NATIONAL REPORT OF FINLAND 1988-1991[1]

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Abstract

Highlights on the activities of photogrammetry, remote sensing and mapping in Finland for the period of 1988 to 1991 are presented.

1. INTRODUCTION

Mapping in Finland in general, is practised by national organizations, municipal surveying offices and private companies. The national organizations concentrate on the small-scale mapping covering the whole country, while the large-scale maps are produced by municipal surveying offices and private companies. These organizations and their addresses are listed in the end of this paper.

Research in the fields of photogrammetry, remote sensing, GIS, and digital mapping is mainly done in the national organizations. Names of these are also listed in the end of this paper.

Education in the field of surveying at the university level is centered at the Helsinki University of Technology (HUT) at the department of Surveying. Fundamentals in photogrammetry and remote sensing are also given in several other universities.

Education in photogrammetry on a lower than university level is given in the branches of surveying in the State Institutes of Technical Education and in the Municipal Institute of Technical Education of Espoo-Vantaa.

2. DEVELOPMENT OF PHOTOGRAMMETRY

The past four years (1988-1991) have been a period of slow but continuous development in the traditional applications of photogrammetry. More sophis-

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ticated equipment and methods have been taken into use more widely. Very important is the conversion of several analog instruments to analytical and purchase of new analytical plotters. In the field of non-topographic photogrammetry much more radical development has occurred as real-time photogrammetric stations have been taken into productive use.

Table I shows the amount of aerial photos taken during the period in question in Finland compared to the average of the previous four years. In the table there is also listed the percentage of the type of film used. A clear trend can be seen towards a wider use of color and color-infra films, although the black-and-white is still the most commonly used. The increase in the proportion of color-infra is partially caused by the increased interest for forestal interpretation and classification for forest taxation. A slight increase in the amount of total aerial photos taken can also be seen.

Table II shows the amount of photogrammetric triangulation that has been done during the same period and it also shows the percentages of the methods used. A significant increase can be seen in the total amount of triangulations done, much due to a greater demand for digital elevation models and to the increase of more sophisticated equipment and methods used. From table IV one can see how the number of analytical plotters is increasing all the time. During 1991 91 % of all triangulation was done by bundle block adjustment. For the first time in 1991, triangulation was also done with digital images.

Table III shows the amount of domestic mapping done during the four year period compared to the previous four years. Below the square kilometers covered, the proportions between two scale groups is displayed. A slight increase in the area covered can be seen analogous to the increase of total amount of aerial photos. The proportions between the two scale groups have been quite stable. A peek can be seen in the large-scale mapping during year 1990.

The non-topographic activity has mostly increased in the field of real-time photogrammetry, where more systems have been taken into productive use. These systems have been installed to applications such as: robot guidance, road maintenance and deformation measurements. The non-topographic applications using close-range cameras have been used at a quite stable level.

3. DEVELOPMENT OF REMOTE SENSING

The remote sensing activities have increased all the time. One indicator is the increase of the number of remote sensing and digital image processing systems (see table V) in operational use. Forest inventory has been one of the main

research topics. Much emphasize has also been put on the development of the HUTSCAT (Helsinki University of Technology SCATterometer) radar by the Institute of Space Technology of HUT, and its use for the remote sensing of forestry. The radar is carried by a helicopter. The interpretation and analysis of these and other radar images have also been under heavy research in Finland during the past four years.

Other important research activities are the use of multi-temporal image sequences to analyze temporal changes and the interpretation of multi-source image data. A research project to develop an airborne remote sensing system using a video-camera for color or color-infra image acquisition has begun. The interpretation of Landsat and SPOT imagery has reached, at least, a half-operational status. The real-time system for transmitting satellite data products to icebreakers has also reached an operational level as well as the land-use classification.

4. DEVELOPMENT OF GIS AND DIGITAL MAPPING

The past four years could well be stated as the era of the second generation GIS-systems. The prototype systems have been replaced with more advanced. Collection of the most important land information in a numerical form, will be finished in the late 1990's. Maps in numerical form cover
500 km^2. This is a very small portion of all large-scale maps of Finland.

The number of GIS users has increased remarkably during the last two years. There are over 300 organizations using GIS in Finland and about 1500 graphical workstations. The increase in the number of users, workstations and GIS-systems taken into use has been about 50 % per year. The emphasis in software development has been in tailoring original systems to the needs of Finnish users. The trend is to UNIX workstations and to PC environments instead of VAX/VMS. Great emphasis has been placed on the joint use of geographical information. The joint use concept for geographical information has been developed in Finland from 1985-1991 in the national LIS-project by a hundred people from about thirty organizations. The concept is based on decentralized data maintenance and it is open to all important geographical information resources as well as users. The Geographical Data Directory System (GDDS) is the kernel of the joint use. It has now been in operation for one year and has nearly 200 users.

For several years forest industry and administration as well as transport optimization, land-use planning, environmental research and control have also been active. The largest expansions in recent years have taken place in facility management applications and in municipalities. A terrain model has been

produced at the scale of 1:10 000 for a mobile telephone network as well as for other purposes. At present, excluding Northern Finland, digital contours are available at 1:10 000. The Environmental Information Centre has digitized catchment areas.

5. EDUCATION AND RESEARCH

5.1 Education in Finland

Education in surveying at the university level is centered to the Helsinki University of Technology (HUT) and the department of Surveying. Annual intake is appr. 50 students of which 1/3 are female. The average time needed for a Master of Science degree is about seven years. In addition to HUT, university level education in fundamentals of photogrammetry and remote sensing plus special courses in the determination of forms and deformations, is given at the Tampere University of Technology (TUT).

Fundamentals in remote sensing are also taught in the departments of geography and forestry at the University of Helsinki, in the department of geography at the University of Oulu, in the departments of geography and biology at the University of Turku, and in the department of forestry at the University of Joensuu.

During the period in question fourteen M.Sc. theses, two licentiate degree theses, and two doctorate theses in photogrammetry or remote sensing have been accepted. The two dissertations were:

> Sarjakoski, T.:"Automation in Photogrammetric Block Adjustment Systems".
>
> Kuittinen, R.:"Determination of Aerial Snow Water Equivalent Using Satellite Images and Gamma Ray Spectrometry".

The post-graduate and supplementary education has been mainly offered at the HUT. In 1988 a post-graduate seminar was held on "Trends of Automation in Photogrammetry", as well as a seminar on "3-D Vision and Photogrammetry for Industry".

In 1989 a seminar was held on "Neural Networks and Image Processing", in 1990 on "GPS for Photogrammetry", as well as on "Digital Image Processing". In 1991 following seminars and post-graduate lectures were held at HUT:
- "Robust Estimation Techniques"
- "Use of Photogrammetry in Medicine"

- "Automatic Aerotriangulation"
- "About Digital Workstations".

Most of the lecturers have been specialists from abroad.

During this year there will be a major reform concerning education lower than the university level, as their curriculum will expand from three to four years.

5.2 Research activities in Finland

Following is a short overview of the research done in Finnish organizations.

HELSINKI UNIVERSITY OF TECHNOLOGY (HUT)
Institute of Photogrammetry and Remote Sensing
Institute of Space Technology

* Recursive estimation methods in photogrammetry
* The stability testing of analytical plotters
* Digital image processing: area based segmentation, feature extraction and representation, and texture classification
* Digital close-range photogrammetry
* Real-time applications of digital close-range photogrammetry
* Approximation of curves and surfaces
* Feature based photogrammetry
* Projective transformations in photogrammetry
* Use of neural networks in remote sensing
* Construction of Airborne Scatterometers
* Development of Airborne and Ground-based Radiometers
* Remote sensing of forests, sea ice and snow

TAMPERE UNIVERSITY OF TECHNOLOGY (TUT)
Department of Civil Engineering

* Measurements in building restoration and CAD-modelling
* Industrial measurements
* The accuracy and quality control of photogrammetric measurements

UNIVERSITY OF HELSINKI (UH)
Department of Forest Mensuration and Management

* Satellite images in forest inventory

UNIVERSITY OF JOENSUU (UJ)
Department of Forestry
Department of Physics

* Use of satellite images in forest inventory
* Pseudo-resolution

* The effect of Forward Motion Compensation on resolving power

UNIVERSITY OF OULU (UO)
Department of Geography
* Physiognomical environmental changes

UNIVERSITY OF TURKU (UT)
Department of Biology
* Interpretation of vegetation using satellite imagery

FOREST RESEARCH INSTITUTE (FRI)
* The joint use of SPOT images, aerial photos and field data in forest mensuration

FINNISH GEODETIC INSTITUTE (FGI)
* GPS in aerial triangulation (jointly with NLS) and in geological low-altitude mapping (jointly with GSF)
* Numerical interpretation methods in remote sensing and their error estimation
* Radiometric calibration of satellite imagery (jointly with NLS)
* Numerical videotechniques in remote sensing (jointly with TRC)
* The influence of temperature variations on the photo coordinates in an analytical plotter
* Design and implementation of a low-cost stereo workstation
* Study of the suitability of desktop scanners for scanning aerial photographs
* Study of JPEG-compression for scanned aerial photographs
* Feasibility study of knowledge based methods for remote sensing and cartography

FINNISH INSTITUTE OF MARINE RESEARCH (IMR)
* Sea ice remote sensing
* Real-time system for transmitting satellite data products to icebreakers (jointly with TRC)

GEOLOGICAL SURVEY OF FINLAND (GSF)
* Exploration of geological resources using remote sensing
* Integration of remote sensing data with geological, geophysical and geochemical data for exploration and geological mapping purposes
* Study of image processing for geological purposes

METEOROLOGICAL INSTITUTE (MI)
* Meteorological applications of Remote Sensing

NATIONAL BOARD OF WATERS AND ENVIRONMENT (NBWE)
Environmental Data Centre

* Deriving atmospherically corrected albedos and brightness temperature from NOAA AVHRR data

TECHNICAL RESEARCH CENTRE OF FINLAND (TRC)
Instrument Laboratory

* Use of videoimages in remote sensing
* Development of a color-infra videocamera
* Polarimetric radar signatures of forests
* Development of image interpretation system using multi-source data
* Analysis of a forest ecosystem using multi-source digital map data
* Compression of remote sensing data

OY MAPVISION LTD

* Development research for photogrammetric stations on automatic measuring procedures and on-line applications of manufacturing control and maintenance

6. SCIENTIFIC AND PROFESSIONAL ASSOCIATION

6.1 Professional subjects

Prof.Dr. Einari Kilpelä is the member of the ISPRS Financial Commission for the period of 1988-1992.

Prof.Dr. Tapani Sarjakoski is the co-chairman of ISPRS Commission III WG 4 "Knowledge Based Systems".

Mrs. Aino Savolainen was granted the honorary membership of the ISPRS.

Prof.Dr. Einari Kilpelä is a member of editorial staff of the journal "Photogrammetria".

Mr. Henrik Haggrén was the vice-chairman of FIG Commission 6 "Engineering Surveys" until 1991 when he became its chairman.

The Finnish representatives in the Organization Européenne d'Etudes Photogrammétriques Expérimentales (OEEPE) are Mr. Matti Jaakkola from NBS, and Prof.Dr. Einari Kilpelä from HUT. Mrs. Pirkko Noukka from NBS, has been the chairperson of Commission A.

Prof.Dr. Einari Kilpelä is the second auditor of OEEPE.

Prof.Dr. Risto Kuittinen from FGI is a member of ESA EOSTAG WG, a member in the Swedish Space Agency's Remote Sensing Committee, the Finnish representative on the International Association of Hydrological Sciences (IAHS) committee for remote sensing.

The Institute of Meteorology is a member of ESA EOPP, EUMESAT Council and ESA/STG.

Prof.Dr. Risto Päivinen from UJ is the president of "International Union of Forest Research Organizations" (IUFRO).

Prof.Dr. Simo Poso from UH is the president of the IUFRO WG "Inventories Aided by Remote Sensing".

The Institute of Photogrammetry and Remote Sensing became the member of EARSeL in 1989, and the Finnish Geodetic Institute in 1990.

Prof.Dr. Einari Kilpelä is a rapporteur on Deutsche Geodätische Kommission.

Mr. Henrik Haggrén from HUT was awarded the Carl-Pulfrich prize in 1991.

The president of the Finnish Society of Photogrammetry and Remote Sensing was Mr. Hannu Salmenperä during 1987-1989, and Mrs. Pirkko Noukka from 1990-1992.

The honorary degree of Doctor in Technology was conferred on Professor Dr.-Ing. Friedrich Ackermann on September 9, 1988.

The International Geoscience and Remote Sensing Symposium (IGARSS'91) was held in Espoo, Finland, June 3-6, 1991.

The FIG XIX Congress was held in Helsinki on June 10-19, 1990.

6.2 Addresses

Organizations other than education and research:

CITY OF HELSINKI
City Surveying Dept.
Viipurinkatu 2
00510 Helsinki

FINNISH SOCIETY OF PHOTOGR.
AND REMOTE SENSING
Institute of Photogrammetry
and Remote Sensing
Otakaari 1
02150 Espoo

FINNMAP OY
FM-PROJECTS Ltd.
Teollisuuskatu 15
00510 Helsinki

GEOPOLAR
P.B. 19
00711 Helsinki

KARELSILVA
Kaijanlahdentie 2
54800 Savitaipale

MT-SURVEY
P.B. 71
04441 Järvenpää

NATIONAL BOARD OF FORESTRY
Planning Department
P.B. 233
00121 Helsinki

NATIONAL BOARD OF PUBLIC
ROADS AND WATERWAYS
Mapping Division
P.B. 33
00521 Helsinki

NATIONAL BOARD OF SURVEY
Aerial Survey Centre
Remote Sensing and Thematic Maps
P.B. 84
00521 Helsinki

OUTOKUMPU Ltd.
Ore Prospection
P.B. 27
02101 Espoo

PRO ORIENTEERING
Esko Naukkarinen
46810 Ummeljoki

SITO OY
Pohjantie 12 A
02100 Espoo

SOIL AND WATER Ltd.
Itälahdenkatu 2
00210 Helsinki

TOPOGRAPHIC SERVICE OF
FINNISH DEFENSE FORCES
P.B. 60
00521 Helsinki

T:MI MIKKO PUNKARI:
SATELLITE SURVEYS
Veklahti
02400 Kirkkonummi

Education and research organizations:

FOREST RESEARCH INSTITUTE
Unioninkatu 40 A
00170 Helsinki

FINNISH GEODETIC INSTITUTE
Ilmalankatu 1 A
00240 Helsinki

FINNISH METEOROLOGICAL
INSTITUTE (MI)
P.B. 503
00101 Helsinki

GEOLOGICAL SURVEY OF FINLAND
Kivimiehentie 1
02150 Espoo

HELSINKI UNIV. OF TECHNOLOGY
Institute of photogrammetry
and remote sensing
Institute of space technology
Otakaari 1
02150 Espoo

INSTITUTE OF MARINE RESEARCH
P.B. 166
00141 Helsinki

NATIONAL BOARD OF WATERS
AND ENVIRONMENT
Environmental Data Centre
P.B. 250
00101 Helsinki

TAMPERE UNIVERSITY OF
TECHNOLOGY
Dept. of Civil Engineering
P.B. 327
33101 Tampere

TECHNICAL RESEARCH CENTRE
OF FINLAND (TRC)
Instrument Laboratory
P.B. 107
02151 Espoo

UNIVERSITY OF HELSINKI
Dept. of Forest Mensuration
and Management
Unioninkatu 40 B
00170 Helsinki

Dept. of Geography
Hallituskatu 11-13
00100 Helsinki

Dept. of Geology and Mineralogy
Snellmaninkatu 5
00170 Helsinki

UNIVERSITY OF JOENSUU
Dept. of Forestry
Dept. of Physics
P.B. 111
80101 Joensuu

UNIVERSITY OF OULU
Dept. of Civil Engineering
Kasarmitie 8
90100 Oulu

Dept. of Geography
90570 Oulu

UNIVERSITY OF TURKU
Dept. of Surface Geology
20800 Turku

Dept. of Geography
Yliopistonmäki
20110 Turku

ÅBO AKADEMI
Dept. of Geology and Mineralogy
Domkyrktorget 1
20500 Åbo

7. PUBLICATIONS

The most important periodical publication on photogrammetry and remote sensing is the "Photogrammetric Journal of Finland" (PJF). It is published by the Finnish Society of Photogrammetry and Remote Sensing and the Institute of Photogrammetry and Remote Sensing, usually once a year. Another periodical publication is the "Surveying Science in Finland" which is published twice a year and consists of articles on different branches of surveying.

There are four series of publications in Finland:
1. Reports of the Institute of Photogrammetry and Remote Sensing (HUT).
2. Publications of Finnish Geodetic Institute
3. Reports of Finnish Geodetic Institute
4. Reports of the Department of Geodesy and Photogrammetry (TUT).

No new textbooks have been published in this four year period.

Over one hundred and fifty papers by Finnish scientists have been published in several national and international journals, periodicals and proceedings.

The Finnish Society of Photogrammetry and Remote Sensing has released two publications:

"Recommendations for large-scale aerial photography in Finland"

"Recommendations for very accurate photogrammetric mapping"

Table I. Aerial photography

	84-87	88	89	90	91
#Photos	23346	29643	26987	24278	25453
b-w	67 %	58 %	55 %	56 %	44 %
infra	7 %	3 %	0 %	0 %	0 %
color	4 %	11 %	18 %	18 %	21 %
color-i	22 %	28 %	27 %	26 %	35 %

Table II. Aerial triangulation

	84-87	88	89	90	91
#Models/images	5560	8353	8427	8539	10609
Model-analog		9 %	4 %	4 %	3 %
Model-analytical	35 %	15 %	12 %	13 %	6 %
Bundle	65 %	76 %	84 %	83 %	91 %

Table III. Stereomapping

	84-87	88	89	90	91
km2 (area)	9417	11346	11269	10299	11502
≥ 1:5 000	18 %	19 %	18 %	32 %	16 %
< 1:5 000 & ≥ 1:20 000	82 %	81 %	82 %	68 %	84 %

Table IV. Topographic mapping instruments

	84-87	88	89	90	91
Aerial cameras	12	11	10	11	10
Comparators	6	8	7	7	7
Analog stereoins.	67	70	71	71	64
Analytical plot.	16	19	22	25	28

Table V. Other

	88	89	90	91
A	6	6	6	6
B	4	4	3	3
C	28	33	49	62
D	15	28	42	41
E	0	0	4	5

A = Close-range cameras
B = Non-metric close range cameras
C = Digital mapping systems
D = Remote sensing and digital image processing systems
E = Real-time photogrammetric systems