

Annual Report 2000

Introduction

The Annual Report in the Congress Year is different from other years because of the change of Technical Commission Presidents and the fact that many aspects of the Society's activities have been reported at Congress.

A summary of the activities of the Technical Commissions during the previous 4 years, as presented at the Congress by Secretary general John Trinder, were published in the September 2000 issue of Highlights. The reports from the Technical Commissions comprise a report from the out-

going president in the activities in 2000 and a summary of the state of the art in the area of the commission. This is then followed by an outlook from the incoming president on what needs to be done and how the Commission will tackle these tasks. Where there are already events they will be listed. The full programme of the Symposia in 2002 is given on page 51.

Ian Dowman
Secretary General

Technical Commission Reports

ISPRS TECHNICAL COMMISSION I SENSORS, PLATFORMS AND IMAGERY

Outgoing President

George Joseph (India)

Incoming President

Stan Morain (USA)

Outgoing Secretaries

Shri A K S Gopalan (India)
Shri V Jayaraman (India)

Incoming Secretary

Amy Budge (USA)

Report of Outgoing President

There is a paradigm shift in earth observation system world over. From massive multi sensor satellites the trend is to have many small spacecraft, which have faster response to mission needs to fly in formation and gather concurrent data, from different sensors in a 'virtual platform'. Another shift in the earth observation scenario is the increasing role of commercial operators in the space segment. The authorisation to own and operate satellites giving 1 meter resolution has stimulated a number of companies to develop high resolution earth observation systems. Dedicated sensors with fixed fore and aft imaging capability for DEM generation (ALOS, Japan, Cartosat, IRS) and interferometric SAR along with airborne Laser altimetry have given a new dimension in cartographic mapping. Spectrometric observation has gained importance with number of systems being planned for the same. The platform capabilities and pre-processing techniques have to be improved to meet the demands posed by the improved sensor quality and observation techniques.

The first successful high resolution imaging system is IKONOS-2, launched on Sept. 1999, providing 1 metre

resolution in panchromatic and 4 metre in multispectral. A number of similar systems are planned in the near future. A medium resolution (~ 10 metre in VNIR and 20 meter in SWIR) system is being planned by Boeing, GDE called Resource-21. Resource-21 will be a constellation of four satellites providing a temporal resolution of twice weekly for nadir viewing. In addition to these commercial ventures the Governments of USA (Landsat), France (SPOT), India (IRS) and Russia have their own programme of earth observation system giving improved continuity to the existing data, as well as new observational capability. Similarly in the microwave area Canadian Government's RADARSAT and ESA's ERS has made Radar images available for many applications.

The major aerial camera manufactures have announced digital aerial cameras with an information content similar to the existing large size aerial film cameras. This will speed up the photogrammetric work flow by saving the time for film scanning which is not negligible.

Laser scanning has become a standard tool for photogrammetry with new possibilities in forest and coastal areas and also cities. The problem of the removing of objects, not belonging to the bare soil, has partially been solved but still has to be improved, like also the correct matching of neighbouring flight strips.

Interferometric Synthetic Aperture RADAR systems (InSAR) can determine the Digital Elevation Model (DEM) of large areas in a short time. Depending upon the used

wavelength, usually only the visible surface will be determined, that means, the effect of the vegetation and buildings has to be removed. Large parts of the land area has been imaged from the Shuttle RADAR Topographic Mission (SRTM). Based on this, in a few years a homogeneous DEMs will be available though the absolute height accuracy is only about 16 metres.

The platform technology has been improving to make spacecraft with lower weight and less power. Another important development is to make the platform agile to point at any point of interest. The flight navigation by GPS has become a standard for satellite position determination. The end of GPS Selective Availability has improved the accuracy, without relative positioning.

Aerial cameras are being supported by relative kinematic GPS-positioning and also Inertial Measurement Units (IMU), allowing a direct sensor orientation. The direct sensor orientation has started with practical use. An accuracy of 20cm on the ground can be reached.

With a number of earth observation cameras having similar characteristics operating from different platforms. It will be necessary to integrate the data from different sensors for proper interpretation. Time series will be essential for certain application, such as NDVI changes for proper understanding of the natural phenomenon happening, extraction of yield etc. This calls for a reliable radiometric calibration programme before launch and in orbit. Similarly complex high resolution systems with along track stereo capability will pose high demands on geometric calibration. This calls for

- (a) Procedures for radiometric and geometric calibration (both laboratory and in-flight) of digital camera systems should be investigated with the objective to derive recommendations for standards.
- (b) Large area test sites with highly accurate ground truth should be established and maintained world wide to ensure reliable verification of geometric lab-derived calibration parameters of different digital camera systems.
- (c) For vicarious calibration ground test fields with known spectral reflectance are to establish worldwide.
- (d) Field campaigns for radiometric inter-calibration of data of different satellites should be conducted.

In the context of increasing relevance and dependence on fusion of data from various sensors, it is necessary to identify a set of sensor parameters, which, if standardised globally, would ensure maximal retrieval of information. In order to make inter-comparison more meaningful it is also necessary to formulate standard procedures for measurement of these parameters.

In summary the past few years witnessed a number of innovations in the field of sensors and platforms, which could make the remotely sensed imagery useful for several new tasks. With large number of sensors, it is necessary to investigate independent from the manufacturers information about its performance parameters. This calls for a uniform code for specifying sensor parameters and its evaluation methodology. This should be one of the major tasks of the next commission.

Outlook by Incoming President

The United States has not hosted Commission I since Dr. M.B. Scher was President between 1968 and 1972. In those days, the Commission was responsible for issues related to aerial photography and navigation. His Commission ended the very year and month that Landsat-I inaugurated the satellite era for civilian Earth observations. Today, Commission-I focuses on sensors (cameras and scanners), platforms (airborne and spaceborne) and imagery (both film and raster-based). The mid-Congress symposium in 2002 will mark the 30th anniversary of the Landsat Program, and the United States is pleased once again to host this very important Commission.

Seven resolutions were passed for Commission-I by the General Assembly in Amsterdam. Six Working Groups have been formed by combining elements from these. The first resolution recognised that collaboration between the Committee on Earth Observing Systems (CEOS) and ISPRS is a most important goal. It is therefore the responsibility of Commission-I to establish and maintain communication with CEOS, IGOS, ICORSE, and other relevant communities. It is also a priority to (1) funnel information to relevant Commissions and WGs in ISPRS, and (2) to serve as a conduit for information from ISPRS to other international communities. The overall aim is to participate in efforts that will improve international co-ordination of EO missions, and that will foster public/private collaboration of R&D activities.

The second resolution addresses the need for standardisation of sensor parameters. WG I/1 will focus on generating a common set of parameters for recommended use by manufacturers, and which image-processing analysts can use when fusing imagery from several sensors. The need for standardising parameters is most urgently felt by specialists whose work requires comparative data from a number of sensors; and will be felt most strongly by those who are creating the databases needed to compare systems.

A third resolution, addressing radiometric and geometric calibration, will be the primary responsibility of WG I/2. The proliferation of both aerial and satellite sensors, coupled with their finer spatial, spectral, radiometric, and temporal resolutions, means that data must be calibrated to ever finer degrees. This can be accomplished in part by inventorying the global set of ground calibration test sites, and by fostering inter-calibration studies between and among sen-

sors whose data sets are the basis of multi-sensor studies of Earth resources. Among other activities, the WG will contribute to an inventory of test sites and help to populate a database with the defining physical, spectral, and radiometric attributes.

The fifth resolution addresses the very important topic of sensors for DTM data generation. There is a growing number of operational airborne LIDARs and planned satellite interferometric SARs designed to generate DEMs. WG I/3 will look at the accuracy and cost effectiveness of these various techniques and identify standard test sites where data from different sensors can be collected for inter-comparison.

Elements of resolutions 1, 2, and 7 form the basis for WG I/4, which addresses advanced sensor systems. The primary responsibilities of this group will be to track the development of small satellite systems, smart sensors, pollution monitors, laser altimeters, polarisation sensors, and hyperspectral sensors.

Resolution 6 (WG I/5) is focused on platform and orientation integration. The increasingly finer spatial resolution of sensor systems and the use of their data for detailed site studies demand better ability to integrate attitude and position information with image processing software. Also, there are growing needs for standardising data formats, and for developing next generation data referencing, archiving, and data retrieval systems.

One of the urgent areas for inter-calibration is in wide swath sensors, many of which are used routinely for vegetation mapping and analysis. Sensors like AVHRR, SeaWiFS, TM, SPOT-Vegetation, MODIS, and IRS are developing historical data sets of land use and land cover changes, globally; so it is important that the fourth Commission-I resolution will address the effects of viewing geometry on radiometric accuracy. Among other activities WG I/5 will undertake studies and monitor the published literature to develop a catalogue of what is known about the effects of viewing geometry on spectral properties, and how these effects influence classification accuracies.

WG I/6 addresses airborne optical sensor systems and is based on elements of resolutions 2, 6, and 7. This all-important field of photogrammetry and remote sensing will focus on development of digital cameras, small format cameras, and video cameras and the methods of their employment.

The seventh resolution recognises the need for an electronic database of sensor and platform information. To be effective, this database should be accessible on the Internet, be searchable using key words, and be interactive. The vision is to create a one-stop database so that sensor and platforms design parameters can be compared and compiled into reports for various engineering, research, and

application needs. The effort will require standardising the parameters drawn from a multitude of sources.

Working groups of Technical Commission I for 2000-2004

WG I/1 Define Standards for Sensor Parameters

Chair: Charles Mondello (USA)

Co-chair: John C. Baker (USA)

WG I/1 Terms of Reference

- Identify and define a common set of sensor and sensor system parameters
- Promote adoption of standardised parameters among sensor manufacturers
- Design data model for, and populate, an electronic database of sensors, platforms, and launch status of new satellite sensors
- Collaborate with CEOS to develop a comprehensive database of sensor and platform specifications
- Pursue organisations to collaborate in support of data model and database maintenance
- Participate in ISO TC 172/SC1, SC9
- Liaise with CEOS member organisations to identify and appoint cross-over WG membership

WG I/2 Sensor Calibration and Testing

Chair: Manfred Schroeder (Germany)

Co-Chair: Veljko M. Jovanovic (USA)

WG I/2 Terms of Reference

- Radiometric and geometric calibration of wide-swath and multi-viewing angle sensors
- Techniques for laboratory calibration of sensors
- In-flight sensor calibration and development of calibration test sites
- Calibration and evaluation of image scanners
- Assess effects of viewing angle on spectral and radiometric data from wide-swath and multi-viewing angle satellite sensors
- Participate in CEOS WGCV, ISO TC 172/SC9, and ISO TC 42/WG3 and WG20 and other international organisations

WG I/3 Active Sensor Systems

Chair: Mike Renslow (USA)

Co-Chair: Mike Palmer (UK)

WG I/3 Terms of Reference

- Collaborate with CEOS to identify global test sites for evaluating SAR, LIDAR, and INSAR systems
- Assess precision and accuracy of active sensors that generate DEM data sets
- Evaluate data recording and pre-processing systems to generate optimal data sets for analysis and measurement

- Recommend best practices for integrating attitude and position information with data processing algorithms

WG I/4 Advanced Sensor Systems

Chair: Masanobu Shimada (Japan)

Co-Chair: Janio Kono (Brazil)

WG I/4 Terms of Reference

- Small satellites for Earth observation—complexity, reliability, and comparative costs
- Platform guidance, navigation and positioning, integration of GPS, and orientation systems
- Performance of high resolution and hyperspectral imaging systems for Earth system science
- Monitor and report developments of new sensors such as smart sensors, polarisation sensors, pollution monitors, laser altimeters, and precipitation radar

WG I/5 Platform and Sensor Integration

Chair: Karsten Jacobsen (Germany)

Co-Chair: Ismael Colomina (Spain)

WG I/5 Terms of Reference

- Define best practices for recording and presenting sensor data together with auxiliary platform data—GPS, INS, orbital definition
- Liaise with Commission III
- Capability of high resolution earth observation systems
- Relation and long-time stability of attitude and position information to sensor orientation

WG I/6 Airborne Optical Sensor Systems

Chair: Brian Huberty (USA)

Co-Chair: Brian Gorin (USA)

WG I/6 Terms of Reference

- Assess data quality for advanced aerial digital camera and video systems
- Integrate airborne digital camera and video systems into user applications
- Install, test, and calibrate airborne digital camera and video systems on aerial platforms
- Develop guidelines for designing aerial missions for small format and video data acquisitions

**ISPRS TECHNICAL COMMISSION II
SYSTEMS FOR SPATIAL DATA PROCESSING, ANALYSIS AND REPRESENTATION**

Outgoing President

Ian Dowman (UK)

Incoming President

Chen Jun (China)

Outgoing Secretary

Ray Harris (UK)

Incoming Secretary

Jie Jiang (China)

Report of Outgoing President

Commission II is mainly concerned with systems. These are relevant to a large number of areas as the work of the working groups demonstrates.

In the area of real time mapping technologies (WG II/1) SAR, LIDAR and hyper-spectral sensors are becoming more widely used in applications, complementing GPS, INS and CCD cameras, where not only real-time but also all-weather and high accuracy is essential. Research in multisensor 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. Great efforts have been made in high-accurate real-time navigation data using radio-link based local DGPS correction techniques for a broad range of applications. It will greatly improve the real-time positional accuracy of sensor orientation. Intelligent processing of mobile mapping data remains a research topic. Multiple image based matching has found its application in mobile mapping processing. Bayesian networks have been actively researched and promise great potential for feature

extraction. The application of invariance theory for sensor orientation and georeferencing in cases of weak navigation data has attracted attention. Object recognition and feature extraction will benefit from the availability of high quality orientation parameters and image sequential information.

Software and modelling aspects for integrated GIS (WG II/2) has concentrated on three dimensional data in GIS, particularly data acquisition, on one side, and the management and modelling of 3-D data on the other. New concepts for integrating the data components to create detailed large scale realistic 3-D models have been developed. Methods combine the generation of 2D building information with a data structure and with topological models to manage them in context with a digital surface model. Generally performance still seems to be a problem but further technical developments in the field of digital acquisition techniques will have 3-D GIS applications combined with acquisition techniques as one of the main future topics in the field. There is 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 land use classification with different layers and parameters. Visualisation standards and also spatial analysis through the Internet advance at high speed. These are topics that will be of considerable interest in the future.

Rapid development in web based services using the Internet

is continuing in WG II/3 (Spatial data handling technologies) 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 Earth observation 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 metadata standards, protocols and incompatible services being developed and this continues to be a problem.

The key trend in systems for processing SAR data (WG II/4) is in the use of data sets with increasing dimensionality. This trend began with the use of multi-temporal interferometric data sets from satellites ERS and RADARSAT. A further increase in dimensionality now exists through increasing research interests involving the use of multi-temporal multi-polarimetric data, derived from experimental platforms such as the E-SAR airborne system operated by DLR. This trend will enable data from future satellites such as ALOS and RADARSAT 2 to be fully exploited.

Techniques supporting this high dimensionality are multi-temporal speckle reduction processes, coherence measurement and polarimetric signature techniques. An important example of speckle reduction is an annealing technique that produces an image segmentation with common region boundaries, as far as is possible. Coherence is a feature that measures the similarity of two complex SAR images. It is now fundamental to many applications although these are constrained by the satellite repeat cycles available. Recently coherence techniques have been extended for use with fully polarimetric radar data, spectacular results have been achieved that isolate returns from particular scattering mechanisms. It is likely that these multi-polarimetric techniques will produce an explosion of new applications in the next few years, in the same way that interferometric data has over the past decade.

In the area of Integration of image understanding into cartographic systems (WG II/6) work continues on the design and implementation of automated and semi-automated cartographic feature extraction (CFE) systems. These systems have reached a level of competence where rigorous performance evaluation is required to truly understand their characteristics. A main thrust of this Working Group has been the definition and dissemination of meaningful evaluation standards for CFE systems. Equipment manufacturers and data producers are looking seriously at automated systems, in terms of in-house development and for licensing technology. While current applications of CFE automation are fairly limited, the demand for such technology is high. We expect to see more examples of automated applications in production systems within the next four years.

WG II/7 has been concerned solely with practical and implementation issues in digital standard data transfer for-

mat, especially image data transfer formats. From 1999 through 2000 the WG has collaborated with the OpenGIS Consortium (OGC), and the International Standardisation Organisation (ISO) mainly through Prof. Wolfgang Kresse. These activities can be summarised as follows:

- The proposal by ISPRS WG II/7 will form the two important components for the ISO/TC211 standard that has been under development since the first meeting of the Project Team (project 19124) in March 1999. The ISO/TC211 standard will be completed by the end of 2001. It is worth mentioning that this is thanks to the tireless activity of Prof. Wolfgang Kresse, who is an active member of ISO/TC211.
- The WG has established links with the proponents of the standard Co-ordinate Transformation Interface to the OGC.

WG II/7 has worked successfully to gain credibility and recognition in ISO and OGC and has succeeded in having ISPRS viewpoints accepted by both organisations. By participating in the development of these standards, we can be confident that the ISPRS ideas will be included and that the industry will adopt them as soon as they become public.

A large number of Digital Photogrammetric Systems (DPS) (Digital systems for image analysis WG II/8) including input and output devices with different degrees of functionality, user friendliness, and automation potential are now commercially available. Vendors of DPS include traditional photogrammetric, but increasingly also remote sensing and GIS companies. The traditional photogrammetric companies are concentrating their resources and merging meaning fewer systems will be available in future years. However a major trend can be observed towards using 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. Automatic DTM generation has been accepted by the practice some time ago, but interactive verification and editing is here to stay, especially in difficult terrain, and at large scales. Digital orthoimages are being produced 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 3-D 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.