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General Remarks

The National Reports of Switzerland have for quite a while been organized after certain and similiarly arranged subjects. This continuity in the display of information was hoped to assist the reader when judging the development of Photogrammetry and Remote-Sensing in Switzerland and enable him readily to compare specific activities.

Probably with similar intentions, the directorate of the ISPRS attempts now to introduce such a concept on an international level. Therefore, the request was made to organize each national report in eight specific sections. The presented report attempts to follow suit in so far as practical with respect to the situation in Switzerland. The subdivisions requested by the ISPRS can be readily seen from the titles of the sections of this report.

1. Section

Topographic Operations

(including cadastre and other large scale work)

Projects executed

by the Swiss Federal Institute for Topography

(Eidg. Bundesamt für Landestopographie, Wabern)

+ Map Revision

In the year 1979 the series of topographic maps in various scales were completed with the edition of the last map at the scale 1 : 25'000. Since then the work concentrates mainly around the problem of map-revision. The revision is performed by aerial photography and photogrammetric evaluation every 6 years. The data acquisition is carried out primarily at a scale of 1 : 25'000. These data are then adapted by cartographic means for smaller map scales.

For the revision work the following procedural steps are accomplished:

1. Aerial photography at a scale of ca. 1'25'000 (camera constant 150 mm) over 1/6 of the area of Switzerland per year (about 40 map sheets at 1 : 25'000).
2. Change-detection in office by topographic engineers experienced in the field of photogrammetry.
3. Field identification by the same staff.
4. Photogrammetric restitution of all detected changes.
5. Cartographic treatment of all detected changes. Incorporation of all processed changes into the existing map.
6. Printing of the revised map.

The main object of our development is a continuous improvement of technical and economical details in the revision procedure. Particularly the following items should be mentioned:

1. Aerial Photography: The procurement of a new lens (15/4UAG) for the WILD RC 10 camera helped to improve the image quality of the photographs taken. Normally the Kodak film Plus X is used. Experiments with the new Kodak product Pantomic X brought good results, particularly for the photogrammetric restitution process. Using the material for follow-up-products, particularly when making enlargements, certain problems were encountered on account of the high contrast of this film material. Further experimenting will take place. Color material is used only on request of others as e.g. other governmental agencies or Technical Universities.
2. Photogrammetric Evaluation: The restitution process for the purpose of map revision is characterized by an unfavourable relation between the time needed for the orientation and the period used for the actual restitution of the model. This situation has been improved by a special program for establishing the exterior orientation. (Defect elimination directly with respect to the reference coordinate system using as mathematical model the condition of colinearity.) The registration of control points is accomplished by digitizing cartographic detail-points at the drawing table of the analog plotter used. All instruments (three A8 and one A7 plotter) are connected by a special programable interface, to a central computer (Prime 400). The operator uses the program with the help of an alpha-numerical terminal. Today the orientation is accomplished including information about the obtained accuracy. A significant reduction in time for the orientation process was obtained. The numerical procedure for orientation has been readily accepted by the operators and is used consistently. Further possibilities for improvement, as the introduction of a data file for passpoints, or the connection to electronic drawing tables or strictly digital restitution methods are studied.

from the Departement for Melioration and Surveying of the Canton Graubünden at Chur.

+ Photogrammetry for the application to cadastral surveying and as basis for inquiries about areal statistics

The government of the canton of Graubünden has ordered to execute during the period of 1981 - 1986 in 54 of its 213 communities (over an area of about 210 km²) a survey over parceled out sections useable for farming and forestry.

This resolution was based on a project of the Departement of Surveying. There it was shown, that the combination of different methods of photogrammetry together with terrestrial supporting surveys gave results attractive from a technical as well as economical standpoint.

During the photogrammetric-numerical point determination the model-coordinates for control-, tie-points and new fixpoints are being registered at least twice, while boundary-points as well as points marking natural borderlines are registered only once.

The aerial triangulation with block adjustment supplies the coordinates of the new fixpoints and the boundary-points and also the initial data for the production of the orthophotos. Triangulation points, which serve as passpoints, will be checked by the aerial triangulation.

The digital elevation model, the basis for the orthophoto production is being set up by using the elements of the relative orientation and the definite coordinates of the passpoints and fixpoints obtained from the blockadjustment.

Profile data in x, y, z with maximum 8 mm scanwidth are registered on magnetic tape at the orthophotoscale of 1 : 2000. With the profile data the control information for the Wild Avioplan OR 1 are computed with the SORA-OP program.

The orthophoto is being used for the checking of the only once determined boundary points. With the help of a Digimeter the coordinates of such boundary points are registered and compared with the computed ones. This check is executed simultaneously with the definition of the boundaries of the allotments for the purpose of automatic engraving, followed by the computation of these areas from the coordinates.

By combining the plot, obtained by engraving, with the rastered orthophoto, applying different reproduction steps, the user-film (allotments + orthophoto) is obtained. The heliographic prints of the user-film are then being used for the entry of elements which serve the areal-statistics.

The authority for the surveying will be transferred by the individual communities to the "Bündner Geometer Association". This organisation divides the contributions among its members, executes certain work-phases itself and places other work with third parties.

The aerial photography is acquired using a Wild-Camera RC 10, with $c = 153$ mm, at an average image scale of $1 : 8'500$. Consequently the average flying height above ground is about 1'300 meters. Rather large height differences in excess of 1000 m are encountered in some models and such well over 2000 meters in the block. Furthermore irregular shaped valleys and their tributaries, remotly situated areas as well as the orthophotoproduction process have to be included into the flight planning. The overlap along the strip is chosen to 90 % while the sidelap is 30 %.

Before the flight the boundaries are established and the boundary markers are signalized with centric arranged plastic foils in the size of 25 cm x 25 cm. In addition two white plastic foils of 20 x 80 cm are placed at a distance of one meter in the directions of the boundaries and fixed to the ground with u-shaped wire bows of 3,5 mm diameter and of the size of 15 x 15 x 15 cm. In a similar manner the triangulation points I. - IV. order and the new fixpoints of V. order are marked. The signalements are sketched into enlargements of the aerial photographs.

These sketches and the well executed signalisation make it possible to introduce after the flight at the office the boundary-lines into the enlargements of the aerial photographs, without any fieldwork,

The data for the 70 aerial triangulation blocks for the computation of the triangulation points V. order and the boundary-markers are registered in the relativ oriented models using an Autograph A 10, with an EK 22. They are recorded on papertapes. The triangulation points I - IV order and the terrestrially surveyed fixpoints around building areas are treated as fixpoints.

The selection of suitable tie-points outside the signalized areas is not an easy task. Such areas are surrounded by forest and alps. The signalisation of such points appears to be problematic and uneconomical.

The computation are accomplished with the Computer PDP 11-23 with the programs PAT-M 43. All as wrong classified pass-points will be treated as "new-points". The mentioned topographic particularities cause a number of iterations, in excess of the number experienced at more conventional applications.

By the end of 1983 the following project status was realized:

Flights 85 %, photogrammetric contributions and aerial triangulation 56 %, orthophotos 35 %, user-heliographic prints 4 %.

The handling of the large amount of data made it necessary to introduce an electronic data-handling concept with data-norms, agreed upon by the administration in the year 1982.

by the National Swiss Surveying-Agency
(Eidgenössische Vermessungsdirektion, Bern)

Photogrammetric cadastral surveys

The photogrammetric data acquisition methods for purposes of cadastral surveys are essentially the same as reported in previous national member reports.

The combination with terrestrial surveying methods.

This praxis results for some new surveying projects at scarcely populated areas in significant cost reductions.

Full scale experiment of cadastral surveying at alpine area using orthophotos.

In the alpine areas of the canton of Graubünden, a simplified method for new-surveying projects is being presently investigated on hand of over 50 experiments. The land owners themselves signalize the boundaries which they themselves have reconnoitred. The photogrammetric-numerical evaluation of the boundary-markers will be inserted into an Orthophoto-map (1 : 2'000). Very significant cost reductions are expected.

Guiding rules and tariff

To provide rules for the application of photogrammetry to cadastral surveys and as guiding rules for the establishment of tariffs, certain instructions are being prepared.

The tariff, which is presently being established, will be comparable in its essential points to the tariff established for terrestrial surveying methods, in order to make possible a comparison of costs and an optimization of costs with respect of methods using a combination of surveying principles.

2. Aerial photography for large scales

The federal administration maintains at the National Swiss Surveying Agency (Eidgenössische Vermessungsdirektion) an airplane of the type DHC-6-300 TWIN OTTER, for use for large scale data acquisition, as particularly needed for cadastral surveying and similiar projects.

Aerial photography (black/white) for cadastral surveys.

Up to now almost exclusively black/white $c = 150$ mm photography is used. In the future, photography based on $c = 210$ mm shall be applied. The films are being developed on the Pakotone Avi machine.

Colour and false colour photography for inventory surveys.

These films are developed now-a-days also mechanically on a HOPE 187 developing unit. The various IR emulsions are tested before the flight application. Based on such tests corresponding corrections are applied by using suited filters and introducing exposure adjustments. With this technique it is possible to obtain a remarkable consistency with regard to color presentation and brightness for similiar objects in varying areas and different times during the day.

Carried-out projects:

- a) Complete coverage of the city of Zürich at a scale of 1 : 5'000 simultaneously in color and false colour photography using a camera with $c = 150$ mm.
- b) Mapping of seaweed (alga) at the coastline of the Lake Constance: Scale 1 : 5'000, colour with $c = 30$ cm instead of the formerly used 15 cm photography. The longer principal distance reduces the distrubing effect of the total reflexion of the sun. Besides the interval usefull for photography is being expanded from 2 to 3 hours per half-day.
- c) Aerial photography of upland moors.
Since a few years the upland moors are being photographed with colour film at a scale of 1 : 3'000.

d) False colour application for registering of forest damages.

Based on the good results made with several tests, since 1984 larger areas up to the size of a canton are covered at a scale of 1 : 10'000 and larger. In addition selected spots distributed over the area of Switzerland are photographed at a scale of 1 : 3'000. Such photography will be periodically repeated in order to gain information about the further development of damages. Lenses with $c = 15, 21$ and 30 cm are used.

by the Institute of Photogrammetry at the Ecole polytechnique fédérale Lausanne

+ Inventory surveys over extended areas using random sampling on areal photographs.

This work is conducted in close cooperation with the Institute for community, regional and country wide planning, Federal Agency for Statistics and the Federal Institute for Forest Research (Eidgenössische Anstalt für das forstliche Versuchswesen).

The realisation of a national inventory for forestry has been started. Also funds were provided by the Swiss government (Bundesrat) for renewing the areal statistics. This project will be initiated at the beginning of 1984.

2. Section

Non-Topographic Operations.

Projects executed

from the group of professional photogrammetrists.

+ Large scale applications

The orders for large scale plans in support of building projects have further been reduced drastically during the reporting period. In a general way the work encompasses the revision of the official large scale map (Uebersichtsplan), the surveying of the existing property lay out for the purpose of land consolidation (Güterzusammenlegung), property surveys with simple surveying methods, situation plans for aerea planning, plans of finished street and railroad projects, as well as the application of photogrammetry for architectural tasks, for the protection of cultural monuments and for problems of industrial surveying.

from the company "Applied Photogrammetry Zürich" (APZ)

+ Close range photogrammetry

The application of photogrammetry for unconventional, that is to say non-topographic tasks has clearly increased in Switzerland. The architectural photogrammetry has by now become a standard application at some photogrammetric offices. Increasing is the successful use of analytical methods for close range photogrammetric evaluations. The only privat enterprise specializing on close-range problematic at Switzerland is the company APZ, which by now is internationally recognized for its pioneering effort at this special application. Besides various measuration tasks, e.g. "classic" spatial triangulation, or the solution to so-called "accident photogrammetry", the APZ is active with respect to the development of instrumentation and auxiliary equipment. With the cooperation of the companies WILD-HEERBRUGG and R. & A. ROST Wien, an universal Base-Bar with variable length for the terrestrial cameras WILD P31 and

P32 has been developed and presented at the CIPA-Symposium 1982 at Siena.

It can be expected that the rather unrestricted potential of the analytical plotter for the evaluation of close-range applications will lead to an increased employment of this method.

3. Section

Remote Sensing Operations (Applications and Development)
Projects executed from Geographic Institute University, Zürich-Irchel

1. Introduction

Remote sensing technologies have been improved further and are widely used in Switzerland for fundamental scientific research as well as in a broad field of applications. The most important topics dealt with and the major trends are outlined briefly in the following.

+ 2. Research based on specific data acquisition systems

2.1. Colour and IR colour photography

Methods for a quick and accurate interpretation of rural crop types and tree species from colour aerial photography are studied by MAURER at the Department of Geography, University of Zurich. All aspects of digitizing the photos, preprocessing and classifying the data by means of spectral and textural parameters, and presenting the results in adequate computer maps are systematically evaluated.

2.2. Multispectral scanners

The longterm project by the Department of Geography, University of Zurich, and the Institute of Communication Technology, Swiss Federal Institute of Technology, Zurich, to analyse and interpret multidimensional airborne and spaceborne (LANDSAT-MSS and TM, NOAA-AVHRR) scanner data was continued during the entire period. Its main purpose is to develop suitable processing and classification methods, adapted to the high accuracy standards and to the specific situations of the high mountain terrain of Switzerland (publications by BAUMGARTNER, HAEFNER, ITTEN, KELLER, LICHTENEGGER, SEIDEL, et al.). The registration and classification of the LANDSAT-MSS-data could be improved considerably by adding topographical information, in particular by combining a digital terrain model with the multispectral remote sensing data.

Besides LANDSAT particular efforts were undertaken to investigate the potential capability of NOAA-AVHRR-data to monitor the snow and vegetation cover. The problem of geometric corrections was thoroughly investigated in a separate study by FREI.

The already existing interactive image processing systems, VAX-780 Gould De Anza-8500 at the Institute of Communication Technology and the BIS/IBIS/ABIS with AED-512 colour display terminal at the Department of Geography, University of Zurich, were enlarged and improved systematically and adapted to the recent tasks of the projects. The Department of Geography, University of Zurich decided after a careful evaluation to install the Aries-II-System by DIPIX combined with a VAX-11/750.

MURI in his research work on the most efficient and economical algorithm to classify the extent of the snowcover on a large-area basis, has used data from the Skylab 13 channel multispectral scanner.

Airborne scanner data was obtained with a Bendix-M2S-Scanner, flown in the morning and the afternoon of the same day for an evaluation of the diurnal variations of the snowsurface and a separation of different snowtypes. Since the spectral characteristics of the various snowtypes deviate only slightly, a specific classification algorithm was created, based on a comparison of the individual course of the spectral curves.

An interactive procedure for the classification of multivariate airborne scanner data (BENDIX M2S) was developed by the Department of Geography, Swiss Federal Institute of Technology, Zurich (BLUM, GILGEN), with the following objectives:

- High degree of flexibility with a view on very diverse possible applications,
- High speed to handle the vast amount of data,
- Correlation of the scanner data with existing digital data bases, such as a 100 x 100 m gridcell data-bank.

Data from airborne and spaceborne thermal scanners were researched in particular by the Department of Geography, University of Berne, in connection with the HCMM-project (WINIGER et al.).

Main objectives are the application of this information to general topoclimatological surveys on mesoscales as well as for airflow and radiation simulation models.

2.3. Microwave systems

The Institute of Applied Physics, University of Berne, is engaged in basic research on the active and passive microwave signatures of snow, ice, soil, soil moisture and vegetation, using various platforms from ground to space (publications by KUENZI, MAETZLER, SCHANDA et al.). The most important study areas include:

- Emission and backscattering characteristics of the snowcover during various yearly lifecycles,
- Emission and backscattering characteristics of sea-ice (measurements during NORSEX and MISEX EXPEDITIONS),
- Assessment and mapping of the global snowcover (quantity of the snowcover) of the Northern Hemisphere using NIMBUS-7-SMMR-data.

2.4. Synthetic Aperture Radar

The value of augmenting LANDSAT-MSS data with SEASAT-SAR imagery for the use in agricultural inventories over extensive areas was examined by NUESCH, Department of Geography, University of Zurich, during his stay at ERIM, Ann Arbor. After preprocessing SAR-data which includes slant to ground range transformation, registration to LANDSAT-data and appropriate filtering of the raw data in order to minimize speckle, textural features were developed based upon the spatial grey level dependence method. By combining LANDSAT and SEASAT-SAR-data mapping of the crop of interest could be achieved more accurately.

Two major aspects are investigated at present: The geometric problems of the SAR-system by adding a digital terrain model to attaching appropriately the radar signals with geographic coordinates, and the development of suitable filtering techniques to overcome the "speckle"-problem and to allow thematic classifications.

2.5. Spectral measurements

Measurements of spectral signatures supporting the LANDSAT experiments regarding atmospheric correction for a direct comparison of multi-temporal data-sets and the snow classification procedure were carried out at the Department of Geography, University of Zurich by STAENZ. Various surface features, in particular snow, vegetation, lake-water, concrete etc. were measured in its seasonal and diurnal variations with an EXOTECH. These research activities are now continued by STAENZ at the Canadian Center for Remote Sensing.

The spectral properties of healthy and damaged pine needles were examined under lab conditions and in the field by OESTER at the Swiss Forest Research Institute.

3. Applied research activities

3.1. National inventories

Two major national inventories based on aerial photo interpretation were planned and officially installed by the Swiss Federal Government:

- National Forest inventory assesses all public and private forests up to 2300 msl, using a systematic sampling method. The inventory, carried out by the Swiss Forest Research Institute, Birmensdorf, will be updated every six year (MAHRER et al.).
- Arealstatistik (land-use inventory) for which careful methodological studies were undertaken (TRACHSLER et al.), will be realized in future by a new concept securing a precise, economical and detailed assessment and a systematic updating in relatively short intervals.

The airphotos taken by the Swiss Federal Office of Topography serve as data base. Hereto a systematic grid of 100 x 100 m. is produced, which is in accordance with the coordinate system of the official topomaps. The distortions as occurring on each aerial photograph are calculated and an appropriate overlay plotted. The land-use is interpreted stereoscopically for each sample point, codified and stored in a data bank. For each new photo the same grid will be reconstructed, therefore allowing a true comparison of the changes. The inventory will be updated in an interval of six years, e.g. in the same manner as the official topographic maps.

An international symposium on land-use, 376
dealing in particular with these aspects, was organized in February 1983
at the Swiss Federal Institute of Technology, Lausanne.

3.2. Forestry

Besides the above mentioned national inventory the Swiss Forest Research Institute is primarily engaged in the assessment of the tree damages due to air pollution. Systematic surveys were carried out especially in the Rhone Valley in the Canton of Valais (KOELBL, OESTER). In future these activities will be undertaken in combination with the national forest inventory.

3.3. Meteorology, climatology and atmospheric sciences

The possibilities of applying satellite data to meteorological purposes are continuously evaluated at the Swiss Institute of Meteorology in Zurich by PIAGET, regarding improvement of the daily weather forecast, cost effectiveness etc.

The University of Berne has constructed and is operating since 1980 a weather satellite receiving station for NOAA. The data is used in various projects such as CLIMOD for topoclimatological studies, mapping the areal extend and the spatial and temporal frequencies of fog layers and estimating the diurnal and seasonal surface temperature pattern etc. by the Department of Geography, University of Berne (WINIGER et al.) and others.

Macrowave radiometer measurements on the altitudinal distribution of tracer gases (O_3 , H_2O , ClO) and of temperature profiles between 10 and 18 km are carried out from ground and airborne platforms by the Institute of Applied Physics, University of Berne (KUENZI, SCHANDA et al.) in cooperation with the Max Planck-Institute and DFVLR.

3.4. Hydrology, snow and ice

A fast, timely and-reliable assessment of the snowcover and its changes is an important parameter for water run-off prediction in high mountain areas. The methods developed (2.2.) allow an accurate and partially automated processing of the snowcover in drainage basins of various sizes, different characteristics and subdividable into numerous elevation zones. The results serve as direct parameter for the run-off model which has been developed by MARTINEC at the Swiss Federal

Institute of Snow and Avalanche Research, Weissfluhjoch, Davos. The model was tested worldwide (especially in the U.S.) successfully.

The Department of Geography, Swiss Federal Institute of Technology, Zurich has compiled a sea ice atlas of the Northern Baffin Bay (North Water) from Landsat-imagery (ITO) and radiometric temperature measurements were analysed for classifying sea ice of the same area (STEFFEN).

3.5. Soils and soil moisture

Aerial photography is used on a routine basis for the deliniation of boundaries between different soil types for the new soil map 1 : 25'000. of Switzerland, compiled by the Swiss Agriculture Research Institute, Zurich-Reckenholz.

The areal assessment of soil moisture by means of various remote sensing techniques (thermal scanner, microwave radiometry and SLAR) has been investigated by R. MEIER in a smaller catchment area of the Prealps, which is well equipped with ground measuring instruments by the Institute of Hydraulics, Hydrology, and Glaciology, Swiss Federal Institute of Technology, Zurich.

3.6. Geography and land transformation processes

Today land is undergoing extensive transformation processes owing to various human activities. For a proper management and a meaningful planning it is essential to gain accurate and updated qualitative and quantitative information on location, extent and rate of these changes.

One of these processes in the Swiss Alps, the abandonment of agricultural land, is studied by the Department of Geography, University of Zurich (HAEFNER, HUGENTOBLE, WALTHER et al.) for the time period 1950 - 1980. A comparison of aerial photographs represents the basis for the survey. All land under agricultural production in 1950 is examined regarding its situation in 1980 and the distribution, extent and ecological condition carefully established of the abandoned parts. A specific method was set up for an efficient mapping of larger areas on a gridcell principle.

The monitoring of the land-use in its time-spatial transformation during the last 100 years is carried out by GUENTER for a mountain resort area (Davos).

Digital processing of Landsat-MSS-data for rural and urban land-use studies as background information for planning activities on a national and regional level are carried out as well (BAUMGARTNER, ITTEN, LICHTENEGGER et al.).

3.7. National and regional planning

Methods, interpretation techniques and examples of applying remote sensing, especially airphotointerpretation, to planning purposes are systematically evaluated by TRACHSLER at the Institute for National, Regional and Local Planning, Swiss Federal Institute of Technology, Zurich. Main topics under evaluation are to set up recommendations for the management of abandoned agricultural land, regional land surveys based on point sampling, and environmental quality investigations on an ecological basis.

3.8. Activities in developing countries

The Department of Geography, University of Berne, has projects under progress on land-use mapping from aerial photography and satellite imagery in Ethiopia and Kenya, whilst the Department of Geography, University of Zurich, is continuing its longterm activities in the Yemen Arab Republic and in Sri Lanka.

The Yemen Arab Republic is undergoing fast and fundamental changes, asking for an urgent monitoring and quantifying of these recent changes in land-cover, crop acreage and production, environmental conditions, natural resources etc. Besides training the following main aspects were studied:

- Land-cover studies and crop acreage estimates from aerial photography and satellite imagery (SCHOCH),
- Concept for the realization of an countrywide agricultural census, including land-use inventory, estimation of crop acreage and crop yield (SCHOCH and GERIG),
- Ancient and recent irrigation systems, with particular reference to the Oasis of Marib (BRUNNER, GERIG, SCHOCH),

- General aspects of assessing and monitoring renewable natural resources³⁷⁹ in developing countries (HAEFNER and SCHOCH).

The most important tasks of the Sri Lanka project were:

- Establishment of a Remote Sensing Center within the Survey Department and training of its staff,
- Preparation of a new countrywide land-use map 1:100'000 (GEISER, ITTEN, SOMMER et al.) as a basis for monitoring land-use changes, especially the paddy cultivations in different growing seasons and the forest cover (GEISER; SCHMID et al.) by means of Landsat imagery,
- Compilation of a countrywide forest cover map from Landsat images (printed in 1:500'000),
- Evaluation of crop yield models to forecast the rice production (TSCHANNEN).

A broad overview on these activities is given in the various papers contributed to the 4th Asian Conference on Remote Sensing, held in Colombo in November 1983, and published in the corresponding proceedings.

from the Institute of Photogrammetry at the Federal Institute of Technology (EPF) - Lausanne

+ Registration of damage on vegetation by remote sensing.

As well known, damage on vegetation can be registered reliably with Infrared-photography. A detailed analysis of the reflexion on needles of firs showed however, that the reflexion in the near infrared is practically invariant, and the damage on the needles can be better detected on the discolouring in the visible spectrum. The phenomena of damage can be recognized with infrared only by the changing position of the needles or by their falling-off.

For the praxis the conclusion can be drawn, that particularly, when applying false colour photography, a delicate filtering process must be introduced between the visible and the infrared portion of the spectrum.

4. Section

Research and Development

from the Institute of Geodesy and Photogrammetry at the Federal Institute of Technology (Eidgenössische Technische Hochschule) Zürich.

- + Research is conducted mainly on basic principles of photogrammetry. The goal is to support the transition of the photogrammetric analog evaluation methods towards a computer assisted method of data reduction for imagery. The problem of increasing the fidelity of the mathematical model of the imaging process is being studied by applying refinements, which can be physically interpreted.

Particularly attention is paid to the establishment of different possible arrangements for the data acquisition. The multitude of such geometric solutions existing within the euclidian space is investigated because their application has become possible, on ground of the availability of electronic computing. Furthermore work is conducted to develop to its fullest extent the universality of the application of the photogrammetry, by providing means for an unrestricted defect compensation in the mathematical model of the photogrammetric evaluation method.

Finally research is conducted dealing with the problem of developing rigorous statistic principles for the treatment of redundant information, for the image measurements proper as well as for the incorporation of excess information, which predominantly is of geodetic nature or is provided by the sector of engineering surveys.

In a general solution the combination of the various data sets must be possible in accordance with the principles of a rigorous adjustment, but equally - mainly for practical reasons - in terms of a so-called "Anfelderung" between various information packages.

An important goal of our activity is the establishment of software, which in accordance with the above mentioned data reduction principles is making it possible to use in an optimal way computer assisted system-components of our analytical system. The know-how obtained from these activities is continuously be incorporated into the process of education in the field of photogrammetry.

Furthermore a method was successfully developed, which makes it possible to adapt the orientation process on digitized analog equipment with the help of a process-computer to the method of computer assisted data evaluation, as e.g. applied on an analytical plotter.

from the Institute of Photogrammetry at the Federal Technical Institute (EPF) (Ecole polytechnique fédérale), Lausanne

In photogrammetric applications the following developments were conducted during the past years:

+ Interactive digital stereomapping

For the tasks of cadastral surveys and the process of revision of topographical maps, several methods were developed, which allow the immediate superimposing of the map and aerial photography (e.g. the projective reconstruction of the map and its superimposing with an enlargement of the aerial photography, or the creation of a screen image in the optical drain of a stereo restitution instrument by reflecting mirrors). Such procedures are presently under test and corresponding technical investigations are being made.

- + Setting up of a precision test field and the analysis of the accuracy obtainable from geodetic and photogrammetric measurements.

The test field was established in order to develop proven methods for the application of photogrammetry to cadastral surveying.

It could be shown, that photogrammetry can very well produce results, which satisfy the most stringent requirements for cadastral surveying, provided the systematic errors on the photographic material are compensated for in a suitable manner.

- + Analysis of landslides with the help of multitemporal photographs made by false colour techniques.

In the course of a interdisciplinary study about the recognition and analysis of landslide areas, the institute has investigated the possibility to detect and measure landslide movements by comparing aerial photographs made in past years and at more recent times. In general photographs were used, which were taken for the revision of the topographic map. With a picture scale of 1 : 25'000 and an interval of 6 years between corresponding flights, it was possible to determine reliably landslide movements of 3 to 4 cm per year.

For the geological and geomorphological mapping false colour photographs have consistently been used.

from the Federal institute for topographic mapping (Bundesamt für Landstopographie)

In the photogrammetric department, the following developments were supported:

+ Digitizing project DIKART

On account of the continuously increasing interest on digitized map information and based on corresponding discussions within the civilian as well as military agencies, a map-digitizing-project (DIKART) has being started.

The aim of this work is the procurement and the operation of a hardware- und software-system suitable for automatic digitizing, storage, interactive processing and output of digitized topographic data. Specifically the following data shall be included into the digitizing process:

- Elevations, based on the contourlines of the topographical map 1 : 25'000, supplemented by restitution of aerial photography (DTM in form of a matrix).
- Aereas covered by forests, open landscape areas used for construction purposes, areas of glaciers and rockformations. This information is considered as supplementary data to the elevation modell.
- Linear elements as trafic net, watercourses, political boundaries.

After an extended period of evaluating and testing, a system SCITEX RESPONSE 280 was selected for the digitizing of maps. For the supplementary information from aerial photographs an analytical plotter WILD BCl-system is used. The data management is performed on the correspondingly modified computer system PRIME 400.

Preliminary work phases are going on and shoud be completed by the middle of 1984. The project plan covers a period until the end of 1987.

To make it clear, this project is not concerned with the automation of the mapping process. For such an undertaking the necessary technical auxiliaires as hard- and soft-ware are still not readily available. The corresponding relations between costs and usefulness appear to be presently still unfavourable. The project DIKART should however provide the possibility to follow the rather fast developments in the field of computer-cartography.

+ Inventory of the coastlines of the lakes in Switzerland

During the past years, the coastlines of all larger lakes in Switzerland were photographed at a scale 1 : 5'000 on colourfilm (Kodak Aerochrome MS) by our aircraft service on request of the federal agency for the protection of the environment.

The photographs serve mostly scientific investigations about the vegetation on the coastlines and in the water. The photographic material is also available to other interested parties.

+ Photothek (Photo-library)

The photo-library has been newly arranged and stored in modern sliding compartments. There are stored ca. 63'000 terrestrials photographs of the alpine area of Switzerland (1926 - 1943), further on also 130'000 aerial photographs (beginning with the year 1936).

The material can be made available to persons interested. The yearly addition is about 3'000 photographs, which to a large extent originate from the map-revision program (scale of the photography 1 : 25'000). The total coverage of Switzerland is repeated at a cycle of 6 years.

The Photo-library is being increasingly used. For outside user a working place was arranged featuring a WILD AVIOPRET instrument.

from the Swiss photogrammetric Industry:

The Swiss photogrammetric industry directed its principal effort to the development of hardware and dedicated software. Particularly the contribution of the Companies KERN & Co. AG, Aarau and WILD-HEERBRUGG AG should be mentioned.

+ Photogrammetry Development at the KERN Comp.

Since the last I.S.P. Congress in Hamburg, KERN & Co. Ltd. has continued research and development on different modules on the KERN CAM SYSTEM. CAM - Computer Aided Mapping - was based from the very start on distributed computing, producing in KERN CAM format sequential ASCII text output files. The KERN CAM SYSTEM evolution of the past 4 years is presented in the following summary:

New Developments: INSTRUMENTATION

- 1 DSR 11 - Analytical Stereo Plotter based on the DSR 1, featuring free hand guidance.
- 2 RM - Map Revisioning Module to project a graphic screen image into the left eyepiece of KERN Stereo Plotters.
- 3 ACOR - Area Correlator Module for the DSR 1 and DSR 11.
The main intention is to automate the model orientation and generation of digital terrain models.
- 4 CPM1 PLUS - Stereo Comparator.
The existing CPM1 has been enhanced with two more linear encoders for the right hand plate carrier.
- 5 PG 21 - Analog Stereo Plotter based on the PG 2, featuring focal length range of 85 - 215 mm and digital display.
- 6 GSD-2 - Digital Table with gantry type cursor connected to DEC PDP11-23 Computer.
- 7 KSIO-11 - Electronic Interface (up/down counters) enabling the DEC PDP11-23 Computer to read encoder signals directly.
- 8 MAPS 300 - The Interactive Graphic Station integrating an IMLAC
Hardware Series II Graphic Screen and a DEC PDP11-23 Computer.

New Developments: SOFTWARE

More programs were added to the already existing software stock. The following are some of the most important:

- 1 CRISP - Metric, non metric close range photogrammetry program, in cooperation with Graz Research Centre.
- 2 DTMCOL - For profile or grid mode DTM data collection.
- 3 CONTUR - Generation of contour lines, processing DTM data.
- 4 AETRI - On-line aerotriangulation with real-time editing features for model connections and SCHUT polynomial adjustment, (for analog and analytical plotters).
- 5 BLUH - Bundle adjustment program adapted for KERN Analytical Plotters by the University of Hannover.
- 6 MAPS100 - For digital data collection with extensive feature coding and partial editing.
- 7 MAPS200 - For digital and/or graphic compilation with extensive feature coding and partial editing.
- 8 MAPS300 - Interactive Graphic System for interactive editing of collected data in preparation for final plotting.
- 9 DATA BASE MANAGEMENT - Data Management program of a project.
- 10 MAPR - Overall job management program.
- 11 CAMEDT - Clips lines creating clean intersections.
- 12 GRID - Map sheet preparation.
- 13 PLOTR - Plots from KERN CAM format files.

PHOTOGRAMMETRIC DEVELOPMENT AT WILD HEERBRUGG LTD.

During the past inter-congress period WILD Heerbrugg Ltd. has put high emphasis in the development of Software related to existing or new products. In this way it has been possible to substantially improve various products, a result of which has increased benefits to the customer.

In addition, WILD has developed a number of new products, with the intention of providing a wider range of instruments available for various fields of applications. The fast on-going progress in electronics, computer technology and the general trend towards automation in mapping have influenced the development activities to a great extent.

1. Aerial photography

With a new generation of high performance objectives a significant improvement of the image quality has been achieved.

The well known aerial camera system Aviophot RC10 has now been replaced by the new Aviophot RC10A system. This microprocessor controlled camera system fulfills the highest requirements with respect to safety, function-control and easy operating. A connection to an inertial navigation system allows for a fully automated aerial flight mission. All relevant data is automatically printed as marginal information on each photograph.

2. Aerial triangulation

In this field WILD has developed programs which allow for on-line aerial triangulation with the Avioplot-RAP-System as well as with the analytical plotters Aviolyt AC1/BC1. With this data from preliminary computations a block adjustment can then be carried out using one of the adjustment programs adapted to WILD-system-computers.

The new point transfer device PUG5 is an important link in the chain of an aerial triangulation process. This instrument significantly improves precision and performance in marking artificial points.

3. Stereo - restitution

With the analytical plotter BC1, WILD has introduced the second instrument of this kind. The BC1 is almost as flexible as the Aviolyt AC1, since both plotters use the same computer and to a large extent identical software. This makes the BC1 a powerful and very economical stereoplotting system.

Besides improvements and additions to the existing software, a special user-interface has been developed to allow the user to produce additional programs for specific requirements.

Software for the computer assisted plotting system RAP has continuously been improved. The new versions are no longer restricted to purely graphical output, but they also permit data digitising. In the latest version of the RAP system a new microcomputer with a higher performance was implemented.

A further step ahead with respect to performance and quality was realised with the RAP 2000 system which allows connection to the new TA 10 plotting table.

4. Automatic drawing tables

Besides the existing drawing tables TA and TA2, a new table TA10 has been developed which can be integrated into the Aviolyt AC1 and BC1 or the RAP 2000 system.

The three existing automatic tables may also be driven by direct computer link or in off-line mode by a magnetic-tape device.

5. Application - Software

The SORA-software, generating image coordinates to drive the Orthophoto-system OR1, has substantially been improved,

A particularly user-friendly version was developed to carry out data acquisition on the Aviolyt AC1 or BC1.

The contour interpolation program CIP, (Zumofen, ETH Zürich), designed to generate and automatically plot contour lines from a digital terrain model was adapted to be run on existing WILD systems.

6. Interactive mapping system

The complete Informap/Wildmap software has been adapted to the powerful VAX-computer family. The formerly used storage tube graphic screens on the workstation have recently been replaced by high resolution colour/mono raster screens. Furthermore development of additional software in various fields of application was carried out.

The stand-alone system Geomap, specially designed for geodetic applications, provides a fully automated chain from data acquisition, interactive graphic data processing to the final plot on an automatic plotting table.

5. Section

Education

Academic lecturing in the field of Photogrammetry with corresponding exercises and practica takes place in German at the Institute for Geodesy and Photogrammetry, Federal Institute of Technology, Zurich and at the Institut de Photogrammétrie, Ecole Polytechnic Federal, Lausanne, in French respectively.

The presented subjects fit into the frame of the specific academic courses either for surveying engineers and for students of rural engineering.

Special education in Photogrammetry is presented to technical engineers particularly at the School for Engineering in Basel.

In line with the different educational goals, these institutes are equipped with various types of analog instruments, partially modified with digitizing auxiliaries and supplemented with modern drawing tables.

Analytical systems are available for education and development at Lausanne and at Zürich.

The Swiss School for Photogrammetric Operations at St. Gallen is an institution with a specific educational goal. The education is directed entirely to satisfy the needs of the practice.

Since the last congress the School has adapted a new and flexible concept for its educational program, tailored to fulfill today's requirements of the private offices, without restricting the education to a one-sided specialized training. Still, as before, the School attempts to offer a broad spread instruction.

The school offers every year from September to May the following courses, which are conducted according to demand in the German, English, French or Spanish language.

- Introductory course (2 months for beginners)
- Advanced course for praxis oriented restitution (4 months)
- Supplementary course for digital data acquisition (3 months), with emphasis on aerial triangulation.

The solid basic education obtained with the above named courses are the pre-requisite for successful and reliable work in the photogrammetric praxis, which is characterized by fast changing technical developments.

It is hoped, that the variation in the offered courses can help to select an optimal educational program for beginners as well as for advanced students.

It is a foregone conclusion, that the equipment of the school does justice to the new objectives in teaching. The presently 22 analog-instruments are partly equipped with coordinate registration systems and the corresponding peripheral auxiliaries.

They can be used also as working stations for computer assisted data reduction or aerial triangulation. Therefore the school can very well offer the experienced operator an advanced education directed towards the requirements of the future. The equipment is supplemented by comparators and point transfer instruments. Furthermore at the school there exists a mini-computer with several program packages for numerical photogrammetry, including a spatial blockadjustment based on independent models.

Special problems, as e.g. the checking of instruments, their adjustment and maintenance or the application of close-range photogrammetry will be treated in special courses.

Special subject-courses for small groups will be conducted during the summer on inquiry.

Participants of governmental agencies of developing countries may, under certain conditions, obtain financial support from international organisations. Corresponding inquiries should be directed first to the Swiss School for Photogrammetric Operators at St. Gallen, Switzerland.

6. Section

Publications

- + The monthly published periodical "Vermessung, Photogrammetrie, Kultur-technik" is edited by the Swiss Association for Surveying and Cultural Techniques (SVVK) and the Swiss Society for Photogrammetry (SGP), the SIA Trade-association for Rural- and Surveying Engineers (FVK), the Association for Swiss Surveying Technicians (VSVT) and the STV Trade Association of Geometer Technicians (FGT).

The editorial secretariat: Institute for Geodesy and Photogrammetry
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7. Section

Professional subjects

+ Foundation of a trade association of independently established photogrammetrists

The independent photogrammetrists joined in 1978 in a trade association for surveying and rural engineers, with the aim to protect their common professional and economical interests.

To day eleven smaller and larger enterprises belong to this group, having in total seventeen analog instruments and one orthophotosystem WILD OR 1. Almost all the analog instruments can be used for digital data acquisition on suitable data carriers. Some of the instruments have interfaces to computers for computer aided mapping and model orientation.

Numerical restitution as well as graphical methods are used. Furthermore an increasing interest on orthophoto products can be recognized. This activity is characterized by heavily changing user conditions and frequently changing model dispositions. The successful private activities are possible on account of the high professional standard of the Swiss photogrammeter. They are well educated surveying specialists with supplementary schooling as stereo-operators and have advanced knowledge in the fields of interpretation and specialized restitution.

The group of professionals is engaged in an effort to increase the use of photogrammetry in the field of Swiss cadastral surveying. Together with the official federal as well as state agencies they work on rules and tariffs, which will be needed to govern the application of the photogrammetric method for the problems of official surveying.

An inventory of photogrammetric work in Switzerland indicates that the available capacity is used only partially. The members of the group of independently established photogrammetrists therefore

intend to ask for photogrammetric tasks in foreign countries. The existence of a sufficient number of restitution instruments and the restitution capacity will make it possible to accept larger projects.

from the Federal Institute for Topographic mapping

+ National Point of Contact

Within the program EARTHNET of the European Space Agency (ESA) (Reception and Administration of Satellite imagery) the Federal agency for topographic mapping agreed in the year 1982 to act as a National Point of Contact (NPOC). This contact transmits satellite imagery to Swiss users recorded in the frame of EARTHNET at the receiving stations Fucino (Italy) and Kiruna (SWEDEN) respectively. Mostly the data are LANDSAT imagery, which is used mainly for scientific purposes.

The NPOC is annexed to the Photo-library (Photothek).

The Swiss Society of Photogrammetry (SGP)

Switzerland is represented at the international Society of Photogrammetry and Remote Sensing by the Swiss Society of Photogrammetry.

This Association, which was founded as a private organisation during the year of 1928 has now 147 individual and 28 collective members. The society includes the more important professional members from industry, private enterprises, scientific institutions and official agencies.

The unchanging objective of the society is mainly the support and application of photogrammetry, supplemented by interests in geodesy, topography and cartography. In the past few years the aspects of remote sensing were more and more integrated into the goals of the society.

The support of professional meetings on subjects connected with the aforementioned goals of the society is practiced, quite often by cooperating with the Swiss Society of Surveying and Rural Engineering. Twice during a year, once at springtime and once in autumn, the society conducts a general meeting. On both of these gatherings - besides taking care of the business aspects of the society - subjects are presented which belong to theoretical as well as practical aspects of photogrammetry and remote sensing.

In the past 4 years, the following fields of interest were covered:

- Current projects and status of remote sensing.
- New developments of instrumentation at the KERN and WILD Companies.
- The application of photogrammetry in the field of land information systems.
- Digital image processing with emphasis on aerial photographs.
- Dynamic data acquisition of terrain profiles.
- The technology of military aerial reconnaissance and a visit at the governmental aircraft service for surveying.

8. Section

Addresses:

8.1 Education and Research

Ecole polytechnique fédérale, Institut de Photogrammétrie, Avenue de Cour 33, CH-1007 Lausanne, Switzerland

Federal Institute of Technology (Eidgenössische Technische Hochschule) Zürich, Institute for Geodesy and Photogrammetry, Eidgenössische Technische Hochschule Zürich-Hönggerberg, CH-8093 Zürich, Switzerland

University Zürich-Irchel, Geographical Institute (Geographisches Institut) Winterthurerstrasse 190, CH-8052 Zürich, Switzerland

Swiss School for Photogrammetric Operators (Schweizerische Schule für photogrammetrische Operateure), Rosenbergstrasse 16, CH-9000 St. Gallen, Switzerland

8.2 Photogrammetric Organisations:

1. Federal Agency for Topographic Mapping
(Bundesamt für Landestopographie)
Photogrammetric Department (Dienststelle Photogrammetrie),
Seftigenstrasse 264, CH-3084 Wabern, Switzerland
2. Federal Agency for Cadastral Surveying
(Eidg. Vermessungsdirektion), Einsteinstrasse 2, CH-3003 Bern, Switzerland
3. Melioration- and Surveying Department, Graubünden
(Meliorations- und Vermessungsamt Graubünden), Kantonale Verwaltung,
CH-7000 Chur, Switzerland
4. KERN & Co. AG, Schachenallee, CH-5001 Aarau, Switzerland
5. WILD-HEERBRUGG AG, CH-9435 Heerbrugg, Switzerland