OEEPE REGIONAL REPORT 1992-1996

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European Organisation for Experimental Photogrammetric Research
Organisation Européenne d'Etudes Photogrammétriques Expérimentales

Regional Member Report

KEYWORDS: Cooperation, GIS, Photogrammetry, Research.

ABSTRACT

The Regional Report addresses OEEPE achievements during the reporting period, as well as perspectives for the coming period. It also gives an overview of the OEEPE Research Plan, and of the OEEPE research projects; a review of the published research reports is given. Organizational changes, to better respond to user requirements and technological trends, and to improve efficiency and effectiveness of the organization, are also addressed. Relationships with international organizations like ISPRS, ICA, EUROGI, CERCO, AM/FM Europe, and CEN are shortly outlined. Finally, the report summarises contributions to the OEEPE Special Session, in the framework of the XVIII ISPRS Congress.

1. PREAMBLE

The International Society for Photogrammetry and Remote Sensing (ISPRS) is holding its 18th Congress entitled "Spatial Information from Images", here in Vienna from July 9 to 19, 1996. As one of the Regional Members of the ISPRS, the European Organisation for Experimental Photogrammetric Research (OEEPE), like ISPRS, is especially pleased that this event has returned to the place where the first such congress was held 83 years ago.

2. THE OEEPE IN SHORT

The OEEPE is a pan-European organisation which was established in 1953 in Paris, in accordance with the recommendation passed by the Council of the Organisation for European Economic Cooperation.

Thirteen European countries are presently member of the OEEPE, namely Austria, Belgium, Denmark, Germany, Finland, France, Italy, The Netherlands, Norway, Sweden, Switzerland, Turkey and The United Kingdom; Spain has recently applied for membership. The Government of any European country may become a Member of the OEEPE.

The aim of the OEEPE is to improve and promote methods, performance and application of photogrammetry by carrying out in mutual co-operation, investigation and research, in particular of an experimental and application- oriented nature.

The Steering Committee is the governing body of the OEEPE and is responsible for the establishment and the continuous maintenance of the OEEPE overall research policy, of a coherent research programme and of the organisational structure; the approval of research programme/projects proposals and the allocation of resources; the monitoring of the execution of research programmes/projects and their evaluation in terms of efficiency and effectiveness; the publication of reports in the official OEEPE Publications; and the appointment of OEEPE officials.

The Science Committee is responsible for the long term review of research requirements, for the preparation of an overall research concept and for the preparation of a coherent research programme; it is also responsible for the scientific evaluation of research programme/project proposals and for their scientific monitoring and coordination.

The Executive Bureau has a staff function to the President of the OEEPE, and is responsible for all day-to-day business relating to the functioning of the organisation. The Secretary General is specially responsible for all administrative and financial matters.

The Commissions are responsible for the identification of problems concerning the whole Geoinformatics Community and suitable for OEEPE research activities, following the guide lines given in the OEEPE Research Plan; the formulation of research programmes or project proposals that will be evaluated scientifically by the Science Committee and for efficiency and effectiveness by the Steering Committee; the preparation of Position or Review Papers and, if applicable, the execution of feasibility studies, to support programme and project proposals.

The Working Groups are responsible for the execution of specific research projects on an ad-hoc basis, following the terms of reference as defined by the Steering Committee. They report on progresses and achievements to the Steering Committee who will monitor the efficiency and effectiveness of the Working Groups, and to the Science Committee who will evaluate their scientific work. Working Groups can be set up within a particular Commission or outside existing Commissions.

The results of the OEEPE research projects are published in the OEEPE Official Publications. Workshops are regularly organised by OEEPE Commissions, and an OEEPE Newsletter is disseminated twice a year. The working language of the OEEPE is English.

3. OEEPE ACHIEVEMENTS AND PERSPECTIVES

(by R. Kilga, President of the OEEPE)

The field of photogrammetry and remote sensing is a striking example of the enormous technological progress made in the course of the twentieth century. From its inception photogrammetry has always been linked to practical applications. The establishment in Paris of the OEEPE in 1953 represented a major step forward for the growth of this specialised field. Since this time valuable research activities were undertaken and techniques developed for various disciplines by the OEEPE, so that the range of applications of photogrammetry was extended far beyond geodesy.

As we stand on the threshold of the next millennium it is vital to the challenge of a modern information society and develop a vision of the future that involves recognizing the complex links between a wide spectrum of scientific knowledge and areas of application. The OEEPE could play a key role according to the European policy in the area of geographic information by significant initiatives and contributions.

The OEEPE has responded to the demands of the times by updating its statutes, adopting modern technologies and introducing a forward-looking management concept for its operations. Management and consulting strategies form the base for the organization's further development on a sound economic basis. Our new Research Plan reflects the role of the OEEPE in the European Geoinformation Society. In the field of technology watching, the OEEPE acts as a link between academia, industry and users in exploring the practical and commercial viability of ideas and proposals and providing potential users with applications profiles.

Without photogrammetry and remote sensing it would hardly be possible to create a topographic infrastructure of Europe as an essential cornerstone for the establishment of geographic information systems (GIS). The OEEPE should enforce to be concerned with the practical aspects of the use of GIS data at a European level. Issues such as standardisation, quality management, data description and the like should be subject of experiments. Here the role of the OEEPE as a multi-disciplinary and multi-national pool of experts, is to pave the way for the work of national institutions.

This congress, bringing together as it does the leading scientists and professionals of various disciplines, is an outstanding forum in which the OEEPE can not only offer its expertise but also put forward its views and vision of the future and to adjust its aims.

In my capacity as current president of the OEEPE I would like to take this opportunity to thank the officials of the ISPRS for their excellent cooperation, and to congratulate them on all their achievements during the last period of office. I wish the organizers a highly successful 18th Congress and I hope that for all the participants in this congress their experiences here among their esteemed colleagues will accompany them on their professional paths. I am confident that the congress will make important contributions to the further development of the field of photogrammetry and remote sensing and to the benefit of the OEEPE, respectively.

4. OEEPE RESEARCH PLAN, PROJECTS AND PUBLICATIONS

The OEEPE has a rolling Research Plan; the Research Plan presents the OEEPE Research Perspective and the OEEPE Research Programmes and Projects.

4.1 OEEPE research perspective

User requirements and technology have changed drastically during the last few decades, from a pure data acquisition to an information system perspective, enabling cost effective access, exchange and integration of Geoinformation. The present OEEPE research perspective is that Photogrammetry should not be considered in a narrow sense but in the framework of Geoinformatics, specially in view of the trend towards large systems and system integration; it should serve the whole European Geoinformatics Community, deal with problems of more than local significance, and be carried out by means of international cooperation; it normally relates to technical and scientific questions or deals with the performance status of methods, but also operational and organisational aspects can be included.

4.2 OEEPE research programmes/projects

The following Research Programmes are considered in the 1995 update of the Research Plan: Data Acquisition; Photogrammetric Point Determination; Information Extraction; Information Management; Information Presentation; Quality, transfer and archiving; and Applications. Research topics included in the rolling plan are considered to be those most in need to solve short term production problems, and to prepare for the introduction of new techniques in the future. In addition to projects related to technological problem solving and cost saving technology, the OEEPE is also embarking on more strategic issues related to GIS for Europe. Following is a list of research projects which have either been completed or started during the reporting period.

**** Research projects which have been successfully completed during the reporting period:***

- *GPS supported block triangulation:* to analyse the strengths and weaknesses of GPS supported aerial triangulation, and to extract factors that have influence on the results.
- *Aerial triangulation using digitized images:* to assess potentials and limitations of methods for aerial triangulation using digitized images.

- *Digital Landscape Model for Europe:* to derive and link data from digital and analogue spaceborne recordings, in order to compile a digital landscape model.
- *Updating of complex digital topographic databases:* to analyse the problems inherent in updating complex digital topographic databases, and to identify and recommend effective procedures to ensure that database currency and maximum functionality is maintained.
- *Quality model:* to develop an application independent quality model, and to define quality concepts and parameters to be used.
- *Accuracy of digital terrain models for civil engineering purposes:* to define rules to indicate parameters of the source data of a DTM, to ensure economical and efficient data collection.
- *Geocoding of ERS-1 SAR data:* to compare methods of geocoding ERS-1 SAR data and to evaluate the use of such data for mapping.

**** Research projects which have been started during the reporting period:***

- *Large scale mapping specifications:* to compile and compare information on methods for large scale map compilation; and to analyse existing specifications for large scale technical and cadastral mapping.
- *Analyses of photoscanners:* to elaborate criteria for the analysis of photoscanners; to perform a standard test, and to derive recommendations for standard test material.
- *Feature extraction from high resolution space imagery:* to develop a methodology, and to derive standard procedures for the assessment of algorithms for feature extraction from high resolution space imagery.
- *Automatic generalisation:* to develop evaluation criteria and measurement tools; to evaluate commercial software packages for automatic generalisation, and some GIS tools.
- *DEM quality:* to identify issues involved with DEM accuracy and choice of parameters; to analyse different DEM accuracy models; and to propose operational strategies to enable creation of DEM's to fulfil specified accuracy requirements.
- *3-D GIS:* to analyse 3D-GIS user and producer requirements; to investigate some 3D-GIS applications and data integration problems; and to compare cost-efficiency of different data acquisition techniques.
- *Development of specifications for a digital camera:* to develop requirements for the development of a digital camera, in cooperation with users and industry.
- *Airborne kinematic GPS positioning:* to investigate the performance of new systems (new dual frequency receiver hardware and new software which has been improved, specially for fast ambiguity solutions), related to obtaining continuous and absolute GPS trajectories.
- *Application of digital photogrammetric workstations:* to analyse experiences with digital photogrammetric workstations in practice.
- *Automatic generation of DEM:* to compare the performance of methods and software packages for automatic DEM generation among themselves, and against conventional analytical DEM generation.; and to demonstrate the potentials of this technology in practice.

4.3 OEEPE Publications

Since 1992, the following research reports have been published in the framework of the OEEPE Official Publications:

- **no. 27**; Proceedings of the ISPRS and OEEPE joint workshop on updating digital data by photogrammetric methods; by P.R.T. Newby and C.N. Thompson, 1992.
- **no 28;** Proceedings of the OEEPE workshop on data quality in Land Information systems; by L.A. Koen and O. Kölbl, 1992.
- **no 29**; Empirical results of GPS-supported block triangulation; by K. Torlegard, 1994.
- **no.30** ; Updating of complex digital databases; by M. Brand, 1995.

In addition, the following research reports will be published in the framework of the OEEPE Official Publications, before the XVIII ISPRS Congress:

- Aerial triangulation using digitized images; by T. Sarjakoski and J. Jaakkola, 1996.
- Geocoding of ERS-1 SAR data; by I. Dowman, 1996.
- Proceedings of the OEEPE workshop on the application of digital photogrammetric workstations; by O. Kölbl, 1996.

Also, the following OEEPE Official Publications are scheduled for early 1997:

- Digital Landscape Model for Europe; by B.S. Schulz.
- Accuracy of digital terrain models for civil engineering purposes; by A. Flotron.
- Large scale mapping specifications; by S. Dequal and L.A. Koen.

Finally, it is worth to mention here that the OEEPE has started disseminating a bi-annual Newsletter in 1995, and is planning to continue to do so in the future.

5. ORGANISATIONAL CHANGES

The changes in the OEEPE research perspective, as reported in the preceding paragraph, have lead to changes in the formulation of the OEEPE mission, and in the working procedures of the organisation, including its relationships with other international organisations, during the reporting period (1992-1996).

5.1 Changed mission

The Statutes of the OEEPE have been amended in 1994, to better reflect the new OEEPE research perspective; the mission of the organisation reads now as follows: "The aim of the OEEPE is to improve and promote methods, performance and application of Photogrammetry by carrying out in mutual co-operation, investigations and research, in particular of experimental and application oriented nature. Experimental research is understood to include, whenever

necessary, theoretical and methodological preparation, as well as scientific analysis of results. The photogrammetric research can extend, as necessary, into related fields in which an interaction takes place, such as sensor technology, data processing, information systems, automation, cartography and geodetic methods. It is to include in particular the integration of data from different origins and the combination to higher level systems of wide scope."

5.2 Changed working procedures

An organisational structure and the related working procedures, should aim at increasing the efficiency (doing the things right) and effectiveness (doing the right things) of an organisation. The OEEPE organisational structure and working procedures as defined in the eighties, had become too cumbersome to permit the OEEPE to function adequately in the research context of the nineties.

It has not been the intention to fundamentally change the OEEPE Structure, but rather to regard it as a frame in which the organisation can manage efficiently and effectively a portfolio of research programmes and projects addressing as well cost saving technology as GIS strategic issues. Emphasis has been put on (quality) monitoring of the research efforts, by means of improved project planning and control, and improved cooperation with other international organisations.

5.3 Improved external relations

During the reporting period, the OEEPE has strengthen its cooperation with the ISPRS, as a Regional Member; this has been achieved through cooperation between ISPRS and OEEPE Working Groups on related subjects, but also by means of active participation of OEEPE members in different ISPRS Symposia in 1994; it is further concretised by the OEEPE organising a Special Session in the framework of the present ISPRS Congress.

Similarly, the OEEPE Working Group on Automatic Generalisation has been very active in the framework of the ICA (International Cartographic Association); this has been concretised by the organisation of a workshop on Generalisation during the last ICA Conference (1995).

Since 1992, the OEEPE is closely cooperating with CERCO (Comité Européen des Responsables de la Cartographie Officielle) under an official agreement; the aim of the cooperation is for the OEEPE to better appreciate the research requirements of the European Geoinformatics community.

During the reporting period, OEEPE representatives have been heavily involved in the standardisation activities of the CEN/TC 287 (Comité Européen de Normalisation), with particular relevance to the standard for data quality.

Cooperation with AM/FM Europe has also been started in the perspective of a join research project on the feasibility of the use of the ISO-9000 series guide lines in a GIS environment.

Finally, the OEEPE is active (with the Observer status) in the framework of EUROGI (European Umbrella Organization for Geographical Information), with particular relevance to harmonisation and standardisation issues.

6. OEEPE SPECIAL SESSION IN THE FRAMEWORK OF THE XVIII ISPRS CONGRESS

The OEEPE has been allocated a Special Session [SS02] in the framework of the XVIII ISPRS Congress; the Session will start by a short introduction on OEEPE current activities and perspectives; this will be followed by the presentation of three papers, and their subsequent discussion. The three papers are summarized hereafter.

6.1 Experimental tests on fast ambiguity solutions for airborne kinematic GPS positioning *(by F. Ackermann)*

High precision kinematic GPS positioning, based on differential methods, has always had the problem of correct ambiguity solutions for the phase observations, especially under the conditions of airborne applications for photogrammetry and remote sensing. Methods have successfully been worked out and applied which do not rely on exact ambiguity solutions after loss of lock of signals. Instead, the resulting systematic GPS position errors were subsequently corrected with the help of external constraints by combined block adjustment, for instance. Aerial triangulation and block adjustment on that basis has been shown to work very well, even if only L1 signals are used. It is a particular feature of the method that the GPS ground receiver stations can be positioned very far from the flight area, up to 500 km or more.

Recently, the appearance of dual frequency receivers and the development of methods for fast ambiguity solutions, known as "on the fly" (OTF) solutions, have created a new situation. It is possible now to re-establish ambiguity solutions after disruptions of signals, as they happen during flight turns in particular. There are several software programs in use which can handle the problem. The result is that continuous GPS flight trajectories are obtained for complete flight missions. If they are linked to a base line initialisation before take-off then the GPS flight trajectories are practically absolute, with regard to the WGS 84 reference system or to any other reference system related to it.

Those methods simplify the airborne kinematic GPS application considerably, especially also the application to photogrammetric block adjustment. The use of cross strips could be abandoned, as (almost) no systematic errors would be effective any more. Also flight trajectories could be used directly which are not supported by image blocks, like laser scanning trajectories, for instance. Thus, obtaining completely continuous GPS flight trajectories is an important development which is highly welcome from many points of view.

There is the problem, however, that the present methods for fast ambiguity solutions are not very reliable. Safe application seems to be limited to short distances between receivers, i.e. the stationary GPS receiver(s) must be close

to the project area, respectively close to the flying aircraft. Available experience suggests safe maximum distances of about 30 km only. This represents a serious restriction, at least in some conditions of application. It is to be investigated, therefore, how far the stationary and the roving receivers can be separated and still give reliable ambiguity solutions. The second point of research is to develop methods or conditions which make the OTF ambiguity solutions safer and more robust.

The paper reports about a number of experimental tests on fast ambiguity solutions which are undertaken by the GPS working group of OEEPE. In summer 1995 three test flights over test areas have been flown, each with several stationary dual frequency receivers which were positioned at different distances from the project area. The range extends up to several hundred km. Receivers of different manufacturers have been used, in order to cover different cases. Several more test flights are scheduled for fall 1995. The tests include smooth flying, avoiding loss of lock as much as possible, as well as rough flights with sharp and steep turns, producing loss of lock by intention.

The GPS data processing (and checking via aerial triangulated camera positions) is going to use several software programs for the ambiguity solutions. The results will be analyzed with regard to the accuracy and the sensitivity of fast ambiguity solutions, possibly related to different external circumstances.

The theoretical development of fast ambiguity solutions of higher performance is not the task of the experimental investigations. The available data will allow, however, to investigate whether the use of several ground stations can robustify the method and extend its range of application.

The experiments concern a problem, the investigation and solution of which is a highly urgent topic for the practice of airborne GPS application. It is not expected that all test data can be processed in time for the paper. But some tests will have been worked out completely and valid results will certainly be demonstrated and analyzed in the paper.

6.2 Updating complex databases; the next step *(by M. Brand)*

Digital topographic databases are fundamental to management of an ever increasing range of business functions within a GIS environment. It follows that currency of such databases is critical to effective use of the new technology.

The more complex the topographic information involved the greater are the implications to the updating procedures, particularly if in addition to current data, archiving of a historical perspective is a requirement. To date these matters have remained largely unaddressed by software houses generally.

The issue increases in importance daily and it is logical that OEEPE should play a leading role in promoting this follow-up activity. Such activity must focus on the use of newer technology, typically digital photogrammetry and mono-plotting, and identify means to effectively apply such methodologies to complex topologically structured, multi-featured coded databases.

The recently completed OEEPE Commission I project "Updating of Complex Digital Topographic Databases" was a major attempt to tease out the principles involved and the difficulties to be overcome in seeking solutions. The paper outlines these and develops on its findings.

6.3 First experiences from the OEEPE Scanner test *(by O. Kölbl)*

In modern aerial photogrammetry, image acquisition is still largely done with photographic cameras. Consequently, the conversion of photographic images into a digital form by scanning represents a key operation for digital photogrammetry. Currently, a considerable number of scanners specially developed for the requirements of photogrammetric processes are available.

In order to develop criteria for a systematic analysis of scanners and to gain experience on different systems, the OEEPE (European Organization for Experimental Photogrammetric Research) has set-up a working group, which besides other activities launched a test.

The test material which included 7 different test-patterns and aerial photographs, was sent to different vendors. Up till now, test results have been received from the following firms, using the referred systems: Agfa Horizon Plus of Agfa, Mortsel, Belgium; PS1 of Intergraph, Huntsville, USA; RM1 of Wehrli & Assoc, Valhalla, USA; and DSW200 of Helava, San Diego, USA. The results of the scanner test confirm the high standard reached by photogrammetric scanners. Nevertheless, open questions remain and differences can also be distinguished between the different systems.

The scanning of the original negatives is still not very satisfying due to the limited dynamic range of the scanner and high image noise in the darker areas. Problems also arise when scanning colour, especially false colour photographs due to the lower sensitivity in the blue area. The scanning process also affects the resolution of the original images and a thorough control of the MTF of the scanner is highly recommended.

Furthermore, it is apparent that the scanning process is still a very time consuming operation, mainly because each photograph has to be treated individually and hardly none of the scanners is equipped for film roll. A problem linked to the management of the scanning process is the organization of the data. The repartition of the disc in units of 2 Giga bytes, or the storing on tape considerably complicates the management of the data, and it appears necessary to conceive a special data base for this task.

7. CONCLUSION

High costs in data acquisition, and increased user demands for sophisticated applications, and thus for transparent access to information, regardless of the hosts on which it

resides, combined with advances in databases systems and communications technology, have brought the Geoinformatics community to change from a pure data acquisition to a (distributed) information system perspective; this to enable cost effective access, exchange, integration, and use of geoinformation residing in distributed databases, to support decision making at different levels.

The OEEPE recognizes those changes, and next to keeping relevance to technical aspects of photogrammetry (experimental problem solving/cost saving technology), is developing a research programme that integrates photogrammetry into systems of wider scope (strategic and technological issues related to the European Geoinformation Infrastructure) for the next reporting period (1996-2000). Those objectives can only be achieved through strengthening international cooperation between the geoinformation user, producer and research communities.

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