ISPRS Technical Commissions

Commission I: Sensors, Platforms and Imagery

President: George Joseph, (India)

Secretaries: A.K.S. Gopalan (India) and V. Jayaraman (India)

State of Science and Technology of Commission Topics
The first very high resolution satellite sensor for 3-D mapping has now been launched and the next systems will follow soon. This opens up the long expected civil applications of large scale mapping from space. The development of the space sensors has also influenced airborne digital sensor development, and now digital images can also be acquired from the air with a sufficient resolution. A new trend is to develop Micro Satellites for Earth Observation. The Hyper-Sat (small and high performance satellite system) with weights less than 200 kg is being studied, which is a simple and compact system to be used by limited single mission users.

The Remote Sensing Community is becoming more aware of the importance of geometric and radiometric calibration and inter-calibration of space sensors. So far suitable standards are not available Further investigations for various sensor types are necessary before standards can be defined. The worldwide availability of geometric test sites with high quality ground control information is a further requirement for the geometric inflight calibration of space-borne sensors.

The quality and also the availability of more precise Inertial Measurement system (IMU) has been improved. The IMU can be used today for the direct determination of the attitude data.

Accomplishments of Commission-I during 1999
The major activity of the Commission was to plan for the Congress. Three theme sessions were planned as follows:
(i) Ocean colour information from space
(ii) Perspective of platforms and sensors for Geoinformation needs
(iii) Space systems for disaster management.

Apart from this, the Commission has the responsibility for following Inter-Technical Commission Theme sessions:
(a) Advances in synthetic aperture radar development
(b) Recent development in SAR applications
(c) High Resolution satellites
(d) Sensor calibration
(e) Data standards

Inputs has also been provided for following Inter-Technical Commission:
(i) Sensor orientation
(ii) DTM generation and ortho-images
(iii) Interoperability of GIS
(iv) Sustainable resource management

Working Group Activities

WG I/1
Sensor Parameter Standardization and Calibration

Chair : Dr Manfred Schroeder (Germany)
Co-chair : Dr Alan Belward (Italy)

State of Science and Technology
Since the Remote Sensing Community is becoming more aware of the importance of geometric and radiometric calibration and inter-calibration of space sensors, the development of standards is a priority.
The status on calibration of current airborne and space-borne sensors have been discussed at WG workshops (see below). The variety of presented methods indicates a strong need for standardisation of methods but also of terminology. Procedures for both laboratory and in-flight calibration of digital camera systems are to be investigated with the objective of deriving recommendations for standards, which will be a long term task for ISPRS. A proposal of these issues has been prepared and sent to ISPRS Council. Furthermore, the following suggestions were given:
- Field campaigns for radiometric inter-calibration of data of different satellites should be conducted.
- Laboratory camera calibration parameters should be checked/readjusted under normal flying conditions over high accuracy ground control test sites using high quality onboard navigation sensors for exterior orientation measurements.
- Investigations of in-flight calibration of upcoming stereo satellite missions (CARTOSAT, SPOT-5, ALOS) should be prepared.
- Calibration parameters for high resolution commercial satellite missions should be made available.
- More efforts should be spent on testing and calibration of Radar - Infrared - and Laser-Sensors with respect to their accuracy potential for generation of topographic products.

The worldwide availability of geometric test sites with high quality ground control information is a further requirement for the geometric inflight calibration of space-borne sensors. First efforts have been made to establish a worldwide database for up- and downloading of ground control information to be used for geometric inflight calibration purposes by the concerned user community.

WG Activities/Events
In 1999 two Workshops were co-organised on topics related to WG1/1:

1. A joint workshop of WG 1/1 and WG 1/3 together with WG IV/4 on 'Sensors and Mapping from Space' held in Hanover, Germany from September 27-30, 1999, (Chairs: Dr Schroeder, DLR; Dr Jacobsen; Prof. Konecny, University Hanover). Proceedings on CD-ROM are available at the Institute for Photogrammetry and Engineering Surveys, University Hanover, Nienburgerstrasse 1, D-30167 Hanover, Germany.
2. A workshop on `In-Orbit Geometric Characterisation of Optical Imaging Systems', held in Bordeaux, France and jointly organised by CNES, IGN, SFPT in co-operation with ISPRS (Chairs: G. Begni, CNES; H Le Men, IGN). Proceedings are available at CNES-Delegation a la Communication, 18, avenue Edouard Belin, F-31401 Toulouse Cedex 4, France.

WG News
The CEOS Cal/Val WG deals with issues related to calibration. On 14-16 April 1999, the 14th Plenary Meeting of the CEOS Working Group on Calibration and Validation took place at the Andøya Rocket Range in northern Norway. WG-1/1 members participated at this meeting.
WG I/1 is the ISPRS point of contact for ISO TC 172 / SC 9 and for the Consultative Committee for Space Data Standards (CCSDS). Both groups produce a lot of publications, which have to be reviewed and commented. The work is in progress. It is suggestion that ISPRS should appoint a special officer who would be in charge of liaison with these organisations.

WG I/2
Pre-processing Archival and Dissemination of Image Data

Chair : Dr Dan Rosenholm (Sweden)
Co-chair : Dr Jolyon Thurgood (USA)

State of Science and Technology
For effective use of remote sensing data, especially for transient events, the data should reach the end user as early as possible. This calls for suitable design of the pre-processing techniques and suitable architecture for data reception and dissemination. With the large number of high resolution satellites being planned in the future, volumes of data acquired will increase and the archival technology must meet this challenge. Spatial data search and retrieval in heterogeneous environments need special attention.

WG Activities/Events
A workshop called 'From Data Producer to the User' on line concerning user requirements of archiving, pre-processing and dissemination of satellite data for on-line distribution, as well as impact of spatial data handling technologies in heterogeneous environments was planned to be held in the island of Langholmen in Stockholm September 1-3. The workshop was planned as a joint event together with WG II/3 Spatial Data Handling Technologies. Since there was not interest shown by the community, in spite of extensive publicity, the proposed event was cancelled.

WG I/3
Sensors and Platforms for Topographic Survey

Chair : Dr Karsten Jacobsen (Germany)
Co-chair : Mr T. Natarajan (India)

State of Science and Technology of WG Topics
The first very high resolution satellite sensor for 3-D mapping has now been launched and the next systems will follow soon. This enables the long expected civil application of large scale mapping from space. A large part of the world is now covered by high resolution stereo images taken by the MOMS-2P camera from the MIR space station, supported by the operational SPOT-4. Therefore, the sitatus of mapping based on optical sensors from space has been improved. A digital elevation model of the largest part of the world will be generated very soon by means of interferometric SAR with the SRTM-mission from space shuttle, now scheduled for launch in January 2000.

The first digital 3-line aerial cameras are in use. The 2 major producers of metric cameras have announced operational digital cameras for the year 2001 as a 3-line-camera or based on a combination of large CCD-arrays.

The direct sensor orientation by means of a combination of inertial measurement units (IMU) and GPS is making progress and will soon become operational. Problems still include the exact determination of the misalignment between the IMU and the photogrammetric camera, which is limited by the stability of the attachment of the IMU to the camera cone.

High Resolution Space Data
Between the end of 1999 and the begin of 2000, the following launches have been announced:

- Quick Bird with 0.82 m pixel size in panchromatic and 3.28m in multispectral
- IKONOS 2 with the same pixel size on the ground
- EROS B1 with 1m pixel size in panchromatic mode, and 4m in multispectral mode
- OrbView 3a wit 1 or 2m pixel size in panchromatic mode and , 4m in multispectral mode
- IRS-P5 (Cartosat) with 2.5m in panchromatic mode

With the exception of IRS-P5, all these sensors will have a pointing capability along- and across-track, so a stereoscopic coverage will be possible within the orbit.

Digital Airborne Cameras
The development of the space sensors has also influenced airborne digital imaging. For example, the WAOSS, HRSC, DPA and MOMS can now acquire digital images from the air with sufficiently high resolution. LHS Systems has announced a digital 3-line camera in co-operation with the German DLR for the year 2000. This camera will be based on the WAOSS-development, originally

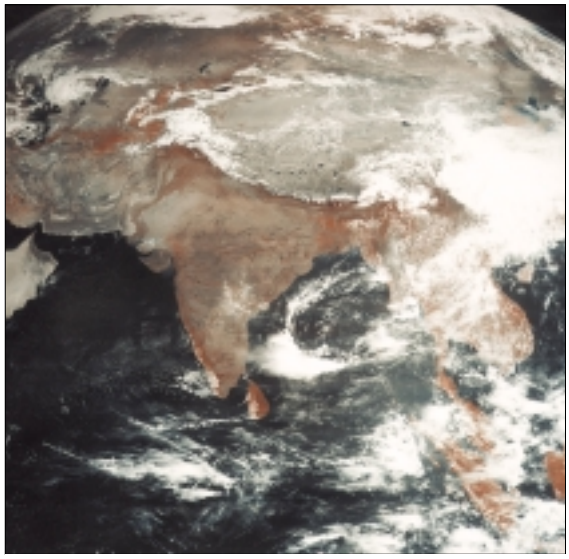

Image acquired by the Indian INSAT-2E which was launched at 2 April 1999. The CCD camera records in the visible, near and medium infrared wavelengths at 1 km ground resolution. Its orbit and swath enable a potential revisit time of 30 minutes within its total field of view and makes it suitable for disaster monitoring.

invented for the mapping of the Mars. Such a development was only possible with the improvement of the direct acquisition of the image orientation.

Z/I-Imaging's development is based on CCD-array-cameras, which will not require a significant change in the mathematics that have traditionally been used for photogrammetry, for photogrammetric processing of digital images acquired by this systems. This is not the case with images acquired by a 3-line-cameras. In the case of CCD-array cameras, the current procedure of scanning of aerial photographs will be replaced by the direct digital imaging.

Direct Determination of the Exterior Orientation

The use of relative kinematic GPS-positioning for the determination of the projection centre co-ordinates has been established as a standard tool. As a stand-alone system it still includes the problem of ambiguity errors, which may be different for the individual flight strips. In a combined system with an inertial measurement system (IMU), incorporating Kalman filtering, cycle slips can be determined and so absolute positions can be derived. In several areas of the world the success of this system will be limited by the problem of insufficient knowledge about the Geoid undulations.

The quality and also the availability of more precise IMU has been improved, so that IMU can be used today for the direct determination of the attitude data. This data is essential for the use of the airborne 3-line-cameras, which are able to achieve a positional accuracy level, based on improvements with control points, as high as 20cm. With inclusion of IMU the first steps towards direct determination of the image orientations have been made. For some cases, such as for the creation of orthophotos, this will be of a sufficient accuracy. However, problems still exist in the relative orientation of images and hence the combined use of the IMU-data in a bundle block adjustment together with the GPS-data has advantages. This method can now reduce the number of control points required for some projects, such as for road alignments.

Activities/Events

A joint workshop was arranged together with the working groups 1/1 and IV/4 with the title 'Sensors and Mapping from Space 1999' from September 27 to 30, 1999 in Hanover. In total 54 papers have been presented. The papers are published on CD. There was a strong international response, with 69 participants from 19 different countries taking part.

WG News

The activities of the working group have been strongly supported by the technical developments of the new sensors. After a long wait, very high resolution space images are available now, interferometric SAR systems are making large progress, digital aerial cameras are being developed, and the direct sensor orientation is becoming operational. In general more changes than expected have occurred in this field and the mapping organisations have new opportunities to speed up the required topographic information about the world.

WG I/4
Microwave and Optical Sensors for Geosphere-Biosphere Studies

Chair : Dr Jean Louis Fellous (France)
Co-chair : Dr John Miller (Canada)

WG Activities/Event

WG Chair was requested to expedite various activities. Dr Fellous has agreed to organise a workshop in the near future and definite plans will be eveloped.
TCP has requested some of the members to bring out a status paper on following topics which falls under WG I/4.

1. Status of data needs for GBP studies and its availability from satellite based sensors.
2. Status of development and operation of new technologies and techniques in microwave sensor design.

WG News

A workshop on 'Global change studies and related observational strategy' jointly with ISRO-GBP is being planned at Ahmedabad during March 2000.

WG I/5
Advanced Platforms and Sensors

Chair : Mr Takashi Moriyama (Japan)
Co-chair : Mr K. Thyagarajan (India)

State of Science and Technology

The new Micro Satellite concept for Earth Observation have been studied. The Hyper-Sat (small and high performance satellite system) is simple and compact, and is limited to single mission users. This satellite weights less than 200 kg, but has the capacity of significantly improve performance over previous generation satellites. The system constitutes some core electrical units which unify a lot of components of the current electrical sub-systems, except high electrical power elements, and peripheral equipment which are related to power, actuator and battery. WG have been studying this system concept, its main characteristics and some potential usage of the compact satellites for Earth observation.

WG Activities/Events
The Interim Report on (Survey of Satellite) published and distributed at TC-1 Symposium in Bangalore, India during February 23-27, 1998) is being updated. The contents of the report are small satellite background and characteristics and typical missions. The updated Earth Observation view missions will be added in this report in its final version.
Current and planned Hyperspectral sensors are being investigated. The study have been focusing on multispectral sensors which have more than 30 spectral channels covering the visible, near-infrared, short wave infrared, middle infrared and thermal infrared regions of the spectrum. On the other hand, images systems designed for very high spatial resolution, are also being investigated. These results will be included in the Survey of Small Earth Observation Satellites.
WG I/5 has been studying 'Advanced Platforms and Sensors' focussing on 'Hyper Sat', a High Performance Satellite System, as described above. The Hyper Sat could be used for earth observations and deep space exploration

Commission II: Systems for Data Processing, Analysis and Representation

President: Ian Dowman (United Kingdom)

Secretaries: Ray Harris (United Kingdom) and Beverly Adams (United Kingdom)

State of Science and Technology of Commission Topics
During 1999 there has been less activity in terms of meetings than in 1998 and also fewer opportunities to assess development. Nevertheless progress has been made and reported and there is a steady advance in the development and use of digital systems. Details are given in the working group reports but the main trends are summarised here.

The trend towards more comprehensive systems encompassing photogrammetric and remote sensing requirements is indicated by the launch and acceptance of ERDAS Orthobase as a new photogrammetric system. The merger of Zeiss and Intergraph indicates consolidation in the future and the establishment of the trend towards Windows NT as the accepted operating system. News of new digital camera systems to be launched in 2000 will no doubt accentuate the trend towards digital systems. Modules for automatic interior and relative orientation and for automatic aerial triangulation are operational and are in daily use in practice. The direct acquisition of the image orientation by means of GPS and IMU is a serious alternative to aerial triangulation for a number of applications, and its use in practical work has commenced.

The evaluation of automated and semi-automated feature extraction systems is becoming of increasing interest to the research and user communities. Automation is slowly coming into use. Photogrammetric and remote sensing imagery play a significant role in spatial data base revision. The research arena is starting to develop integrated updating concepts including various data sources and automation.

The improvement of GPS/INS technology continues to have a significant influence in data acquisition and processing and has an important impact on sensor integration and triangulation. Great efforts have been made in high-accurate real-time navigation data using radio-link based local DGPS correction techniques for a broader range of applications. There is a move towards systems which will handle a range of data types and to tailor systems to particular requirements providing complete data processing chains. On the global scale this is happening through the IGOS programme in which international considerations are being given to providing data for particular applications.

Dynamic and Multi-Dimensional GIS is a topic of increasing interest and was the subject of a major conference in 1999. Two of the main themes concerning three dimensional data in GIS are the data acquisition on one side and the management and modelling of 3D data on the other. Fuzzy techniques and visualisation are also important. Web based services using the Internet is continuing and distributed search and retrieval for distribution is a major issue

SAR is of continuing importance with new missions imminent and the establishment of complex processing chains to produce DEMs and image mosaics from SRTM for example. Processing techniques for data sets that have an increased dimensionality is becoming an increasingly important requirement and many users now have large multi-temporal data sets. Multi-polarimetric data processing is also of increasing interest.

The increasingly important role of the Open GIS Consortium (OGC) in establishing data standards is recognised. ISPRS is working in this area through both OGC and ISO and there is a willingness of vendors to be involved in this development.

Accomplishments of Commission during 1999
There have been a number of important working group meeting during 1999. An International Workshop on Mobile Mapping Technology was held in Bangkok, Thailand, April 21-23, 1999. WG II/4 combined with WG III/6 and the CEOS Working Group on Calibration and Validation for a meeting on Validation of Digital Elevation Models and Terrain Parameters in London in May 1999. The major activity of Working Group II/6 on Integration of Image Understanding into Cartographic Systems in 1999 was the organisation of an International Workshop on '3D Geospatial Data Production: Meeting Application Requirements', in Paris. WG II/6 and WG II/8 combined with WGs III/1, III/2, III/3, III/4 for an ISPRS Conference on Automatic Extraction of GIS objects from digital imagery in Munich, Germany, September 8-10, 1999.

The final report of the OEEPE/ISPRS Test on Performance of tie point extraction in automatic aerial triangulation, was published in the official OEEPE publication No. 35, pp. 125-185.

WG II/7 has been very active in producing a draft Image Transfer Standard. The Abstract Specifications of ISPRS-ITS have been presented at an ISO meeting. The general concept of ISPRS/ITS has been very well accepted, and ISO wants the ISPRS/ITS to be integrated into TR 16569, which will result in a new chapter of the TR. A memorandum of Understanding is being negotiated between ISPRS and OGC. In addition Ian Dowman is chairing an ad hoc ISPRS WG to consider the impact on the use of rational functions into photogrammetric systems.

Working Group Activities during 1998
WG II/1
Real Time Mapping Technologies
Chair : Dr Rongxing Li (USA)
Co-chair : Holger Schade (Switzerland)

State of Science and Technology of Working Group Topics
Great efforts have been made in high-accurate real-time navigation data using radio-link based local DGPS correction techniques for a broader range of applications. It will greatly improve the real-time positional accuracy of sensor orientation. Supported by this development and along with the progress in GPS/INS integration, real-time accurate sensor orientation will soon be a reality in some parts of the world.

Sensor integration continues to be a challenging but demanding topic in both research and industrial communities. In addition to GPS, INS and CCD cameras, integration of laser, SAR and hyper-spectral sensors is becoming evidently advantageous in applications where not only real-time but also all-weather and high accuracy is essential. Research in multi-sensor and multi-platform based sensor integration and data processing will be an important topic in the next few years. Its applications can be found in emergency management, environmental monitoring, and others.

Intelligent processing of real-time mapping data remains a research topic. The application of invariance theory for sensor orientation and georeferencing in cases of weak navigation data has been attracting attention. Object recognition and feature extraction will benefit from the availability of high quality orientation parameters and image sequential information. Algorithms for automatic data processing such as model-based object recognition, multiple image-based matching, Hopfield and Bayesian networks have found applications in the mobile mapping data processing.

Recent WG Relevant Publications
Li, R and S. Murai (Ed.) 1999. Proceedings of the International Workshop on Mobile Mapping Technology. Bangkok, Thailand, April 21-23, 1999, Int. Achives of Photogrammetry and Remote Sensing, Vol, XXXII Part 2-5-3/W10
Direct Versus Indirect Methods of Sensor Orientation. Proceedings of Workshop organised by ISPRS WG II/1, Barcelona, November 25-26, 1999.

Working Group Plans
The 3rd International Symposium on Mobile Mapping Technology will be held in Cairo, Egypt in January 2001, co-sponsored by ISPRS, IAG, and FIG

WG II/2
Software and Modelling Aspects for Integrated GIS
Chair : Dr Manfred Ehlers (Germany)
Co-chair : Mark Gahegan (Australia)

State of Science and Technology of Working Group Topics
The main topics of interest of the working group were covered by the Second International Workshop on 'Dynamic and Multi-Dimensional GIS held in Beijing in October 1999. The issues discussed at that meeting summarise the main advances during the year.

Time stamps are a necessary attribute of geographic information. The GIS way would be to apply GIS operators to objects with time as an additional dimension or separate level. An emphasis had been put on minimising performance loss on spatial analysis operations. Approaches regarding the extension of the two spatial dimensions towards continuous time model have been discussed, in particular integrating cellular structure theory and the

functional data model. There still seems to be sufficient demand for further studies regarding a consistent time management in GIS. At least we have not seen any sort of satisfying implementation.

Two of the main focuses concerning three dimensional data in GIS are the data acquisition on one side and the management and modelling of 3D data on the other. Work has been going on to use airborne laser scanning for high resolution mapping of terrain and cars have been used as platforms for acquiring 3D data. New concepts for integrating the data components to create detailed, large scale realistic 3D models have been developed. Methods combine the generation of 3D building information with a data structure and topological methods to manage them in context with a surface DGM. Generally performance still seems to be a problem, but further technical developments also in the field of digital acquisition techniques will have 3D GIS applications combined with acquisition techniques as one of the main future topics in the field. The Beijing Workshop in October has shown only a few application examples but also a strong trend towards modelling 3D in GIS.

There is still an interest in using fuzzy techniques, algorithms and applications and there is work on integration of fuzzy rules and neural networks in GIS modelling for the use of land use classification with different data layers and parameters. The study of topics of visualisation standards and spatial analysis through the Internet, are progressing rapidly and will be of considerable interest in the future.

Accomplishments of WG during 1999

The WG was a co-sponsor of the Second International Workshop on 'Dynamic and Multi-Dimensional GIS' in Beijing from October 1 - 6, 1999. Other activities included the participation in the program committee of the International Symposium on Spatial Data Quality in Hong Kong from 18 - 20 July, 1999.

WG II/3
Spatial Data Handling Technologies

Chair : Henrik Osterlund (Italy)
Co-chair : Dr Wyn Cudlip (United Kingdom)

State of Science and Technology in the WG Area

Rapid developments in Web based services using the Internet is continuing and distributed search and retrieval for distribution is a major issue. Many new tools, mostly based on Java are being developed. New, fully commercial end-to-end providers are entering the EO market, providing very high resolution data at high processing levels via the Internet. They will meet the increasing demands of faster satellite data distribution. The lack of globally accepted standards and non-existing co-ordination in related fields leads to different meta-data standards, protocols and incompatible services being developed and this continues to be a problem.

WG II/4
Systems for Processing SAR Data

Chair : Dr Douglas Corr (United Kingdom)
Co-chair : David Stanley (Canada)

State of Science and Technology of Working Group Topics

Processing techniques for data sets that have an increased dimensionality is becoming an increasingly important requirement. Many users now have large multi-temporal data sets, acquired by systems such as ERS. Techniques for speckle reduction have been developed that form common segments across the multi-temporal data. This is an advantageous processing strategy for both change detection and classification.

The data dimensionality can also be increased by the combination of SAR data with optical or hyperspectral data. High resolution is a feature of several of the SAR systems now planned. Future systems with 1 m resolution are Radar1 (2001), SkyMed COSMO (2002) and Terra SAR (2004). Radarsat 2 (2002) is planned to have 3 m resolution. SAR data will then be compatible in terms of resolution with optical systems such as IKONOS, which will be distributing products from December 1999 that have resolution of 1 m or better. There are also other systems operating at a lower resolution. ENVISAT (2001) allows the possibility of simultaneous operation of low resolution SAR with other sensors such as MERIS and AATSR.

Multi-polarimetric data processing has also seen significant advances, a number of these have been based on new techniques that decompose the multi-polarimetric return in terms of scattering characteristics and their homogeneity. These techniques have led directly to features for use in unsupervised classification schemes. Recently the techniques have been extended for use with multi-temporal interferometric data sets. By isolating different scattering mechanisms these techniques have resulted in the measurement of tree height. These techniques too are underpinned by the use of new speckle reduction techniques appropriate for multi-polarimetric data.

Multiple polarisation SAR data will be available from ENVISAT (2001) with 30 m resolution, ALOS POLSAR (2003) with 10 m resolution and fully polarimetric data from RADARSAT 2 (2002) at 3 m resolution. There are also airborne systems available for commercial operations that have multi-polarimetric SAR such as the E-SAR system; this system can also operate at X, C, L or P band.

Accomplishments of Working Group during 1999

Working Group Meeting combined with WGIII/6 and the CEOS Working Group on Calibration and Validation for meeting on Validation of Digital Elevation Models and Terrain Parameters in London in May 1999.

WG II/6
Integration of Image Understanding into Cartographic Systems

Chair : Dr David McKeown (USA)
Co-chair : Olivier Jamet (France)

State of Science and Technology of Working Group Topics

The evaluation of automated and semi-automated feature extraction systems is becoming of increasing interest to the research and user communities. In the research arena, systems have gone beyond merely being able to perform limited feature extraction on a small, carefully selected set of images to performing at some level of competence on a range of images. Evaluation of such systems requires more than the publication of one image on which it worked; this Working Group has pushed strongly for more stringent evaluation standards for publication of cartographic feature extraction results, and is beginning to have some effect.

Data producers are beginning to look seriously at automated systems and are performing their own experiments to evaluate the productivity and output of automated CFE systems in a production context. A good example of this is the ongoing work at IGN on evaluation of road extraction systems.

Adoption of rigorous evaluation techniques by researchers and users is proceeding rapidly. We expect to report on more of these efforts at the ISPRS Congress in Amsterdam next year.

Accomplishments of Working Group during 1998

The major activity of Working Group II/6 on Integration of Image Understanding into Cartographic Systems in 1999 was the organisation of an International Workshop on '3D Geospatial Data Production: Meeting Application Requirements'.

The major theme of this workshop was to encourage participants from government, academe, and industry to share requirements, research results in the area of performance evaluation of image understanding systems for geospatial data capture. Included in this theme were issues in predictive analysis of internal quality measures in automated feature extraction processes, end-user quality metrics, and post-processing analysis of automated systems.

Other activities included participation in the ISPRS meeting in Munich in September, 1999, which was sponsored by a number of different working groups from Commissions II, III, and IV. Several papers from members of the II/6 Working Group were presented.

WG II/7
Practical and Implementation Issues in Digital mapping

Chair : John Thorpe (USA)
Co-chair : José Colomer (Spain)

State of Science and Technologies of Working Group Topics

There is widespread confidence in the importance of Earth imagery. Major corporations have been making large investments in Earth imaging satellites and data delivery systems. On the other hand, today's photogrammetric services and servers tend to be tightly linked to proprietary environments, not designed for shared image-related processes, and often are specific to one family of sensors.

Several organisations are currently working on the development of interoperability standards. The largest international and most influential is the Open GIS Consortium, but also organisations like the ISO TC 211 (Geographic Information – Image and grid data) and the American agency NIMA play a major role on this issue.

Accomplishments of Working Group during the Current Year

The WG activities have been focused on promoting an Image Transfer Standard (ITS) for digital photogrammetric systems, which will define the storage of image data as well as the relation between a georeference system (UTM, State Plane, etc) and the measurement system (pixel, image co-ordinates). The ITS should cover images from various sensors, aerial and satellite sensors, as well as processed images like ortho images.

Last year a Development Committee with independent representatives of developers users and academia has been established. Several meetings resulted in a first draft version of the Abstract Specification of the ITS.

WG Activities

The WG hosted a Meeting during the Photogrammetric Week in Stuttgart on September 20th 1999. Besides WG members A. Balada, representing DIN has been invited. A. Whiteside, representing OGC attended the meeting via conference telephone. The result of the meeting can be summarised as follows:

- The ISPRS has a policy of collaboration and its voice must be heard.
- The activity of WG II/7 is important and the ITS must gain acceptance from the ISO and the OGC.
- There is a debate on 'rigorous vs. non-rigorous models': the ISPRS intends to test and evaluate the problem carefully and has created a working group to support this activity. The group is chaired by Ian Dowman.
- A standard coming from a commercial company is likely to raise problems regarding acceptability from other software vendors. Therefore, the standard should be defined by a completely independent body like OGC, ISO or ISPRS.

The working group has established collaboration with ISO which has set up a project within the Technical Committee TC211: TC211/WG1/Project 'Imagery and Gridded Data Components'. In the past the

ISO/TC211/WG1 focused, besides others topics, on 'Imagery and Gridded Data'. The current status is documented in a technical report (TR 16569) on existing standards for raster data in the GIS environment. TR 16569 is now in the draft stage.

Prof. Kresse, who has worked tirelessly on behalf of WG II/7) was nominated by DIN to serve as an ISO member in ISO/TC211 'Geographic Information / Geomatics'. DIN expects a good synergy effect, as Prof. Kresse is a member of DIN, ISO and ISPRS working on the same topic in different organisation. The Abstract Specifications of ISPRS-ITS have been presented at an ISO meeting. The general concept of ISPRS/ITS has been very well accepted, and ISO wants the ISPRS/ITS to be integrated into TR 16569, which will result in a new chapter of the TR.

The working group has also been collaborating with the OGC. Generally the OGC handles topics related to ISPRS-ITS with less priority, i.e. photogrammetry and remote-sensing in general do not seem to be the most important issues on OGC's agenda. Rather, more important topics are GIS related, as database structures, SQL, and Internet-GIS. The OGC has released a White paper on Image Geometry Models (OGC Project Document 98-107), which promotes a 'Universal Real-time Image Geometry model' based on rational functions. ISPRS WGII/7 questions the accuracy and the feasibility as a standard of a non-rigorous model based on rational functions, especially for photogrammetric applications. In April 1999 Prof. Kresse attended an OGC-meeting in Enschede, The Netherlands. As an official representative of ISPRS WGII/7 he presented the Abstract Specifications of the ISPRS/ITS in the 'Special Interest Group: Image Exploitation Services'. The concept presented in the ISPRS/ITS was not directly accepted but hopefully will lead to reconsideration of the current OGC approach.

WGII/7 together with the ISPRS Executive Committee is currently working on a formal relationship with OGC to work collaboratively in establishing standard acceptable algorithms and models, which will support an OGC interoperability specification.

Future plans are to continue collaborating with the OGC and ISO. The goal is a triangular structure ISO/ISPRS/ OGC around the ITS.

WG II/8
Digital Systems for Image Analysis

Chair : Dr Christian Heipke (Germany)
Co-chair : Dr Tapani Sarjakoski (Finland)

State of Science and Technology of Working Group Topics

A large number of Digital Photogrammetric Systems (DPS) including input and output devices with different degrees of functionality, user friendliness, and automation potential is commercially available. Vendors of DPS include traditional photogrammetric, but increasingly also remote sensing and GIS companies. A concentration is taking place on the side of the traditional photogrammetric companies. A major trend can be observed to use Windows NT as operating system. Modules for automatic interior and relative orientation and for automatic aerial triangulation (AAT) are operational and are in daily use in practice. For AAT interactive editing is necessary, at least as a safeguard against distorted blocks. The direct acquisition of the image orientation by means of GPS and IMU is a serious alternative to aerial triangulation for a number of applications, and starts to be used in practical work. Automatic DTM generation has been accepted in practice some time ago, but interactive verification and editing is there to stay, especially in difficult terrain, and for large scales. Digital orthoimages are being produced routinely on a daily basis and are being integrated into geographic information systems (GIS). There is a need especially for large scale applications to use true orthoimages, i.e. to correct for effects from 3D topographic objects.

Semi-automatic extraction of GIS and CAD (computer aided design) data is still mostly restricted to research and development. Implemented algorithms combine computer vision approaches with rigorous photogrammetric modelling. Some results indicate that future systems will be equipped with more powerful tools. The human-computer interface is increasingly being seen as an important factor. In practice, GIS and CAD data are often still acquired from film imagery using analytical plotters. The term ´semi-automatic´ is interpreted in at least two different ways: it is used to mean (1) post-editing of automatically generated results, and (2) a close interrelationship between human operator and computer in the actual data acquisition phase. Clarification of the term is needed.

Photogrammetric and remote sensing imagery play a significant role in spatial data base revision. As compared to map revision, there are many more attribute data to be acquired. The research arena is starting to develop integrated updating concepts including various data sources and automation. The work flow in practice is still highly manual and the GIS data capture often occurs from paper plots showing the actual GIS objects, even though digital imagery might be used for acquiring the object geometry.

Accomplishments of the WG in 1999

The ISPRS Conference on Automatic Extraction of GIS objects from digital imagery
Munich, Germany, September 8-10, 1999 was organised together with WG II/6, III/1, III/2, III/3, III/4.

The final report on the OEEPE/ISPRS Test on 'Performance of tie point extraction in automatic aerial triangulation was published as official OEEPE publication No. 35, pp. 125-185.

Commission III: Theory and Algorithms

President: Toni Schenk (USA)

Secretaries: Kim Boyer (USA) and Ayman Habib (USA)

State of Science and Technology of Commission Topics
The scientific agenda of Commission III addresses a wide range of activities from data acquisition, surface reconstruction, object recognition to image understanding. The State of Science in these diverse topics can be judged from papers presented at four workshops organised by the working groups of Commission III. The workshop proceedings reflect the high standard of the papers and the timely topics.

As has been noted in last year's report, there is an increasing trend in using different sensors in data acquisition. Apart from instrumental and logistic challenges, there is the problem of establishing a common reference system for all sensors involved, as well as the combination of the sensor data at a suitable level. Not much progress has been achieved regarding the latter problem, usually loosely termed fusion, except for an increased awareness that it is indeed a difficult problem that needs to be tackled by researchers with different expertise.

The workshop in Barcelona Direct vs. Indirect Orientation provided an excellent snapshot on the status of direct platform orientation systems that have reached a high level of performance. But it also showed limitations. While some of these limitations will be overcome in future, others are inherently related to the difficulty of accurately modeling the sensor's interior orientation. It also appears desirable to discuss instrumental and algorithmic aspects together with Commission I and Commission II.

New applications, most notably city modelling, increase the need for quickly and economically generating DEMs and DTMs. Airborne laser ranging has become a very viable option to traditional photogrammetry methods. The workshop in LaJolla, organised by WGs III.2 and III.5, demonstrated the potential of laser altimetry, and the need for standardising calibration procedures. Certain applications, for example extracting man-made objects, require the combination of laser ranging with imaging methods. This is an another example of a challenging fusion problem; increased research activities are expected in this area, as well as in developing suitable algorithms for processing laser data sets (thinning, merging, segmenting, etc.).

The majority of research related to Commission III is in the area of object recognition and image understanding. Since these are hard problems, progress is incremental. The workshop in Munich reflected the state-of-the-art. There is an increasing trend to utilise multispectral data for the recognition process. However, most approaches are still ad-hoc. More theoretical investigations into object recognition with multispectral and multisensor data is required. As an example, models of real world objects must include spectral aspects to the extent they are recorded by multispectral/hyperspectral sensors.

Accomplishments of Commission during 1999
The major accomplishment in 1999 was the organisation of four workshops. The effort of working group officers and members bears fruits. I take this opportunity to extend my thanks to the working group officers for organising workshops and to the participants for their presentations. The workshop proceedings reflect the high standard of the presented papers as well as the timely topics that have been chosen.

Another highlight was the PERS issue containing the best papers presented at last year's symposium. Thanks go to Helmut Mayer (WGIII.3) and Eberhard Gülch (WGIII.4) who acted as guest editors.

The test site of Ocean City, established 1997, has been extended. Some aerial photographs have been scanned (15 micrometer resolution) and the exterior orientation of one strip was established by aerial triangulation. The Commission III WEB site contains updated information about the data set.

Commission III and the working groups promoted the submission of abstracts to the Congress in Amsterdam. As a result, many abstracts that are related to our Commission topics, have been received.

Working Group Activities during 1999

WG III/1
Integrated Sensor Calibration and Orientation

Chair : Peggy Agouris (USA)
Co-chair : Ismael Colomina (Spain)
Secretary : Anthony Stefanidis (USA)

Accomplishments of WG during This Period
The highlights of our Working Group's activities during this period were two workshops, organised in USA and Spain. Links to the workshops are provided through our WG Web page, http://www.spatial.maine.edu/~peggy/ISPRSWGIII1.html. By holding two workshops in Europe and the US we expect to provide more opportunities for researchers to share their accomplishments. In addition to these two workshops, WG III/1 participated in the organisation of the conference on 'Automatic Extraction of GIS Objects from Digital Imagery', held in Munich, Germany on September 8-10, 1999.

The first WG III/1 Workshop was held in Portland, ME, USA on June 16 and 17, 1999. The workshop topic was 'Integrated Sensor Calibration and Orientation', attracting a total of 11 presentations. It was held in conjunction with the NSF-sponsored workshop on 'Integrated Spatial Databases: Digital Images and GIS' (June 14-16, 1999). Together, the two workshops attracted a total of over 50 participants, from the photogrammetric, computer vision, and GIS communities. Detailed information for this workshop may be found on-line at: http://www.spatial.maine.edu/~peggy/isprsWS.html. A CD was produced with the proceedings of the workshop, while select workshop papers were included in a volume of the LNCS series (Springer Verlag) dedicated to above mentioned the NSF-sponsored workshop.
A summary of the presentations and notable issues addressed during the workshop was published in the journal Photogrammetric Engineering & Remote Sensing (Vol. 65, No. 9, pp. 983-985).

The second Workshop of WG III/1 took place in Barcelona, Spain on November 25 and 26, 1999. The topic of this workshop is 'Direct vs. Indirect Methods of Sensor Orientation'. More detailed information can be found at: http://www.icc.es/catala/isprs_workshop.html.

Commentary on Trends
An interesting trend seems to be evolving regarding sensor orientations. While applications reflect the increasing use of novel, diverse sensors, research seems to lag behind in orientation issues for these sensors, as well as for system calibrations. There seems to exist a prevalent notion that orientation issues are solved. In addition to the well documented advancements in this field during the last decade (see numerous presentations and products dealing with automatic orientations) this is also due to a sense of security provided by in-flight GPS/INS information. Researchers tend to ignore the fact that orientations are still necessary, since in addition to considering camera locations and rotations, they also correct for a variety of deviations from perfect camera models and relevant distortions. Consequently, they fail to exploit the full accuracy potential of photogrammetric processes, and furthermore face insurmountable obstacles when GPS/INS information flow is interrupted.

Future Plans
Our future plans obviously concentrate on the upcoming ISPRS Symposium. During the Symposium we will be convening a session on 'Sensor Orientation' (IC-11).

WG III/2
Algorithms for Surface Reconstruction

Chair : Amnon Krupnik (Israel)
Co-chair : Charles Toth (USA)
Secretary : Maxim Fradkin (France)

Accomplishments and State of Science of WG Topics
The main activities of the Working Group during 1999 were the preparation and participation in two workshops, co-organised with other ISPRS working groups.
The first workshop, held in Munich, Germany on September 8-10, 1999, is entitled 'Automatic Extraction of GIS Objects from Digital Imagery'. The workshop was co-organised by WG II/6, II/8, III/1, III/2, III/3 and III/4. The papers presented are related to various research aspects in photogrammetry and computer vision. Of approximately 30 papers, eight were related directly to surface reconstruction. The following trends can be observed:

- There is a strong link between surface reconstruction and object extraction. In particular, buildings are considered for the generation of urban surfaces, and for city modelling.
- Laser altimetry is now considered as an important tool in the process of surface reconstruction in general, and for urban areas in particular.
- Although it is widely agreed that the combination of laser and imagery is very promising, the applications presented at the workshop used laser altimetry, almost exclusively as a stand-alone tool.
- Algorithms and software for surface reconstruction still have limitations that should be studied and overcome, either by using additional sources of information or by improvements in particular problematic areas.

The second workshop, entitled 'Mapping Surface Structure and Topography by Airborne and Spaceborne Lasers', was held on the sunny coast of La Jolla, California, November 9-11, 1999. The workshop was co-organized by WG III/5 and III/2, and hosted by the Institute of Geophysics and planetary Physics at SCRIPPS Institute of Oceanography. This workshop was an attempt to gather researchers that deal with various aspects of laser altimetry. Many of the 55 participants came from academic, industrial and governmental institutions. Approximately 30 papers were presented, spanning a wide range of subjects, for example:

- Technical and scientific aspects of airborne and spaceborne systems and platforms (small and large footprints).
- Accuracy aspects.
- Integration between laser altimetry and digital imagery.
- Various applications, such as forestry, glaciers and virtual urban mapping.

Future meetings of this kind are expected in order to strengthen the connections among the relevant disciplines dealing with laser altimetry as it pertains to mapping.
Further WG activities are planned for the ISPRS Congress in Amsterdam. Authors of 25 papers have indicated that their paper is related to WG III/2 or technical session III/2 that is related to the WG. The WG will be responsible for two oral sessions, and will have a rather large number of papers in a one of the poster sessions. In addition, our WG will be involved in other sessions.

WG III/3
Feature Extraction and Grouping

Chair : Helmut Mayer (Germany)
Co-chair : Ram Nevatia (USA)

Secretary : Albert Baumgartner (Germany)

State of Science and Technology

- By means of differential geometry and scale-space theory high sub-pixel precision but also a good robustness can be obtained for feature extraction. This is valid for image as well as digital surface model (DSM) data, e.g., from laser-scanning. The results have to be evaluated analytically and experimentally.
- Sub-pixel analysis, alleviating the mixed pixel problem, seems to be a way to overcome problems in multi-spectral image classification.
- Fusion of multi or hyper-spectral imagery with different resolutions and possibly DSM data can improve the classification outcome but results in a need for additional modelling in image and also object space.
- Grouping is essential because feature extraction alone cannot be expected to result directly into parts of objects. Particularly, three trends can be noticed. Firstly, grouping uses more and more attributes such as the strength of the gradient or colour values of the features themselves as well as of adjacent features. The second tendency is that grouping is done in three-dimensional object space using photogrammetric camera models and constraints on two or more images. Third, there is a trend to interleave grouping and matching processes.
- Optimisation techniques like snakes, which were used mainly in a semi-automatic manner until now, show a high potential for the verification of automatically extracted hypotheses for objects.
- Simulated annealing and similar techniques make it feasible to optimise/learn parameters for image processing with the advantages of being able to overcome local minima and making available statistical information for higher level processes.

Accomplishments of the WG in 1999

Meetings:

September 8-10, 99: Conference on 'Automatic Extraction of GIS Objects from Digital Imagery', Munich, Germany in co-operation with WG II/6, II/8, III/1, III/2, and III/4. Helmut Mayer and the former WG Chair Heinrich Ebner were in the Conference Chair.

PERS Special Issue on Image Understanding, July 1999

Together with Eberhard Gülch from WG III/4 a special issue of the Journal photogrammetric Engineering & Remote Sensing (PERS) has been prepared. It comprises 6 papers that are the outcome of a review process of 14 preselected papers. Those have been the most exciting papers presented at the sessions of WG III/3 and III/4 during the Symposium of Commission III in Columbus, OH, USA, July 6-10, 1998.

WG III/4

Image Understanding/Object Recognition

Chair : Wolfgang Eckstein (Germany)

Co-chair : Eberhard Gülch (Germany)

Secretary : Carsten Steger (Germany)

State of Science and Technology

- Fusion of multiple data sources is applied in research, but so far mostly limited to two sources, e.g., multiple images and map (GIS) data, digital surface models (DSM) and map (GIS) data, or DSM and image data. No general trends can be observed, nor a comparative evaluation of the suitability of either combination on various tasks. So far it seems more difficult so solve problems caused by contradictions of different sources than to gain additional information.
- Building extraction from images and/or laser scan data attracts numerous researchers, as well as road/road-network extraction from aerial and satellite imagery. The research efforts on object recognition from laser data, seems however reduced, despite the fact, that digital elevation models are more and more derived from airborne laser data.
- In building and road reconstruction more complex models are used, e.g., buildings are reconstructed by parts, or road detection algorithms are able to handle crossings or partially occluded areas. The problems of correctness, accuracy, and optimal choice of level of detail of the models are still unsolved, but research in these areas becomes more important.
- Several research groups deal with the problem of extraction information on trees from various data sources, like aerial images, laser or radar data with very promising results.
- Almost all object recognition systems developed so far contain a problem-specific control structure. Therefore, the adoption of these systems to, even slightly, changed conditions or new applications remains very difficult. As a consequence, this research should focus more on the general strategies instead of solving specific problems.
- There is a definite trend to real incorporation of interaction, due to the so far limited success rates of so called 'fully automatic' methods. This holds for object recognition in images and digital surface models. This will have the consequence that in the future more research results will become available for practical applications.
- Newest investigations concern the quality and efficiency of image understanding algorithms and results on building and road extraction have been presented.

Accomplishments of the WG in 1999

Meetings

- Conference on 'Automatic Extraction of GIS Objects from Digital Imagery' in co-operation with ISPRS WGs II/6, II/8, III/1, III/2, and III/3, Munich, Germany, September 8-10, 1999.

WG News

Plans for Meetings

- Workshop in connection with the ISPRS Congress on 'Models and Strategies for Object Reconstruction' in co-operation with ISPRS WGs III/3 and IC WG

IV/III.2, Bonn, Germany, July 14-15, 2000.
- Tutorial at the ISPRS Congress on 'Image analysis techniques for aerial image interpretation', Amsterdam, NL, July 16-22, 2000.

Change in Address of Commission Officers

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WG III/5
Remote Sensing and Vision Theories for Automatic Scene Interpretation

Chair : Beata Csatho (USA)
Co-chair : DeLiang Wang (USA)
Secretary : Erzsebet Merenyi (USA)

State of Science and Technology

The main activities of the Working Group during 1999 were related to the co-organisation of and active participation in two workshops. From the joint ISPRS/EARSeL workshop on 'Fusion of Sensor Data, Knowledge Sources and Algorithms for Extraction and Classification of Topographic Objects', held on June 3-4, 1999 in Valladolid, Spain, the following trends signal the state of science and technology as far as our WG topics are concerned:

- The use of multispectral/multi-sensor data increases the potential for solving the object recognition and scene classification problem more effectively. However, exactly how to solve this difficult multi-stage fusion problem is not clear, and only little progress has been achieved. It remains a major research topic.
- A sensor combination that delivers independent information about the object space comprising laser ranging, imaging, and multispectral/hyperspectra systems. It is even conceivable to have this combination on one platform.
- Traditional object recognition approaches must be extended to include classification techniques that have been successfully used in remote sensing for many years. Another 'burning' issue is object modelling: it ought to include information that the new sensors deliver, such as spectral aspects of objects.

From the second workshop, 'Mapping Surface Structure and Topography by Airborne and Space-borne Lasers', held in La Jolla, California, November 9-11, 1999, the following conclusions are describing the state of science and technology of our WG topics:

- Many airborne/space-borne laser ranging systems are in use. Depending on the application, they may differ greatly in the technical specifications, e.g., footprint size, sampling density, recording/analysis of returned signal, range.
- A limiting factor for the flying height of airborne systems is the accuracy of the spatial position and attitude of the laser beam as required for precise surface reconstruction.
- Since laser ranging has no inherent redundancy for surface reconstruction, quality control is an important issue. Related to this is the need for transparent calibration procedures.
- The returned signal contains useful information about the footprint, e.g., surface roughness, surface topography, and perhaps material. However, this information is only implicitly encoded in the signal. To extract this information, the signal must be recorded for a time interval equal to the interaction time. Moreover, suitable extraction methods must be developed.
- It is widely agreed that laser range data should be augmented with imaging data. The ideal system is one that provides continuous imagery of high quality and range data.
- Another important aspect is the post-processing of raw laser ranging data, including quality control, surface segmentation, extraction of surface properties, merging of different sources of surface related information.

Accomplishments of the WG in 1998

Meetings

Co-organisation and participation of the workshop 'Fusion of Sensor Data, Knowledge Sources and Algorithms for Extraction and Classification of Topographic Objects', held June 3-4, 1999 in Valladolid, Spain, jointly organised by ISPRS WGs III/5 and VII/4, IC WG IV/III.2, and EARSeL SIG Data Fusion.

Organisation of the workshop 'Mapping Surface Structure and Topography by Airborne and Space-borne Lasers' in La Jolla, Nov 9-11, 1999, together with WG III/2. Some 55 persons attended 30 presentations. Proceedings are currently in press.

Other WG Activities

Continuing work on the test data site 'Ocean City' (see WEB page for more information).

WG III/6
Theory and Algorithms for SAR

Chair : Laurent Polidori (France)
Co-chair : Soren Madsen (Denmark)

Accomplishments of the WG in 1998

Meetings

Our WG was formally associated with the CEOS/ISPRS workshop 'Production and Validation of DEMs and Terrain Parameters from Spaceborne Sensors', organized by Ian Dowman and held in London, May 1999. Apart from a personal paper, I took this opportunity to present the scope of our working group.

Review of SAR Techniques

In the spring of 1999, I tried to encourage WG member to

contribute to a 'review' work, e.g. a commented bibliography on SAR techniques, but unfortunately little information has been received. Finally, I think scientists are more interested in writing papers on new algorithms than in organizing the knowledge, although this is very useful for young researchers.

Concerns/Recommendation
There is considerable overlap in ISPRS WGs on the topic of radar. We strongly feel that this should be better coordinated in future, for example by an intercommission WG on radar techniques.

Commission IV: Mapping and Geographic Information Systems

President: Dieter Fritsch (Germany)

Secretaries: Monika Sester (Germany) and Markus Englich (Germany)

Accomplishment of the Commission during 1999
During 1999 several workshops were organised by the TC working groups, both jointly with other WGs and individually. Although there is a tendency to hold joint workshops, it is very valuable in some cases to study a specific area of interest in depth in an individual WG workshop.

The following report comprises the individual reports of the Working Group chairmen. The work of a Technical Commission is done in the Working Groups, thus it is their efforts and engagement, which makes a Technical Commission successful. It can be stated, that the activities reported here indicate the quality of work in this Commission. As Technical Commission President it can be stated that the Commission is very active and it is an honour for me to hold this position.

Working Group Activities during 1999

IC WG IV/III.1
GIS Fundamentals and Spatial Databases

Chair : Martien Molenaar (The Netherlands)
Co-chair : Y.C. Lee (Hong Kong)

Accomplishments
The main action of the Working Group involved the study of uncertainly measures in spatial data structures, with the participation in the International Symposium on Spatial Data Quality in Hong Kong from July 18 to 20 1999. This was organised by Dr. Wenzhong Shi and by Prof. YC Lee (Co-chair of WG IV/III.1), of the Department of Land Surveying and Geo-Informatics of the Hong Kong Polytechnic University. There were about 120 participants from 25 countries and from many different disciplines involved in spatial data handling. They presented some 70 papers on issues related to different aspects of uncertainty of spatial data.

The WG also participated in the Working Group in the 2nd International Workshop on Dynamic and Multi-Dimensional GIS, which was organised by Prof. Jun Chen, Chairman of ISPRS working group IV/3 in Beijing from October 4 to 6. There were some 160 participants from about 13 countries, predominantly from China.

Working Group members participated in a workshop organised by the ICA working Group on generalisation from August 12 to 14, in Ottawa. This was a good opportunity to exchange ideas about multi-scale approaches and generalisation with the cartographic community. A rough observation in this respect is that the members of our working group approached the subject matter predominantly from a database and model generalisation perspective, whereas the ICA participants worked mainly from an approach based on the digital map paradigm. One of the main outcomes of this meeting was that our working group and the ICA working group (which is now an ICA Commission) will continue to co-operate, the chair of the ICA Commission will be involved in the session(s) on multi scale approaches in our Congress in Amsterdam in 2000.

During the Symposium on data Quality in Hong Kong the Chairman of WG IV/III.1 visited Prof. Antony Yeh, chairman of the Spatial data Handling Group of the International Geographic Union to discuss future co-operation between the SDH-group and ISPRS. An agreement has been reached to co-ordinate our activities and to jointly organise symposia of SDH and ISRPRS Commission IV. This agreement has now been expressed in a letter of intent, which will be co-signed by the President of ISPRS, Larry Fritz and Prof. Yeh.

Specific WG News
The Co-Chair and Chair of WG IV/III.1 are acting as guest editors for a Special Issue ISPRS Journal in which papers from members of this working group will be published. These authors have been selected by their contributions to the Commission IV Symposium in Stuttgart '98 and the Hong Kong Symposium of '97. They have been invited to revise and expand these contributions for publication. These contributions will be reviewed through the normal ISPRS process and publication is expected sometime next year. The major activity of the Working Group for 2000 will be the publication of this Special Issue and the activities related to the Congress in Amsterdam.

IC WG IV/III.2
Integration of Image Analysis and GIS

Chair : Emmanuel P. Baltsavias (Switzerland)
Co-chair : Michael Hahn (Australia)
Secretary : Dirk Stallmann (Germany)

Accomplishments
Due to lack of space we point to a paper by the WG that briefly summarises progress, trends, problems and needs: Baltsavias, E., Hahn M., 1999. Integration of Image Analysis and GIS. In: IAPRS, Vol. 32, Part 7-4-3-W6, pp. 12-19.999 references on WG topics (see also references in the above paper). The WG members have increased to 91. One circular letter was sent out regarding the preparations for the ISPRS Congress, while other letters provided information on preparations for the Joint ISPRS/EARSeL Workshop and the availability of the ISPRS Journal articles in electronic form.

Many papers relevant to the TOR of the WG have been published in the Proceedings of a Joint ISPRS/EARSeL Workshop, Valladolid, Spain, 3-4 June 1999, (International Archives of Photogrammetry and Remote Sensing, Vol. 32, Part 7-4-3-W6). Apart from some overviews, the Volume includes papers on detailed aspects concerning prerequisites for data fusion/integration, object and image classification, fusion of sensor-derived products, fusion of variable spatial/spectral resolution of images, use of GIS/maps in image analysis, and image classification. In some of these papers, extensive bibliographic information can be found. All papers of this workshop are freely available on the WEB (abstract and full text) at www-datafusion.cma.fr/sig/meeting/.

The WG initiated and co-ordinated the successful Joint ISPRS/EARSeL Workshop 'Fusion of sensor data, knowledge sources and algorithms for extraction and classification of topographic objects' in co-operation with ISPRS WG III/5 'Remote Sensing and Vision Theories for Automatic Scene Interpretation', ISPRS WG VII/4 'Computer Assisted Image Interpretation and Analysis' and the EARSeL SIG 'Data Fusion'. The Workshop had 27 papers from 11 countries and 56 participants. According to comments of the participants, it was very successful and of high quality. The most positive aspect of the meeting was that it brought together two different groups, which are active within ISPRS and EARSeL, and have common work areas and problems, but otherwise little contact. The preface to the Workshop Proceedings, which gives a short overview on the Workshop can be found at www.ifp.uni-stuttgart.de/comm4/wg4_32/letter4.html. The proceedings of the workshop were carefully edited and are available from RICS Books, Surveyor Court, Westwood Way, Coventry, CV4 8JE, UK, tel. + 44-171-2227000, fax +44-171-3343800, www.rics.org.uk or free as Postscript files at www-datafusion.cma.fr/sig/meeting/. The organisers have sponsored three Best Young Author Awards, each of 2,500 SFr. value, for the forthcoming ISPRS Congress in Amsterdam, from the surplus funds of the Workshop. This surplus was made possible through the substantial support of the University of Valladolid (Prof. J.L. Casanova) and the Space Applications Institute, JRC, Ispra.

Specific WG News
The WG is co-organising together with the Institute for Photogrammetry, University of Bonn, and the ISPRS WGs III/3 and III/4, a Workshop on 'Models and Strategies for Object Reconstruction' at Bonn, on 14-15 July 2000, just before the ISPRS Congress. More details can be found at our WG WEB page or at www.ipb.uni-bonn.de/workshop2000.html.
The WG Co-Chairs, in co-operation with Christine Pohl, ITC, will organise a one-day tutorial on 'Multi-source data fusion in photogrammetry and remote sensing' at Enschede on July 14th. More details can be found at www.itc.nl/~isprs.
The WG will continue its activities for the scientific participation of the WG in the ISPRS Congress and the preparation of a 4-year report and recommendations for further work of the WG in the period 2000-2004.

WG IV/1
Database Design and Spatial Database Access
Chair : Lutz Pluemer (Germany)
Co-chair : Stephan Winter (Austria)

Accomplishments
The Web-page of the Working Group has been completely revised. Since the field of spatial databases is extremely large (< 10000 pages in altavista), the page is not very prominently placed by search engines. We have no information of the number of visits of the Web-page. We will promote the Web-page by adding meta tags in the html-file, but we are facing the general problem of offering a service in a broad existing infrastructure.

Another promotion was the introduction of an email discussion list that was added to the Web-page. This initiative aimed to attract researchers who are looking for information or help in the topics of the working group, to establish contact in an informal manner. Although the direct response was rather poor: (no new contact could be established, neither from within ISPRS nor from outside) the indirect effects are rather promising. There is such a surprisingly large number of abstracts contributed to the Amsterdam Congress within the focus of this working group, that there was no problem in selecting high quality contributions for two sessions.

A major event for the WG was the Second International Workshop on Dynamic and Multi-dimensional GIS 99 in Beijing in October 1999. A major topic of this workshop was the method of handling time in spatial databases, and the WG chairman was actively involved in this workshop.

Specific WG News
The WG co-chair is organising a EuroConference on 'Geographical Domain and Geographical Information Systems' in September 2000 (http://www.esf.org/euresco). This conference deals with ontology and epistemology as a basis for the development of formal models of space and of spatial uncertainty. So far it focuses on the gap between spatial reality/knowledge and representation in spatial databases. The conference is funded by the European Science Foundation and by the European Commission in the Human Potential Programme.

WG IV/2
Digital Terrain Models, Orthoimages and 3D GIS

Chair : Roy Welch (USA)
Co-chair : Klaus Tempfli (The Netherlands)
Secretary : Marguerite Madden (USA)

Accomplishments

In 1999, ISPRS Working Group IV/2, 'Digital Terrain Models, Orthoimages and 3D GIS' conducted two special technical sessions at the American Society for Photogrammetry and Remote Sensing Annual Conference held in Portland, Oregon, USA on May 19, 1999. Seven papers were presented in these sessions by speakers from the US, UK, The Netherlands and Austria. Highlighted topics that were discussed include the use of softcopy photogrammetric techniques for mapping rugged terrain areas, digital orthophotos for large scale mapping in Antarctica, DTM accuracy, and visualisation and analysis of 3D GIS databases.

Specific WG News

Dr. Roy Welch will be the Convenor of two Inter-Commission sessions at the Congress designated as IC-15 and entitled, 'DTM Generation and Orthoimages'. Although a total of 77 abstracts were submitted for consideration for IC-15, only 10 could be selected for oral presentation in the two 1.5 hour long sessions. It is anticipated that this strong response to the Call for Papers and high interest in WG IV/2 activities will result in quality technical sessions and valuable scientific exchanges at the upcoming Congress.

WG IV/3
Temporal Aspects and Topographic Database Maintenance

Chair : Jun Chen (China)
Co-chair : Fabio Crosilla (Italy)
Secretary : Jie Jiang (China)

Accomplishments

The WG organised the Second International Workshop on 'Dynamic and Multi-Dimensional GIS (MDGIS'99)' during October 4-6 1999 in Beijing. The workshop was jointly organised with the following six other working groups:

- ISPRS Inter-Comm. Working Group IV/III.1 (GIS Fundamentals and Spatial Databases)
- ISPRS Inter-Comm.Working Group IV/III.2 (Integration of image analysis and GIS)
- ISPRS Working Group II/2 (Software and Modelling Aspects of Integrated GIS)
- ISPRS Working Group IV/1 (Database Design and Spatial data access)
- ISPRS Working Group VI/3 (International co-operation and technology transfer)
- IGU Study Group on Geographical Information Sciences

About 160 delegates, coming from 13 counties (Australia, Canada, China, Czech, Germany, Italy, Japan, Malaysia, S. Korea, Switzerland, Thailand, the Netherlands, USA) and two regions (Hong Kong and Taiwan), attended this conference. 72 papers were accepted in the Workshop and about 60 oral presentations were given. The topics covered were diverse: there were 18 papers on spatial-temporal modelling; 8 papers on spatial concepts and spatial relations; 6 papers on cartographic presentation and transformation; 7 papers on 2.5D modelling and 6 papers on 3D modelling; 5 papers on image processing or database management, and 22 papers on system design and application. The papers are published in the proceedings of this workshop (International Archives of Photogrammetry and Remote Sensing, Vol..32 Part 4W12).

Two keynote addresses were given by Prof. Dieter Fritsch and Prof. C.M.Gold. Prof. Fritsch spoke on 'Spatial data revision'. He compared the vision (the requirement) with reality (current situation) of the geo-reference data and analysed the methods, results and applications of data revision. He pointed out that data revision is an issue of sustainability. Prof C.M. Gold from Laval University spoke on 'Spatial relations'. He stated that the spatial tessellation could be space-primary and feature-primary. The Voronoi diagrams could be used for spatial relations description and modelling.

The WG was also co-organiser of the International Symposium on Spatial Data Quality held at The Hong Kong Polytechnic University from 18th to 20th July 1999.

Specific WG News

The WG will co-organise the Workshop 'Bringing the gap' in Ljubljana from 2nd to 5th Febuary, 2000 with the ISPRS WG VI/2

WG IV/4
Mapping Using High Resolution Imagery

Chair : Gottfried Konecny (Germany)
Co-chair : Volker Walter (Germany)

Accomplishments

The Working Group organised a 4 day workshop in Hanover jointly with WG´s I/1 and WG I/3 from September 27 to 30 1999, with about 80 participants. The proceedings are available on CD-ROM from the Institute for Photogrammetry and Engineering Surveys at the University of Hanover. A review of the meeting will be published in EARSeL News.

Specific WG News

The Co-chairman Don Light retired and therefore has been replaced by Volker Walter, who can be reached through the following address:

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WG IV/5
Extra-terrestrial Mapping

Chair : Jan-Peter Muller (United Kingdom)
Co-chair : Randy Kirk (USA)
Secretary : Karl Mitchell (United Kingdom)

Accomplishments

In 1999, a mirror of the Working Group web site at the University College, London, was established at the U.S. Geological Survey in Flagstaff at the address http://wwwflag.wr.usgs.gov/USGSFlag/Space/Isprs/index.html. In addition, regional digital topographic models and orthophoto-mosaics of Mars produced at the USGS over the last decade have been collected and we have begun the work on reformatting them to make them available through the web site.

The WG followed up its workshop in London last year with an extremely successful second workshop 'Mapping of Mars--1999' on the Caltech campus in Pasadena, California 23-24 July, 1999. The ISPRS workshop was held in conjunction with the 5th International Conference on Mars, sponsored by NASA, JPL, and Caltech. This week-long conference, with over 200 papers in 15 sessions, was attended by hundreds of planetary scientists from the US and around the world. The ISPRS contribution consisted of a poster session on Friday, 23 July and a full-day session of oral presentations on Saturday, 24 July, both of which were well-attended; the majority of mapping enthusiasts also attended the full Mars Conference and participated in its several social events. Attendees at the Saturday session also continued their lively discussions of the presentations over lunch and at a reception held after the final talk. A total of 10 posters and 10 talks were presented. Abstracts of these talks were included on the CD-ROM volume provided to Mars Conference registrees, and can also be downloaded from the WG web site http://wwwflag.wr.usgs.gov/USGSFlag/Space/Isprs/Caltech99/index.html)

The topic of 'Mapping of Mars' was divided into three sub-sessions. The first, 'Mars Control Networks and Global Mosaics' was highlighted by talks on the location of the three US Mars landers by Dr. Timothy Parker (JPL), on revision of the Martian control net and production of new global mosaics by Dr. Randolph Kirk (USGS), and on the production and use of improved global maps of Mars at DLR by Dr. Juergen Oberst. Dr. Kira Shingareva (Moscow State University) also reported on her work with Dr. Lev Bugayevskii on the development of map projections for triaxial ellipsoids. Posters related to global mapping of Mars included a report on the status of the RAND-USGS control network (Dr. Merton Davies, RAND), a full-size presentation of the DLR mosaic (Dr. Wolfgang Zeitler), and a presentation of DLR plans for a 1:200,000-scale map series of Mars contributed by Dr. Hartmut Lehmann of the Technical University of Berlin.

Closely related posters by Dr. Chuck Acton (JPL) and Trent Hare (USGS) covered the use of the SPICE system of ancillary data in Mars mapping, and the USGS planetary GIS web site 'PIGWAD,' respectively. The second subtopic of the workshop, 'Mars Topographic Mapping,' was addressed by a talk by Dr. Paul Schenk (LPI) on his recent progress in stereogrammetric mapping with Viking Orbiter images, and one by Dr. Thomas Duxbury (JPL) on the revolutionary impact of the MOLA altimeter for both topographic mapping and planimetric control of Mars. Posters were contributed by Dr. Peter Mueller (University College, London) comparing early MOLA results with the USGS global topographic model of Mars, and by Dr. Tony Cook (National Air & Space Museum, Washington, DC) reporting on the UCL stereo-derived topographic model of Ius and Tithonium Chasmata. Randy Kirk also contributed a poster on a simple database of Viking Orbiter images that can be used to identify stereo coverage for topographic mapping of Mars.

Dr. Mark Lemmon (University of Arizona) introduced the third topic, Mars Lander Missions and Cartographic Plans,' with a presentation on the imaging systems of the Mars Polar Lander, which was programmed to land on December 3rd. Dr. Raymond Arvidson (Washington University, St. Louis) reported on cartographic and navigation planning for the FIDO, APEX, and Athena experiments that will fly on subsequent Mars Landers. Dr. Matt Golombek (JPL) summarized the constraints that determine where those future landers can go and the GIS approach being used to identify candidate landing sites. A final oral presentation by Eric Zbinden (NASA Ames Research Center) on the virtual reality system developed by the Ames group for visualization of Mars Lander data included a dramatic video presentation of the system in use with data from Mars Pathfinder and Mars rover field tests. Posters on Mars Lander cartography included an update on USGS cartographic work with Mars Pathfinder data submitted by Randy Kirk, and a map of the Pathfinder landing site contributed by M. Kuschel (DLR).

A month after the 'Mapping of Mars-1999' workshop, WG Co-chair Randy Kirk attended the International Cartographic Congress in Ottawa to meet with members of the International Cartographic Association Working Group on Planetary Cartography, including Dr. Kira Shingareva (Moscow State University), Dr. Phillip Stooke (University of Western Ontario), and Dr. James Zimbelman (National Air & Space Museum). They discussed planetary mapping efforts at their home institutions as well as the plans of the ISPRS and ICA working groups. Several ideas for ISPRS/ICA collaboration on planetary topics were generated, ranging from a glossary explaining the different terminology used by planetary mappers in different countries (to be incorporated in the ISPRS web tutorials) to longer-term collaborations. At the ICA session on Planetary Cartography, Kirk delivered an impromptu talk on plans to revise the Mars control net and USGS image mosaics of Mars. Several examples of planetary maps compiled by the USGS and DLR were also on display at the Cartographic Exposition associated with the Congress.

WG IV/6
Global Databases Supporting Environmental Monitoring

Chair : Ryutaro Tateishi (Japan)
Co-chair : David Hastings (USA)

Accomplishments

The Working Group has continued its activities aiming to publish a book titled (tentatively) 'Global Environmental Databases – Present Situation and Future Directions' at the Amsterdam Congress. Everyone recognises the importance of global environmental databases for science, policy making, and education concerning global environment. There are many research projects and satellite missions which plan to develop global data sets as one of their purposes. The problem is that these efforts are mostly independent of each other, and that they are not integrated, nor co-ordinated. Since the development and use of global database of different fields have common problems/obstacles, the Working Group is trying to collect the best available knowledge and ideas on present situation and future directions about Global Environmental Databases from professionals of different fields.

As one of the steps to pursue this, the Working Group had a workshop on 'Better Direction of Global Environmental Database Development' at Burns Hall of the East-West Center, Honolulu, Hawaii from 15-18 November 1999. Twenty-three outstanding participants had a productive four-day discussion on nine thematic subjects and five cross-cutting issues. The workshop did not involve research presentations, but discussion to find the way forward to lead global environmental databases in better directions. One of the successes of this workshop and the book publication project is that experts of extensive fields including, oceanographic data, socio-economic data, and soil data co-operatively joined the WG activity. As a chairman of the Working Group, I believe that the outcome of the Working Group activity, that is the book, will certainly influence the development of the Global Environmental Databases in all fields and lead it to better integration of Global Environmental Databases.

Lastly, the activity of this Working Group is not confined in the conventional fields of the ISPRS. Therefore, the Working Group needs the continuing co-operation with other societies and organisations. The members of the Working Group are willing to extend this activities for the next four year term to contribute to global environmental studies, policy making, and education.

Commission V: Close-range Techniques and Machine Vision

President: Hirofumi Chikatsu (Japan)
Secretary: Eihan Shimizu (Japan)

State of the Science and Technology

Commission V covers a number of rapidly emerging research areas within photogrammetry and remote sensing, and specifically those related to digital close-range photogrammetry and machine vision. Recent innovations have spanned a broad area of applications, which has offered a significant opportunity for Commission V to broaden its focus and become more interdisciplinary in nature.

Current topics of wide research interest include real-time image sequence analysis, automated sensor orientation and calibration, feature extraction, image matching, 3D modelling and knowledge-assisted 3D scene reconstruction. A number of these are also research topics of interest in computer vision. This once again emphasises the need for Commission V to pursue the goal of becoming a focal point for the communication of ideas and research progress in interdisciplinary areas where close-range imaging is used for 3D scene reconstruction, both within ISPRS and in associated organisations.

In order to accomplish this goal a change in the title and terms of reference of Commission V may be warranted in order to attract more participants from related disciplines such as machine vision, robot vision and computer vision.

Main Accomplishments in 1999

In order to steer Commission V to success as an interdisciplinary commission, the following five workshops or conferences relating to commission terms of reference and attracting formal participation from Commission V working groups were held in 1999:

1. Videometrics VI, San Jose/USA, January 28-29, WG V/3, SIG
2. International Workshop on Mobil Mapping Technology, Bangkok/Thailand, April 21-23, WG II/1, WG V/1, IWG V/III, IAG WG1, FIG WG3
3. International Workshop on Photogrammetric Measurement, Object Modeling and Documentation in Architecture and Industry, Thessaloniki/Greece, July 6-9, WG V/2 & V/5
4. Technical Meeting of the Coordinate Measurement Systems Committee, CMSC'99, Seattle/USA, July 26-30, CMSC, WG V/1
5. International Workshop on Vision-Based Techniques in Visualization and Animation, Onuma/Japan, October 14-16, SIG, WG V/3 & V/4, IWG V/III

It was noticeable in these events that there were many new applications involving multi-image and multi-sensor con-

figurations, as well as laser scanner applications, virtual reality and computer animation. Further details are provided within the individual working group reports.

Commission V News Related to the 2000 ISPRS Congress
An impressive total of 195 abstracts were submitted for the 12 technical sessions of Commission V at the Amsterdam Congress, and 184 were accepted for either oral or poster presentation. The topics of the proposed presentations further indicates the developing interdisciplinary nature of Commission V.

WG V/1
Close-Range Imaging and Metrology

Chair : Clive S. Fraser (Australia)
Co-chair : Horst Beyer (Switzerland)

State of the Science and Technology
The principal development themes in close-range imaging and vision metrology continue to focus upon automation in all phases of the photogrammetric process. Specific examples include continuing developments in 'intelligent' cameras, development of stand-alone measurement probes integrating one or more imaging sensors, innovations in projected light systems for off-line and on-line vision metrology, further advances in target and feature recognition with associated solutions to the multi-image correspondence problem, and new developments in models and procedures for automated sensor orientation. The resurgence in the development of integrated systems where the vision metrology component is used as a real-time dimensional control mechanism, be it for machining, milling or cutting control is also continuing. This area of development has also given rise to further work on the integration of vision metrology and CAD, and on model driven object reconstruction. Generally, the state of the science and technology of vision metrology could be characterised as reasonably mature in terms of fundamentals, with considerable development attention being given to advances in system automation, performance, reliability and productivity.

Main Accomplishments for 1999
The first principal activity for WG V/1 in 1999 related to participation in the International Workshop on Mobile Mapping Technology held in Bangkok from 21-23 April. The WG was a co-organiser of this successful conference, which had close to 200 participants from 17 countries. Of the 42 oral presentations, a number dealt specifically with WG themes of integration of imaging technology and sensor calibration. There were two technical sessions specifically dedicated to close-range imaging, and a poster session where the topic was imaging sensor systems. A number of WG members attended this symposium, where the WG Chair, Dr Clive Fraser also served as a session chairman.
The second main activity involved the 1999 Conference of the Co-ordinate Measurement Systems Committee (CMSC), which was held in Seattle from 26-30 July. The CMSC is a group whose focus is large-scale co-ordinate metrology in manufacturing and engineering. ISPRS is currently endeavouring to establish a formal relationship with the CMSC, in recognition of the prominent role played by the technology of close-range digital photogrammetry in the field of industrial measurement. CMSC'99 incorporated two technical sessions specifically for presentations related to ISPRS WG V/1 activities, and the conference drew many members of our working group. The WG V/1 combined technical sessions were chaired by the WG Co-chair, Dr Horst Beyer, there being a total of seven presentations related specifically to industrial vision metrology. These presentations covered a broad range of applications, and contributions came from the following countries; Australia (2), France (1), Germany (1), Norway (1), Switzerland (1) and the United Kingdom (1). The ISPRS technical sessions drew an audience of approximately 130 people and the event was a very successful WG V/1 activity.

Plans for 2000
WG V/1 will concentrate on three main activities in 2000. The first of these is supporting the Commission in its organisation of the technical program for the Amsterdam Congress. The second is to continue to promote closer links and possibly the development of a formal relationship with the CMSC, and the third is to further improve the WG web site (http://www.geom.unimelb.edu.au/isprs wgv1/).

WG V/2
Integration of Photogrammetric Systems CAD/ CAM

Chair : Jürgen Peipe (Germany)
Co-chair : Stuart Robson (United Kingdom)

State of Science and Technology
During the last years, Cax techniques such as CAD, CAM, CAE, CAT, CAQ have widely and successfully used for the design, manufacturing, testing, quality control etc. of 3-d objects. Moreover, CAD systems serve as database for the integration of different types of data acquired by a number of measurement techniques including photogrammetry. 3-D object models can be generated, e.g. for the as-built documentation in areas such as industry and architecture, 3-D indoor scene modelling and reverse photogrammetry, for object visualisation, manipulation, animation etc.. In addition, CAD modelling concepts support the automated or semi-automated photogrammetric measurement using a priori knowledge of the object from a 3-D model. The integration of photogrammetric tools with existing CAD environments may lead to closer partnering between the measurement and end user communities.

Main Accomplishments in 1999
In 1999, the main activity of WG V/2 was participation in a meeting jointly organised with WG V/5 'World Cultural Heritage'. The workshop 'Photogrammetric Measurement, Object Modelling and Documentation in

Architecture and Industry' was held in Thessaloniki/ Greece from July 7-9, providing a forum for a total of 43 papers published in International Archives for Photogrammetry and Remote Sensing, Vol. 32 Pt 5W11. An overview paper of WG V/2 topics entitled 'On the Integration of Digital Photogrammetry with Computer Aided Engineering' was given by the WG chairpersons together with Dave Chapman, UK. A series of presentations dealt with automated and semi-automated production of constructive solid geometry models from image networks offering considerable potential for the future. Combined with this was the increasing automation of photogrammetric computation and model generation techniques appropriate for engineering applications. In addition, important developments from the architectural/archaeological and visualisation side were presented that can be expected to provide significant benefits to ease of use and acceptance of the data produced by end users. On the one hand, some examples were given of the ability of state of the art systems to generate output of not only geometric but also aesthetic quality. On the other hand, the automatic production of 3D models appropriate for visualisation purposes from image sequences captured using video camera equipment is worth mentioning. Whilst not yet geometrically precise, such techniques can be combined with established photogrammetric geometry and calibration principles to promote and uptake them also by non-photogrammetrists.

A number of working group members, as well as the chairpersons, were involved in some other conferences with a more or less strong CAD component, e.g.

- Videometrics VI, held on January 28 and 29 in San Jose, California/USA and
- XVIIth CIPA Symposium, Oct. 3-6 in Recife/Olinda, Brazil

WG V/3
Scene Modelling for Visualisation and Virtual

Chair : Sabry El-Hakim (Canada)
Co-chair : Wolfgang Forstner (Germany)

State of the Science and Technology

There is increasing integration of computer graphics with Photogrammetry, image processing and computer vision. This is evident particularly in image-based rendering (IBR) and blending of real-world data (e.g. from 2D/3D images) with computer-generated imagery. IBR is evolving into more of a combination of geometric modelling and pure image based. There is the realisation that without the 3D geometry the realism is definitely lacking. Many efforts are being made in automating the feature extraction, matching, and modelling procedures. However, the success has been limited to image sequences such as those obtained by video cameras. One observation has become clear over the past year, those creating 3D models in the computer graphics community are rediscovering basic photogrammetric techniques such as proper camera modelling and bundle adjustment. It is realised that real cameras cannot be accurately simulated with a pinhole camera approximation and that registration of multiple images is better done simultaneously. Therefore, more interaction between the two communities is needed, particularly at each other's conferences and by publishing in their society's journals.

Activities and Conference Report

1. The official WG workshop was Videometrics VI, Part of SPIE Photonics West - Electronic Imaging 99, San Jose, California, January 23-29, 1999. Thirty-two papers from 16 countries were presented covering the topics of this working group and the SIG on animation.
2. A theme issue of the ISPRS Journal on the topics of the WG, titled: Imaging and Modelling for Virtual Reality, has been published in December 1998. Due to page constraint and good participation, two additional papers were published in the February 1999 issue. A total of 8 good papers covered many of the bases of creating virtual environments, primarily: data acquisition, processing, registration, modelling, and rendering.
3. The Second International Conference on 3-D Imaging and Modelling took place in Ottawa, Canada, in October 4-8, 1999. Although not officially a WG workshop, many of the WG members are on the program and organising committees and a significant number attended and presented papers, including one of the keynote papers.
4. The working group co-operated in organising the V/SIG Animation International Workshop on Vision-Based Techniques in Visualisation and Animation, October 14-16, 1999, Onuma, Japan.
5. The WG web site, which has been established in January 1997, is continuously being updated. It links to the members web pages (50 members from 16 countries) and e-mail, evaluated VR useful sites, related conferences, and various types of raw data provided by some of the WG members.

Plans for 2000

Two TC session (sessions TC V-5 and TC V-8) and one IC session (IC-16) are planned for ISPRS Congress in Amsterdam. A total of 49 abstracts were submitted for the three sessions. A tutorial (TU5 An introduction to virtualised reality systems) will be given at the Congress.

WG V/4
Human Motion and Medical Image Analysis

Chair : Felix Margadant (Switzerland)
Co-chair : Masako Tsuruoka (Japan)

State of Technology and Trends

The main emphasis is again back on visualisation and less on automated image understanding. The developments mainly follow the trend of high-end graphic engines currently emerging and interactive image understanding, i.e. the combination of machine visualisation and human decision making.

Edge detection and boundary definition always used to be one of the major problems for all image processing based measurements, but they become exceedingly difficult and contradictory to handle when it comes to colour or multi-spectral images. Many WG V/4 abstracts for Amsterdam 2000 address the problem of colour image interpretation but it seems still a long way to go for a common agreement or even availability for universal filter methods.
Within medical graphical applications the trend goes from displaying raw data and schematics to volume rendering and animation. The low cost of high-end graphics hardware currently dominates the field and to some extent blocks the development of smart software alternatives and even the progress of computer understanding developments. The upcoming WG V/4 presentations for Amsterdam will show the problems of computer graphics being far more advanced than image interpretation. On the positive side rendering is more standardised than it used to be, many contributions even rely on the same software tools. The set of tools for Human Motion and Histology on one side, and Microscopy and general Medical Imaging on the other, are still fundamentally different, but with each class a broad consensus is noticeable. Last year's hope of determining a common terminology, at least for the display and data representation side, for all WG V/4 contributors therefore failed, but the WG has still come closer to the ideal. This is particularly important, since comparison of graphically represented results makes very limited sense, when not derived with similar algorithms.

The 1998 Hakodate meeting clearly showed that medical imaging was a heterogeneous field whose disciplines only marginally coincide. For Amsterdam the situation is clearer, and there are broad areas of overlap The problems of camera systems, microscopes, CAT scanners and ultrasonic heads, dealing with thoroughly different physics and therefore varying algorithms, has become much less significant, mostly due to the limited availability of good tools for volume-image processing and because of the fast convergence of these products.

In the field of human motion analysis the main effort has moved from on-line human expression recognition to general gesture interpretation. Applications are patient supervision, jaw and joint movement and support, as well as motion synthesis for VR. Two systems to be presented can even deal with ambiguous data from their camera systems by the feedback of implied restraints.
Strong emphasis is also found on equipment to calibrate the above listed processes or to determine the precision of the method applied. Work is undertaken in measuring the absolute precision, reliability and efficiency of human motion analysis and medical imaging, as well as offering fast and efficient calibration systems for telemetric systems or virtual reality equipment.

Plans for Year 2000
So far, the next activity planned is the conference in Amsterdam in 2000. Both chairs work in the field of medical and biological imaging respectively, whereas the WG V/4 hosts Medical Imaging as well as Human Motion Analysis. During the Hakodate 1998 conference the two disciplines were clearly split and the background terminology of both was strongly different. However, the majority of the Human Motion contributions for the Amsterdam 2000 conference is dedicated to medical projects. This may be involuntarily induced by the funding situation, though it brings the benefit that the background of WG V/4 becomes stronger and there should be a broader exchange of innovative designs and elaborate work in the field. Also Amsterdam sessions will not feature the separation into Human Motion and Medical Imaging that we had in Hakodate but will focus on an application based selection of the contributions.
As one of the chairs, I'm currently collecting edge- and boundary detection algorithms and definitions that are universally used in the field of Medical Imaging as well as in Human Motion. I would like to have the edge description software together with a database for an image exchange forum available online in the near future in order to found a more common discussion base for WG V/4.

WG V/5
World Cultural Heritage
Chair : Petros Patias (Greece)
Co-chair : Wenhao Feng (China)

State of the Science and Technology
The main event of the WG activities during the past year was the International Workshop on 'Photogrammetric Measurement, Object Modelling and Documentation in Architecture and Industry', which was organised by WG V/5, in co-operation with WG V/2 (Integration of Photogrammetric Systems with CAD/CAM). The Workshop took place in Thessaloniki, Greece (July 7-9, 1999); a wide range of topics from the fields of interest of both groups was covered. A number of CIPA Working Groups co-operated in the Workshop, as well, namely: WG3 (Simple Methods and Architectural Photogrammetry), WG4 (Digital Image Processing), WG5 (Archaeology and Photogrammetry) and TG2 (Single Images in Conservation).

There were three presentation sessions, where 39 papers were presented and one poster session with 4 papers. An invited paper, given by the CIPA President preceded the first session. The papers covered the following topics:
- Mathematical Models
- Measurements and Processing in Archaeology and Architecture
- Algorithmic Aspects
- Integration of Photogrammetric Systems with CAD/CAM
- Sensor Integration and Data Fusion
- Measurements and Processing in Industry
- Object Modelling and Visualisation
- Documentation in Archaeology and Architecture
- Spatial Information Systems in Archaeology and Architecture

About 110 participants from 12 countries attended the Workshop. Colleagues from: Austria, Belgium, Finland, France, Germany, Greece, Italy, Japan, The Netherlands, UK, USA and China comprised the audience.

Main Accomplishments in 1999
Active maintenance and information fusion through the WG V/5 Home page http:/photo.topo.auth.gr/wgv5
Joint workshop with WG V/2 in Thessaloniki/Greece (7-9 July 1999).

Plans for 2000
A total of 39 abstract were submitted for the three sessions for ISPRS Congress in Amsterdam.

IC WG V/III
Image Sequence Analysis

Chair : Hans-Gerd Maas (Switzerland)
Co-chair : Osamu Murakami (Japan)

Working Group Activities during Last Year
IWG V/III was co-organizor/sponsor of the following events:
- Videometrics VI, SPIE Electronic Imaging '99, San Jose, USA, 23-29 January 1999
- ISPRS/IAG workshop 'Mobile Mapping Technology', Bangkok, Thailand, 21-23 April 1999
- ISPRS workshop 'Vision-based Techniques in Visualisation and Animation', Onuma, Japan, 14-16 October 1999

State of the Science and Technology
A number of trends can be read from the member list of IWG V/III, the contents of the above mentioned conferences and the abstracts submitted to the ISPRS congress:
- A large percentage of the IWG V/III members do not consider themselves photogrammetrists in the classical sense. In fact, their provenance shows a large variability, ranging from neuro-biology to remote sensing. This leads to a very wide variety of research topics and application fields dealt with.
- A certain focus can be found in traffic-oriented applications, including airborne traffic surveillance, mobile mapping systems and autonomous car navigation tasks.
- As already realised at the Hakodate Commission V Symposium in 1998, much of the work is performed on various practical applications. On the algorithmic side, work was mainly oriented towards image flow analysis and spatio-temporal matching techniques.

Main Accomplishments in 1999
We consider bringing together researchers from different fields in ISPRS as one of our main tasks. This is reflected in the composition of the WG V/III member list. The wide scope of the working group is conceived as an advantage, but it is also accompanied by a large heterogeneity, making it difficult to find topics for common efforts. Nevertheless, the different background of the members can stimulate discussions on many aspects of image sequence processing. The ISPRS/IAG Mobile Mapping Workshop in Bangkok also accentuated the interrelation between image sequence processing and GPS/INS sensor integration.

Working Group News
A total of 20 abstracts was submitted for the ISPRS congress in Amsterdam, where two technical session and one poster session are scheduled.

Other Relevant Information
Update information can be found on the IWG V/III web page http://www.geod.ethz.ch/p02/wg_isprs/WG.V_III/WG.V_III.home.html).

Commission Officer Address Updates
Current addresses of WG V/III chairmen:
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Special Interest Group on 'Animation'

Chair : Armin Gruen (Switzerland)
Co-chair : Shunji Murai (Japan)

State of Science and Technology
Image-based animation is a wide field, which draws scientists from many disciplines. Worldwide there are such a large number of conferences and other events which relate to visualisation and animation, that it is very difficult to give a comprehensive picture of the state of all sciences involved. Photogrammetrists seem to enter this field only reluctantly. They obviously consider it an exotic area with little to gain from. We believe that this attitude is fundamentally wrong and that photogrammetric experts could contribute quite a lot to this ever increasing market. This is true in particular at this very moment where animation people turn more and more to image-based techniques for more realistic landscape, city, face and body modelling and motion estimation.

As indicated by the conferences which where co-organised by our group we see a great variety of sensors, platforms and data being used in this field (satellite, aerial and terrestrial images, laser scanners, video theodolites, mobile mapping cars, spectrometers, computer radiographs, x-rays, magnetic positioning devices, DTMs/GIS, maps, historic maps, historic and current reports). A similar variety holds for the processing algorithms used (image and template matching, deformable contour models, feature extraction of points,

lines and regions, optical flow, tracking in image and object space, slit scanning, video mosaicking, DTM modelling, DSM segmentation, reflectance modelling and so forth).
At the Onuma conference we have encountered the following array of applications: Landscape modelling, city modelling including historic towns, tourist guide, dynamic process simulation, vehicle and human motion, bone mineral density determination, stomach wall analysis, traffic sign recognition, roadside image database generation, power lines, slope management, coral reef, sea surface temperature, biomass, flame detection, violine bowing, refraction analysis, solar energy simulation. It is obvious from these facts that the use of photogrammetry in visualisation and animation is both scientifically interesting and technically rewarding. It is to be hoped that ISPRS will recognise this fact and pay more attention to these issues in the near future.

Main Accomplishments in 1999
- Preparation and conduction of three Technical Sessions at Videometrics VI, San Jose, USA, 28-29 January 1999. These sessions were devoted to the topics ' Head and Body Modelling and Animation' and 'Tracking and Motion Analysis' with a total of 10 papers.
- Organisation, Preparation and Conduction of the Workshop 'Vision-based Techniques in Visualisation and Animation', Onuma, Hokkaido, Japan, 14-16 October 1999. There was a rich program with six Technical Sessions and two Poster Sessions. The main topics treated, as evidenced by the titles of the technical sessions, where Landscape Modelling and Visualisation, City Modelling, Matching and Ranging, Motion Estimation and Body Modelling, and Various Applications.

Plans for 2000
- Contribution to the Sixth International Symposium on the 3-D Analysis of Human Movement, Cape Town, South Africa. This is an event of the ISB (International Society of Biomechanics)
- Support of the ISPRS Congress in Amsterdam
- Contribution to the Summer School on Mobile Mapping, Rottenmann, Austria, 18-22 September 2000 (in co-operation with FIG and IAG)

Others
The participants of the Onuma Workshop have agreed that it would be appropriate to the relevance of the topic to hold such an international workshop every two years. The next one is planned for Ayutthaya, Thailand, at the end of February 2001 and is concerned with Recreating the Past-Visualisation and Animation in Cultural Heritage. This will be organised in co-operation with AIT (Asian Institute

Commission VI: Education and Communication

President: T. Lukman Aziz (Indonesia)

Secretaries: Riadika MASTRA (Indonesia) and Fahmi AMHAR (Indonesia)

ISPRS Mid Term Symposium Technical Commission VI (Bandung, Indonesia, 15-17 April 1999)
The Symposium was originally planned in Bandung Indonesia in August 1998. However, due to political and economic problems that occurred in Indonesia in 1998, the ISPRS Council agreed to reschedule the Commission VI Mid-Term Symposium to April 15-17, 1999. The venue of the Symposium was the Campus of the Institute of Technology Bandung in Bandung.

Prior to the Symposium a HLT Session was organised. The spirit of this tutorial was useful international co-operation and transfer of mature and innovative technologies, with the positive aim of their peaceful use. The HLT was organised by the Indonesian Surveyor Association (ISI) and the International Society for Photogrammetry and Remote Sensing (ISPRS) - Technical Commission VI: Education and Communication. The tutorials consist of 6 lessons given by 6 expert in photogrammetry, remote sensing and geographic information system during two half days.

The Symposium organised by the Indonesian Surveyors Association in co-operation with the Institute of Technology Bandung (ITB). It had a large participation, including 60 Indonesians and 32 participants from abroad, from 14 countries. The President, the Secretary General, the Treasurer of ISPRS as well as all chairpersons and some co-chairs of WGs of Commission VI were present in the meeting. The Symposium consisted of eight Technical sessions, one special session on Earth Monitoring, a half-day Tehnical Tour and a social gathering (Sundanesse Cultural Evening). A total of 32 papers were presented. The theme of the symposium was 'Sharing and Co-operation in Geo-Information Technology' which covered topics on education in geodesy, survey, photogrammetry, remote sensing and GIS, CAT/CAL, WEB and Internet, knowledge sharing and technology transfer

The first day began in the morning with the opening session and the welcome addresses. The Rector of ITB Prof. L. Hendrajaya, opened the meeting and welcome addresses are made by President of Indonesian Surveyors Association R. Anshary, President Commission VI T. Lukman Aziz, President ISPRS L. Fritz and Chairman of the Indonesian Co-ordination Body for Survey and Mapping (BAKOSURTANAL) Prof. J. Kahar.
The half day technical tours comprised of The Indonesian Post Office to see how they developed the Internet busi-

ness and the private surveying company BLOM-NARCON to observed the progress of digital mapping of Island of Jawa and Leseer Island of the scale 1:25.000.

In a business meeting, future activities of the Commission were discussed and planned.

WG VI/1
Education

Chair : Tania Maria Sausen (Brazil)
Co-chair : Walter Schuhr (Germany)

Working Group Activities during 1999

- Attended and paper presentation in the International Symposium and Exhibition on Sharing and Co-operation in Geo-Information Technology, April 1999, Bandung, Indonesia.

The chair person attended:

- the ISPRS Workshop on Remote Sensing for the Detection, Monitoring and Mitigation of Natural Disasters, in Vienna, Austria, UNISPACE III, July, 1999
- the Seminar on Environment and remote Sensing for Sustainable Development, organized by ISPRS and NASA, during UNISPACE III, Vienna Austria, July 1999
- With regard to ISPRS Educational Task Force, a directory of the development of Education, training, research and fellowship opportunities in the remote sensing, GIS and its applications has been made available on the Web, linked to the ISPRS Home Page

Other relevant activities includes:

- the development of the web site addresses directory on education in remote sensing and GIS
- announcement of many ISPRS seminars, symposia and workshops in Latin America through the Educator network

WG VI/2
Computer Assisted Teaching

Chair : Kohei Cho (Japan)
Co-chair : Joachim Hohle (Denmark)

State of Science and Technology

Nowadays, various kinds of educational material or datasets for science are provided to the users by means of CD-ROMs or through the Internet. The worldwide Internet is expanding the meaning and rolls of distance learning. The importance and impact of computer assisted teaching and learning (CAT/CAL) are becoming greater than ever before. Considering those situations, the WG is working more on utilising CAT/CAL technology under the internet environment.

On the other hand, the WG is concerned about the differences in quality and level in educational material which is currently available to the users. A certain guideline for the development and evaluation of good CAT/CAL materials may be needed in the future and the WG plans to work on this matter.

The WG activities and important information have been announced in a timely manner using the WG Home Page(Address: http://www.tric.u-tokai.ac.jp/research1/cat/cat.html). The detailed report of the WG was published in the EARSeL (European Association of Remote Sensing Laboratories) Newsletter No.40 which was issued in December 1999.

Accomplishments of the WG in 1999

(1) CAT/CAL software on the net

Nowadays, platform independent programs can be developed with JAVA language. Anyone whose computer is connected to the Internet can use those programs with a JAVA compatible browser such as Netscape Communicator or Microsoft Explorer. This is a great advantage for distance learning. The WG co-chair Joachim Hohle has developed an interactive CAT/CAL program LDIPInter which covers the topic ‘Automatic measurements of images’, which can be used on the Internet by means of a browser, for example Netscape ‘Communicator 4.5’. It can be downloaded from http://www.sunsite. auc.dk_ /LDIPInter.

(2) CBLIS'99

The fourth international conference on Computer Based Learning in Science (CBLIS '99) was organised at the University of Twente, Enschede, the Netherlands in July 1999. Total of 64 participants, including some members of the WG, from 14 different countries attended the conference. The sessions covered teaching packages, simulation packages, intelligent software, virtual reality and virtual laboratory in science teaching, distance learning, multimedia techniques, evaluation, and monitoring of performance took place.

Specific WG News

(1) CATCON2

In order to promote the development and dissemination of good/user-friendly software packages, videos, as well as data sets for computer-assisted teaching, the working group plans to organise the software contest CATCON2 at the ISPRS Congress in Amsterdam in the year 2000. Anyone who have registered to the ISPRS Amsterdam Congress has the right to nominate one's software or dataset to the contest. For further information, contact Kohei Cho(kcho@keyaki.cc.u-tokai. ac.jp).

(2) Distance learning demo

Nowadays distance learning is very much in demand. Lifelong education is important all over the in the world. Various kinds of educational materials are available on the WWW. The video conferencing technology can realised the easy exchange of scientific knowledge among students, teachers and scientists in different places. The WG plans to make a demonstration on distance learning and organise a Inter-technical Commission Session on ‘Computer assisted and distance learning ‘ at the ISPRS Congress 2000.

WG VI/3
International Co-operation and Technology Transfer

Chair : Luigi Mussio (Italy)
Co-chair : Mojca Kosmatin (Slovenia)

Accomplishment of WG VI/3

The WG participated in the following events:

- From February 15 to 19, 1999 the WG VI/3 'International Co-operation and Technology Transfer' and the Italian Society of Surveying and Photogrammetry organised a meeting (of the working group) in Parma, Italy. The one-week meeting was dedicated to the memory of Prof. Mariano Cunietti, the Italian internationally esteemed scientist, who died two years ago. The meeting was ambitious in program (more than thirty papers were presented) and covered different disciplines: digital photogrammetry, architectural surveying, WEB, DBMS and GIS, thematic cartography and remote sensing, metrology and data processing, deformation monitoring, positioning and reference frame, mapping from space and extraterrestrial mapping. A poster session, presenting twelve posters, was organised as well. More information are available via internet on the WEB-site http://ipmtf14.topo.polimi.it/~sage.
- 2nd Regional Conference of the African Association of Remote Sensing of the Environment (Abidjan – Cote d'Ivoire, October 4-10, 1998), presenting its activities and looking forward to future opportunities. The topic 'Lesson of Experience and the Way Forward' was strongly related to the ISPRS Commission VI and, in particular, to the ISPRS WG VI/3 Terms of Reference: Foster relationship with Regional Member organisations.
- ISPRS WG VI/3 meeting in Cotonou (Benin – Western Equatorial Africa) from December 6, 1999 to December 10, 1999, chaired by the AARSE Delegate of the Benin, Mr. Vincent Joseph Mama, and the ISPRS Treasurer and Delegate for Africa and Middle East, Prof. Heinz Ruther, dealt with the topics of Education and Communication (Networking). Its motto was 'Promoting Space Technology Transfer and Geomatics Education in Africa' or, in the French language, 'Promotion du Transfert de Technologies Spatiales et la Formation en Geomatique en Afrique', with the aim to overcome the language barriers.

State of Science and Technology of WG VI/3

The Terms of Reference should be suggestions and not boundaries, because it is impossible to cut the science and the related techniques. Therefore the activities are defined, but not restricted to the Terms of Reference; furthermore new arguments are riches and not uncertainty.

The following list provides some informal ideas, with the aim to better focus the Terms of Reference of the WG VI/3:

- offer an open floor for people entering ISPRS;
- establish close contacts with Regional Member Organisations and, through them, Ordinary Members and Associated Members;
- collect real examples of knowledge sharing and technology transfer;
- promote the growth of basic knowledge and its circulation;
- encourage a peaceful use of mature and innovative technologies:
- establish contacts of ISPRS TC's and/or WG's, as well as Sister Societies, Regional Member Organisations and other International Institutions, which agree with the above mentioned sentences.

WG VI/3 News

The WG will organise a conclusive meeting in Ljubljana (Slovenia) at the beginning of February 2000, where all topics of the WG over the four year period will summarised.

The International Archives of Photogrammetry and Remote Sensing series (at present time, no. Vol. XXXII - parts 6W1, 6W4 and 6W7) will collect all the papers presented at WG meetings.

WG VI/4
Internet Resources & Spatial Data Sharing

Chair : Tuan-chih Chen (Taiwan)
Co-chair : John Felkner (USA)

The Internet, with the World Wide Web, has become worldwide phenomena and will be a major and vital data sharing system for humankind in the 21st Century. The Internet and the World Wide Web provide a superhighway for information access and transfer. As such, they offer an unprecedented source of information. Their potential for research purposes (the reason for the original creation of the Internet) and for education is immense. The use of powerful Internet search engines offers enormous potential for information retrieval and sharing. Because of its position as an international nexus for photogrammetry, remote sensing and GIS technology, it is very important that the ISPRS maintain a very visible and active position on the WWW through the creation of colourful, exciting and informative web pages. The primary function of the Internet and the Web pages will be to convey, share and distribute information.

Working Group Activities and Accomplishments during 1999

The WG VI/4 has attended the ISPRS Technical Commission VI Symposium 12th to 17th in ITB Campus, Bandung, Indonesia. The activities include meeting, Workshop, Tutorial and Symposium.

The WG VI/4 has suggested that the Internet domain name of ISPRS should be registered as 'isprs.org' and therefore the home page address should become www.isprs.org. This procedure has been completed in September 1999 and the new address is now active.
The WG VI/4 has published two announcements on the ISPRS Highlights:

- ISPRS Members Homepages – A Request to Ordinary

Members (September 1999).
- Request for Important World Wide Web Links for the ISPRS Homepage (December 1999).

The WG VI/4 is investigating a wide range of links to relevant Web sites containing freeware, feeware, data, and educational courses for ISPRS. It is our goal to provide a truly information-rich central ISPRS Web nexus for relevant and useful Internet links, and hope that all in the ISPRS community will make use of these links for research, information exchange and global communication for those in the ISPRS community. The WG VI/4 is also drafting Guidelines for National Report. The WG VI/4 is one of the official ISPRS points of contact with CEOS WGISS.

Working Group News
The WG VI/4 will hold a Technical Commission Session in the XIXth Congress ISPRS Amsterdam 2000 -- TC VI-2 Multi-media approach for education. The session will cover the latest multi-media approaches for education,

Technical Commission VII: Resources and Environmental Monitoring

President: Dr. Gábor Remetey-Fülöpp (Hungary)
Secretaries: Péter Winkler (Hungary) and Frank Hegyi (Canada)

State of Science and Technology of Commission Topics
Much of the research and development related to the topic 'Fundamental physics and modelling' has been reported in recent workshops and conferences reported on later in this report.

In 1999, the 'Global Monitoring' working group activities have been focused on the role of remote sensing in the context of the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). The Kyoto Protocol stipulates quantified and legally binding national commitments on greenhouse gas emissions, and a principal aim of the working group has been to assess the potential and limitations of global scale remote sensing in the context of the Protocol, with particular emphasis on forest inventories and change monitoring of global carbon stocks. The review of available and future technology for monitoring treaty compliance was the subject of a meeting organised as joint action by the WGs VII/5(Global monitoring) and VII/6 (Radar applications) in-close co-operation with the hosting University of Michigan (Dept. of Electrical Engineering and Computer Science, EECS) (Ann Arbor, MI, October 20-22, 1999. The Protocol requirements on biomass monitoring were assessed, and the capabilities of current and future RS sensors to meet those requirements were addressed. Particular emphasis was put on the potential of Low Frequency SAR technology for biomass monitoring. More information about the workshop can be found at http://www.eecs. umich.edu/kyoto/. The major outcome of the meeting is summarised in the Chapter WGVII/5.

The year 2000 has provided some significant technical breakthrough.
- After the successful launch of Ikonos 2, the era of the very high resolution satellite remote sensing has arrived and having positive impact on the application oriented R+D activities
- The development of virtual laboratories enabling knowledge based effective design, analysis, simulation, optimisation and verification of application tailored RS systems within pure software environment.
- Final preparation of the NASA's New Millennium program Earth Observing 1 (anticipated launch of EO-1 is: April 2000) having 3 revolutionary land imaging instruments all in line with the Landsat 7 ETM+ (ALI, the advanced land imager, Hyperion, the imaging spectrometer and AC, the atmospheric corrector).
- Advances in hyperspectral imagery exploitation and field spectroscopy instrumentation using standardised spectral libraries
- Similar Earth-observation oriented R+D achievements can be reported at ESA, NASDA, ISRO, and other programme implementation. Nodal points of the institutional network (JRC SAI, CNES, DLR, CCRS, NASA, NRSA, SAC, AUSLIG, INPE etc) have became fundamental for the wider global spatial data infrastructure.

Accomplishments of Commission VII during 1999
The actual scientific work of the Commission were done in the seven Working Groups. However, some activities of the Commission officers are summarised as follow:
- Edited by Alison Munro of the Space Application Institute of the Joint Research Centre and contributed by G. Remetey-Fülöpp, the document entitled 'A strategic view of GIS Research and Technology Development for Europe', has been published by the European Union.
- On the Database Service Providers' Annual Conference the use GIS/RS as tools in the European integration-related tasks have been discussed in Budapest, on November 12, 1998. Four presentation were in line with the Commission VII activities: 'CORINE Land Cover' (Gy. Büttner), 'GEIX the European Geological Information eXchange System' (G. Erdélyi), 'UNDP project on the applicability of DAIS for hyperspectral survey of Hungary' (P. Kardeván) and the 'Multipurpose parcel-based information system' (A. Podolcsak et al) .
- The UNISPACE III Conference and Exhibition held in Vienna July 22-24, 1999 was actively participated in the Earth Observation session by WG VII/2 Chair

Dasika. P. Rao, WG VII/2 Co-chair Vernon Singhroy, the President of the Commission and his both Secretary (Peter Winkler and Frank Hegyi).

- The International Symposium on Spectral Sensing Research (ISSSR) was for the second time organised by the US Army Topographic Engineering Center's GIS/Remote Sensing Center in co-operation with ISPRS Working Group VII/1 with personal active involvement of Chair Karl Staenz. TEC Director Dr. William E. Roper and ISPRS Commission VII President G. Remetey-Fülöpp opened the event,. in the Tropicana Hotel of Las Vegas, on November 1, 1999. Jan Clevers, Secretary of WG VII/1 and liasion officer of the ISPRS Congress to the Commission VII as well as Prof. James Taranik Co-chair of WG VII/7 took part on the event having the motto 'Systems and sensors for the New Millennium'. There were 117 experts of 11 countries at the Symposium.
- The operational use of remote sensing in the agriculture is becoming inevitable. The 5th Conference on the use of remote sensing in the control of agricultural area-based subsidies chaired by Olivier Leo of SAI JRC was held in Stresa on November 25-26, 1999. The appearance of the new very high resolution satellites will open a new line for cost-benefit analysis and pilot applications.
- At the Third GEIXS (ESPRIT) Workshop in Budapest (December 2-3, 1999) devoted to 'The future of geo-referenced information exchange in Eastern Europe and the NIS area' about 70 participants from more than 30 countries (mainly representatives of national Geological Surveys) were present incl. president of ISPRS Commission VII. Established by EuroGeoSurveys, GEIXS has set up a new, harmonised metadata architecture for European environmental and natural resource information. The follow-on actions (year 2000-2002) focus on environmental data such as natural hazards, pollution and contaminated land. GEIXS put the weight on public-access one-stop shop of inter-linked information catalogues and indexes, which are accessible on-line and based on a pan-European GIS and a multilingual keyword index (www.eurogeosurveys.org.en/geo-data). The geoscience community now uses the momentum that the EU supports the topic: Remote Sensing of Environment. The main conclusion was the call for co-operation, standardisation and patience.

Inter-commission Activities

The EARSeL/ISPRS workshop on „Fusion Sensor Data, Knowledge Resources and Algorithms for Extraction and Classification of Topographic Objects' took place from 3-4th of June in Valladolid, Spain. The workshop was organised from ISPR WG III/5 „Remote Sensing and Vision Theories for Automatic Scene Interpretation', WG IV/3 „Integration of Image Analysis and GIS' and WG VII/4 „Computer Assisted Image Interpretation and Analysis' together with EARSeL SIG. The Valladolid symposium had been very successful and that the income generated had been allocated to award travel grants to some students to attend the ISPRS Congress in Amsterdam in July 2000.

Links with Regional Organisations

Commission VII Secretary Peter Winkler, as member of the EARSeL Bureau, keeps daily contact with the European Association of Remote Sensing Laboratories. Commission VII President Gabor Remetey-Fülöpp, as member of the Executive Committee of EUROGI, ensures link with the European Umbrella Organisation of Geographical-Information. (EUROGI and SAI JRC)

WG VII/1
Fundamental Physics and Modelling

Chair : Dr. Karl Staenz (Canada)
Co-chair : Dr. Jan G.P.W. Clevers (The Netherlands)
Secretary : Dr. Philippe M. Teillet (Canada)

Accomplishments of ISPRS WG VII/1 during 1999

The major activity of WG VII/1 was participation in the organisation and execution of the 1999 International Symposium on Spectral Sensing Research (ISSSR 99) held in Las Vegas, Nevada, October 31 – November 4, 1999, together with the US Army Topographic Engineering Center (TEC). The theme of the symposium, the fifth in the ISSSR series, was 'Systems and Sensors for the New Millennium', emphasising the next generation of capability in data acquisition, analysis and product generation.

Several sessions dealt with sensors and their calibration. Several satellite imaging spectrometers scheduled for launch in 2000 were highlighted, including NASA's Earth Observing-1 Hyperion, the OrbView-4 Warfighter-1, and the Coastal Ocean Imaging Spectrometer (COIS) EarthMap Observer (NEMO). Particular attention was paid to Hyperion, which will fly in formation with Landsat-7 and constitutes a technology test mission towards an eventual Landsat follow-on mission.

Hyperspectral image simulation and the design of spectral libraries were featured at the symposium. There was also a mix of military and civilian applications, including minefield detection (including the detection of disturbed soils), military target detection, chemical and biological agent, and disaster mapping and monitoring. Special attention was paid to spectral mixture analysis (both linear and non-linear) and spectral matching techniques. Use is not only made of the reflective, optical part of the spectrum, but also of the thermal infrared and microwave parts.

Proposed Future Working Group Program and Workshop Planned for 2000

The main WG VII/1 activity for 2000 will be involvement in the ISPRS Congress to be held in Amsterdam in July. Imaging spectrometry will continue to be of special interest to the WG. This topic will also be featured at many conferences in 2000, most notably at NASA's 9th Annual AVIRIS Earth Sciences and Applications Workshop (Pasadena, February), the International SPIE Conference on Algorithms for Multispectral, Hyperspectral, and Ultraspectral Imagery VI (Orlando, April), and the International SPIE Conference

on Imaging Spectrometry VI (San Diego, August). Negotiations continue with CNES regarding the possibility of holding the 8th International Symposium on Physical Measurements and Signatures in Remote Sensing, which has traditionally been the main event of WG VII/1, in the beginning of 2001 in the French Alps.

WG VII/2
Application of Remote Sensing and GIS for Sustainable Development

Chair : Dr. Dasika P. Rao (India)
Co-chair : Dr. Vernon Singhroy (Canada)
Secretary : Dr. S. K. Subramanian (India)

Accomplishments of ISPRS WG VII/ during 1999

The major activity of WG VII/2 was the organisation of a Workshop on 'Environmental Modelling using Remote Sensing and GIS for Sustainable Development' at the Indian Institute of Remote Sensing (NRSA), Dehra Dun, India on March 11, 1999. The Workshop was organised as a part of post-International Conference on 'Geoinformatics for Natural Resources Assessment, Monitoring and Management' titled 'GEOINFORMATICS BEYOND 2000'.

While releasing the Abstract volume of the Workshop, Prof. Shunji Murai, 1st Vice President of ISPRS Council gave a brief account of the activities of ISPRS and Working Groups. He appreciated the work being done under ISPRS in India. There were 69 participants in the Workshop from different countries including The Netherlands, Sri Lanka, Belgium, USA, Nepal and Thailand apart from the host country, India.

The Chair WG VII/2, Dr.D.P.Rao presented an overview of the applications of space technology for sustainable development including the next millennium's high resolution sensors like IRS-P5, Quickbird and IRS-P6. Other invited papers were presented by the senior scientists of various centres of the Dept. of Space, namely, Indian Space Research Organisation (ISRO), National Remote Sensing Agency (NRSA), Regional Remote Sensing Service Centres (RRSSCs), Indian Institute of Remote Sensing (IIRS), Space Applications Centre (SAC) and Advanced Date Processing Research Institute (ADRIN), and Indian Institute of Science. The following topics were covered in the Workshop:

Ecological analysis and modelling: Issues and challenges, present and alternate land use based on natural resource; National soil and land degradation mapping: Remote sensing perspective; Geoinformatics for forest ecosystem management: Remote sensing and GIS for modelling; Land degradation due to mining: Concepts and case studies; Remote sensing and GIS for agricultural crop acreage and yield estimation; Integrated watershed developmental planning using remote sensing and GIS; Ground water modelling for sustainable development using GIS techniques and hydrogeomorphic criteria in ground water modelling. The proceedings of the Workshop has been published as ISPRS Archive Vol. XXXII Part 7-W9.

Dr. D.P. Rao attended the UNISPACE-III at Vienna in September, 1999 and presented a paper on 'Sustainable Development and Remote Sensing' in ISPRS Workshop on Resource Mapping from Space.

Proposed Future Working Group Program and Workshop Planned for 2000

In addition to participating in Commission VII activities at the Congress, a pre-congress workshop is being planned on the theme 'Disaster Mitigation'.

WG VII/3
Thematic Application of High Spatial Resolution Satellite Imagery

Chair : Prof. Dr. Bruce Forster (Australia)
Co-chair : vacant

Accomplishments of ISPRS WG VII/3 during 1998

While a range of workshops were organised in 1998 as Working Group activities to provide prior-launch-information, with a view to conducting further application workshops in 1999 with real data, these did not eventuate due to lack of data resulting from unsuccessful system launches. However the year was not without success for high spatial resolution image data, as the following highlights illustrate.

September 24th 1999 saw the launch of the first commercial, high resolution imaging satellite - IKONOS. Space Imaging will begin selling and distributing imagery to customers within 60-90 days, after system testing and calibration have taken place. The system has 0.82 m panchromatic resolution, and 3.28 m multispectral resolution in blue, green, red and near infrared spectral ands. It also allows for both in and crosstrack stereoscopic viewing.

Two papers of importance to the WG were published in the ISPRS Highlights, and are recommended reading for application scientists and potential users of high resolution image data. These were in the June and September, 1999 issues:

- High Resolution Commercial Remote Sensing Satellites and Spatial Information Systems by Lawrence W. Fritz (Vol. 4, No. 2, pp 19-30, June 1999).
- High Resolution Earth Imaging from Space by John Neer (Vol. 4, No. 2, pp 20-27, September 1999).

These highlights illustrate the future strength of the 'high resolution industry', and it is hoped that some papers relating to data from IKONOS and other systems that may be launched before the Congress date of July 2000, will be presented at the Congress. However one can be assured that there will be plenty of papers on high resolution applications for the 2000 Congress in Amsterdam.

WG VII/4
Computer Assisted Image Interpretation and Analysis

Chair : Prof. Dr. Barbara Koch (Germany)

Co-chair : Dr. Alois Sieber (Italy)

Accomplishments of ISPRS WG VII/4 during 1999

There have taken place two important activities:

The WG participated in the EARSeL/ISPRS workshop on „Fusion Sensor Data, Knowledge Resources and Algorithms for Extraction and Classification of Topographic Objects' took place from 3-4th of June in Valladolid, Spain, referred to earlier. The workshop lasted two days and there were seven different technical sessions. The objectives were:

- overview of image, data, information fusion and integration
- prerequisites for fusion/integration: image to image/map registration
- object and image classification
- fusion of sensor derived products
- fusion of variable spatial/spectral resolution images
- integration of image analysis and GIS
- applications

There were 30 presentations of very high quality, on topics on data fusion from algorithm developing to applications. The workshop closed with an intensive discussion on data and sensor fusion and highlighted needed future developments. There was an excellent social program where the participants from different European countries and the States had the opportunity to enjoy Spanish live style and food. The printed publication of the presentations are available from RICS Books as International Archives of Photogrammetry and Remote Sensing, Vol. 32, Part 7-4-3-W6. The papers and the conclusions are already presented on www.datafusion.cma.fr/sig.

The IUFRO/ISPRS/EARSeL workshop on Remote Sensing and Forest Monitoring was held from 1-3 June 1999, Rogow, Poland. The Conference was organised under auspices of the Polish Minister of Environmental Protection, Natural Resources and Forestry. The objectives were to:

- Review the state-of-the-art of remote sensing as a tool of forest monitoring and inventory
- Review the research and application problems of the use of remote sensing in forestry
- Review the present and future remote sensing systems in relation to forestry oriented applications
- Discuss the recommendations concerning future activity of IUFRO remote sensing society in relation to IUFRO-2000 Congress
- Produce conference proceedings summarising the use of remote sensing in forestry

A total of 130 people from 19 countries (America, Asia, Australia, Europe) participated in the Conference, where ISPRS WG VII/4 Chair Prof. Koch delivered a keynote speech on the subject 'The contribution of Remote Sensing for Afforestation and Forest Biodiversity Studies'. Another relevant paper on applied photogrammetry and remote sensing was delivered by P. Adler and B. Koch discussing the subject 'Digital Photogrammetry for Forest Ecosystem Monitoring'. The conference proceedings will be printed by Joint Research Centre in Ispra. Papers and conclusions are available at: http://giswitch.sggw.waw.pl/rogow99. Participants had occasion to participate in some social events as concert of forest and hunter horn signals, visit to university forest: arboretum and alpinarium, to local church (traditional country style Corpus Christi service), forest meal.

By personal guidance of WG Chair Prof. Koch the following fields of interest were investigated in 1999:

- Monitoring and Assessment of Resources in Europe-Forest (MARIE-F)
- Satellite based Environmental Monitoring of European Forests (SEMEFOR)
- Model for a monitoring system of the Alps (ALP-MON)
- Thematic mapping using Smart SAR for regional or supraregional forest inventory (ZUFORST)
- 3D Landscape simulation for visual inspection of the environmental impact of high-voltage wires
- Development of a remote sensing aided area-based Agro-informationsystem (AGRO)
- Intensive observation of forest ecosystems
- Tree Resources Outside the Forest (TROF)
- Assessing forest stand attributes by integrated use of high-resolution satellite imagery and laserscanner (HIGH-SCAN)

The results of expert studies and projects have been and are to be utilised by supranational institutions (EU, FAO), space industry (Dornier), central government and utility companies

WG VII/ 5
Global Monitoring

Chair : Dr. Ake Rosenqvist (Italy)
Co-chair : Dr. Mark Imhoff (USA)
Secretary : Dr. Shintaro Goto (Japan)

Accomplishments of ISPRS WG VII/7 during 1999

The work of WG VII-5 for Global Monitoring is being focused on the organization of the workshop 'Remote Sensing and the Kyoto Protocol'.

The Kyoto Protocol Workshop

In collaboration with WG VII/6 (Radar Applications) and the University of Michigan (MI, USA), a 3-day workshop was held in Ann Arbor, Michigan, October 20-22 1999, hosted by the University of Michigan. The objective of the workshop, 'Remote Sensing and the Kyoto Protocol: A Review of Available and Future Technology for Monitoring Treaty Compliance', was to examine how the remote sensing community can contribute to the information requirements raised by the implementation of - and compliance with - the Kyoto Protocol. The meeting featured invited panel speakers addressing three principal themes; remote sensing implications of the Kyoto Protocol, the potential of contemporary remote sensing platforms, and direct mapping of biomass by low frequency radar systems.

A selection of the major findings can be summarised very briefly as follows:

- Out of the six greenhouse gases covered by the Kyoto

Protocol, it is recognised that the information Earth Observation can provide focuses on CO2 and CH4.
- EO contributions can be made to provide systematic observations and data archives in order to reduce uncertainties in the global terrestrial carbon budget; supporting national and international networks and observation programs - especially for above-ground biomass and trends and shifts in land cover; as well as help support national accounting of Afforestation, Reforestation and Deforestation (A.R.D.).
- The review of state-of-the-art EO technology in the context of the Kyoto Protocol revealed the capabilities - but also the limitations - of each of today's operational optical and microwave sensors.
- Although direct measurements of biomass is possible by contemporary space-borne microwave platforms, the limitation to shorter wavelength radars (C- and L-band) restricts the sensitivity to biomass levels of less than 100 tons/ha. The usefulness of orbital lower frequency microwave sensors (P-band, VHF) was acknowledged, however more research in this field was recommended. A detailed workshop report is available on the Internet at http://www.hegyi.com/isprsc7/wgroup5.html .

Related Meetings
Relevant to the WG activities is the 4th Global Rain Forest Mapping (GRFM) Science Meeting that was organised by the Institute for Space Research of Brazil (INPE) and the National Space Development Agency of Japan (NASDA) in São Jose dos Campos (Brazil) November 8-12 1999. The meeting demonstrated the usefulness of medium resolution (100 m) semi-continental scale (JERS-1) SAR mosaics for regional scale thematic analysis. It also showed how SAR data can constitute easy-to-use information for users not usually accustomed to microwave data, if presented in a user-friendly way. More information about the meeting and GRFM mosaics (distributed free of charge for scientific use) is available at http://www.eorc. nasda.go.jp/JERS-1/ and at http://southport.jpl.nasa.gov/ GRFM/ .

Working Group Program for 2000
Maintaining the thematic focus, WG VII-5 will be organising two sessions related to the Kyoto Protocol at the ISPRS Congress in Amsterdam, between 16-23 July 2000. 'Global Remote Sensing and GIS in the service of the Kyoto protocol' (jointly with ISPRS WG IV-6 (Global databases supporting environmental monitoring). It will provide an opportunity for a larger number of EO scientists to participate and discuss the importance of EO technology in the context of global treaties. The session 'Space-borne Low Frequency Microwave sensors - assessing user needs and technical limitations for global biomass estimations' (jointly with ISPRS WG VII-6 Radar Applications) will address particular issues related to a new generation of microwave systems for assessment of global terrestrial carbon stocks.

Recent publications and lectures of Chairperson Ake Rosenqvist are well representing the areas, where significant achievements are expected using remote sensing technology.

Rosenqvist A. Temporal and Spatial Characteristics of Irrigated Rice in JERS-1 L-band SAR Data. International Journal of Remote Sensing, 1999, Vol., 20, No. 8, pp. 1567-1587.
Rosenqvist A., Birkett C., Bartholomé E. and De Grandi G. Using Satellite Altimetry and Historical Gauge Data for Validation of the Hydrological significance of the JERS-1 SAR (GRFM) Mosaics in Central Africa. International Geoscience and Remote Sensing Symposium (IGARSS'99). Hamburg, Germany, 28 June - 2 July, 1999. Proceedings. IEEE Catalog No. 99CH36293C.
Rosenqvist A., Forsberg B.R., Pimentel T. and Richey J.E. GRFM Activities in the Jaú River Floodplian - Modelling of Methane Emissions and Flooding Dynamics. JERS-1 Science Program '99 - PI Reports, pp 118-122. National Space Development Agency of Japan, Earth Observation Research Center, March 1999.

WG VII/6
Radar Applications
Chair : Dr. Tony Milne (Australia)
Co-chair : Dr. Jürg Lichtenegger (Italy)

Accomplishments of ISPRS WG VII/7 during 1999
This WG collaborated with WGVII-5 (Global Monitoring) and the University of Michigan and participated in the 4th Global Rainforest Mapping GRFM Science Meeting held in Brazil, November 8-12, 1999 (see report WG VII-5).

Members of this WG have been active in the organisation of PACRIM2 which will see the NASA-JPL Airborne SAR (AIRSAR) flown in sixteen countries in the Pacific, Australian and Asian region in the April-May 2000 time period. This collaborative science research mission provides the opportunity for environmental scientists in the region to acquire multi-polarimetric and interferometric SAR. In addition the Modis-Aster simulator MASTER will also be flown on this mission to acquire imagery in the visible NIR, SWIR and thermal portions of the electromagnetic spectrum.

The Working Group co-hosted a Pacific-Rim Significant Results Workshop in Maui, Hawaii from 24-26 August 1999 attended by 60 people. Papers and information on this meeting can be obtained http://Southport.jpl.nasa. gov/AIRSAR/

Working Group Program for 2000
WG V11-6 will conduct a Tutorial on 'Recent Developments in Radar Science and Applications' given by Dr. Tony Freeman from the Radar Sciences Group at JPL and participated in an Inter-Technical Commission, IC-22, on 'Global Remote Sensing and GIS in the Service of the Kyoto Protocol', in addition to organising two Technical Sessions at the Amsterdam Congress. The Workshop on Disaster Monitoring and Mitigation using

remotely sensed data is being co-hosted with WG VII-3.

WG VII/7

Non-renewable Resources and Geotechnical Applications

Chair : Dr. Tshehaie Woldai (The Netherlands)
Co-chair : Dr. James V.Taranik (USA)

Accomplishments of ISPRS WG VII/7 during 1999

Major activity of the WG VII/7 is planned for the ISPRS 2000 Conference in Amsterdam. The Chairman of the WG VII/7 (also in his capacity also as Secretary General of the African Association of Remote Sensing of the Environment - AARSE) fully participated in various meetings and organisations in line with the activities of the Working Group.

- Accra, 21-25 June 1999. 4th Africa GIS Conference and exhibition on 'Emergent Africa-GEO-Information and Globalisation' organised by the EIS Program, OACT, and AARSE in collaboration with the Ministry of Environment, Science & Technology and Ministry of Lands & Forestry. More than 140 participants attended the Conference.
- Enschede, 11-13 July, 1999. Second EARSeL Workshop on Imaging Spectroscopy, The Netherlands (http://www.itc.nl/is2/).
- Vechta, Germany (October 28-29, 1999). Two days Workshop on 'Integrated Modelling by favourability functions' held under the European Union GETS Project in Vechta, Germany. Woldai, attended the GETS meeting of Team Leaders. Woldai's involvement in this meeting as Chairman of CVII/WG7 has resulted in both financial and participatory support for the TU11 Workshop will be held in Amsterdam. The EU-GETS Project will totally finance (all speakers, students, and computers for the workshop, Workshop rooms at the Free University of Amsterdam, including the publication of the papers presented in a book form).
- Cotonou 06 - 09 December 1999. Conference on 'Promoting Space Technology Transfer and Geomatics Education in Africa', Cotonou, Benin. The Conference dealt with several themes and more than 120 participants coming from 20 African and other countries attended the conference. The Conference was organised by the ISPRS Commission VI, AARSE and CENATEL (Benin). (http://xerxes.sph.umich.edu:2000/confs/benin/). The Proceedings of the Conference is given in ISPRS, Volume XXXII, part 6W7, edited by Luigi Mussio.

In 1998 (11-15 May), a scientific Symposium on Operational Remote Sensing for Sustainable Development was held at the International Institute for Aerospace Survey & Earth Sciences (ITC), Enschede, in The Netherlands. An outcome of the papers delivered during this Symposium is now published in the International Journal of Applied Earth Observation and Geoinforma-tion, Vol. 1, issue, pp.2-78, ITC, The Netherlands (Special Editors: van der Meer, F., Molenaar, M., Niewenhuis, G., Woldai, T.).

Working Group Program for 2000

Active participation of the 28th International Symposium on Remote Sensing of Environment and the 3rd African Association of Remote Sensing of the Environment (AARSE) on 'Information for Sustainable Development'. Cape Town, March 27-31, 2000. (For more information