NATIONAL REPORT OF FINLAND FOR PHOTOGRAMMETRY, REMOTE SENSING, GIS AND DIGITAL MAPPING 1996-2000

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ISPRS Commission VI

KEY WORDS: Finland, National Report.

ABSTRACT

The national report of Finland outlines activities and developments in photogrammetry, remote sensing, GIS and digital mapping during the period 1996-2000.

1 INTRODUCTION

National organizations, municipal surveying offices and private companies practice mapping in Finland. The national organizations concentrate on small-scale mapping covering the whole country. Municipal surveying offices and private companies make large-scale maps.

Most research in the fields of photogrammetry, remote sensing, GIS and digital mapping is done in the national organizations, institutes and universities. However some companies have also made remarkable research for their commercial products.

Education of surveying at the university level is centered at the Helsinki University of Technology (HUT) at the Department of Surveying. Fundamentals of photogrammetry and remote sensing are given also at some other universities. In the field of surveying, engineer is a new degree in Finland. The first surveying engineers graduated in the year 1996. Education in this level is given at the Espoo-Vantaa, Mikkeli and Rovaniemi Institute of Technology. Education in technician level is given at several educational institutes.

2 DEVELOPMENT OF PHOTOGRAMMETRY

During the past four years digital photogrammetric techniques have been taken into operational use by several national and private mapping organizations. Digital systems are used in parallel with analogue and analytical systems.

Standard photogrammetric cameras produce photography for the traditional applications. These analogue images are nowadays scanned to digital format by high-resolution photogrammetric scanners. For example the National Land Survey of Finland (NLS) scans all aerial images they take into digital format. In addition to traditional aerial photography also applications for digital cameras has been developed and used.

DGPS support is extensively used in aerial triangulation to get projection centers of aerial images. That has helped to reduce significantly the number of ground control points. Aerial triangulation is performed by digital and analytical systems. In digital systems either automatic or interactive tie point measurement techniques are used.

A popular digital photogrammetric product is a digital orthophoto. The following two projects are examples of the extensive application of digital orthophotos. Digital orthophotos with 1 m pixel size and mostly better than 2.5 m root-mean-square accuracy were produced of the whole of Finland, utilizing existing 1:60 000 aerial photography and DEMs, during 1996-1997. The National Land Survey of Finland performs the revision process of the Topographic Database using digital orthophotos produced of 1:31 000 black-and-white aerial photography. The interest of digital orthophotos has increased greatly. For example the National Land Survey produced in the year 1999 three times more digital orthophotos than in the year 1996.

During the period in question, some experimental tests with airborne laser scanning have been completed. This technique has great expectations in the future.

3 DEVELOPMENT OF REMOTE SENSING

The Finnish remote sensing activity concentrates in the following tree fields: construction of airborne microwave sensors, retrieval of geophysical parameters from air- and spaceborne optical and microwave sensors, and development of operational applications. In all of these fields remote sensing has been developed during the reporting period. Most resources have been used for developing operational applications in crop yield estimation, snow mapping, sea ice monitoring, forest inventory, SAR interferometry for determining digital elevation models and monitoring the environmental impact of mining activities. In sensor construction the main emphasis has been in developing microwave radiometers (interferometric) and radiometer calibration systems. Modeling of spectral signatures of snow, sea ice, forest and soil has been carried out during the reporting period.

Novo Group and the National Land Survey of Finland incorporated operations of the Satellite Image Centre of the National Land Survey of Finland. The new company, Novosat Ltd, started operating at the beginning of 1999. The incorporation was carried out through a holding arrangement, in which Novo Group owns 60 per cent of the company, while the National Land Survey of Finland owns 40 per cent.

4 DEVELOPMENT OF GIS AND DIGITAL MAPPING

The National Land Survey of Finland (NLS) (http://www.nls.fi/index_e.html) is responsible for Finland's general mapping assignments. It also promotes the shared use of geographic information. Besides the National Land Survey of Finland there are private surveying companies and municipal surveying organizations producing maps. They produce normally large-scale maps for purposes like land use planning and road building. GIS has increased the need and production of digital map-data in cities and other municipalities. Private companies add value to the existing digital databases and produce high-class products for customers.

Classical cartography has been transformed mostly into digital cartography, and more generally into GIS. Map making has become more like just a part of the GIS data visualization process. To be useful GIS databases must be update continuously. For example the National Land Survey of Finland uses digital orthophotos to update their land information. All map data that the National Land Survey of Finland produces is nowadays in digital format. Digital map data is used for example for planning, follow-up, documentation, navigation, positioning, optimization, and in newspapers. The National Land Survey of Finland provides following digital products:

- Land Information Database
- National Road Database
- Address Database
- Basic map 1:20 000
- Topographic map 1:50 000
- Small-scale map databases 1:100 000, 1:250 000, 1:500 000, 1:1 million, 1:2 million and 1:4.5 million
- Nordic Map Database 1:2 millions
- Administrative Boundaries
- Digital terrain model
- Land use and forest classification
- Seamless Administrative Boundaries of Europe

The National Land Survey of Finland has developed a new information system called JAKO on Smallwold GIS platform. Information system contain for example a new land information system, information services, interface to current information system, possibility to update land information, and the system is integrated with a digital stereo workstation.

The Finnish Maritime Administration produces naval charts in Finland. Digital naval charts are now covering northern parts of the Gulf of Finland and the lake Saimaa. These naval charts can be used with GPS devices for real-time navigation.

Within past four years many organizations and companies have done research and development to distribute their GIS database through Internet. As an example here are Internet addresses for three map distribution pages:

- The National Land Survey: Finland, many scales, http://www.kartta.nls.fi/karttapaikka/eng/home.html. (no fee up to 1:40 000, charge for more accurate data)
- The Finnish National Road Administration: Road Map of Finland http://www.tieh.fi/kartta/kartta.htm
- The City of Helsinki: Tourist map of Helsinki and the Metropolitan area: http://kartta.arenanet.fi/kktesti/helsinkien/nsdef.asp

Accurate, up-to-date digital databases and the development of positioning techniques have brought new possibilities for personal navigation, which is strongly developed in Finland. Private companies have started to distribute digital maps and other geographic information into mobile terminals especially into mobile phones.

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) at the Department of Surveying. Intake is 67 of which 27 will study surveying and mapping technology and 40 property economics and law. At the year 2001 there will be reorganizations at the Department of Surveying. There will be two separate degree programs: Geomatics and Property Economics. Each of them will split into smaller sub programs.

There are also a number of other institutions which are selectively active in photogrammetry, remote sensing, GIS, image analysis, machine vision etc. For example remote sensing is taught also at the Laboratory of Space Technology at the Helsinki University of Technology, the Department of Forestry at the University of Joensuu, the Laboratory of Geoinformatics at the University of Tampere and the Department of Forest Resource Management at the University of Helsinki.

In the field of surveying, engineer is a new degree in Finland. The first surveying engineers graduated in year 1996. Education in this level is given at the Espoo-Vantaa, Mikkeli and Rovaniemi Institute of Technology. Education in technician level is given at several educational institutes.

During the period in question fifteen M. Sc. theses and two doctoral theses have been accepted at the Institute of Photogrammetry and Remote Sensing at the Helsinki University of Technology. The dissertations were:

- Lammi, Jussi: A Method for Three-Dimensional Modeling of Buildings from Digital Aerial Imagery
- Gong, Min: Distributed Parallel Processing for Photogrammetry and Image Processing

The post-graduate and supplementary education has been mainly offered at the HUT. In the Institute of Photogrammetry and Remote Sensing and Institute of Geodesy and Cartography a post-graduate seminar was held on “Dimensional Modeling and Visualization” during years 1998 and 1999.

5.2 Research activities

Following is a short overview of some Finnish organizations that has done research in the fields of photogrammetry and remote sensing.

5.2.1 Finnish Institute of Marine Research (IMR)

The research in the fields of remote sensing is focused mainly to monitor ice conditions on the sea. Projects on the subject have been for example IMSI - Integrated use of new microwave satellite data for improved sea ice observation, BASIS - Baltic Air-Sea-Ice Study and SARKOMP - Compression of SAR Images for Visual Utilization

5.2.2 Finnish Environment Institute (FEI)

Ongoing Remote Sensing Projects at Finnish Environment Institute (FEI)

In Remote Sensing FEI concentrates on research and development aiming at operational environmental monitoring. All research projects are co-operation projects with national and international research organizations. Main research projects in year 2000 are:

- ENVISAT-Water project concentrates on improving methods for remote sensing of water quality (lakes and sea). It creates the technical and theoretical basis to the future operational use of the data from the earth observation satellite ENVISAT.
- ENVISAT-Snow project focuses on development of remote sensing based methods for snow cover monitoring in Finland. It creates the technical and theoretical basis for adaptation of ENVISAT-data and the relevant remote sensing algorithms.
- Land Cover and biodiversity. FEI participates in several projects where Land Cover and Land Cover changes are estimated using different resolution satellite imagery. These results are then imported to GIS and

environmental models where they are analyzed, parameterized and integrated with other observation and GIS data.

- NOAA AVHRR software. This software calculates (automatically) from raw AVHRR images atmospherically and geometrically corrected environmental parameters like NDVI or surface water temperature. The software is in operational use but it is continuously developed for other instruments.

5.2.3 Finnish Geodetic Institute (FGI)

Photogrammetry in the Finnish Geodetic Institute

The photogrammetric research has dealt with orientation of airborne and spaceborne images and quality control of photogrammetric processes. The orientation research concerned the use of untargeted ground control, GPS-supported aerial triangulation, multisensor aerial triangulation and automatic tie point measurement. Methods for the quality control of airborne images were investigated, and permanent and transportable test-fields were developed. The FGI functioned as an expert and a quality control consultant in the generation of the nationwide Finnish Land Parcel Identification System (FLPIS). For that project, quality control specifications and procedures were developed for scanning of 1:60 000 airborne images, orthophoto production and land parcel boundary digitization.

Remote sensing in the Finnish Geodetic Institute

The Finnish Geodetic Institute has carried out remote sensing research in the following areas:

- Land use and crop species interpretation as well as crop leaf area index estimation using SPOT and NOAA/AVHRR data to develop methods for crop yield and production estimation.
- Land use interpretation using SPOT and ERS SAR data to develop methods for updating topographic maps.
- Snow area and state (wet/dry) interpretation using NOAA/AVHRR and ERS/SAR data to develop the use of remotely sensed data in hydrological modelling.
- Estimation of BRDF of natural targets by using field measurements by spectrometer, goniometer and aerial images.

5.2.4 Geological Survey of Finland (GTK)

Remote Sensing projects at the Geological Survey of Finland (GTK)

Remote Sensing Laboratory

Remote Sensing Laboratory at GTK offers a new base for projects dealing with utilization of remote sensing in geology, mining activities, mining environments and natural hazards. Currently, the laboratory is equipped with non-reflecting sample shelf and systems for controlled moving of imaging and portable spectrometers to scan the sets of objects on the shelf (Funded by GTK, 1999-2005, Volume 2.8 Mfim)

Hyperspectral study of mineral indications and environment

Hyperspectral study of mineral indications and environment Hyperspectral remote sensing (electromagnetic wavelengths 400-2500 nm) is used to study bedrock and soil geology, indications for ore deposits and industrial minerals and geoenvironmental contamination. Hyperspectral test imaging of samples is carried out in laboratory from near distance. Imaging of field targets, i.e. of soil and bedrock outcrops and mineral mines is done from crane, helicopter, airplane and - in future - from satellite. Mainly ENVI software is used for identification of target materials. (Funded by TEKES, GTK and Finnish Mining Industry, 1999-2001, 5.5 Mfim)

Assessing and monitoring the environmental impact of mining activities in Europe using advanced Earth Observation techniques (MINEO)

The MINEO project develops the key components of the decision-making tools to exploit Airborne and Earth Observation data and facilitate their use to locate and monitor environmental risks related to mining sites and aid the decision processes. Such tools will give the sound basis for effective environmental management through a dialogue between industrialists and decision-makers, ensuring a sustainable development of the mineral industry, which faces increasing environmental pressure and regulatory controls. (Funded by EU FP5 IST-Program, Geological Surveys of Finland, France, Denmark, Austria, Germany, Portugal and UK, Deutsche Steinkohle, Environmental Agencies of Denmark and France, 2000-2002, 19.0 Mfim)

5.2.5 Helsinki University of Technology (HUT)

5.2.5.1 Institute of Photogrammetry and Remote Sensing

Institute of Photogrammetry and Remote Sensing does both basic research and application development. The research topics of actual interest are: image analysis and pattern recognition; photogrammetric mapping; digital photogrammetry; interpretation and classification methods; automated measuring procedures, and; system development for photogrammetric on-line control and for 3-D digitizing.

During the past four years there has been research projects for example on environment modeling, 3-D object reconstruction, forest modeling and inventory from digital imagery, photorealistic modeling, signal based image matching, airborne laser scanning, videodigitizing for made-to-measure fashion design, image georeferencing, sensor fusion, photogrammetric modeling and documentation of archeological excavation (Jabal Haroun), creation of panoramic images etc. (http://www.foto.hut.fi)

5.2.5.2 Institute of Space Technology

The main research areas in remote sensing at the Laboratory of Space Technology (LST), Helsinki University of Technology (http://www.space.hut.fi), are development of methods to retrieve geophysical parameters from the data of spaceborne sensors for various applications, operation of the LST research aircraft and construction of active and passive sensors. LST participates in several international research projects funded by the European Space Agency and European Union. In 1999 the research output was 30 person-years, 12 international journal articles and 22 international conference reports.

The main applications are forest (development of forest monitoring and management system; development of methods based on lidar and very high resolution data), snow (development of an operational optical/microwave snow extent and melt monitoring system; retrieval of snow water equivalent from satellite data), sea ice (development of ice monitoring methods including ice extent and deformation), water quality (development of an operational monitoring system) and stratospheric ozone (long-term observations vs. altitude in northern Finland).

In sensor construction the emphasis is on developing the first airborne 2-dimensional interferometric microwave radiometer in the world, and on participating in an ESA programme to develop an on-board calibration system and a ground support system for the near-future ESA SMOS interferometric 1.4 GHz radiometer mission that will produce global data on soil moisture and sea surface salinity. The airborne HUTRAD system (6.8 to 94 GHz) of LST has been in operation since 1998.

5.2.5.3 Laboratory of Computer and Information Science

The research in the fields of remote sensing is focused to classification of weather radar imagery.

5.2.6 Tampere University of Technology (TUT)

Department of Civil Engineering

The research in the fields of photogrammetry is mainly focused to modeling and measuring small objects, buildings and land surfaces.

5.2.7 Technical Research Centre of Finland (VTT)

Remote sensing research at VTT Automation 1998-1999 (http://www.vtt.fi/aut/rs)

At VTT Automation, remote sensing research and product development is being conducted for the external customers, particularly for and the Finnish companies and in the partnership with them. International activities have an essential role in VTT's activities. VTT is doing research using both optical and SAR data. The most important application area has been recently forestry and forest related applications.

The most important projects have been in 1998-1999 development of:

- an aerial CCD camera imaging and image mosaicing system for Stora Enso Forest Consulting Ltd.
- a method and software to generate Digital Elevation Models using SAR interferometry for NovoSat Ltd.
- an automatic forest fire alarming system using NOAA AVHRR data for the Ministry of Interior and ESA,
- Continental-scale forest mapping methodologies and European forest maps as commercial projects for the European Commission.

The pre-operative research focuses now on change detection methods, automatic image interpretation chains, automatic generation of DTM's and orthoimage mosaics from airborne CCD camera data, SAR image mosaicing methods and microwave back-scattering modeling.

5.2.8 University of Helsinki (UH)

Department of Forest Resource Management

The research in the fields of remote sensing is focused on forest inventory, planning and monitoring.

5.2.9 University of Joensuu (UJ)

Faculty of Forestry

The research in the fields of remote sensing deals with both general forestry inventory and detailed forest information. Own land resource information system (LARIX) has been developed.

6 SCIENTIFIC ORGANIZATIONS

6.1 Education and scientific organizations

Espoo-Vantaa Institute of Technology
Leiritie 1, FIN-01600 Vantaa, Finland

Finnish Environment Institute
PO Box 140, FIN-00251 Helsinki, Finland
http://www.vyh.fi/eng/welcome.html

Finnish Geodetic Institute
Geodeetinrinne 2, P.O.Box 15, FIN-02431 Masala, Finland
http://www.fgi.fi/index_eng.html

Finnish Institute of Marine Research
P.O Box 33, FIN-00931 Helsinki, Finland
http://www2.fimr.fi/

Geological Survey of Finland (GTK)
P.O.Box 96, FIN-02151 Espoo, Finland
http://www.gsf.fi/

Helsinki University of Technology, Institute of Photogrammetry and Remote Sensing
P.O Box 1200, FIN-02015 HUT, Finland
http://www.foto.hut.fi/

Helsinki University of Technology, Laboratory of Space Technology
P.O Box 3000, FIN-02015 HUT, Finland
http://www.space.hut.fi/

Tampere University of Technology, Department of Civil Engineering, The Laboratory of Geoinformatics
P.O. Box 527, FIN-33101 Tampere, Finland
http://www.ce.tut.fi/index_e.html

Technical Research Centre of Finland,VTT Automation, Remote Sensing Group
P.O. Box 1304, FIN-02044 VTT, Finland
http://www.vtt.fi/aut/rs

University of Helsinki, Department of Forest Resource Management
PL 24 (Unioninkatu 40 B), FIN-00014 Helsingin yliopisto, Finland

University of Joensuu, Faculty of Forestry
P.O.Box 111 (Yliopistokatu 7), FIN-80101 Joensuu, Finland
http://gis.joensuu.fi/

6.2 The Finnish Society of Photogrammetry and Remote Sensing

The Finnish Society of Photogrammetry and Remote Sensing (1931-) is devoted to the research and development of photogrammetry and remote sensing in Finland. The Society gives recommendations for aerial photogrammetry. Last recommendation has been Recommendations for the Use of Digital Aerial Images (issue 1/1998), in Finnish. This publication is also available in CDROM.

The most notable part of the work of the Society is to publish The Photogrammetric Journal of Finland (http://foto.hut.fi/seura/pjf.html). The Society is member of the International Society for Photogrammetry and Remote Sensing.

Chairperson of The Finnish Society of Photogrammetry and Remote Sensing is Mr. Risto Kuittinen during the period 1999-2001, co-chairperson is Mr. Matti Virrantaus during the period 1998-2001 and secretary is Mr. Petri Rönnholm beginning at the year 2000. Previous chairperson was Mr. Jussi Paavilainen (years 1996-1998), co-chairperson was Mr. Juha Vilhonmaa (years 1995-1997) and secretary was Mr. Jyrki Mononen (years 1997-1999).

Web address for The Finnish Society of Photogrammetry and Remote Sensing is http://foto.hut.fi/seura/fsprs.html.

Postal address:

Finnish Society of Photogrammetry and Remote Sensing
Institute of Photogrammetry and Remote Sensing
P.O. 1200
FIN-02015 HUT
FINLAND

7 ACTIVITIES IN INTERNATIONAL ORGANIZATIONS

7.1 International Society for Photogrammetry and Remote Sensing (ISPRS)

Prof. Dr. Tapani Sarjakoski has been the co-chairman of the ISPRS Commission II Working group “Digital Systems for Image Analysis”. Mrs. Aino Savolainen is the honorary member of the ISPRS.

Contact persons of the ISPRS are:

- Commission I Risto Kuittinen
- Commission II Reino Ruotsalainen
- Commission III Tapani Sarjakoski
- Commission IV Kirsi Virrantaus
- Commission V Hannu Salmenperä
- Commission VI Anita Laiho-Heikkinen
- Commission VII Antti Vertanen

7.2 Organization Européenne d’Etudes Photogrammétriques Expérimentales (OEEPE)

The representatives of Finland in the executive committee are Prof. Dr. Risto Kuittinen and Mr. Juha Vilhomaa.

7.3 Associations Towards an European Network for Earth Observation Education and Training (ATENEO)

The Finnish Society of Photogrammetry and Remote Sensing applied an application, among 13 European scientific societies, for ATENEO-project. The purpose for this project is to make new connections and increase co-operation between European scientific societies.