from Albania has participated in an ISPRS Congress.

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Poster Session 40P2 - **Applications of GIS, Extra-terrestrial Mapping and Global Databases**
July 12, 1996, 10:30-12:30
Session Reporter: **Kirsi Artimo** *(Finland)*
Chairman: **Kirsi Artimo** *(Finland)*

There were 11 posters and short oral presentations in this session.

L.R.A. Narayan (India) - **Remote Sensing and Geographical Information Systems for Conservation and Assessment of Biological Diversity**

Margrit Gelautz (Austria), F. Weinbermair, F. W. Leberl - **On the Detection and Exploitation of Layover in Magellan SAR Imagery**

Orhan Altan (Turkey), F. G. Toz, S. Külür, D. Z. Seker, Ü. A. Iyidiker, H. Iydiker, Z. Duran - **The Rijid Problems During the Establishment of Information Systems in Turkey**

Aleksandra Bujakiewicz (Zambia) - **Simple Photogrammetric Methods for Mapping of Vegetation Polygon Boundaries in National Parks in Africa**

Monika Sester (Germany) - **Acquisition of Rules for the Transition between Multiple Representations in a GIS**

Jerzy Chmiel (Poland), T. Gumbricht - **Knowledge Based Classification of Landscape Objects Combining Satellite and Ancillary Data**

Hartmut Lehmann (Germany) - **A New Map Series for the Planet Mars - Concept and Realization of the "Topographic Image Map MARS 1:200,000"**

Oktay Aksu (Turkey), M. Onder, W. Narli - **An Application of Kinematic GPS-Supported Aerial Triangulation in General Command of Mapping (Turkey)**

Ulrich Rhein (Germany), M. Ehlers - **The Role of Remote Sensing and GIS for an Operational Statewide Environmental Monitoring**

Ion Gr. Sion (Romania), O. Balota, C.-D. Nitu - **The Natural Patrimony Information System - A Deltaic Case Study**

Lidija Semak (Croatia) - **Bay of Bakar**

The main topics of the presentations were environmental monitoring (four papers), GPS and Mapping (three papers), object-oriented methods (two papers), computer graphics (seven papers), and system establishment (seven papers). Many papers presented combinations of these topical areas.

It appears clear that the various applications of environmental monitoring are the largest group and primary topic of interest. These papers demonstrated several good examples of applications integrating remote sensing and GIS. For example, Manfred Ehlers demonstrated the combination of aerial photographs, satellite images and radar image data in a GIS for protecting ecologically sensitive bog areas in Germany.

Use of artificial intelligence and knowledge is one of the most interesting topics in this session and in general. For example, Monika Sester described her object-oriented approach to multiple representation in spatial databases. Generalisation and presentation always require knowledge. This paper was well-organised and presented providing one of the best posters in the session.

There appears to be an invasion of computer graphics to ISPRS and Margrit Gelautz showed a good quality and well-prepared poster on the use of simulation and graphics. Also it is interesting to find more papers on GIS design and establishment. These papers treat not only technical issues such as database development, but also economic aspects for practical implementation. Orhan Altan gave an interesting poster-paper on the problems of establishing a GIS in Turkey and the poster by Aleksandra Bujakiewicz treated the economic aspect examining inexpensive photogrammetric methods of mapping vegetation in Africa's National Parks.

COMMISSION IV

Poster Session 40P3 - **GIS Applications of Topographic Mapping**
July 15, 1996, 15:00-17:00
Session Reporter: **Lynn E. Usery** *(USA)*
Chairman: **Marguerite Madden Remillard** *(USA)*

There were 6 posters in this session.

Fahmi Amhar (Austria), R. Ecker - **An Integrated Solution for the Problems of 3D Man-Made Objects in Digital Orthophotos**

Hans Schoch (Australia), M. Goble-Garrat, P. M. Roberts - **Automatic DEM and Orthophoto Generation on Analytical Stereoplotters**

Joon-Mook Kang (South Korea), W.-J. Oh, Y. S. Bae - **Large Scale Geographic Information Acquisition by 35 mm Camera**

Krystian Pyka (Poland), M. Borowiec - **SCOP as an All-Purpose Tool for Elaboration of Digital Terrain Model - The User's Comments**

R.J. Wicherson (The Netherlands) - **Implementation of Digital Photogrammetric Techniques at the Survey Department**

Wanning Peng (The Netherlands), M. Pilouk, K. Tempfli - **Generalizing Relief Representation Using Digitized Contours**

The posters in this session make an interesting collection of methods and applications of digital elevation models (DEMS) and digital orthophotos. Automatic methods of producing these datasets are now in production use as illustrated by their use at the Survey Department in the Netherlands. R.J. Wicherson gave historical evidence that in years past, automated production was unacceptable to his clients while now these are the methods of choice. Positive user comments concerning DEMs were also presented by Krystian Pyka from Poland.

Several posters examined production methods or methods of refining the DEM or digital orthoimage. Amhar Fahmi from Austria presented a method to remove the non-vertical representation of buildings in orthoimages. His method integrates a 3D building model with a DEM and uses both to remove the distortion and create vertical building representations. The hidden area is recovered from the alternate photo of the pair. A problem with these techniques is the lack of available building models in acceptable formats and the expense of developing such models.

Wanning Peng presented a method to generalise digital contours by creating a DEM. The DEM is generalised and then new contours are created. The process provides an automatic method to generalise the contours.

Joon-Mook Kang from Korea presented a method of acquisition of Geographic scenes with a 35 mm camera which has been modified to meet metric standards. Incorporation of fiducial marks and correction for lens distortion allow accurate measurement. While Kang worked on the camera acquisition of data, Michael Goble-Garratt of Australia presented a system which bridges the gap between analytical stereoplotters and digital photogrammetric systems. Using video cameras mounted on a stereoplotter, digital images are captured and DEMs

produced for orthoimage generation. Both panchromatic and colour orthophotos can be generated with his system.

The entire session provided a good focus for those interested in DEMs and digital orthophotos and indicated that these datasets are production tools which have become essential components of GIS applications. Readers are directed to the archives for complete details of the papers.

COMMISSION IV

Poster Session 40P4 - **Applications of Database Revision and Mapping from Space**
July 16, 1996, 15:00-17:00
Session Reporter: **Lynn E. Usery** *(USA)*
Chairman: **Paul Newby** *(U.K.)*

There were 11 poster-papers presented in the session.

Ivan Katzarsky (Bulgaria), L. Koleva - **Revision of the Large-Scale Topographic Map in Bulgaria**

Camilla Mahlander (Sweden), D. Rosenholm, K. Johnsson - **Semi-Automatic Identification of Revision Objects in High Resolution Satellite Data**

Takayuki Inomata (Japan), H. Ieda, S. Kaminishi - **Study of GIS for Grasping of the Dysfunction of Street - A Case of Hanshin-Awaji Earthquake**

Rainer Kalliany (Austria) - **Application-Tailored Mapping and Monitoring with High Resolution Spaceborne Imagery, Using an Interdisciplinary Connected Computer Network**

Xiaowei Yu (Finland), L. Matikainen, R. Kuittinen - **Updating Topographic Map in Southern China by Using Satellite Image and Ancillary Data**

Vitezslov Novacek (Czech Republic), J. Kolejka, J. Zaloudik - **Satellite Atlas of the Czech Republic**

John Anthony Allan (U.K.), J. Shears - **Softcopy Photogrammetry and Its Uses in GIS**

Martin Smith (U.K.), M. Dumville - **Analysis of Rule Bases in Hybrid Neural Networks for Georeferencing Earth Observation Imagery**

Michael Urtheil (Canada), G. Tomlins, D. Werger - **Satellite Image Map Aids in Planning at the Greater Vancouver Regional District**

Renate Bartl (Austria), W. Schneider, J. Steinwendner - **Image Map Fusion Based on Line Segment Matching**

Serge Le Blanc (France) - **Spatiocarte Numérique Interprétéé**

Most of the papers explored the use of satellite image data and image maps for map and database update. Rule-base development formed the approach in several posters including the use of fuzzy logic for the identification of forest revision objects by Camilla Mahlander, classification by Leena Matikainen, and a hybrid neural network for geo-referencing by Martin Smith. Development of an ortho-rectified image map of Vancouver for a planning application using merged SPOT and Landsat Thematic Mapper data was presented by Michael Urtheil while Vitezslav Novacek showed the development of a satellite image atlas for the Czech Republic.

Two posters showed the use of aerial photography with John Allan illustrating the use of softcopy photogrammetry to produce DEMs and orthoimages and Takayuki Inomata demonstrating the ability to assess road blockages caused by earthquakes. The latter poster used the photos with a GIS and provided time measurements required to complete the different parts of damage assessment.

Ivan Katzarsky provided a poster illustrating the revision of topographic maps of Bulgaria and Serge Le Blanc showed an integrated digital spacemap with vector overlay. Rainer Kalliany showed the use of high resolution images with networking technology. Network services included management and product dissemination with software developed with JAVA.

Renate Bartl's poster showed a method for combining images and maps by first extracting line segments from the image and matching them to lines on the map. The results indicated that meaningful matches were found while excluding some lines correctly. Coarse pre-registration of the image and map were necessary to start the process.

The complete set of posters provided a good overview of some methods and applications of the use of satellite image data for map/database revision and map product generation.

COMMISSION IV

Poster Session 40P5 - **Applications of GIS: I**
July 18, 1996, 9:00-11:00
Session Reporter: **Kirsi Artimo** *(Finland)*
Chairman: **Luis Alberto Vieira-Dias** *(Brazil)*

Nine oral presentations were given as well as nine posters shown.

In general the main topics were: Use of GIS and GIS data (7 papers), different land use planning and monitoring applications (7 papers). One paper war about problems in GIS development and one paper described a small/inexpensive system for mapping.

A typical trend and idea in today's ISPRS session is that GIS data (digital maps) is used in a remote sensing/digital image processing system. However we saw in this session that the data flow can also be vice versa: from satellite data and digital orthoimages to a GIS

system. Anyway the integration of RS and GIS is the word of today.

Also we saw a lot of land use applications, both monitoring and planning. Different types of land use planning applications will be the increasing area in RS as well as in ISPRS.

In all sessions of Com IV WG1 we saw that ISPRS is no more only for photogrammetrists and perhaps geographers.

And also, once again, the question about inexpensive systems were discussed.

Because I was standing in my own booth during the poster presentations I cannot say anything about them. My opinion about the oral presentations is that the one given by Masaaki Shikada was the best.

COMMISSION IV

Poster Session 40P6 - **GIS Applications of DEMs and Digital Orthoimages**
July 18, 1996, 12:30-14:30
Session Reporter: **Ryutaro Tateishi** *(Japan)*
Chairmen: **Ryutaro Tateishi** *(Japan)*
  Luiz Alberto Vieira-Dias *(Brazil)*

Seven papers were presented. Four of them were related to the DEM generation.

J. Luuk Spreeuwers (The Netherlands), Z. Houkes - **The Construction of DEMs of Textured Areas using Aerial Video Image Sequences**

Alias Abdul Rahman (Malaysia), G. Desa - **TIN-Based Digital Terrain Modelling Application: Identification of Developable Land**

David Waldram (U.K.), M. Smith - **Automated Digital Terrain Modelling of Coastal Zones**

A. Stewart Walker (USA), R. Kirwan, S. B. Miller - **Successful Digital Photogrammetry at the Ordnance Survey of Ireland**

Emmanuel Baltsavias (Switzerland), S. Mason, H. Li, A. Stefanidis, M. Sinning - **Comparison of Two Digital Photogrammetric Systems with Emphasis on DTM Generation: Case Study Glacier Measurement**

Claudia Robbi (Brazil) - **Visualisation of Cartographic In-formation Using DTM**

Philip Soole (Australia), X. Wu - **Improving the Automated Terrestrial Reconstruction Accuracy**

Spreeuwers presented the result of experimental research to generate DEM using aerial video images. He reported that time sequential images compensate for the low resolution of video images in image matching by his proposed method.

Waldram reported on digital photogrammetric technique for DEM generation of coastal zones including cliffs.

Soole reported on the results of determining the influence of projective distortion on automatic image correlation based on a relaxation image matching algorithm.

There are other papers on comparison of two digital photogrammetric systems (Sinning), DTM application (Abdul Rahman), cartographic visualisation (Robbi), and the introduction of digital photogrammetry in a national mapping agency of Ireland (Walker).

COMMISSION IV

Poster Session 40P7 - **DEMs and Digital Orthoimages for Mapping/GIS Applications**
July 19, 1996, 11:15-13:15
Session Reporter: **Jonathan Smith** *(USA)*
Chairman: **Marguerite Madden Remillard** *(USA)*

Farrag Ali Farrag (Egypt) – **The Influence of Terrain Type and Density of Digital Elevation Model on the Geometric Quality of Satellite Ortho-Images**

Mikhail M. Fomtchenko (Russia), V. F. Chekalin – **The Use of Russian TK-350 Images and GPS-Points in Generation of DEM**

Using TK-350 and KVA-1000 images at 10-m and 20-m resolutions, respectively, with navigational information only resulted in DEMs with vertical accuracies of about +/- one pixel. With the introduction of GPS points, the accuracies increased +/- 5 m.

Helmut Kager (Austria), A. Halmer, D. Heitzinger – **3D-Surface Modelling with Basic Topologic Elements**

A 3-D surface modelling system that utilises a TIN surface and includes a line management system for the separate smoothing of lines was discussed.

Laszlo Molnar (Austria), J. Winter, B. Wöhrer – **DTM System SCOP in a New Technological Generation**

Laszlo Molnar discussed the latest version of a DTM system, SCOP. New features include enhanced user interface, advanced DTM techniques (for example, regions can be considered as separate models with their own structure) and 3D capabilities.

Wolfgang Rieger (Austria) – **Accuracy of Slope Information Derived from DEM-Data**

Wolfgang Rieger explained the accuracy of slope information derived from DEM data and warned that elevation errors may not be independent from one another. The impact of error correlations and propagation on derived products was tested using aerial photographs of 1:32,000 scale.

Massoud Sharif (The Netherlands), M. J. Salim – **DEM Optimisation Using Satellite Images**

They concluded a SPOT stereomodel controlled by 10 GCPs and rectified using automatic generation of DEMs ensures adequate accuracy for the production of 1:50,000-scale maps.

Yasushi Shimoyama (Japan), M. Murakami, A. Kinoshita – **Verification of the 50m Grid DEM Data Accuracy**

Yasushi Shimoyama estimated DEM precision for a 50-m resolution DEM being prepared for Japan. DEMs produced using stereomatching procedures of a digital photogrammetric system were compared with results using an analytical stereoplotter.

COMMISSION IV

Poster Session 40P8 - **Applicaions of GIS: II**
July 15, 1996, 15:30-17:00
Session Reporter: **Kirsi Artimo** *(Finland)*
Chairman: **Lynn E. Usery** *(USA)*

There were four oral presentations and five posters in this session.

R.J. Ackermann (The Netherlands), E. Rad - **A Quality Control Procedure for Photogrammetric Digital Mapping**

Hiroshi Hanaizumi (Japan), S. Fujimura, K. Saito, S. Chino - **An Efficient Supervised Classification Method of Remotely Sensed Multispectral Images**

Markus Guretzki (Germany), H. Ehrhardt, H. Meuser - **Acquisition of Urban Building Models with the Use of Digital Photogrammetry, Image Processing and GIS**

Michael Gruber (Austria), S. Zlatanova, M. Kofler - **Merging DTM and CAD Data for 3D Modelling Purposes in Urban Areas**

Mohamed Omari Cherkaoui (Morocco), F. Barkan, M. Gay - **Utilisation d'un système d'information géographique pour l'évaluation des risques d'érosion et l'analyse des potentialités forestières: Mise au point méthodologique**

The main topics of the session were urban 3D models (two papers), quality control (one paper), use of remote sensing and GIS in erosion management (one paper), and supervised classification (one paper).

Markus Guretski and Siyla Zlatanova presented papers on providing digital elevation models (DEMS) and 3D models of buildings in urban environments. Zlatanova presented a study made at ITC, together with the Technical University in Graz, Austria, in which a triangulated irregular network (TIN) model is including buildings. They have developed a data model in which building volumes are a part of the TIN. Also Guretski's

paper described the production process of adding buildings to the DEM by using orthoimages.

Ackermann's presentation on quality of the photogrammetric process showed that systematic and continuous quality control contributes to the optimisation of a mapping production line. Quality control is especially needed for the final field check and completion. He also introduced the depiction of quality assessment information on hardcopy map products.

Cherkaoui's paper described the application of remote sensing and GIS in erosion risk management. Spatial information on rainfall erosivity, soil erodibility, land cover and topography were combined using the Universal Soil Loss Equation (USLE) to predict the relative risk of erosion and target areas that require further management attention. The poster was clearly presented and illustrated the integration of remote sensing and techniques for natural resource management.

This session showed that we are moving toward the integrated use of photogrammetry, remote sensing, and GIS for many applications, and that 3D modelling of urban areas is a topic of increasing interest for future research.

COMMISSION IV

Poster Session 40P9 - **GIS Applications and Mapping from Space**
July 18, 1996, 15:30-17:30
Session Reporter: **Jonathan Smith** *(USA)*
Chairman: **Donald Light** *(USA)*

Seven people presented results.

Christoph Lüken (Germany) - **UQUADO - Environmental Quality Chart of Dortmund**

Anke Steinbach (Germany), T. Bouloucos - **Photogrammetric Data Capture System for the German ALK Data Model**

Sabine Patzig (Germany), H. Kränzle - **Landnutzungsdaten für die Funknetzplanung bei E-Plus**

Werner Maier (Germany), E. Dorrer, X. Zhou - **First Experience with Stereocompilation of MOMS-02 Scenes on the Analytical Plotter**

Lars Tyge Joergensen (Denmark) - **TOP10DK, The National Topographic Database of Denmark**

Jerzy Mozgawa (Poland), J. Mozgawa, E. Piekarski, K. Bedkowski, D. Korpetta - **GPS-, Fernerkundungs- und GIS-Technologien zum Schutz der Biodiversität polnischer Forste**

Jane Drummond (U.K.)

Three of the presentations discussed country-wide digital databases. One discussed the construction of a

GIS user interface for ARC/INFO. Another one discussed automated cadastral mapping. Two discussed topographic mapping, one using MOMS-02 data, the other large scale photography.

The two best presentations were: Lüken programmed the user interface in AML. It allows for various environmental information to be presented in both text and graphical form.

Drummond discussed the use of large scale photography to map the dynamics of coastal madflats. The data is to be used to model probable locations of radioactive particles released from a nearby nuclear power plant.

COMMISSION IV

*Poster Session 40PA - **Mapping and GIS Applications***
July 12, 1996, 15:30-17:30
*Session Reporter: **Marguerite Madden Remillard** (USA)*
*Chairman: **Donald Light** (USA)*

Rafael Wiemker (Germany), K. Rohr, L. Binder, R.Sprengel, H.S. Stiehl – **Application of Elastic Registration to Imagery from Airborne Scanners**

Rafael Wiemker discussed the problems involved with registration of airborne scanner image data where flight tracks are not in a straight line and traditional polynomial approaches are not adequate. He introduced two alternative and parameter-free registration approaches, Radial Base function and Bivariate Akima Interpolation.

Pasi Laurila (Finland), H. Salmenperä – **Photogrammetric System Calibration**

Pasi Laurila presented a poster on photogrammetric system calibration that can be used to train and test stereo operators and test stereoplotters. Critical factors include primarily the stereo operators' skills, characteristics of the ground objects, the resolving power of the photographs and image deformations of the stereoplotter.

Hiroyuki Hasegawa (Japan), A. Okamoto, S. Hattori, T. Ono, K. Tachibana, M. Gildengorin – **Aerial Photo/ Triangulation Database System for Kobe Earthquake in 1995**

Ground control was resurveyed in 1996 with a GPS and used to map deformations from aerial photographs of 1:10,000 and 1:5,000 scales flown before and after the earthquake.

Gerhard Sehnalek (USA) – **Effective Ways to Revise Digital Maps and GIS Databases in Urban Areas**

Wilfried Müller (Germany), E. Seyfert – **Updating of the ATKIS Digital Landscape Model 25 at the State Survey Administration of Brandenburg**

Wilfried Muller introduced the Authoritative Topographic and Cartographic Information System

(ATKIS) that will be established in all states of Germany and contain landscape models with topographic objects and relief objects described by coordinates and attributes.

J. Raul Ramirez (USA) – **Spatial Data Revision: Toward an Integrated Solution Using New Technologies**

Raul Ramirez is interested in spatial data revision which he indicated in the United States implies a "total" revision approach since the average age of U.S. Geological Survey 1:24,000 scale topographic maps is 25 years. He stated that this is being done as a "cottage industry" in which 20 individual contractors are working out of their homes for the past three years on map revision.

**Torbjörn Westin** (Sweden) – **Photogrammetric Potential of JERS-1 OPS**

A robust method for photogrammetric restitution of along-track stereo image data (B/H only 0.27) was demonstrated with horizontal accuracies of +/- 7 m and vertical accuracies of +/- 20 m.

Zübeyde Alkis (Turkey) – **Design and Implementation of Geographic Information System for the Local Authorities in Turkey**

Zubeyde Alkis presented the design and implementation of a GIS for local authorities in Turkey in an urban application where cities are growing rapidly but are not developing properly. The database is being constructed from existing map sheets of various scales, dates and co-ordinate systems.

Yonglong Xu (Germany), V. Sasse, K. Harms – **The European Digital Road Map Multimap and its Applications**

Yonglong Xu presented the European Digital Road Map that integrates map and field information. Street networks and urban objects along with software for navigation is available for cities in Germany, Switzerland and England. The Vehicle Information System with Route Guidance accesses these databases to display the road networks, accept voice instructions, calculate alternate routes and provide information on traffic conditions.
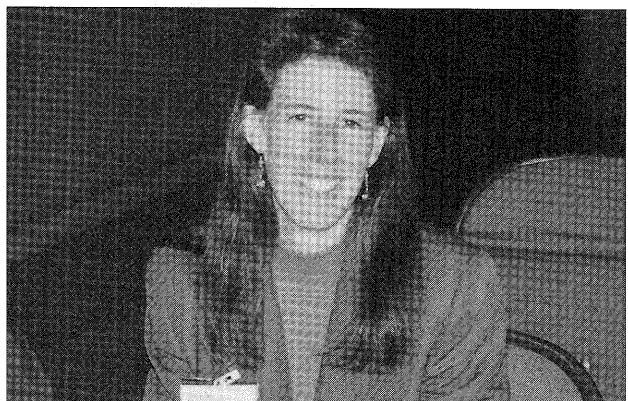
Marguerite Madden-Remillard, the soul of Commission IV

COMMISSION V
Working Group V/1

Session 5101 - **Knowledge-Based Vision Measurement Systems**
July 10, 1996, 8:45-10:15
Session Reporters: **Kam W. Wong** *(USA),*
John Fryer *(Australia)*
Chairman: **Kam W. Wong** *(USA)*

Sebastian Weik (Germany), O. Grau - **Recovering 3-D Object Geometry Using a Generic Constraint Description**

A knowledge-based approach was developed for the recognition of surfaces and their subsequent linkage to form a model of a building. The algorithm involved the use of a priori knowledge about the scene as well as geometric constraints.

L. C. Anderson (Australia), C. J. Bellman - **Uniformity and Proximity Applied to the Generalisation of Target Fields in Close Range Photogrammetry**

The paper reported on the use of uniformity and proximity criteria for the generalization of target fields into combinations of planes, cylinders, spheres and cones.

Augusto Sarti (Italy), F. Pedersini, S. Tubaro - **A Multi-View Trinocular System for Automatic 3-D Object Modeling And Rendering**

A system was developed to generate 3-D object models from images captured from a 3-camera set-up. The experimental routine achieved accuracies of 300 to 400 ppm for a complete reconstruction of a scene from a series of trinocular views.

Carl-Thomas Schneider (Germany) - **DPA-WIN - A PC Based Digital Photogrammetric Station for Fast and Flexible On-Site Measurement**

The paper described a digital system for the measurement of XYZ coordinates of targets in a 3-D field. The system is commonly available with either a Kodak DCS420 or 460 camera or a Rollei Chippack.

During question and discussion period, both C. Fraser and H. Beyer commented about highly automated systems such as that presented by Schneider are now used in industrial applications in 3-D targetting. However, the first three papers clearly pointed out some of the major problems associated with the automatic generation of digital models of objects or scenes from 2-D images.

COMMISSION V
Working Group V/1

Session 5102 - **Data Integration from Multiple Sensors**
July 15, 1996, 11:15-12:15
Session Reporters: **S. F. El-Hakim** *(Canada),*
John Fryer *(Australia)*
Chairman: **S. F. El-Hakim** *(Canada)*

Kazuo Oda (USA), T. Kanade, A. Yoshida, H. Kano, M. Tanaka - **A Video-Rate Stereo Machine and its Application to Virtual Reality**

Key points were: (1) A video-rate stereo machine which has the capability to calculate depth images in real-time has been developed, (2) The system uses up to 6 video cameras mounted on a specially designed head. Special hardware has been built for processing at frame rate.

This real-time depth mapping opens up new applications in virtual reality, particularly for those integrating graphic-based objects with the real objects captured by this multi-camera system. During question time, K. Oda suggested there are many factors affecting accuracy, especially the base separation of the cameras and the low resolution 256 by 240 of the images used (in order to get frame rate processing).

S. F. El-Hakim (Canada), J-A. Beraldin, G. Godin, P. Boulanger - **Two 3-D Sensors for Environment Modeling and Virtual Reality: Calibration and Multi-View Registration**

Key points were : (1) Laser-range cameras and digital photogrammetry are proposed for the creation of virtual reality scenes at high accuracy. (2) The special laser-range cameras have been developed by the National Research Council, Canada. (3) The paper showed their calibration and application for a model of size 7.5m from over 50 views.

It is believed laser-range cameras will gain in importance, used in conjunction with digital images, for the creation of virtual environments.

Claus Brenner (Germany), M. Hahn - **Object Recognition Using Multi-Sensor Fusion and Active Exploration**

Key points were : (1) A system consisting of a stereo camera, a laser point projector using coded light, a color CCD camera and several light source arrays has been developed. (2) The main purpose of this sensor integration was object recognition and inspection.

The system was the result of co-operation between five institutes at the University of Stuttgart.
In question time, the author said that the combination of sensors with different inherent accuracies must be seriously considered.

COMMISSION V
Working Group V/2

Session 5201 - **Developments in Close Range Imaging (Session Dedicated to Memories of Wilfried Wester-Ebbinghaus and Duane Brown)**
July 11, 1996, 1:30-3:00
Session Reporters: **Volker Uffenkamp** *(Germany),* **John Fryer** *(Australia)*
Chairman: **Horst A. Beyer** *(Germany)*

John Fryer (Australia) - **Single Station Self-Calibration Techniques**

The paper highlighted the work of Brown and Wester-Ebbinghaus in developing complementary camera calibration techniques which work from a single station by tilting the camera and rolling it for a series of images of a target field. The method has potential use in industrial and robotic applications.

Martin Michaelis (Germany) - **Kombination von Photogrammetrie und Streifenprojektion zur Vermessung großer Objekte**

The paper concentrated on the use of fringe-projection systems, combined with more conventional photo-grammetry, for applications in the car manufacturing industry. The result is a 3-D surface which can be displayed in certain perspective projections.

James Bethel (USA), J. Marshall - **Analysis of Residuals from L1 Norm Estimation**

The L1 estimation for the detection of blunders has some favourable convergence properties. L1 absorbtion numbers and redundancy numbers may be a useful concept worth exploring but some areas of difficulties were discussed such as non-uniqueness. A geodetic and photogrammetric example illustrated these points.

Horst A. Beyer (Germany), V. Uffenkamp, G. van der Vlugt - **Performance of Digital Photogrammetry - Automation and Accuracy**

Accuracy of digital photogrammetry has been proved against industrial standards. Many fields of applications are now in routine service. A highlight was a demonstration of a practical measurement by the speaker during his presentation. In question-time, Beyer answered that self-calibration was his calibration technique; targeted objects could be measured more accurately by a factor of 10 over non-targeted (imaged and matched) objects.

COMMISSION V
Working Group V/2

Session 5202 - **Performance of Modern Digital Systems**
July 12, 1996, 10:45-12:15
Session Reporters: **Horst A. Beyer** *(Germany),* **John Fryer** *(Australia)*
Chairman: **Volker Uffenkamp** *(Germany)*

Reinhard W. Malz (Germany) - HIGHLIGHT-PAPER: **"Flying" 3-D Sensors for Efficient Close-Range Measurement and Reverse Engineering**

A comprehensive summary of concepts and issues relating to detecting surface characteristics using different lighting sources. The calibration of light projector systems was also discussed.

Heinz Rüther (South Africa), G. van der Vlugt - **Multi-Image Correlation for Digital Photogrammetric Measurement Systems**

The advantages of multi-image correlation were discussed. The technique was outlined step-by-step and illustrated with several practical results.

Lucian Turdeanu (Romania), I. Ionescu, C. Nedelcu - **Sur l'utilisation des contraintes a l'ajustement simultane des observations photogrammétriques et geodésiques dans la photogrammétrie a courte distance**

The use of the collinearity equations for the simultaneous adjustment of geodetic and photogrammetric observations was outlined, along with constraint equations for parallelity, planarity and coplanarity of points and lines. A practical example on a facade was shown.

COMMISSION V
Working Group V/3

Session 5301 - **Industrial Applications of Vision Metrology**
July 16, 1996, 10:45-12:15
Session Reporter: **John Fryer** *(Australia)*
Chairman: **Clive S. Fraser** *(Australia)*

George W. Johnson (USA) - HIGHLIGHT-PAPER: **Practical Integration of Vision Metrology and CAD in Shipbuilding**

The use of digital photogrammetry in the day-to-day operations of a large ship-building yard was described. The human problems faced by a scientist in introducing a modern technology to an industry with a measurement ethic steeped in tradition should not be underestimated. The speaker presented a sympathetic view to the introduction of high technology to the ship-building

industry, liberalling sprinking illustrations and examples throughout his talk.

Werner Bösemann (Germany) - **The Optical Tube Measurement System OLM. Photogrammetric Methods used for Industrial Automation and Process Control**

A digital camera system for determing the size, shape and complications of bends in pipes was described. Accuracy of 0.5mm over lengths of 2.5m was demonstrated for this industrial apllication and quality control system.

Masumori Chida (Japan), H. Ohtani, N. Kochi, S. Nakamura, M. Yamada, T. Utiyama, T. Noma, H. Aoki, T. Ito - **The New System of Surface Measurement**

A two CCD-camera stereo system which uses projected light to place targets on an object such as the nose cone of the bullet train was described. The camera calibration with a test field was detailed.

Brian Macklin (United Kingdom), R. Brade, G. Celentano, J. Tait, E. van Lente - **Developments Towards Remote Metrology for Component Alignment under Conditions of Restricted Access in Jet's Toroidal Vacuum Vessel**

The survey of a large and extremely complicated research machine was described. The needs for accuracy simulation, target field placement and integration of measurement tools were highlighted.

Rongxing Li (Canada), C. Tao, W. Zou, R. G. Smith, T. A. Curran - **An Underwater Digital Photogrammetric System for Fishery Geomatics**

The use of CCD cameras for an underwater survey was described. Various sensors were integrated for the positioning of a Remotely Operated Vehicle which held the cameras.

COMMISSION V
Working Group V/3

Session 5302 - **Industrial Measurements for Reverse Engineering and CAD/CAM**
July 12, 1996, 3:30-5:00
Session Reporter: **Clive S. Fraser** *(Australia)*
Chairman: **Heinz Rüther** *(South Africa)*

André Streilein (Switzerland) - **Utilization of CAD Models for the Object Oriented Measurement of Industrial and Architectural Objects**

This paper demonstrated the effectiveness of employing CAD models for semi-automated feature extraction and results verification. The particular example of the Otto-Wagner Pavilion of Karlsplatz was highlighted.

Frank Petran (Germany), P. Krzystek, P. Bonitz - **CAD-Based Reverse Engineering with Digital Photogrammetry**

This paper focussed on the automated measurement of ordered point cloud data in digital close range stereo photogrammetry. An integration of CAD and photogrammetry was effected to enable surface extraction for reverse engineering in the automobile industry. Questions from W. Foerstner and C. Fraser were answered by stating that the procedure described was time-consuming and usually run as a batch job overnight.

Katri Oksanen (Finland) - **The Design and Simulation of Video Digitizing by Using Three-Dimensional CAD-Models**

The use of CAD-based network design and simulation for videometric networks was discussed, along with a visualisation tool. Responding to a question from H. Beyer, the author stated that the present system could not handle the problem of target occlusions.

Wolfgang Faig (Canada), H. El-Habrouk, X. P. Li, M. Hosny - **A Comparison of the Performance of Digital and Conventional Non-Metric Cameras for Engineering Applications**

A deformation survey of a lightweight wire-net roof structure was performed with both a non-metric 35mm and a CCD camera. The hard-copy photos were measured directly on an analytical plotter and also after scanning on the Digital Video Plotter, where also the digital images of the CCD camera have been measured. The CCD camera gave slightly better results but a question from the Chairman about the very small residuals and high accuracy claimed for the digital mensuration phase was not well explained.

Petros Patias (Greece), A. D. Styliadis, J. Paraschakis - **CAD-Supported Determination of Sensor Attitude in Terrestrial Photogrammetric Applications**

The paper centred on the use of CAD in the determination of initial values for exterior orientation in close range photogrammetric triangulation. The method hinges on achieving projective correspondence between a shape in the image and its equivalent in object space. Presently there is considerable manual intervention, and it was demonstrated on a near planar building facade. R. Munjy stated in question time that this approach was unnecessary, given the ability to solve the resection problem in a closed form via scale variations in the imagery.

COMMISSION V
Working Group V/4

John Badekas (Greece), C. Ioannidis, C. Potsiou - **3-D Detailed Reconstruction of a Demolished Building by Using Old Photographs**

The reconstruction of architectural plans from a combination of old aerial photographs, postcards, etc. for an old Town Hall was described. The use of a CAD system and analytical and digital photogrammetric techniques was stressed.

Laura Baratin (Italy), G. Folloni, J. P. Saint Aubin - **PAROS: Un système d'information pour l'architecture**

The PAROS system integrates several survey techniques and information systems for heritage preservation projects. An analysis of the architectural information system was presented.

Michel Florenzano (France), J.-Y. Blaise, P. Drap - **PAROS: Le sens de la mesure. Photogrammétrie et modèles architecturaux: Le cas du forum antique de la ville d'Arles (France)**

This paper also described the PAROS system and its use to construct virtual representations of historical buildings and enhance the CAD models with draping of actual photographs.

Giorgio Vassena (Italy), T. Kludas, J.-U.. Pfeil, M. Scaioni - **Automatic DEM Generation Using Digital System InduSURF: An Application to the Artworks of Milano Cathedral Finalized to Realize Physical Marble Copies**

Restoration work on the Milan Cathedral was described, especially the replication of statues and images from a very high number of points (up to 500,000 for a sculpture). It is now possible to record and reproduce physical copies in marble.

COMMISSION V
Working Group V/4

Cliff Ogleby (Australia) - **A Reconstruction of the Ancient Thai City of Ayutthaya Using Modern Photogrammetric Techniques**

Photogrammetry along with historical data is used to create a 3-D virtual reconstruction of a historic city. The final result of this ongoing project will be a video animation of life in the ancient city and a bi-lingual CD-ROM for distribution to schools in Thailand.

Urs Hirschberg (Switzerland) - **Object-Oriented Data-Integration between Digital Architectural Photogrammetry and CAAD**

Object-orientated data integration between digital photogrammetry and CAD has been made. The use of CAD models as the basis of measurement was stressed.

Albert Wiedemann (Germany) - **Digital Orthoimages in Architectural Photogrammetry Using Digital Surface Models**

Based on CAD modelling, architectural orthoimages using digital surface models are generated. Occluded areas have been eliminated and pixel by pixel 'rectification' using the collinearity equations takes place. During questioning, it was pointed out that many clients prefer original photos taken square-off rather than suffer rectification.

Hirofumi Chikatsu (Japan), K. Nakano, T. Anai - **A Study on Real-Time Photogrammetry for Archaeological Sites Using Wireless CCD Camera**

Many architectural sites are examined in Japan each year. The use of a tethered balloon or kite equipped with a camera which can transmit images was described. The result is near-real time recording of sites.

COMMISSION V
Working Group V/4

Session 5403 - **Methods in Architectural and Archaeological Photogrammetry**
July 19, 1996, 11:15-12:15
Session Reporter: **Klaus Hanke** *(Austria)*
Chairman: **Cliff Ogleby** *(Australia)*

Wolfgang Böhler (Germany), G. Heinz - **Methods of Surveying in Archaeology demonstrated at the Tang Emperors' Mausoleums**

This paper reviewed surveying methods and their applications for archaeological documentation. An excellent description of work proceeding on the Tang Emperors' Mausoleums Documentation Project in China was then described.

Michael Doneus (Austria) - **Photogrammetrical Applications to Aerial Archaeology at the Institute for Prehistory of the University of Vienna, Austria**

From an archaeologist's point of view, aerial photogrammetric applications were described. Digital orthophoto production was mentioned and the use of various techniques for determining the characteristics of an archaeological site illustrated with practical examples.

Józef J. Jachimski (Poland), J. M. Zielinski - **Digital Stereoplotter for Historic Monuments Recording**

The authors have developed a cheap digital stereoplotter VSD based on a PC and stereo observation by half-screen digital images and a simple mirror stereoscope. The easy to handle system is equipped with several special functions indispensable or at least recommendable for architectural photogrammetry. It has been tested at many monuments.

COMMISSION V
Working Group V/5

Session 5501 - **Biomechanics**
July 11, 1996, 8:45-10:15
Session Reporter: **Harvey Mitchell** *(Australia)*
Chairman: **Thomas Leemann** *(Switzerland)*

Helga Gäbel (Germany), D. Kakoschke - **Photogrammetric Quantification of Changes of Soft-Tissue after Skeletal Treatment of the Facial Part of the Skull**

A system, comprising four digital cameras and either a projected dot or grid pattern, is used to photogrammetrically record the shape of the face both before and after surgical reconstruction of the jaw. Questions concerned the total time which the procedure required, from imagery to results, and whether the facial measurement was related to radiograph information.

Harvey Mitchell (Australia), T. Leemann - **Issues in Medical Photogrammetry in the Digital Imaging Era**

The paper indicated that many digital image - based systems were an offer to the medical community but photogrammetrists had little input to these systems. However, wishes for photogrammetric development do exist. Discussion referred to the photogrammetrists' forte in image correlation, and to the meeting on human motion analysis (Grenoble, June 1996) at which a group interested in photogrammetry was formed.

Hirofumi Chikatsu (Japan), T. Anai, S. Murai, H. Yanagi - **Dynamic Analysis of Human Motion Using Sequential Images of Video Theodolite**

This paper concerned the photogrammetric recording of human walking over short distances using CCD/Theodolite technology to record a series of eight frames over two seconds, with automatic feature extraction by templates to assist processing. The paper did not generate discussion

Masako Tsuruoka (Japan), R. Shibasaki, S. Murai, M. Kurita, T. Wada, E. O. Box - **Spectral Analysis of a Human Walking Sequence Using Medical Stereo Images**

This paper emphasized the analysis of the motion to derive medically relevant information. The paper did not generate discussion.

COMMISSION V
Working Group V/5

Session 5502 - **Body Shape Measurement**
July 11, 1996, 3:30-5:00
Session Reporter: **Thomas Leemann** *(Switzerland)*
Chairman: **Harvey Mitchell** *(Australia)*

Ian Newton (United Kingdom), P. Thomas, K. Fanibunda - **Evaluation of a Low Cost Digital Photogrammetric System for Medical Applications**

The use of low-cost, off-the-shelf, digital imaging equipment and PC-based software for medical applications were described. One application was for combining a radiograph and a digital image of the head for dental studies and another was for back shape measurement.

Wolfram Höflinger (Austria) - **Digital Stereophotogrammetric Solutions for Orthodontics**

An innovative solution for digital measurement for orthodontic treatment was discussed. A system using a front-surfaced mirror with in-built reseau crosses was used. The goal of the project is the development of a more or less fully automatic measuring system that allows for the determination of 3-D position and orientation changes of every single tooth with an accuracy of better than 100 microns during orthodontic treatment. The

excellent presentation concluded with a video showing mobile DTMs of a mouthful of teeth.

Thomas Leemann (Switzerland), F. Margadant, H. Walt, U. Haller, P. Niederer - **Quantitative 3-D Microscopy for Photodynamic Therapy of Cancer Cells**

The use of a confocal laser scanning microscope to take multiple images of tumors was discussed. It is important to quantify the local concentration and spatial location of the sensitizer used to illuminate the tumor.

Jon Osborn (Australia), G. Wise – **Stereophotogrammetric Mapping of the Anterior Surface of the Human Cornea**

The key points were: (1) the importance of corneal topography, especially for corrective surgery; (2) three different approaches to measuring corneal topography with i) reflected mires, ii) structural light with self-luminance, iii) stereophotogrammetry with a targetted cornea, and (3) results using stereophotogrammetry.

INTER - COMMISSION V
Working Group V/III

Session 5001 - **Image Sequence Analysis: sensors, systems and applications**
July 17, 1996, 3:30-5:00
Session Reporter: **John Fryer** *(Australia)*
Chairman: **Emmanuel Baltsavias** *(Switzerland)*

Jürgen Peipe (Germany), J. Dold - **High Resolution Data Acquisition to Observe Moving Objects**

Test measurements of a moving object - a rotating bar with targets on the end - were performed with Kodak DCS-460 cameras and the V-STARS software package. Comparisons were made with the SMART 310 Laser Tracker. The advantages with photogrammetry were the ability to locate many targets per epoch.

Peter Geissler (Germany), B. Jähne - **A 3-D Sensor for the Measurement of Particle Concentration from Image Sequences**

The measurement of the size and concentration of small bubbles was described.

The key points were : (1) the depth was determined from focus, (2) processing of the CCD images can overcome problems with poorly defined bubbles, and (3) a calibration using pseudo bubble sizes and shapes was used.

Frank Hering (Germany), G. Balschbach, B. Jähne - **A Novel System for the Combined Measurement of Wave- and Flow-Fields Beneath Wind Induced Water Waves**

The slope of small waves in a test tank was measured and the path of small particles placed in the flow tracked.

Concentrations of up to 1000 particles per image can be tracked.

Osamu Murakami (Japan), Y. Matsumoto, M. Nakagawa - **Measurement of Railway Surface Flaws with the CCD Line Sensor Camera System**

The maintenance of railway tracks to detect flaws in the surface of the rails is done with a CCD Line Sensor Camera, high speed data recorder and a powerful workstation. The key problem was the illumination of the shiny rail surface. The use of video tape meant that approximately 10,000 line scans per second could be recorded at 512 pixels per line.

INTER - COMMISSION V
Working Group V/III

Session 5002 - **Target Measurement and Object Reconstruction in Automatic Processes**
July 18, 1996, 11:15-12:15
Session Reporter: **John Fryer** *(Australia)*
Chairman: **Emmanuel Baltsavias**

Thomas Luhmann (Germany) - **Results of the German Comparison Test for Digital Point Operators**

The results of a comparison test for the sub-pixel measurement of targets in digital close range images were presented. Some targets were synthetic and others real and their shape severely distorted (poorly imaged) for some tests. The best accuracy obtained for real targets was approximately 1/50th pixel. The test data can be obtained from the author.

Jussi Heikkinen (Finland) - **Object Reconstruction from Images of a Moving Camera**

A technique to reconstruct a stationary object from a moving camera was presented. Feature based matching was used and the aim was to use tremendous redundancy to overcome poor observational accuracy. Only simulation data used to date, with the project ongoing.

Jin Chen (United Kingdom), S. Robson, M. A. R. Cooper, R. N. Taylor - **An Evaluation of Three Different Image Capture Methods Suitable for Measurement and Analysis of Deformation within a Geotechnical Centrifuge**

The key points were: (1) to evaluate the geometric properties of devices used to store long sequences of images; (2) S-VHS video recorder, J-PEG image compression and on-line measurement of target coordinates applying a priori knowledge were used; (3) results show JPEG compression of 50:1 can be used for retro-reflective targets if only 1/10th of a pixel accuracy is required.

Poster Session 50P1 - **Aspects of Close Range Measurement**
July 10, 1996, 10:30-12:30
Session Reporter: **Mark Shortis** *(Australia)*
Chairman: **John Fryer** *(Australia)*

Kenneth Edmundson (Australia), C. S. Fraser - **Implementation of Sequential Estimation for Single-Sensor Vision Metrology**

The key points were: (1) the merits of sequential estimation have already been established by on-line triangulation, robot vision, image sequence analysis and autonomous vehicle navigation, (2) sequential estimation improves the speed and efficiency of the triangulation from the on-line inclusion of quality control and observational error detection, (3) sequential adjustment can be incorporated into single-sensor vision metrology for industrial inspection, so (4) the issues of sequential data collection and the structure of the bundle solution are described and (5) the implementation of the solution with respect to approximate values, blunder detection and datum establishment are discussed.

Yoshiaki Takahashi (Japan), H. Itoh, N. Fujii - **Advanced Study of Non-Prism Laser-Ranger and its Imaging (Low-Cost 3-D Imaging and Range Imaging Using Non-Prism Laser-Ranger)**

This is a development of a terrain profiling equipment using a range finder from the market place, yet of high performance and economical.

The key points were (1) to develop a method of acquiring the shape of the ground surface directly from the sky, without the use of image data, such as photos or videos, (2) using non-prism laser-ranger available in the market, (3) to design economical and eye safe yet high performance and (4) low-cost 3-D imaging and range imaging were an aim in the development.

Jürgen Dold (Switzerland) - **Influence of Target Size on the Results of Photogrammetric Bundle Adjustment**

This paper introduces the method to estimate the minimal and maximal target diameter for high precision close-range photogrammetric applications. A simulation will be presented to demonstrate the influence of large target diameter on the results of photogrammetric bundle adjustment.

Marco Scaioni (Italy), G. Forlani, G. Vassena, A. Guissani - **Target Detection and Epipolar Geometry for Image Orientation in Close-Range Photogrammetry**

The measurement of complex 3-D objects still requires a considerable amount of manual intervention. Improved automation of the sub-task of point transfer and exterior orientation is required. A technique for the automatic location and numbering of targets is presented. Using an epipolar constraint, automatic exterior

orientation of any other photograph can be implemented once three image correspondences are determined.

Mark Shortis (Australia), S. Robson, T. Short - **Multiple Focus Calibration of a Still Video Camera**

The key points were: (1) still video cameras are widely used in industrial metrology and sensor resolutions are increasing with advances in technology, (2) external accuracies from bundle solutions often do not match the internal precisions, (3) the accuracy is dependent on the fidelity of the collinearity model, so (4) research is being conducted to develop and verify an extended lens model allowing for variation of distortion with distance and variation of distortion within the camera depth of field and (5) experiments are underway to determine the shape of CCD sensors from direct measurement with laser interferometers.

Piotr Sawicki (Poland), B. Wiecek - **CCD Multicameras Interactive Digital System for Close Range Photogrammetric Applications**

The presented system is the result of the first stage of the research. A new video-thermal digital photo-grammetric system is being developed at present. On the basis of one frame grabber a thermal sensor and four CCD cameras will be integrated. It will serve for multi-purpose industrial monitoring.

Bernd Pollak (Germany) - **Configuration Optimization and Workspace Enlargement of CCD-Video-Cameras**

The key points were: (1) CCD video systems are gaining increasing importance in industrial quality control, (2) such systems are limited by their relatively low resolution and consequent small operating range, (3) enlargement of the operating range is possible using a flexible configuration and (4) video systems can be combined with other techniques such as video theodolites.

Masaru Mori (Japan), R. Yamana, T. Yahara, M. Setojima, Y. Akamatsu - **Discussion on the Automatic Measurement of Traffic Flow by Video Camera Mounted on Balloon**

The key points were: (1) Traffic flow monitoring system using a video camera system mounted on a balloon, (2) automatic measurement of velocity using a running locus of cars on the road with real-time image correlation processing equipment, (3) examination of the accuracy of measurement. The measurement errors of velocity and the running locus of cars are sufficiently small if the vehicles and road surface can be distinguished by image correlation and matching.

Wolfgang Faig (Canada), C.-K. Lee - **Vibration Monitoring with Video Cameras**

The key points were: (1) video cameras have suitable characteristics for dynamic scene analysis, (2) there is a requirement to model the displacements and vibrations of vehicles in motion, (3) a system using targeted points, camcorders, a frame grabber and the DLT solution was designed and (4) displacements of the targets were successfully measured.

Amir Saeed Homainejad (Australia) - **Real Time Tracking a Dynamic Object**

The key points were: (1) a study on real time stereo matching and developing a program for stereo matching in real time, (2) study and developing a program for real time visual system positioning and (3) developing a method for real time object detection and tracking.

Yury V. Morzeev (Russia), Y. V. Visilter, S. Y. Zheltov, A. A. Stepanov - **Frame-based Analysis of Multisensor Image Sequences**

The key points were: (1) the combined analysis of multi-images is gaining more interest, (2) a system has been designed to allow the further development of multi-sensor data fusion algorithms and (3) the system is modular to allow various filters to be applied in order to (4) apply data fusion at the pixel, feature vector and soft-vector levels for target recognition.

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Poster Session 50P2 - **Industrial and Other Close Range Applications**
July 12, 1996, 12:30-2:30
Session Reporter: **John Fryer** *(Australia)*
Chairman: **Mark Shortis** *(Australia)*

Dana Klimesová (Czech Republic), T. Suk - **Image Sequence Analysis**

Examples of aerial photography were presented to illustrate problems in image sequence analysis. The key points were difficulties with image registration on long period data and the possibility to evaluate trends over time.

Atsuyuki Matsumoto (Japan), F. Souda - **Data Fusion of Three Dimensional Measurement and CAD in Plant Construction**

The presentation concentrated on the measurement of pipes in a chemical plant. The differences between theodolite total stations and photogrammetric techniques were highlighted and the use of CAD emphasised. The problems of 'off-set' targets to flange holes were examined.

Franco Guzzetti (Italy), G. Forlani, L. Pinto - **Reconstruction of the Deformation Surface of CFER Panels**

Carbon Fibre panels were examined for deformation by: photography with a Rollei camera; scanning of the film images; template least squares matching; and, production of deformation surfaces to show the results of bending tests. The photogrammetric results were compared with finite element predictions which indicated that the theoretical model could be refined.

Yongru Huang (Australia), J. C. Trinder, B. Donnelly - **Object Recognition for a Flexible Manufacturing System**

A complete procedure was described to recognise 3-D objects, using model-based recognition techniques. Objects in the scene are reconstructed by digital photogrammetry, while those in the data base are generated by a CAD system. Details of this operational system (still in its infancy) were presented.

Pavel Bartos (Slovak Republic), V. Gregor - **Photogrammetric Measurement of Deformations of the Gabcikovo Lock Gate**

This lock is one of the world's largest and the deformations of the lock gate were determined to an accuracy of better than 3 mm. The total deformation was 45 mm. The ORIENT software system was used after the Zeiss UMK super wide angle photographs had been measured on a Zeiss Jena stereocomparator.

Heinrich Schewe (Germany), E. Moncrieff, L. Gründig - **Improvement of Fishfarm Pen Design Using Computational Structural Modelling and Large-Scale Underwater Photogrammetry (CoSMoLUP)**

The 3-D geometry of the underwater nets used in fishfarm pens was reconstructed from underwater CCD video cameras. The accuracy achieved was 30 to 50 mm which was considered excellent for a dynamic object of size 15 m x 15 m x 15 m in a water environment, especially considering a diver had to swim around the net to take the video pictures in poor lighting conditions. Interesting calibration problems were clearly solved.

Kosuke Tsuru (Japan), T. Inoue, N. Ogino, N. Matsuyama, T. Nanjo, N. Yano, T. Hino - **A Study and Development for Stereo Fundus Camera System Using Stereo Matching Technique**

A fully automatic system to obtain 3-D information of human eye fundus images was presented. The aim was to examine for glaucoma, and a CCD-camera was used to gather data for stereo-matching and final presentation of the DTM as a draped image. A very colourful poster was presented.

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Barbara van Geems (South Africa) - **The Use of Multiple Surviews of a Computed Tomography Scanner to Determine the 3-D Coordinates of External Cranial Markers**

Computer Tomography (CT) surviews were taken from different positions on the CT gantry and were used as an equivalent multiple camera set-up. The positions of cranial markers could be determined using a specially modified DLT formulation since CT surviews are not central projections.

Kevin Jones (Australia), G. N. Askin, W. E. Ryan, C. Natalie, A. D. Porter - **Measurement of Spinal Deformities Using Stereophotogrammetry**

Back shape measurement was done with a single camera photographing through a mirror-stereoscope type device to obtain a stereopair. The photogrammetric model, and not the image, was the basis for calibration. Accuracies of 3 mm were obtained on repeated testing of human models using targets on their backs. The aim was to reduce radiographic examinations.

Kengo Miyashita (Japan), T. Sekita, S. Minakuchi, Y. Hirano, K. Kobayashi, M. Nagao - **Denture Mobility Measuring System of Complete Dentures using Four Infrared Video Cameras**

Hundreds of targets were measured with CCD cameras to determine the mobility and movement of teeth and jaws. Innovative targets are described which allowed movements to be determined to 0.3 mm

James Bethel (USA), A. W. Voss - **Valve Measurement Using Photogrammetric Feature Modeling**

The size of flanges, pipes and bolt holes were measured in a non-contact manner using mirrors to obtain some of the more difficult images. Feature extraction and CAD modelling was performed and although the results to date were not up to the precision expected. The project is ongoing.

S. Robson (United Kingdom), H. B. Setan - **The Dynamic Digital Photogrammetric Measurement and Visualisation of a 21m Wind Turbine Blade Undergoing Structural Analysis**

Five multiplexed CCD cameras were used with retro-reflective targets to monitor the deformation of a long wind turbine blade which was subjected to loading tests. Target accuracies under 0.2 mm were achieved and vector plots of target movements between loading epochs produced.

Rolf-Peter Mark (Germany) - **Optical 3-D Measurement Techniques for Industry - New Photogrammetric Solutions and Applications**

A range of photogrammetric techniques and equipment was presented on this poster for a commercial manufacturer - the poster display aroused considerable interest, but a paper was not available for distribution.

Clemente di Thiene (Italy), L. Fregonese, L. Pilot, F. Guerra, C. Balletti - **Photogrammetry and Survey Procedures for the Analysis of Venetian Villas : the Case Study of Villa Zeno by Andrea Palladio**

The results of a test study into the architectural photogrammetric survey of a Venetian villa was presented. Historical drawings, maps, plans and recent surveys were combined to discover how the villa had been altered over time. A CD-ROM of all the data gathered should be the final outcome of this project.

A. T. D. Deacon (United Kingdom), D. P. Chapman, A. Hamid, M. A. Jones - **Spatially Indexed Image Archives**

This presentation was added to the program too late for publication and there was insufficient time for the author to give a verbal report. The poster presentation attracted considerable attention but no copy of the paper was obtainable by this reviewer. The contents will be published elsewhere.

INTER - COMMISSION V
Working Group V/III

Poster Session 50P3 - **Techniques in Architectural and Archaeological Reconstruction**
July 18, 1996, 3:00-5:00
Session Reporter: **Mark Shortis** *(Australia)*
Chairman: **Cliff Ogleby** *(Australia)*

Antonio Arrighi (Italy) - **Via Georgofili, May 27, 1993: A Testimony**

The survey of the Pulci tower and its surrounding area in order to document the consequences of an attack in 1993. Terrestrial as well as aerial photographs were used to construct 3-D models of the damaged Uffici Gallery which were presented from various view points.

Camillo José Martins Gomes (Brazil), W. Prado, C. Pires, L. Alves, H. Erwes - **Tower Castle of Garcia D'Avila - First Outcomes for the Restoration Procedures**

The Brazilian experience in the preservation of historical monuments was presented, illustrated with the documentation of a 16th Century tower. Photogrammetric restitution and digital orthophotos used.

George E. Karras (Greece), P. Patias, E. Petsa - **Digital Monoplotting and Photo-Unwrapping of Developable Surfaces in Architectural Photogrammetry**

The use of digital monoplotting (that is using one image at a time) is shown in the case of a railway water-tower to develop a mosaic of raster and vector developments of the surface.

Pierre Grussenmeyer (France), F. Perdrizet - **Archaeological Photogrammetry with Small Format Cameras: The Survey of the Forum Vetus of Sarmizegetusa (Romania)**

Key points were: 1) Planning in archaeology for mapping a Roman forum with stonework and excavations; 2) low-cost data capture with a small format camera; 3) ORIENT software and 4) analytical stereoplotting.

Bock-Mo Yeu (South Korea), Y.-I. Kim, W. Kim, Y. Ryu - **Cultural Assets Preservation Using Digital Photogrammetry Methods**

Key points were: 1) Data acquisition by digital photogrammetry, 2) preservation of cultural monuments; 3) example of Buddha statue.

Hirofumi Chikatsu (Japan), K. Hatano, H. Yokoyama - **Real-time Ortho Projection and Drawing for Archaeological Artifacts of Complicated Form**

Key points were summarised as 1) ortho projection; 2) image synthesis; 3) real-time; 4) application to a complex vase object.

Klaus Hanke (Austria), Mostafa Abdel-Bary Ebrahim - **A General Approach for Object Oriented 3-D Mapping in Digital Close Range Restitution**

Key points were: 1) 3-D object oriented digital restitution; 2) draping of original images on surface model 3) a new technique for digital restitution of any arbitrary surface using a ray-tracing program.

Frank Boochs (Germany), G. Heinz - **Generation and Use of Surface Models for Volume Objects**

Digital photogrammetry used to reproduce 3-D surfaces. Image matching used in the data collection. Examples from China used with tomb location and stone sculpture reconstruction.

Jolanta Malgorzata Orlinska (Poland), R. Preuss - **Numerical Inventory of Architectural Objects**

Model reconstruction of the Vienna Karlsplatz underground station using metric and non-metric cameras with analytical stereoplotter and Microstation. This is a part of the international CIPA test concerning the accuracy and reliability of amateur photogrammetry.

Peggy Freudenreich (Germany) - **Photorealistic Presentation of the Palais Grand Ducal Based on Photogrammetric Recording**

A 3-D CAD model from photogrammetric measurements which fulfils the requirements of hidden-line and rendering functions was built. Rollei 3003, Rollei metric MR2, AUTOCAD and AccuRendo packages were used to produce a photo realistic model.

Petros Patias (Greece), A. Streilein - **Contribution of Videogrammetry to the Architectural Restitution Results of the CIPA "Otto Wagner Pavillon" Test**

The use of camcorders for the Karlsplatz test are compared to the results of conventional photogrammetry. The advantages of videogrammetry were extolled.

Günter Pomaska (Germany) - **Implementation of Digital 3-D Models in Building Surveys Based on Multi Image Photogrammetry**

An ancient castle was reconstructed from multi-image photogrammetry. Image rectification with bitmap mapping used.

Manfred Weisensee (Germany), R.-D. Düppe - **Ist die Photogrammetrie reif für das Museum?**

Examples for the application of standard techniques of photogrammetry, cartography and remote sensing to non-standard tasks in architecture, archaeology and history of arts have been given.

Erwin Heine (Austria) - **Architekturdokumentation und High End Computeranimation mit synthetischen Architekturmodellen**

The detailed analysis of architectural objects and their visualisation is presented. A digital 3-D model was constructed of a Maya architecture model and an animation presented by video.

INTER - COMMISSION V
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Poster Session 50P4 - **Further Applications in Close Range Photogrammetry**
July 11, 1996, 9:00-11:00
Session Reporter: **Clive S. Fraser** *(Australia)*
Chairman: **Clive S. Fraser** *(Australia)*

Piero de Fazio (Italy), J. Jansa - **Generation of a Panorama Mosaic for the Dome of a Planetarium**

This paper concerned the use of digitized amateur photographs to form a projected panorama mosaic for a hemispherical planetarium dome. The emphasis of the paper was on the use of digital image processing to create a geometrically and radiometrically continuous panorama projection.

Orhan Altan (Turkey), G. Toz, S. Külür, D. Z. Seker, A. Iyidiker, H. Iyidiker, Z. Duran - **Die photogrammetrische Ergänzung der Karte der Ruine von Hattusas, der Hauptstadt des Hethiter Reiches**

The subject of the paper was the integration of traditional surveying techniques and terrestrial photogrammetry for the map revision process for an ancient city.

Francesco Guerra (Italy) - **Archaeology and Photogrammetry: The Site of Laodikeia**

This paper also concerned an archaeological photogrammetric survey in Turkey. A review was given of the survey program for the site of the ancient city of Laodiceia and mapping results obtained to date were presented.

Jozef Cernansky (Slovak Republic) - **Long Time Photogrammetric Measurement of Rockfill Dam**

This paper which addressed the topic of deformation monitoring of a rockfill dam by photogrammetry. Photogrammetric techniques have been integrated with geodetic survey method, for the multi-epoch measurements of spatial displacements to an accuracy of a few millimetres.

Arnaud Dumont (France) - **Measurement in Hazardous Environment: Review of Several Applications**

The paper "Measurement in Hazardous Environments Review of Several Applications" by A. Dumond of France was presented by F. Signorette. The application of photogrammetric techniques in radioactive, underwater and thermal chamber environments was discussed, with emphasis being placed on process industrialization and integration with CAD/CAM.

Steffen Landes (Germany), H.-P. Bähr, K. Ringle - **Architectural Photogrammetry and Picture Processing for Acquisition and Documentation of a Brazilian Town Ensemble**

A two stage process for the documentation of building facades was described, which employed low-cost image acquisition and orthophoto generation followed by archival of the data in an urban information system.

Yoshito Miyatsuka (Japan) - **Archaeological Real-time Photogrammetric System using Digital Still Camera**

A system based on the use of a DCS460 camera, coupled with orthoimage generation and a level of automated feature extraction was described. Fast digital techniques are required to fulfil the requirements of 8000 archaeological site surveys per year in Japan.

Rajendra Singh (United Kingdom), D. P. Chapman, K. B. Atkinson - **Laser Dot-Matrix Based Digital System for Monitoring Textureless Roof Strata of Mines**

The problems of conjugate point identification and object targetting were solved for the case of photogrammetrically measuring mine shaft roofs by a laser dot matrix projection system. The imaging system is complemented by a motor driven turning and tilting device for the CCD camera.

Tosio Koizumi (Japan), K. Ono, H. Kawasaki - **Drawing Up of a Fireworks Viewing Area Map**

The subject matter dealt with the use of balloon photography to establish a 'line of sight' map for the viewing of fireworks displays.

COMMISSION VI
Working Group VI/1

Session 6101 - **Education and Training**
July 11, 1996, 13:30-15:00
Session Reporter: **Wladyslaw Mierzwa** *(Poland)*
Chairman: **Józef Jachimski** *(Poland)*

Olubodun Ayeni (Nigeria) - **Digital Mapping and GIS Education in Developing Countries**

Digital Mapping for the purpose of this paper is defined in terms of operational activities involved in Digital Surveying, Digital Photogrammetry, Digital Remote Sensing and Digital Cartography. Its relationship with GIS and Computer Assisted Mapping is explained. A survey was conducted country-wide at tertiary level institutions in order to provide answers to questions such al "How have the developing countries fared in the acquisition and application of modern techniques of Digital Mapping and GIS education?"

The result of the survey shows that developing countries and their tertiary institutions can be divided into four categories in descending order of advanced development of modern techniques. The fourth category represented by least developed countries needs urgent attention.

The survey also portrays North-South technical co-operation between developed and developing countries as a necessity for all developing countries for the acquisition of Digital Mapping and GIS education and its application for mapping projects. Donor countries and agencies involved in this type of co-operation are identified and commended. Possibilities for potential South-South technical co-operation amongst developing countries are also identified. The merits of multinational co-operation through regional centres and multi-institutional linkage co-operation are highlighted and encouraged.

Manfred Wiggenhagen (Germany) - **Data Fusion and Data Integration of Raster and Vector Data**

This paper presents methods and algorithms for data fusion and data integration of digital raster and vector data. In education and training it is very important to explain the differences of standard image file formats, the necessary transformation methods and practical solutions for image processing on personal computers and workstations. Principally two different data types have to be considered. Raster formats of digital satellite and digitised aerial photographs as well as vector formats for all additional interpretations can be handled by most of the known standard and individual software packages. It is shown that standard hardware and software components on modern personal computers are sufficient for image interpretation and image processing in education. To enlarge the acceptance of potential applicants new individual image processing software has been developed which will be described in this paper. With this software geometric image correction, rectification, digital image mosaicking and radiometric

correction of digital images can be carried out in education and training.

Q (D. Li - P. R. of China): Did you put your data fusion software and data in your institution's Homepage for any use by other university students and developing countries?

A: I'd like to do this job, but I have no time. I need the necessary support to do it.

C (D. Li): Comm VI has a special WG: Computer assisted Teaching. You can contact the WG. Chairman is Prof. Kohei Cho. And you are also welcome to attend the CAT Contest tomorrow.

COMMISSION VI
Working Group VI/2

Session 6201 - **Computer Assisted Teaching (CAT)**
July 17, 1996, 8:45-10:15
Session Reporter: **Walter Schuhr** *(Germany)*
Chairman: **Kohei Cho** *(Japan)*

Kohei Cho (Japan), S. Takeuchi, N. Duong, R. Fuhu, M. Nakai - **Toward the Optimization of PC Based Training for Remote Sensing and GIS**

Key points were: There are mainly three critical matters in computer assisted hands on training: They are 1) computer operation complexity, 2) software availability and 3) data set availability. To solve these problems, within the framework of the Regional Remote Sensing Seminar on Tropical Ecosystem Management, three days hand-on training is performed with provision of good software and CD-ROM data sets to trainees free of charge. To keep this kind of mechanism, feed back from trainees is necessary.

Jonas Nelson (Sweden) - **PC-TAS: PC-Tooled Analytical Stereo-modelling Making Use of Microsoft Excel for Education in Basic Analytical Photogrammetry**

The Dept. of Geodesy and Photogrammetry at the Royal Institute of Technology Stockholm (R.I.T.) realised that a single analytical stereoplotter would not be enough when we were to teach over 100 students in a single course. To solve this problem, we developed PC-TAS, which is a way to teach the basics of analytical photogrammetry using cheap equipment: a digitising table and an ordinary PC with Microsoft Excel.

Q1:How is least squares adjustment achieved?
A: By Excel.

Q2:Are you considering to extend your software to use digital images?
A: No plan.

Joachim Höhle (Denmark) - **Learning Digital Photogrammetry by Means of Personal Computers**

The paper dealt with a new CAT/CAL program "Learning about Digital Photogrammetry". With the help of one subject "The automatic measurement of réseau crosses" he wants to explain, what CAT/CAL is and what it can do in the training for sophisticated topics.

Q: Do you have any ideas of using networks in the future for computer assisted teaching?
A: We should be using internet for our next step.

Andreas Georgopoulos (Greece), V. Fotinopoulos - **'Photogrammetrist v. 1.0': The Greek Introduction to Photogrammetry**

"Photogrammetrist v. 1.0" is a Computer Assisted Learning software package aiming to introduce 3rd year students to Photogrammetry. This package employs multimedia technology while, at the same time, keeping the hardware requirements low. "Photogrammetrist v. 1.0" is comprised of seven books, which may be studied independently. The study sequence is concluded by exercises with simple questions, which intend to help the self studying student to assess his progress.

Dinh Duong Nguyen (Vietnam), S. Takeuchi, K. Cho - **ASEAN - An Image Analysis System for Remote Sensing Training and Education**

The image analysis system ASEAN (Advanced System for Environmental ANalysis with Remote Sensing Data) was developed by the Institute for Geography, NCST of Vietnam under technical co-operation with the Remote Sensing Technology Centre of Japan and financial support by the National Space Development Agency of Japan. There are two versions of ASEAN, ASEAN for DOS operating systems and WinASEAN for Windows environment.

Principal functions of ASEAN cover most basic items of image analysis and they are divided into groups as pre-processing, image display multispectral classification, post classification, geometric correction, change analysis, bird's eye view generation and image overlay.

At the present time, the ASEAN is used for remote sensing training in many countries in the South-East Asia region and it is released through the annual Regional Remote Sensing Seminar on Tropical Eco-System Management organised by NASDA, UNCRD and ESCAP and other JICA training workshop as public domain software.

COMMISSION VI
Working Group VI/4

Session 6401 - **International Co-operation and Technology Transfer**
July 10, 1996, 11:15-12:15
Session Reporter: **Stanley A. Morain** *(USA)*
Chairman: **Stanley A. Morain** *(USA)*

Seppo Väätäinen (Finland), M. Holm - **The Remote Sensing Visual Library on the World Wide Web**

Key points were: "Virtual Library of Remote Sensing" is available on the World Wide Web. The URL for this site is http://www.vtt.fi./aut/ava/rs/virtual/ It is divided into "What's New, Remote Sensing Organisations" - by regions of the world, and "Other Remote Sensing Information" - by topics. This database has grown so rapidly that the next version will be key worded with a search engine for quickly finding items of interest.

Q1 (M. Kopp - Austria): How many people does it take to maintain the database?
A: One.

Q2: Is the Information free?
A: Yes.

Q3: What is being transferred?
A: Information about remote sensing organisations and their research and application projects from all over the world.

Michael McLean (Australia) - **The Vicroads Approach to Outsourcing of Survey and Photogrammetry Services**

Key points were: The rational and experience for VICROADS (Victoria, Australia) outsourcing (contracting out) photogrammetric and surveying activities of his department. This is a very involved process since it requires ascertaining the qualifications of the vendors as well as maintaining in-house capability.

Vlastimil Hanzl (Czech Republic) - **CEI IN Photogrammetry - Help to Reform Countries**

The paper focused on a project within CEI, the Central European Initiative. The software packages SCOP and ORIENT of the TU Vienna have been presented to 13 photogrammetric university institutes in Poland, Czech Republic, Servia , Hungary, Romania, Bulgaria, Slowenia and Croatia. Eight one-week courses in Vienna, organised by and at the Institute for Photogrammetry and Remote Sensing, enabled the necessary know-how transfer and the exchange of practical experiences. The aim was to establish a Central European network of expert centres for photogrammetry as a basis for UNESCO-ICOMOS co-operative projects in cases of cultural heritage at risk.

COMMISSION VI

Session 6001 - **What is the Future of our Profession?**
July 12, 1996, 10:45-12:15
Session Reporter: **Juliang Shao** *(Australia)*
Chairman: **Deren Li** *(P. R. of China)*

Hans-Peter Bähr (Germany) - HIGHLIGHT-PAPER: **What is the future of our profession?**

Key points were: (1) "Future" and "Our Profession" can't be predicated fully. (2) Several key elements drive the future. These key elements include a growing demand for data of our environment, for technologies of sensor development, for computer sciences and communication sciences. (3) The terminology of our profession is at these points diverse. (4) The nature of "Photogrammetry and Remote Sensing" is widely related to natural sciences, engineering sciences and political sciences. (5) Three dimensions about time, space and activity and education comprise our profession. (6) A market to our profession has to be taken into account. (7) Few questions and proposals are provided in the conclusions.

C (Zd. Kalensky - Canada): In Canada, our profession will be optimistic in case of 3D & 4D developments in our profession.
A (H.-P. Bähr - Germany):It's optimistic in GIS techniques Splitting into "optimists" and "pessimists" is a fuzzy concept like "future" and "our profession".

Józef Jachimski (Poland), P. Waldhäusl - **Objectives and Guidelines for the ISPRS Member Reports**

Key points were: (1) General goals of Member Reports are monitoring history and provision of basic information. (2) Form of Member Report. (3) General scheme of information Arrangement: matrix-like structure. (4) Proposals on information contents about the country and the member society, the "state of profession", co-operation and publications. (5) Publishing conditions.

Guidelines have proposed for the expected Member Reports. Also, Internet and the ISPRS Homepages in the World Wide Web (WWW) have been suggested for collection, synthesis and publication of reports and analyses.

Ivan Katzarsky (Bulgaria), L. Koleva - **The Place of Photogrammetry in Land Reform and Cadastre in Bulgaria**

Key points were: (1) Use of retrospective aerial photo-graphs. (2) Production of orthophotomaps. (3) Production of large-scale topographic maps. (4) Production of photo-mosaics for interpretation. (5) Determination of points by aerial triangulations. (6) Numerical plotting of aerial photographs. Also, that photogrammetry in Bulgaria is provided with reliable technical means and technologies including software had been concluded.

Gerhard Lindig (Germany), H.-P. Bähr - **Revised Concept and Status of ISPRS Multilingual Dictionary**

Key points emphasised on the concept and status of multilingual dictionary. The critical opinion that the multilingual dictionary can't be addressed efficiently via modern communication methods had been pointed out in the paper. The authors detailed the history of the terms and definitions in English and equivalents in other languages such as French, German, Italian, Portuguese, Spanish and Russian. Also, the revised concepts for ISPRS dictionary had been proposed based on the ten fundamental ones.

Walter Schuhr (Germany), E. Kanngieser - **Review on Public Relations on Photomatics**

Key points were: (1) Reviewed three folders on public relations, international co-operation and technology transfer. (2) Addressed great improvements in adapting digital models, processing and evaluation methods. (3) A standardised manner for the national achievements was indicated to stimulate the further international exchange and progress.

Keith Murray (United Kingdom), A. Davey, G. Tait - **Ordnance Survey: Image Applications in Support of a National Geospatial Data Infrastructure**

Key points were: (1) Having established national large scale digital datasets of United Kingdom, Ordonance Survey is now encouraging the United Kingdom data integration and access to the national database in UK through the concept of the National Geospatial Database (NGD). (2) An infrastructure such as the NGD is vital if engineering applications are to be expedited at affordable cost. (3) Imagery has an important part to play, if we recognise that it is not a substitute for an information infrastructure in itself.

The NGD aims to remote access, to NGD exploitation of national datasets, to reduce data duplication and realise the benefits and applications based on integrated government datasets. Imagery will play an increasing role in maintaining the geospatial databases of the future.

Chryssy Potsiou (Greece) – **Cost of Photogrammetric and Cadastral Surveys for the Compilation of the Hellenic Cadastre**

Hans-Peter Bähr (Germany), A. Schwender – **Linguistic Confusion in Semantic Modelling**

Jürgen Peipe (Germany), St. Dunkel, K. Günther – **PC Based Dictionary of Photogrammetry And Remote Sensing**

Pietro Grimaldi (Italy) – **Territory Defence is not for a Few: The "StereoFot" Programme**

Kombo Mwero (Kenya), M. Akiyama – **KISM - New Educational Institute for Surveying and Mapping in Kenya**

Dave Kisor (USA) – **On the Necessity of an International Space Agency**

Alexander L. Dorozhynskiy (Ukraine), N. Moskal – **Training of Specialists on Photogrammetry and GIS in the Universities of Ukraine**

Bhagwan Singh Chaudhary (India), M. Kumar, A.K. Roy, D.S. Ruhal – **Applications of Remote Sensing and Geographic Information Systems in Ground Water (Investigations in Sohna Block, Gurgaon District (India))**

Nkem Ononiwu (Nigeria) – **Comparative Development of Remote Sensing and Geographic Information System Technologies in the Developing Countries**

COMMISSION VI

Poster Session 60P1 - **Economics, Professional Matters and Education**
July 16, 1996, 13:00-15:00
Session Reporter: N. N.
Chairman: **Hans-Peter Bähr** *(Germany)*

No report received!

Wolfgang Kainz (The Netherlands), N.G. Antimisiaris, V. Samara – **PRONET - Multimedia Computer Based On-Line Training and Support Service for Professionals**

COMMISSION VII
Working Group VII/1

Session 7101 - **Aspects of Physical Measurements and Signatures in Remote Sensing for Resources and Environmental Monitoring**
July 10, 1996, 8:45-10:15
Session Reporter: **Roberto Pereira da Cunha** *(Brazil)*
Chairperson: **Roberto Pereira da Cunha** *(Brazil)*

Gerhard Meister (Germany), R. Wiemker, J. Bienlein, H. Spitzer - **In Situ BRDF Measurements of Selected Surface Materials to Improve Analysis of Remotely Sensed Multispectral Imagery**

The speaker addressed the physical aspects of the Bidirectional Reflectance Distribution Function for artificial (roof) surfaces such as aluminium roof tiles. Results were obtained with a Spectralon panel for different incident angles and compared with previous mathematical model in the literature (e.g. Walthall, 1985; Liang, 1994). The author concluded that the models of the above author, with modification is best suited to describe the reflectance measures obtained in this experimental study.

Piero Boccardo (Italy), G. Comoglio - **New Methodologies for the Integration of Multispectral Data Acquired by Aerial and Satellite Platforms: The November 1994 Flood in Piedmont (Italy) Case Study**

The author used an integration of digital elevation model and the equalisation of the illumination conditions. Based on slope and aspect relation models he presented a map indicating the landslides condition for the Piedmont area of north-western Italy. The flood occurred in November 1994. Boccardo used satellite data of 1991, 1992, 1994 and 1995.

Jari Varjo (Finland) - **Radiometric Correction of Multitemporal Landsat TM Data for Detecting Rapid Changes in Forest**

The author presented the methodology for calibration of Landsat data calibration for change detection, that is forest cover change. He used a robust regression method and "studentisation" (T-test). He found that, based on the T-test of the different classifications, the best channels were TM 2, 3, 5 and 7.

Dmitry Yurievich Tsipenyuk (Russia) - **Selective Resonance Excitation in Remote Laser Spark Spectroscopy**

The author explained the use of selective resonance excitation in remote laser spark spectroscopy. He tested the following samples: iron in water in the Mediterranean Sea, concrete and dry mood material. He showed that the remote spectrochemical analysis is a promising tool to discriminate material.

Keiji Kushida (Japan), K. Yoshino - **A Monte Carlo Radiative Transfer Simulation of Rice Canopy Based on Digital Stereo Photogrammetry**

The author's experiment included the Near Infrared bidirectional reflectance for different types of rice canopies. The canopy reflectance is simulated using 3-D Monte Carlo method. Radiative transfer of Vegetation Canopy models are compared (Ross (1988), Kimes et al. (1982)). As the result of the simulation, the ratio of the reflectance factors (view zenith: 45 deg to 0 deg) from wide spread field is suggested to give the average inclination of rice canopy.

Athula Mandanayake (U.K.), J.-P. Muller - **Automated Cloud-Top Height Retrieval Using Stereo ATSR and MOMS**

The speaker **Jeremy Morley** focused on the retrieval of cloud top heights using stereo ATSR and MOMS. Cloud heights and cloud top temperatures results were presented. The method called "MM" shows advantages in comparison with 11 µm brightness temperature. The author has shown the current U. K. cloud-detection algorithm.

COMMISSION VII
Working Group VII/2

Session 7201 - **Resource and Environmental Monitoring Using Radar Data**
July 11, 1996, 11:15-12:15
Session Reporter: **Hiroyuki Wakabayashi** *(Japan)*
Chairperson: **Hiroyuki Wakabayashi** *(Japan)*

Jeremy Morley (U.K.), J.-P. Muller - **Wetland Monitoring Using SAR Imagery and Interferometry**

The potential use of ERS-1/2's interferometry data (phase coherence) for wet land monitoring was reported.

Ismat M. Elhassan (Saudi Arabia) - **Planimetric Area Determination Using Almaz Radar Imagery**

Almaz SAR data could be used for area measuring in urban area.

Syoji Takeuchi (Japan) - **Monitoring of Land Cover Conditions in Paddy Fields Using Multitemporal SAR Data**

JERS-1 could detect flooded area because flooded area usually has low back scatter.

COMMISSION VII
Working Group VII/3

Session 7301 - **Renewable Resources**
July 10, 1996, 10:45-12:15
Session Reporter: **Frank Hegyi** *(Canada)*
Chairperson: **Frank Hegyi** *(Canada)*

Gabor Remetey-Fülöpp (Hungary) - **Parcel Based Land Information System - Tool for Inventory and Monitoring**

The author gave an excellent insight into the development of new infrastructures for land ownership, that are being established in eastern Europe. In particular, emphasis is being placed on the use of GIS for cadastre mapping.

Frank Hegyi (Canada) - **Emerging Remote Sensing Technologies in Forestry**

The author discussed the importance of decentralising GIS and Remotely Sensed data collection and applications. The presentation was illustrated with the Mobile Technical Office, including the use of hand held, pen-based computers integrated with GPS and wireless communications.

Barbara Koch (Germany), P. Adler - **Photogrammetric Delineation Accuracy of Landcover Units**

Koch presented the results of tests being carried out on the delineation accuracy of photo interpreters in forestry. The difficulties of interpreting aerial photos in heterogeneous populations was well illustrated. There was a consensus that visual interpretation is still an operational tool, although the Commission should invite presentation at the next Congress on the automation of digital photo interpretation.

Freek van der Meer (The Netherlands) - **Geologic Prospecting for Mineral Exploration in the Troodos Ophiolite Complex of Cyprus using TM Data**

While both the presentation and subject matter of the above paper was interesting and created a lot of interaction with the participants, it would have been better to schedule it under Working Group 4. However, in terms of analysis techniques, the author made a highly informative presentation.

COMMISSION VII
Working Group VII/4

Session 7401 - **Remote Sensing for Geology and Mineral Resources**
July 10, 1996, 15:30-17:00
Session Reporter: **James V. Taranik** *(USA)*
Chairperson: **James V. Taranik** *(USA)*

David Spatz (USA) - **Remote Sensing Strategies for Mineral Exploration and Development**

Franz K. List (Germany), N. Ott - **GIS Analysis of Integrated Landsat TM, Topographic, Geologic and Geophysical Data Sets of the Basement Area of the Red Sea Hills, Sudan**

Key Points were: (1) Improved visualisation and classification of lithologic units can be achieved by integrating remotely sensed, topographic and geophysical data sets. (2) Geophysical data provides a "second opinion" on the reliability of iron anomalies derived from multispectral band ratios. (3) Digital classification of lithologic units is greatly improved by combining a priori knowledge from geological maps by grouping and masking of the image data. Classification is then performed separately for each group.

By these means more reliable results of visual and digital classification are obtained.

Robert E. Crippen (USA), R. G. Blom - **Measurement of Dynamic Geologic Processes at Subpixel Scales**

Valentina Sokolova , V. V. Proskuryakov - **Interpretation of Air-views and Satellite Images: More Potentialities Found**

Fabio Souza e Silva da Cunha (Brazil), E. Gottardo, A. J. Strieder - **Characterisation of Different Lineaments Types from TM-5 Landsat Images and their Application to Control of Gold-Quartz Veins in the Porto Nacional (TO) Region, Brazil**

This work is based on the experience got in lineament study for gold-quartz veins control in the Porto Nacional (TO) Region, Central Brazil. It aims to emphasize the importance of distinguishing at least two lineament types at the extraction. This method enables the discrimination between ductile and brittle structures and the understanding of the geometric nature of these structures. The Type 1 lineaments are related to penetrative structures (regional foliations, transcurrent shear zones and granite intrusions) and display rectilinear as well as curvilinear patterns; they develop paired positive and negative geomorphic features and are associated with tonal banding because of lithological changes.

The Type 2 lineaments are related to brittle disjunctive structures (joints and faults) and are often rectilinear; they represent negative geomorphic features, characterised by drainage patterns and are also important features to the control of most of the gold-quartz veins.

Irina Smirnova (Russia), A. Rusanova - **Application of Remote Sensing Including High Spectral/ High Spatial Data Based on GIS for Petroleum Structures Prospecting**

COMMISSION VII
Working Group VII/4

Session 7402 - **Remote Sensing for Geology and Mineral Recources - New Techniques and New Sensors for Environmental Monitoring**
July 11, 1996, 15:30-17:00
Session Reporter: **David Spatz** *(USA)*
Chairperson: **David Spatz** *(USA)*

James V. Taranik (USA), A. P. Crosta - HIGHLIGHT-PAPER: **Remote Sensing for Geology and Material Resources, an Assessment of Tools for Geoscientists in the Near Future**

Anne Kahle (USA), A. D. Morrison, H. Tsu, Y. Yamaguchi - HIGHTLIGHT-PAPER: **Geologic Remote Sensing in the Thermal Infrared**

Alvaro P. Crosta (Brazil), C. Sabine, J. V. Taranik - **High Spectral Resolution Remote Sensing for Mineral Mapping in the Bodie and Paramount Mining Districts, California**

This session provided an overview of new sensors for geologic mapping and mineral development applications as well as specific case studies. An outline of new sensors under development for geologic applications was presented by James Taranik, then Anne Kahle focused on the mid-thermal infrared portion of the spectrum. The ASTER sensor will provide geologists with VNIR/SWIR hyperspectral resolution as well as narrow band thermal data that the geologic community has been anxiously awaiting. These exciting reviews were followed by Crosta's case studies at the Bodie mining district, California, and structural and stratigraphic studies in the mid-East. New hyperspectral sensors with high spatial resolution capabilities mounted on space platforms could revolutionise remote sensing applications in the geosciences.

COMMISSION VII
Working Group VII/5

Session 7501 - **Terrestrial Ecosystems**
July 12, 1996, 11:15-12:15
Session Reporter: **Ake Rosenqvist** *(Japan)*
Chairperson: **Paul Curran** *(U.K.)*

Ramesh Singh Hooda (India), D. Dye, R. Shibasaki - **Estimation of Indian Agricultural Productivity Based on Production Efficiency Model**

Key points were: (1) Development of automated technique for identification and mapping of agricultural vegetation. (2) Estimation of agricultural productivity using Production Efficiency Model (PEM).

An automated method for identification and mapping of agricultural areas using NDVI (Normalised Difference Vegetation Index) - climatological modelling was described. Agricultural productivity was estimated using PEM which involves the decomposition of productivity into independent parameters involved in the production built-up process like incident PAR, absorbed PAR and PAR conversion efficiency. The model can be used for regional and global productivity studies.

Q (P. Curran – U.K.): Why only use R and NIR (Red and Near Infra Red) channels of NOAA. The MIR band is possibly useful, too.
A: NOAA NOVI (R&NIR) was available as a ready-to-use-product.

Horst Weichelt (Germany), E. Jung, M. Pilarski, K. Schmidt, K.-H. Marek - **Applications of Multitemporal and Multisensoral Remote Sensing Data for Monitoring Aspects in Opencast Lignite Mining and Post-Mining Landscapes**

One of the main tasks for an environmental monitoring system is the observation of vegetation changes.

In opencast mining regions the vegetation in the surrounding of the mines as well as in the recultivation areas has to be observed.

The calibration of the different data sets has pointed out to be a central problem. The use of relative values related to mean values of the surrounding or to reference objects is proposed as an easy way to get a comparability of the data.

COMMISSION VII
Working Group VII/6

Session 7601 - **Desertification Soil Erosion, Land Degradation**
July 12, 1996, 8:45-10:15
Session Reporter: **Clovis Carlos Carraro** *(Brazil)*
Chairperson: **Clovis Carlos Carraro** *(Brazil)*
Attendance: approx. 50 persons

Jiang Yu (USA), C. Shi, G. Yu - **Rough Area Soil Erosion Assessment Via GIS Modelling**

Yu showed a wonderful photographic documentation of soil erosion in China.

P. Bosdogianni (U.K.), M. Retrou, J. Kittler - **Robust Mixed Pixel Classification in Remote Sensing**

Bosdogianni presented the best scientific work.

Andy Yaw Kwarteng (Kuwait), D. Al-Ajmi - **Using Landsat Thematic Mapper to Detect and Map Vegetation Changes in Kuwait**

Shiro Ochi (Japan), S. Murai - **Land Degradation Risk Mapping Using NOAA NDVI Data**

Ranghui Wang (P. Republic of China) - **The Study on Desertification with Remote Sensing Cartography in Alagan Region, the Lower Reaches of Tarim River**

COMMISSION VII
Working Group VII/7

Session 7701 - **Hazardous Waste and Environmental Pollution**
July 12, 1996, 13:30-15:00
Session Reporter: **Vernon Singhroy** *(Canada)*
Chairperson: **Vernon Singhroy** *(Canada)*

Michael Howard (USA), C. Nalezny, L. R. Tinney, S. Riedhauser - **Multisensor Surveys of Nuclear Facilities**

V. I. Lyalko (Ukraine), S. Oppitz, V. Y. Djary, A. I. Sakhatsky, V. Ilieva, A. J. Hodorovsky, L. D. Woolfson, Z. M. Shportjuk, O. N. Sibirtseva, G. L. Gimel'farb, K.-H. Marek - **Estimation of Heavy Metals and Radionuclides Contamination within the Chernobyl Danger Zone Using Remote Sensing Data**

Barbara Theilen-Willige (Germany) - **Seismic Risk Analysis in SW-Germany Based on ERS1-Data**

Vernon Singhroy (Canada), F. Kuehn - **Remote Sensing for Characterising and Monitoring of Hazardous Waste Sites - Case Studies in Canada and Germany**

Bryan J. Albers (USA), J. di Benedetto, S. Lutz, C. Purdy - **Laser Induced Fluorescence Imaging (LIFI) for Environmental Characterisation**

Malcolm M. Pendergast (USA) - **Remote Sensing of Petroleum Contaminated Soil**
Several international papers dealt with different techniques for characterising and monitoring hazardous waste-sites: Satellite images were used for small scale monitoring and airborne and ground spectrometry techniques were needed to assess local sites at scales of 1:5,000 - 1:20,000.
Future work should concentrate on the role of high resolution optical and SAR data in all areas, particularly in the tropics, where remote sensing case studies need to be further developed.

COMMISSION VII
Working Group VII/7

Session 7702 - **Monitoring of Environmental Pollution**
July 16, 1996, 15:30-17:00
Session Reporter: **Vernon Singhroy** *(Canada)*
Chairperson: **Vernon Singhroy** *(Canada)*

David M. Carden (USA), C. L. Nalezny, A. L. King, J. Smyre, T. K. Evers - **Streamlined Environmental Remediation Characterisation Using Remote Sensing Techniques: Case Studies for the U.S. Department of Energy, Oak Ridge Operations**

Boudewijn van Veen (The Netherlands), C. Cassells, X. Zhang - **The Synergistic Use of Remotely Sensed Data for the Detection of Underground Coal Fires**

Alexandra Rusanova (Russia), I. Smirnova - **Application of Multifrequency Radar Data to Distinguish the Oil Polluted Areas**
Several international papers dealt with different techniques for characterising and monitoring hazardous waste-sites: Satellite images were used for small scale monitoring and airborne and ground spectrometry techniques were needed to assess local sites at scales of 1:5,000 - 1:20,000.
Future work should concentrate on the role of high resolution optical and SAR data in all areas, particularly in the tropics, where remote sensing case studies need to be further developed.

COMMISSION VII
Working Group VII/8

Session 7801 - **Snow, Ice, Ocean Coastal Zone Monitoring**
July 17, 1996, 15:30-17:00
Session Reporter: **Shintaro Goto** *(Japan)*
Chairperson: **Shintaro Goto** *(Japan)*
Attndance: approx. 30 persons

Yoshiyuki Kawata (Japan), A. Yamazaki - **Atmospheric Parameter Estimation Using the Reflectance and Polarization Data**

Hong-Gyoo Sohn (USA), K. C. Jezek - **Automatic Approach to Detect Ice Sheet Margin Using ERS-1 Synthetic Aperture Radar Imagery**

Shintaro Goto (Japan), K. Iisawa, M. Shikada - **The Verification of 2-D Wave Parameter from Marine Radar by In Situ Measurement**

Jim Chandler (U.K.), S. N. Lane, K. S. Richards - **The Determination of Water Surface Morphology at River Channel Confluences Using Automated Digital Photogrammetry and Their Consequent Use in Numerical Flow Modelling**

Liang-Chien Chen (China-Taipei), J.-Y. Rau - **Quantitative Assessment of Shoreline Changes Using Multi-Temporal Satellite Images**

This session was divided according to three categories as follows:
- Sea and water surface monitoring (3 papers)
- Shoreline detection by RS data (1 paper)
- Ice sheet detection by RS data (1 paper)

This session covers basic techniques to monitor coastal and cryosphere environment.

COMMISSION VII
Working Group VII/9

Session 7901 - **Human Settlement**
July 18, 1996, 13:30-15:00
Session Reporter: **Myriam Ardila-Torres** *(Columbia)*
Chairperson: **Myriam Ardila-Torres** *(Columbia)*
Attendance: approx. 70 persons

Keitarou Hara (Japan), S. Takatsuki - **Integrating GIS and Remote Sensing for Evaluation and Monitoring of Sika Deer Habitat on Kinkazan Island, northern Japan**

Kornelia Christke (Germany) - **Remote Sensing and GIS-Techniques for the Evaluation of Macrophytes in the Greifswalder Bodden**
Derya Maktav (Turkey), F. Sunar, S. Kapdasli, N. Musaoglu - **Remote Sensing Application in a Specially Protected Area (Small Paradise) in Turkey**
No special report received.

COMMISSION VII
Working Group VII/9

Session 7902 - **Remote Sensing of Human Settlements**
July 16, 1996, 8:45-10:15
Session Reporter: **Catherine Ticehurst** *(Australia)*
Chairperson: **Bruce Forster** *(Australia)*
Attendance: approx.100 persons

Florian Kressler (Austria), K. Steinnocher - **Change Detection in Urban Areas Using Satellite Images and Spectral Mixture Analysis**

C. P. Lo (USA) - **Integration of Landsat Thematic Mapper (TM) Data and U.S. Census Data for Quality of Life Assessment**

Floyd Henderson (USA) - **Wavelength, Polarisation and Incident Angle as Variables in Settlement Detection with Satellite SAR Imagery**

The 3 papers were of an excellent standard covering the problems of disaggregating mixed urban pixels for change detection over the city of Vienna, the important study of deriving socio-economic information from remotely sensed data combined with auxiliary data and finally the new area of study relating to using radar data for settlement detection. Major points of methodology addressed in the paper by F. Kressler was the decomposition of the images into fraction images that gave the percentage of three "end-member" cover types, vegetation, built and water, and then the use of these over a five year period (1986-1991) to determine changes in the built category. For Lo's paper the major point was the strong relationship between the well known measure of NDVI with "Quality of Life Assessment", and for Henderson's paper that L-Band large incidence angle radar data was most useful in detecting urban areas.

Q (C.P. Lo - USA): Had the Landsat TM TIR been considered for use in the study?
A (F. Kressler - Austria): No.

Lo replied to a question on the high classification accuracy from Manfred Sties that the high accuracy was due to the manual correction of the maximum likelihood classification, after field correction. He indicated that the classification was not the main purpose of the paper, more the relationship with socio-economic variables.

A general question of classification accuracy of whether IFOV or EIFOV should be the basic classification unit was addressed by Forster, who said that accuracy is more a function of the mixture of urban features, of the size of the resolution element, it must be finally related to what the user requires, rather than to a rule based approach.

A general discussion on the future of remote sensing in monitoring urban settlements was initiated by the chairperson following the presentation of the papers. Major points raised related to the impact of high spatial resolution images over the next four years, on urban monitoring, and the potential of radar data, particularly integrated with visible /NIR - data.

COMMISSION VII
Working GroupVII/10

Session 7A01 - **Global Monitoring Strategies and Projects**
July 19, 1996, 10:45-12:15
Session Reporter: **Erika Podest**
Chairperson: **Sergio Camacho**
Attendance: approx. 50 persons

Summary: The presentations provided information on the objectives and expected results of JERS-1 global mapping of the rain forest; an innovative camera system integrating a GPS receiver to geo-locate the acquisition of

ground truth data; and the use of data from five different sensor systems to monitor changes in tropic forest cover.

Ake Rosenqvist (Japan) - **The Global Rain Forest Mapping Project by JERS-1 SAR**

The Global Rain Forest Mapping project is an effort by NASDA, in co-operation with among others NASA and the Joint Research Centre of the EC, to collect JERS-1 SAR data over the major part of the tropical belt of the Earth.

Yousif Ali Hussin (The Netherlands), S. R. Shaker - **The Use of Remote Sensing and GIS in Monitoring Tropical Rain Forest**

The paper is showing preliminary results on two test sites in Indonesia (Southern & Central Sumatra) of deforestation

For forest type differentiation optical and radar satellite images have been used of many types: e.g. Landsat TM, Spot, ERS-1, JERS-1.

Yoshiaki Honda (Japan), K. Kajiwara, Y. Kimura - **Ground Truth Image Database for Global Scale Research**

Key points were: (1) GPS Camera, (2) Ground Truth, (3) Application of GPS Camera and (4) Global Image Network. We integrated GPS receiver, compass and camera. It is called GPS camera. GPS camera is very useful for field research (Ground truth).

COMMISSION VII

Poster Session 70P1 - **Neutral Networks/Fuzzy Classification**
July 10, 1996, 13:00-15:00
Session Reporter: **Hermann Johann Heinrich Kux**
(Brazil)
Chairperson: **Joao Roberto Dos Santos** *(Brazil)*

Steffen Bock (Germany) - **A Region-Based Approach to Land-Use Classification of Remotely-Sensed Image Data Using Artificial Neural Networks**

Yukiyo Yamamoto (Japan) - **The Application of Neural Networks to GIS in the Construction of Land Evaluation Models**

Joao Roberto dos Santos (Brazil), A. Venturieri, F. d. S. Liporace, R. J. Machado - **Applicability of the Neural-Network Architecture by a Fuzzy to Identify Natural Vegetation Regrowth Areas in Brazilian Amazonia**

Bobo Nordahl (Norway) - **Comparison of Statistical Methods and Neural Networks in a Post-Object Classification for Forestry Registration**

Masumi Mizukami (Japan), Y. Moriyama, N. Mizutani, K. Satou - **Development of a Monitoring System Integrated Airborne Videography and GPS**

Oscar Ricardo Vergara (Brazil), A. L. B. Candeias, M. d. L. De O. Kurkdjian - **Data Fusion in Urban Cartography**

Jee-Cheng Wu (USA) - **Classification of TM Image Using a Competitive Learning Neural Network**

Wim J. Droesen (The Netherlands), P. Van Deventer, M. Van Til - **Fuzzy Classification of Digital Orthophotos for Spatio-Temporal Landscape Modelling**

Chi-Farn Chen (China-Taipei), S. W. Chen, S. Shyn - **Classification of Remote Sensing Imagery Using - An Unsupervised Neural Network**

Edel Garcia Reyes (Cuba) - **Using Neural Network to Integrate Contextual and Spectral Information to Improve Land Use Classification of Satellites Images in Cuba**

Xinghe Sun (P. Republic of China) - **Dynamicly Monitoring of Land Salinisation and Urbanisation by Remote Sensing - GIS**

This Technical Session was important from the point of view of neural networks for integrated land use/land cover studies. Different descriptors (spectral, textural and contextual information) were used to train the networks. The classification algorithms were formed by forward backpropagation methods and non-supervised processes called "adaptative resonance theory".

In order to process TM-Landsat and HRV-SPOT images or digital orthophotos, these neural network-fuzzy classification procedures have shown a good performance for the identification of several land use classes, such as: forest, urban areas, crops, pasture, among others.

The integration of neural networks with GIS techniques can give a support for the study of land use dynamics and spatio-temporal landscape modelling.

COMMISSION VII

Poster Session 70P2 - **Spectral and Radiometric Studies and Measurements**
July 11, 1996, 12:30-14:30
Session Reporter: **Bruce Forster** *(Australia))*
Chairperson: **Bruce Forster** *(Australia)*

Choen Kim (USA) - **A Winter Cover Classification of Lower Nakdong River Region Using JERS-1 OPS Data**

A. J. Chen (China-Taipei), C. H. Liu, G. R. Liu - **A Robust Algorithm for Correcting the Topographic Effect of Satellite Image over Mountainous Terrain**

Mitsunori Yoshimura (Japan), T. Nakajima, I. Arakawa, K. Nemoto, M. Honma, H. Tojo - **Spectral Feature of Rice Leaves Infected By Blast**

Xiufeng Wang (Japan), I. Horiguchi, T. Machimura - **The Relationship between Canopy Surface Temperature by IR-Thermometer and Canopy Structure**

Takashi Kusaka (Japan), T. Kakehi, M. Ootuka - **Change Detection Using Relative Atmospheric Correction of Satellite Images at Different Times**

Yunhan Dong (Australia), B. Forster, C. Ticehurst - **Decomposition of Radar Polarisation Signatures from Built and Natural Targets**

Beata Hejmanowska (Poland), S. Mularz - **Thermal Inertia Modelling for Soil Moisture Assessment Based on Remotely Sensed Data**
Gotthard Meinel (Germany), M. Netzband, V. Amann, R. Stätter, G. Kritikos - **Analysing an ATM-Scanner Flight for the City of Dresden to Identify Urban Sealing**

Tsukasa Hosomura (Japan), K. Katou - **Colour Correction of Fused Images Using Colour Space Transformation**

The papers represented a range of topics from correction of topographic effects to radar image decomposition, and could not be categorised into a single topic area. However a number of new approaches were introduced. These included the use of reference surfaces to correct for topographic effects, an approach to thermal imaging of soil that accounted for solar direction on the recorded field measurements, decomposition of radar backscatter into different mechanisms for the analysis of urban areas, and a new HIS transformation. Other papers used well known approaches for new application, such as the estimation of impervious surface in urban areas using NDVI.

COMMISSION VII

Poster Session 70P3 - **Agriculture, Vegetation Studies, Integration and Classification using Radar Data / Snow, Ice and Coastal Zone Monitoring**
July 12, 1996, 15:00-17:00
Session Reporter: **Shintaro Goto** *(Japan)*
Chairperson: **Shintaro Goto** *(Japan)*

Gerhard Smiatek (Germany) - **Crop Area Estimates Using ERS-1 SAR Data**

Nicolaie Oprescu (Romania), C. Braescu, M. Vais - **Integration of SPOT and SAR-ERS Imageries with other Types of Aero-Satellite and Terrain Data, for Studies on the Danube Delta and the Continental Platform of the Black Sea**

Wolfgang Wagner (Austria), P. Gloersen - **Detection of Periodic Climate Anomalies over Greenland with Microwave Radiometers**

Joao Roberto Dos Santos (Brazil), M. Keil, H. J. H. Kux, S. P. Lacruz, D. R. Scales - **Interactive Analysis of SIR-C and Landsat-TM Data for the Spectral-Textural Characterisation of the Land Cover in SW Amazonia, Brazil**

Herman Johann Heinrich Kux (Brazil), J. R. Dos Santos, M. Keil, D. R. Scales - **Evaluation of SIR-C/X-SAR Data for the Improvement of Geomorphology and Soil Maps in Acre State Brazil**

Joao Antonio Lorenzzetti (Brazil), S. A. Gaeta - **The Cape Frio Upwelling Effect over the South Brazil Blight Northern Sector Shelf Waters: a Study Using AVHRR Images**

Jose Luiz Stech (Brazil), J. A. Lorenzzetti, C. E. S. Araujo, J. M. C. De Souza - **A Mesoscale Brazil Current Frontal Eddy Observed through AVHRR Images and Current Meter Moorings**

Pierre Larouche (Canada), C. Fuentes-Yaco, A. F. Vezina - **Spatio-Temporal Variability of Phytoplankton Pigments in the Gulf of St. Lawrence as Measured by CZCS**

Yifang Ban (Canada) - **Multi Temporal ERS-1 SAR and Landsat TM Data for Agricultural Crop Classification: An Artificial Neural Network Approach**

Meritt Stevenson (Brazil), F. B. Mendes de Castro - **Comparison of Surface Layer Currents Determined by Satellite Tracked Drifters and in Situ Anchored Current Meters of Southeast Brazil**

Denes Bajzak (Canada), B. A. Roberts - **Determination of Snow Water Equivalent (SWE) Using Multichannel Air Borne and Space Borne Synthetic Aperture Radar (SAR)**

Rosana Maria Rodrigues (Brazil), S. A. de Araujo, J. R. Provesi - **A Study on the Sediment Plume of the Midnorth Coast of Santa Catarina State, Brazil, from Landsat TM-5, Imagery**

Tony Ho (Singapore), Z. Cai - **Cloud Detection in Satellite Images for Tropical Regions**

Hui Lin (Hongkong), G. Lu - **GIS-Based 3D Modelling Support System for Coast Change Analysis**

Chi-Farn Chen (China-Taipei), C. S. Wu, K. S. Chen, A. J. Chen - **Shoreline Extraction on Remote Sensing Image Using Mathematical Morphology**

This session concerned three categories as follows:
- land use classification (3 papers)
- coastal zone monitoring (6 papers)
    - currents dynamics (3 papers)
    - sea colour (2 papers)
    - other (1 paper)
- criosphere monitoring (2 papers)

This session covers many kinds of phenomena, but each presentation has the tendency of integrative use of optical and microwave sensors. Especially this trend is typical in land use classification.

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Poster Session 70P4 - **Agriculture, Crops, Land Cover and Land Use**
July 15, 1996, 9:00-11:00
Session Reporter: **Roberto Pereira da Cunha** *(Brazil)*
Chairperson: **Roberto Pereira da Cunha** *(Brazil)*

J. G. P. W. Clevers (The Netherlands), H. Kramer, H. J. C. Van Leeuwen, D. H. Hoekman - **The Merit of JERS-1 Data in Addition to ERS-1 and Optical Satellite Data for Agricultural Applications**

This very interesting paper presented two important aspects. One was the multi-temporal radar imagery composite (better seen at the poster area); for crop classification. The other aspect was a comparison between ERS-1 data versus JERS-1. The author concluded that the Japanese satellite data is more appropriate for forest classification than the ERS-1.

Konrad Eder (Germany), G. Aumann - **An Integrated System of Digital Monoplotting and DTM Modelling for Forestry Applications**

The author presented significant results on the utilisation of the integration of software packages for DTM modelling, orthophoto-image generation and photo-grammetric data acquisition and digital monoplotting system for map revision, forest inventory and forest monitoring.

A. Farzaneh (Iran), S. Babaie - **The Role of GIS and Remote Sensing in Renewable Natural Resources in Iran**

The author compared data sources versus output map production for 1:25,000 maps. He showed that satellite based image maps at scales up to 25,000 are possible by a fusion of satellite images and aerial photographs.

Harendra S. Teotia (Brazil), K. A. Ulbricht, D. L. Civco - **Land Use and Land Cover Mapping in Paraiba-CNPQ Project - the Application of Remote Sensing Technology**

The speaker limited to present a digital image processing system to map major land use classes (water, cultivated land, urban, pasture land, forest land, swamps, alluvial land etc.) at the coast of north-eastern Brazil. For this the author used SPOT image data and a ERDAS image processing system.

Ursula Schmitt (Austria), G. S. Ruppert - **Forest Classification of Multitemporal Mosaicked Satellite Image**

The speaker showed how multitemporal mosaicking images could be used for forest classification. It was discussed the classifier, particularly the Maximum Likelihood for forest type and stand class. The author stressed that as to chose the best classifier is important to take into account the confusion matrix.

Mu-Lin Wu (China-Taipei), Y.-G. Chang, K.-L. Chen - **Plantation Planning Using GIS and Remote Sensing at Taipei Water Resource Commission**

Presented only in the poster area.

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Poster Session 70P5 - **Forestry, Vegetation and Others / Global Change**
July 16, 1996, 12:30-14:30
Session Reporter: **Adam Linsenbarth** *(Poland)*
Chairperson: **Adam Linsenbarth** *(Poland)*

Thelma Krug (Brazil) - **Applications of the Brazilian Remote Sensing Satellite (SSR) to Monitor the Amagon Region**

The poster presents the applications of the recently approved Remote Sensing Satellite, which is programmed to cover the Amazon region 6 times a day, at a spatial resolution of 100 - 220 meters.

Gianpaolo Pennati (Italy), A. Canesi, A. Galli, M. D'Angelo, R. Ambrogi - **Continuous Classification of Natural Vegetation in a Mediterranean Ecosystem by Linear Unmixing Methods Applied to Multitemporal TM Data**

Vegetation continuum estimation has been performed in an area of 70 x 40 km in the north-eastern Sardinia

district (Italy). Five endmembers corresponding to natural vegetation classes have been estimated as fraction coverage for each TM Pixel. Multitemporal data has been employed from TM sensor.

Yoshio Awaya (Japan) - Spruce Stand Monitoring Based on the Successional Spectral Trajectory using Landsat TM Data

A forest monitoring method, which was based on the exponential function and the minimum distance classifier, was proposed. Averages and standard deviations of age classes were estimated and used for the classification of four Landsat Thematic Mapper images, which were obtained in winter and summer. The method was applied for spruce stands, and it was found that the method reduced effects of seasonal spectral variation on classification. The results suggested that successional stages can be monitored quite well using summer images, and comparison of winter and summer imagery showed forest structure differences, which were mainly due to difference of spruce density in stands.

Yrjö Rauste (Finland) - Forest Fire Detection with Satellites for Fire Control

An automatic fire detection system was developed to detect forest fires using data from the AVHRR sensor aboard the NOAA satellites. The fire detection is based on the 3.7 µm channel. In areas where the imaging geometry is close to the specular-reflection conditions, all fires are rejected as false alarms. This is essential in an application where the requirements on reliability are high.

All 6 fires detected in areas where verification was possible in 1994 were real fires. Similar results were obtained also in 1995.

Fire detection with satellite data for fire control purposes is feasible in the Boreal forest zone provided that mid-infrared data (3.7 µm) are available in daytime.

Ali Darvish Sefat (Iran) - Einsatz und Fusion von multisensoralen Satellitendaten zur Kartierung der Waldtypen

Das Ziel besteht darin, in einem topographisch anspruchsvollen Gebiet in der Zentralschweiz vertiefte Erkenntnisse über die Möglichkeiten und Grenzen der Erfassung von Waldtypen mit Hilfe von Satellitendaten (TM und SPOT) zu gewinnen.

Die fast gleichzeitig aufgenommenen Satellitenbild-daten wurden zuerst einer Qualitätsanalyse unterzogen. Bei TM-Daten wurden mehrere Arten von geometrischen Fehlern festgestellt und zum Teil korrigiert.

Bei der Geocodierung der Satellitenbilddaten wurde die höhenbedingte Lageversetzung der Bildelemente durch das Einbeziehen des Höhenmodells mittels der Paßpunkt-Methode korrigiert. Die Standardfehler (RMS) lagen dabei deutlich unter einem halben Pixel.

Zur Optimierung der Informationsextraktion wurde in die multispektralen TM- und XS-Daten der hoch-auflösende SPOT Pan-Kanal fusioniert und daraus neue Hybridkanäle hergestellt.

Die Unterscheidung der Waldfläche von der Restfläche erfolgte mit einem schrittweisen binär-hierarchischen Verfahren unter Einbezug des digitalen Höhenmodells. Die Bestandeskartierung nach der zusammengefaßten Klasse „Jungwuchs/Dickung/Blößen" und drei Mischungsklassen wurde mit dem binär-hierarchischen Verfahren und Maximum-Likelihood-Klassifikator durchgeführt.

Zum Potentialvergleich der einzelnen Sensoren, sowie zur Feststellung der Eignung der mit Pan integrierten und synthetische Kanäle wurden sämtliche Kanäle in den fünf Datenblöcken (Sensorkombinationen) verwendet.

Florea Zavoianu (Romania), C. Nitu, I. Noaje - Étude de la dynamique de la zone urbaine de Bucarest à l'aide des données TM de Landsat et HRV de SPOT

In this paper there are secreted the opportunities offered by satellite remote sensing images, with large spatial resolution, able to disseminate efficient and quickly the information about big surfaces. This information are needed for: studies on the evaluation of urban and per-urban areas, analyses of soil areas and for monitoring of the pollution of urban and per-urban environment. For this paper there where studied history and updated maps, satellite images Landsat TM and SPOT HRV images obtained at different periods and also by aerial photogrammetry. The changes detected in development of urban and per-urban areas, and also the TM, HRV and classified images obtained were input into a land information system of urban and per-urban areas (SITU). The results, obtained up to now, concern the analysis of the present situation, the global analysis of the distribution and the derivation of build-up areas etc.

Jurandir Zullo Junior (Brazil) - Atmospheric Correction of Satellite Images in a Tropical Region

This paper describes our work on atmospheric correction of satellite images, started in 1990, focusing on the computer system called SCORADIS. It gives also special attention to the acquisition of the atmospheric parameters used as input data to the System, the importance of the atmospheric correction and the studies in development at UNICAMP. All experimental work is being done under the conditions of tropical atmosphere, soil occupation and data disposable existent in Sao Paulo state. Our main objective is to contribute to a better use of satellite images in applications related to vegetation monitoring, like the biomass estimating, for example. The most part of the atmospheric studies in remote sensing corresponds to the atmospheric conditions of the north hemisphere that are very different of our conditions.

Toshiaki Hashimoto (Japan) - Geometric Consideration of Image Composite for Vegetation Monitoring - NOAA/AVHRR, ADEOS/OCTS, ADEOS-2/GLI

NOAA/AVHRR data have been widely used for vegetation monitoring, especially in a large scale. For this purpose, some sequent images are overlayed to make a

composite image for eliminating cloud effects. NASDA is developing new sensors, ADEOS/OCTS and ADEOS-2/GLI. They will be expected to be utilised for vegetation monitoring. They have the advantages in resolution and spectral property compared to NOAA/AVHRR.

OCTS and GLI have a different scan geometry than AVHRR. Some attention should be paid to image composites.

In this paper the methods of image compositing for OCTS and GLI are introduced.

Paulo Roberto Martini (Brazil) - Depicting the Headwaters of the Amazon River through the Use of Remote Sensing Data

Following the concept that the most remote slope is the very birth place of a river a new site for the headwaters of the amazon is proposed. To depict the site emphasis has been done on the use of Landsat TM images. Synoptic viewing and spectral attributes have strongly contributed to follow the mainstream of the amazon from Iquitos to the vicinities of Cusco and upwards to the headwaters deep in the cliffs of the western Andean range of Peru. According to TM-images the Amazon source is in the northern cliffs of Nevado Queuhicha situated south 15 degrees 31 minutes and long west 71 degrees 41 minutes. From this new site and flowing through the channels of Japura and Tapara the Amazon is the longest river on earth. Based on the water signature of the Amazon in TM-3 images a correlation is proposed between the growing banks of the Atlantic coastline of Guyanas and the eastern Andean landscapes.

Reinfried Mansberger (Austria), W. Rieger - True Colour Visualisation of Colour Infrared Aerial Photographs

For many planning purposes especially in rural areas it is necessary to use false colour infrared material for interpretation purposes. On the other hand the acceptance of planning materials by the population is much higher for true colour images. A linear transformation algorithm is presented to transform the infrared images to true colour as a cheap and easy-to-be-implemented method with standard tools.

Janette C. Gervin (USA), H. H. Bloemer, J. O. Brumfield, J. A. Langdon, C. Yuill - Determination of Forest Communities in a Temperate Mountainous Forest Using Remotely Sensed and Ancillary Data of Varying Spatial Resolution

Techniques for identifying forest communities were explored for an area near Spruce Knob, West Virginia, containing representative Appalachian forest communities and one of the more southerly outliers of the red spruce community. The utility of spatial and spectral resolution in the determination of forest communities was examined by comparing classifications of digitised aircraft photography at 3 meter spatial resolution and of TM imagery, using the six non-thermal bands and those equivalent to colour infrared photography, at 30 meter resolution. The aircraft-

based classification provided much greater detail, demonstrating a greater refinement in response to the small characteristic distance of change in these temperate mountainous forests. The larger TM pixel average much of this detail to produce a classification of more uniform classes and graduated change, which may be less representative of the surface vegetation but nevertheless useful for studies for larger areas. The addition of the blue and mid infrared TM bands does improve the classification when compared with the colour infrared-equivalent bands of TM. The inclusion of elevation and aspect adds additional information and capability which may result in a more accurate delineation of forest association and composition. ore work will be required to fully develop and utilise its potential for describing and understanding forest communities.

Kristof Ostir (Slovenia), V. Gaffney, T. Podobnikar, Z. Stancic - Environmental Monitoring in Central Dalmatia

Following the early seventies, when satellite imagery became widely available, a wide range of professionals have attempted to utilise satellite images in environmental studies. The presented one has been carried out on the Central Dalmatian islands (in Croatia). The natural environment data - when available - was largely supplied as thematic maps which were frequently unsuitable for detailed analysis. Satellite imagery seemed to be an adequate alternative source for such data. The study has two important implications. First, the land use map of Šolta was produced, and second, the possibilities of a simple and non-expensive image processing system for this kind of analysis have been demonstrated.

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Poster Session 70P6 - **Structures, Tectonics, Geological Mapping**
July 17, 1996, 10:30-12:30
Session Reporter: **Stanislaw R. Ostaficzuk** (Poland)
Chairperson: **Stanislaw R. Ostaficzuk** (Poland)

Maurizio Poscolieri (Italy), K. Serelis, I. Parcharidis - Integration of Landsat TM Data and DEM-Derived Spatial Models to Investigate a Macro-Scale Shear Zone in Lesvor Island (Greece)

Key points were: (1) Structural setting of the area. (2) Discovery of a new shear-zone. (3) Statistical analysis of lineaments and use of DEM. The distribution of lineaments varies locally due to variable extension of sedimentary basin's axis. Variably oriented shadowing was necessary in detection of whole array of discontinuities. In the slope-aspect combination map the circular features were visible, some of curvilinear forms represent bent parts of the basin's axial zone. The unknown shear zone was detected using a combination of Landsat's 5-TM 7, 3 and 1 bands and DEM data.

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Questions concerned lack of application of automatic procedure in detecting lineaments, and the use of thermal band.

Answers: In geological interpretation of uncertain features human decisions are essential, and thermal band of TM was not used because of its poor resolution.

Jinfei Wang (Canada) - **Evaluation of Lineament Detection Algorithms Using Multi-Band Remote Sensing Images**

Key points were: (1) Use of multi-channel materials. (2) Lineament maps. (3) Structural analysis and the Canadian shield geology. (4) Special algorithm. (5) Resource potential exploration.

Algorithm for extracting lineaments from Landsat-TM imagery of the Canadian shield appear effective. Application of multi-channel detection gave better results than the best single-channel material.

Poster was supported by eye-catching illustrations.

Questions concerned basic materials used, geological features and future investigations.

Answers were: Landsat TM, ratio bands 4/3, 6-channel composite analysis, rocks were igneous, mostly granitic, Radarsat materials scheduled for the future works.

Beate Eibl (Germany), W. Mauser, H. Bach - **Classification of a Landsat-TM Image with the Spectral Mixture Analysis under the Application of Field Spectroscopy**

Key points were: (1) Assessment of optimal spectral mixture. (2) Field spectrometry. (3) Area of Wadi Rayan, Libyan Desert, Egypt.

Very small differences in spectral signatures of the surfaces were discriminated due to high resolution (2 - 6 nm) of field spectroscopy and TM-5. Nummulitic limestone, loose nummulite cover, sand and hard-rock outcrops' spectra reflectances were presented. The experiment proved that a fractional classification of the Landsat-TM is useful for bare soil surfaces.

Questions concerned details of atmospheric corrections, methods of linear discrimination, problems of shadows etc.

Answers were highly technical and extended into merit problems, delineation of surface deposits in desert areas, and possible automation of work.

No more posters have been presented during this session.

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Poster Session 70P7 - **Studies of Ecosystems, Habitats, Change Detection and Environmental Monitoring**

July 17, 1996, 13:00-15:00
*Session Reporter: **Ake Rosenqvist** (Japan)*
*Chairperson: **Ake Rosenqvist** (Japan)*

Elmar Csaplovics (Germany), L. Bacsatyai, A. Sindhuber, I. Markus - **High Resolution Digital Terrain Models of the Bottom of Lake Fertö (Austria, Hungary) - A Hungarian-Austrian Joint Project for Creating Cross-Border Data Bases for Ecosystems Research**

Digital terrain models (DTMs) of bottoms of lakes depend on selected methods of data collection and data treatment. As research on limnetic ecosystems needs exact information of the topography of the regions under investigation DTMs are most efficient tools for providing suitable data bases for interdisciplinary co-operation. Applying DTMs to hydrological and limno-ecological tasks opens a wide range of possibilities of multithematic modelling and simulation of ecosystems behaviour in function of variations of water levels, water currents and patterns of human impact. Building up powerful data bases for holistic research has to connect DTM layers with multitemporal remotely sensed information of landuse and landcover. Very high resolution mapping of vegetation structure, physiognomy and vitality is guaranteed by colour infrared (CIR) aerial photography and by space photography. Digital data of the topography of the terrain and of landcover extracted from DTM and multisensor images are therefore the basic parts of an operationalised GIS for monitoring and modelling of limnetic ecosystems.

Yoshiki Yamagata (Japan), Y. Yasuoka - **Unmixing Wetland Vegetation Types by Subspace Method Using Hyper Spectral CASI-Image**

A new approach to unmixing with subspace methods is proposed and an experiment using hyperspectral images was conducted. In subspace method, unmixing is calculated as the projection of each unknown pixel vector on the subspace of each class. This method is more stable than conventional methods against noise in the data and works effectively as a feature extraction and data reduction procedure as well. The performance of this method was tested by an unmixing experiment using a hyperspectral airborne CASI (Compact Airborne Spectral Images) image acquired over the Kushiro wetland in NE Japan. Unmixing for the 7 wetland vegetation classes were calculated using a least squares, quadratic programming, orthogonal subspace projection and the subspace method. Finally, the results of unmixing experiment were evaluated in regard to wetland vegetation monitoring.

Wen-Shu Liou (Taiwan), S. A. Sader - **Evaluation of a GIS Rule-Based Model to Map Forested Wetlands in Maine**

The key point was to employ a Geographic Information System (GIS) rule-based model to identify forested wetlands. In order to clarify the contribution of GIS variables to forested wetland delineation, several analytical methods were conducted. After the GIS layers were analysed statistically. an integrated model was formulated. The integrated GIS model offered a greater degree of versatility and automation for a less subjective classification approach. The results indicated that the

model had the highest classification accuracy among all tested methods. The results also suggest that the physical characteristics of the study sites may have had more influence on the conventional classification methods than on the integrated model because the model incorporated the physical variables into the decision rule.

Saeid Noori-Bshehri (Iran), N. Khorsandian - **Improved Classification of SPOT Multi-Spectral Images for Land-Cover Types Evaluation Assisted by Digital Elevation Model (DEM) and Aerial Photographs, a Case Study**

The SPOT scene available for fieldwork site, annually used by ITC students, was classified. The classified part is our area of interest for improved classification, whose existing classified map has been used as the ground truth. In addition, topographic data has been collected from mosaicked orthophoto which are subsequently digitised and overlaid to the composite SPOT image. The so formed topographic network superimposed to the landuse parcels visible on the satellite images is basically a tool for further classification improvement.

Genong Yu (P. Republic of China) - **Agricultural Land Investigation and Change Detection by Incorporating GIS and Satellite Remote Sensing - Case Studies in Sichuan Province, China**

Repeated agricultural land information requirements prompt the study of the potential application of remote sensing techniques and geographical information systems. A procedure for agricultural land investigation and change monitoring by incorporating these techniques was summed up through the studies carried out recent years in Sichuan province, China, which was proved feasible and operational. It is mainly based on the visual interpretation of Landsat TM image in print with digital processing and geometric correction, completed in the light of available historic data and/or maps and routine ground survey. Geographical information systems are used to manage all data and information with facilities for editing, area summary, interactive information retrieving and updating. Two application cases, one on agricultural land change detection and another on renewable resources and environment monitoring, are fully discussed and resulted in favourable results.

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Poster Session 70P8 - **Desertification, Soil Erosion / Hazardous Waste and Environmental Pollution**
July 17, 1996, 15:00-17:00
Session Reporter: **Stanislaw Mularz** *(Poland)*
Chairperson: **Zbigniew Sitek** *(Poland)*

Helio Olympio da Rocha (Brazil), D. Schmidlin - **Application of Remote Sensing and GIS to Compile and Update Soil Maps at the Environmental Protection Area - APA of Guaratuba, Parana, Brazil**

The principal point of the work is the development of a metrology to compile and update soil maps through remote sensing and GIS, using IHS transformation as a basis for the interpretations.

B. F. Borodin (Russia), V. Mishanin, A. Shutko - **The Local Monitoring System "Biosphere TM"**

The paper describes a system for local monitoring of land utilising a small motor delta-plane equipped with optical and microwave sensors.

The areas for application: agriculture, land reclamation, wetland delineation, etc.

Adam Linsenbarth (Poland) - **Application of MOMS-02 Data for Analysis of Sand Dune Forms and their Development**

The main objective of investigation was to evaluate the MOMS-02 data for geomorphological analysis of sand desert areas. The performed analysis was based on MOMS-02 data registered from orbits 75 and 91 over Ramlat Zaqqut and great sand sea in Libya in 1993.

The MOMS data allowed to detect small dune forms and their relationship with terrain topography and wind regime.

The comparison with metric camera photographs from 1983 indicated the changes in dune forms confirming sand desert dynamics.

Zbigniew Sitek (Poland) - **Experience with Environmental Monitoring of Cracow Region (Poland) Based on GIS**

A multipurpose environmental monitoring system was built for the Cracow region in Poland.

The paper presents experience and examples connected with this project.

Marinko Oluic (Croatia), M. Buchroithner - **Low Cost Remote Sensing Investigations of a Waste Dump Near Zagreb, Croatia**

The waste dump near Zagreb is one of the largest in Europe. Its volume of waste is about 6,000 000 m³. The waste dump is located in quaternary clastic (alluvial) sediments. Below of it are gravels and sands, which are the main aquifer in this area, important for water supply.

For this waste dump multitemporal Landsat TM and SPOT PAN imagery have been analysed, as well as multitemporal pan chromatic and CIR airphotos and airborne thermal IR images.

Geological-structural terrain relations have been established as well as old river backwaters and meanders. The increase in the waste volume from 1968 to 1989 was calculated by photogrammetric measurements on stereo-models. That compared to terrestrial methods, is faster and less expensive.

Mario Valerio Filho (Brazil), G. J. L. Araujo - **Geoprocessing Techniques and Modelling Applied to Monitor Erosion of Tropical Soils**

A study made in an agricultural watershed (eastern Sao Paulo state of Brazil). Its purpose is to monitor soil erosion areas and to provide information for rural planning. TM/Landsat images were digitally processed. Based on the analysis of different products and field information land use and land cover maps were prepared. A Geographic Information System was used to integrate physical parameters of the Universal Soil Loss Equation, to obtain the soil loss estimation and characterisation of areas under erosion process during 1988 and 1994.

El-Din M. Y. Zein (Egypt), A. El Ghawaby - **Remote Sensing Approach for the Study of Geological Structures of the Northern Sinai Peninsula, Egypt**

During the last decade, Northern Egypt and Sinai had been stroke by a relatively great number of earthquakes. Delineation of structural elements helps to understand and to define the zones of these seismic activities.

Selection of the best image processing enhancement technique for structural delineation in an area at northern Sinai was done. The Pass filtering method was found the best for the enhancement lineaments and of various trends.

We could define four fault sets from which two are active.

Tania Neusch (Germany) - **Evolution de l'occupation des sols entre 1984 et 1993, sur le domaine Haguenau-Karlsruhe, à partir de données landsat-TM**

A wide range of papers were presented at the poster session, all relating to the impact of human development on the landscape or physical disasters impacting human development. Unfortunately because of poor organisation the poster presenters were only given 10-15 minutes to put up their displays, which was too short, and some did not have sufficient time to speak. Nevertheless all the presentations and posters were of excellent standard. The papers addressed land use change, for a range of purposes, for example assessment of changes relating to a class in Istanbul and the changing community needs, other were related to surface cover and surface cover change, as an estimate of building density and social and environmental conditions, and also areas of impervious surface, while a further paper provided information on a GIS related study via the North-East Thailand Village Information System. Papers also came from a wide range of countries, which included Turkey, Sri Lanka, Thailand, Japan and Germany.

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Poster Session 70P9 - **Human Settlements**
July 16, 1996, 14:30-16:30
Session Reporter: **Bruce Forster** *(Australia)*
Chairperson: **Bruce Forster** *(Australia)*

Yukio Mukai (Japan), H. Hasegawa - **Extraction of Damaged Areas of Fallen Trees by Typhoon using Landsat TM Data**

Konrad Ringle (Germany), M. Sties - **Vergleich verschiedener Methoden zur Bestimmung der Oberflächenbeschreibung besiedelter Gebiete für die Modellierung des Schmutzeintrags in das Abwasserkanalnetz**

Yoshikatsu Nagata (Japan) - **Changes in Rural Areas of Northeast Thailand in the Latter Half of the 1980's as Seen through the Northeast Thailand Village Information System**

Sanath Bandula Jayamanna (Japan), M. Kawamura, Y. Tsujiko - **Relation Between Social and Environmental Conditions in Colombo. Sri Lanka and the Urban Index Estimated by Satellite Remote Sensing Data**