National Report of the Israeli Society of Photogrammetry and Remote Sensing 1992-1996

Prepared for the Israeli Society of Photogrammetry and Remote Sensing
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ABSTRACT

The National Report of Israel outlines the pattern of activities and new developments in photogrammetry and remote sensing during the period 1992-1996. The involvement of most sectors engaged in these activities is described, including government, education, research, systems and equipment supply, consultancy, professional practice and contract services. A wide range of applications is reviewed and therefore the report treats them briefly.

COMPILATION OF THE REPORT

This abbreviated version of the National Report, has been compiled from proceedings of various professional meetings, symposia and conferences, from published papers, from responses to a circular letter to members of the National Society and from responses to direct questions by the authors. Editorial discretion has been used in presenting the various material received. This report does not necessarily represent the views of the Israeli Society of Photogrammetry and Remote Sensing.

KEY WORDS: Photogrammetry. Remote Sensing. Development. Education. Tasks.

1. INSTITUTIONS

The Israel Society of Photogrammetry and Remote Sensing is the adhering body to the International Society for Photogrammetry and Remote Sensing and is a non-profit society, existing solely for the purpose of advancement of the profession. It is run on a voluntary basis by elected officials, is funded by membership fees and aided by services provided by members. The National Society was founded in 1949 and has currently 70 members. This rather small membership is perhaps characteristic of a small country, in which, for many years, photogrammetric practice was limited to the Survey of Israel, the government mapping institute and a small number of private companies. The number of private companies active in photogrammetry has increased considerably in the last decade (currently 16). Remote sensing applications are rather limited in Israel, because in a small country photogrammetry still dominates the field of mapping and land use monitoring.

The National Society conducted a symposium on photogrammetric and remote sensing application in Israel in June 1993, with some 200 persons in attendance. A Remote Sensing Symposium was held in June 1994 under the auspices of the National Space Committee, with published proceedings.

2. PHOTOGRAMMETRY

Photogrammetry provides professional interest or employment, or both, for some 200 persons in Israel.

This is a fairly considerable number, considering the trend for increased productivity, not only through improved technology, but also through the omnipresent cost analysis. As a general policy, the government decreases gradually the number of employees in the Survey of Israel, and one observes the increase in contracts for photogrammetric projects awarded to private companies. In general, the users of surveying and mapping products, readily accept the photogrammetric product as the best solution to their requirements. The early nineties saw a wave of immigration in Israel, with a corresponding need for housing, access roads etc. etc. Photogrammetry provided the necessary response to the urgent need for planning background maps, monitoring construction and "as made" maps. Most of these products were of the digital variety.

Today, one sees an increasing involvement of photogrammetry in cadastral tasks, in response to the policy of providing registration of rights, parallel with

the new housing occupancy, and the desire to secure mortgages by registration, all within the framework of a Torrens type cadastral system.

The recognition of the need to establish a National Digital Mapping Database, brought with it the need for re-mapping.

2.1 Re-Mapping

In 1992, following the decision to entrust the Survey of Israel with the responsibility for coordination of the various government sponsored or funded GIS activities, the basic layers and standards for the National Digital Mapping Database (NDMDB) were defined.

The foundation layers of the "National G.I.S." were to serve, both map series production by the Survey and the national data source for spatial information analyses.

The basic concept is to establish a seamless, unique and homogenous database.

The re-mapping project is based on photogrammetric mapping from 1:40 000 scale aerial photographs.

Private photogrammetric companies were commissioned, under bid, to carry out the data acquisition. Quality control is in the hands of the Survey of Israel.

Data which have passed the quality control are integrated into the NDMDB, by joining the models, building attributes tables, marking each feature by its source code and refiling the merged data into the Survey's database files.

Look-Up-Tables (LUT) permit derivation of 1:5000, 1:10000, 1:20000 and 1:25000 map scales. The data collection has reached approximately 30% per cent of the country's area, mainly in the developed areas.

2.2 Photogrammetry for cadastre

Mutations to the existing land settlement subdivisions require the preparation of a registration plan, which complies with the approved planning documents and with the Survey Ordinances. A project was undertaken by one of the private companies to produce a registration plan with an orthophoto background. Aerial photography at the sale of 1:5000 was controlled by presignalised GPS points. The photographs were scanned at 12μ density and the solution supplied conformed with the standard of 4cm, both in position and elevation. The photogrammetric map at 1:1250 scale required some field completion. Following mapping, a DEM was derived with a 5 m. density in hilly areas and 8 m. in flat areas. On this DEM basis an orthophoto was produced with a ground resolution of 8 cm and this served as a basis for the subdivision. The subsequent field check proved that 95% of the subdivision points complied with the accuracy standard without any additional field surveys. It appears, however, that from the cost/benefit point of view, the digital photogrammetry/orthophoto method is more expensive than the conventional combination of photogrammetric and field surveys.

The conventional procedure is based on photogrammetric survey of detail and field survey of boundaries, both connected to uniform GPS control network.

At the present, some 470 projects are in various stages of execution, involving some 120,000 housing units, the registration of public housing receiving very high priority.

2.3 Aerial photography and related products

There are six modern major aerial cameras in Israel, the Survey owns an RC 30 and an RC 8, and Ofek, Aerial Photography Ltd., the largest private aerial photography company, owns an RMK TOP and several other cameras. Ofek owns two planes for aerial photography, an additional plane for oblique photographs and a helicopter for electronic and video cameras.
The Survey has a black and white photo lab., whilst Ofek Ltd. handles colour, black and white and infra red photography.

Contact prints and enlargements are very popular products with the Israeli customers and the total sales of these products in 1995 are estimated at approximately $1,400,000.

Aerial photographs are admissible as evidence in courts of law, if supported by an appropriate declaration of a photointerpreter and some 40 cases per year are dealt with by courts on this basis, pertaining to rights to land.

2.4 Photogrammetry for engineering and special surveys

Urban and rural planners, public works engineers and architects, require topographic map background, usually in digital output form. It is estimated that some 400 projects in this field were executed by private photogrammetric companies.

In the year 1993 a special project was carried out for

the Central Bureau of Statistics, comprising photogrammetric mapping of 195 villages and towns of more than 2,000 inhabitants. Five private companies carried out mapping at 1:2500 scale, which contained only roads and houses as a background to population census maps.

2.5 Facilities

The following photogrammetric facilities exist in the country for internal use and to provide contract services. There is no manufacturer of photogrammetric equipment in Israel.

Aircraft	3
Major aerial survey cameras	6
Terrestrial cameras	1
Stereoplotters	12
Analytical plotters	20
Orthophoto	2
Digital Photogrammetric Work Stations	6

2.6 Education

The Technion - Israel Institute of Technology, offers a curriculum leading to a Bachelor of Engineering degree in 4 years, or a Bachelor of Science degree in Geodetic Science in 3 years. The curriculum includes courses in aerial and close range photogrammetry, digital photogrammetry and image processing, remote sensing and mapping from satellite images, as well as a whole range of courses typical of a degree programme in Geodetic Engineering. There are some 180 students in the undergraduate programme, 20 students in M.Sc. programme and 5 doctoral candidates.

Photogrammetry, remote sensing and GIS related courses

- **Photogrammetry 1** (undergraduate level): introduction to the basic mathematical models of photogrammetry.
- **Photogrammetry lab** (undergraduate level): Familiarisation with and utilisation of basic photogrammetric equipment.
- **Photogrammetric mapping** (undergraduate level): Theory and practice of mapping with aerial photogrammetry.
- **Photogrammetry 2** (undergraduate level): Aerotriangulation; GPS in photogrammetry; calibration of equipment.
- **Advanced analytical photogrammetry** (graduate level): Dynamic aerial and satellite imagery; close-range photogrammetry.
- **Introduction to digital photogrammetry and remote sensing** (undergraduate/ graduate level): Sources for digital imagery; basic image processing techniques.
- **Digital Photogrammetry** (undergraduate/graduate level): Using digital imagery for the preparation of maps, digital orthophoto and mosaic maps; basics of image matching techniques.
- **Advanced digital photogrammetry** (graduate level): Automatic and semi-automatic procedures for extracting information from digital images.
- **Remote sensing for cartography** (undergraduate/graduate level): Image segmentation and classification; link to GIS.
- **Databases in Geodesy** (undergraduate level): Database models, topological relations, representation of features in a 3-D database.
- **Geographic information systems** (undergraduate/graduate level): Combining vector and raster data, from different sources, in a structured database.

2.7 Research

Applied research is conducted at the Survey of Israel and at the Technion - Israel Institute of Technology.

The location of the projection centre by airborne GPS in developing photogrammetric control leads to a decrease in field control points required for solution. A research project in this topic covers various applications of GPS controlled photogrammetry and seeks to establish optimal configurations of control.

Another research project deals with the application of digital photogrammetry and orthophoto in cadastral mutation plans. The objective here is to establish criteria for the successful applications of these techniques in the planning and execution of new cadastral subdivisions.

A number of research topics were treated in the reporting period in the wide realm of data collection and analysis for LIS/GIS, which included photogrammetric aspects, such as analysis of urban traffic accidents.

The following is a list of recent graduate theses and research projects in photogrammetry, remote sensing and GIS at the Center for Research and Mapping of the Technion - Israel Institute of Technology.

- Graduate theses
  - Automatic targeting in digital photographs.
  - Automatic digital capture of hypsographic data of topographic maps.
  - Developing procedures for defining an accurate digital cadastre.
  - Extraction of digital mapping data from satellite images.

- Automatic compilation of distortionless digital orthophoto.
- Digital definition of environmental impact maps.
- Topological aspects of topographic mapping.
- Relative correlation of geographic information layers.
- Accuracy of DTM databases and of derived applications.
- Mapping from SPOT images.
- Development of a geographical information system for urban transportation management.
- Temporal land information systems.

- Research projects
  - Automatic generation of digital elevation models from SPOT images in Israel.
  - Using digital photography and orthophoto for the preparation of registration plans.
  - Extraction of ground coverage of aerial images.
  - Extraction of uniformly covered areas from aerial and satellite images.
  - the creation and evaluation of environmental impact statements via information systems.
  - Analytical cadastre in Israel.
  - Documentation of industrial plants by semiautomatic 3-D reconstruction from digital images.

3. REMOTE SENSING

Although remote sensing is becoming more and more widespread in many walks of life, one must remember that a small country (approximately 20,000 square kilometres) leans naturally towards large scales in mapping and higher resolutions in the national databases.

Considering, however, tasks such as monitoring of the environment, the development of GIS databases, participation in regional and global projects and the ever increasing data volume, one comes to the conclusion that remote sensing has a raison d'être, even in a small country.

Sharp transition from Mediterranean to extreme desert and high intensities of human interference with nature characterises Israel's environment. The country is going through intensive processes of environmental change due to population increase and the consequent growth of residential, commercial and industrial areas and of the infrastructures keeping them alive. A major part of these processes take place in the Mediterranean and semi arid regions resulting in one of the highest intensities of population activity per area in the world. The fact that the country is small, resulted in slow adoption of environmental monitoring technologies as many of the scientists, experts and government officers have felt that they are well aware of the processes taking place. One of the major obstacles for the use of remote sensing was the relatively low resolution provided by commercial satellites. During the last few years, a major shift has been noted in these attitudes, due to the understanding that remote sensing data allows visualisation of processes which cannot otherwise be discovered or perceived. The spread of Geographic Information Systems (GIS) and digital image processing technologies was an instrumental force motivating this shift. The aim of this paper is to discuss the following two main aspects of environmental remote sensing in Israel:

- the establishment of data infrastructure supporting environmental processes and hazards monitoring.
- the development of interpretation methods for deriving information from single and multiple images.

3.1 Data Infrastructure

Historical remote sensing images are important source for discovering environmental changes and determining their frequencies. Data infrastructure involves the development of acquisition, organisation and maintenance procedures facilitating environmental change detection.

3.2 Applications

Since the beginning of the 1990's there have been some major developments concerning digital imagery infrastructures:

- A receiving station of SPOT and ERS-1 & 2 satellites was established by the Israeli Aviation Industry (IAI) Company, facilitating the acquisition and archiving of images from these satellites.
- A receiving station of NOAA AVHRR and METEOSAT satellites was established in the Institute of Desert Research (Sde Boker) as an interuniversity collaborative research facility.
- A joint project of five government agencies was established for assessing environmental changes in the whole country by developing a database of images coverage. Within this framework 6 Landsat scenes were acquired in 1995. A full mosaic of 36 SPOT multispectral images (for the year 1992) covering the whole country was also created in the Survey of Israel with the help of the Israeli Space Agency. Further extension of these databases will be considered on a yearly basis with the intention of formalising the agreements between the different agencies according to the success of their utilisation.

Future development of the remote sensing data infrastructure are linked to the availability of small

satellites such the EROS of the IAI and regional agreements following the Israel's joining the European Community.

Methodological developments have taken place in three main areas: multispectral analysis, multitemporal analysis and patterns classification. Applications of these methods include a wide range of themes, from water quality assessments, through land use and vegetation dynamics monitoring, to soils and biogenic crust mapping.
Water quality assessments were conducted for the Lake Kinneret area by developing spectral signatures of, for example, chlorophyll concentrations which are indicative of pollution levels.

Land use monitoring was conducted for the Mount Carmel and Haifa area. New methods of multiscale texture analysis and parameterisations were developed using SPOT panchromatic and multispectral images. One of the interesting findings concerned the relationships between socio-economic characteristics and image parameterizations of building densities and vegetation abundance. In another work concerning change detection, a technique for monitoring landuse changes using SPOT images was developed.

Soil and lithological studies represent one of the areas of common interest. Unmixing methods were developed for determining mineral compositions in the Machtesh Ramon area using airborne scanner data. Biogenic crusts were found to indicate grazing intensities and provided new insight into the understanding of the Israeli-Egyptian border contrast compared to earlier works. In another word vegetation dynamics were studied along the climatological gradient of the Judean Desert and found that temporal patterns of vegetation dynamics correlate well with soils distribution. Thus allowing soils mapping, using distributions of vegetation indices determined from satellite images.

Rainfall distributions mapping, using radar techniques, has been researched. These data may provide better understanding of soil erosion and vegetation abundance in the semi arid and desert areas.

Future directions of methodological developments and their applications will involve higher levels of integration between the spectral (including radar), spatial and temporal dimensions of remote sensing interpretation.

Multispectral and multitemporal satellite imagery is used in Israel in mapping forested areas, classification, identification of changes caused by deforestation, forest fires, disease etc., and monitoring change in canopy density.

The study and classification of water reservoirs has been made using SPOT imagery, through calculating surface spectral radiance. 99 Reservoir images were analysed and classified by degree of pollution, using a drinking water reservoir as ground truth.

Geological mapping of particularly interesting areas is another remote sensing application, especially in desert areas. Landuse and urban density mapping has been performed, developing computerised technologies for differentiating between different types of urban areas and their densities.

A project in geometric model solution of a SPOT image, production of orthoimage from panchromatic and multispectral imagery and the production of a landuse classification map, has been carried out.

3.3 Education and Research

Haifa University offers a number of courses in the Department of Geography, at the graduate level, namely, Introduction to Remote Sensing and Advanced Remote Sensing.

Amongst the research projects at Haifa University there are: subsurface coastal mapping by remote sensing methods, monitoring coastal changes in the Herzlia Marina area by aerial photographs and satellite images.

The Bar Ilan University Laboratory for Environmental Information and Dynamics is a central facility for research and teaching in the areas of Remote Sensing, GIS and Environmental Dynamics.

The objectives of the laboratory are:
1. Developing methodologies for environmental remote sensing with emphasis on monitoring Mediterranean, arid and semi-arid environments.
2. Integrate environmental and ecological data derived from remote sensing interpretation into Geographical Information Systems (GIS).
3. Modelling environmental dynamic processes in Mediterranean, arid and semi-arid environments.
4. Providing computer facility for teaching undergraduate, M.A. and Ph.D students in the areas of Remote Sensing and GIS.

More than 100 undergraduate students are participating in various courses, seminars and workshops carried out in the Laboratory each year. Research collaboration includes joint projects with many scientists in Israel and abroad within the framework of groups involved with Mediterranean

Environmental monitoring, such as MEDALUS III programme, ERMES Project (Environmental Response of Mediterranean Ecological Systems) and international research groups working on desertification in arid and semi-arid regions.

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