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PRACTICAL EXPERIENCE WITH ANALYTICAL PLOTTERS IN STATE SURVEY ORGANIZATIONS

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1. System configuration

The Topographic Survey Office of Lower Saxony has been working with a C-100 PLANICOMP Analytical Stereoplotting System by CARL ZEISS of Oberkochen since February of 1978. Up to now, the instrument has been used for the following types of work:

- Aerial triangulation for cadastral and heighting work.
- Measurement of spot heights for the 1:5000 German Base Map.
- Coordinate measurement for determining areas and checking distances.
- Topographic plotting (motorways, etc.).
- Mapping of control and grid points for plotting work on analog machines.

The stereoplotting system installed in Lower Saxony consists of the following:

- Measurement unit.
- HP 21 MX-M computer.
- HP 7900 disk unit with a capacity of 4.9 Mbytes.
- HP 2748 B punched-tape reader.
- HP 2640 video display terminal.
- HP 9871 printer with a capacity of 30 characters per second, connected to the VDT as a subsystem.
- DZ-6 Tracing Table.

Instead of a magnetic tape unit, a remote data transmission line was installed to the type 7.738 Siemens computer of the Survey Office. The RJE/1000 program package by Hewlett-Packard is being used for remote data transmission. Some nine months were required to design and install this line.

A first expansion of the C-100 PLANICOMP Analytical Stereoplotting System into a computer-supported aerial mapping system called for the procurement of a second video display terminal and a printer. The latter was connected to the VDT as a subsystem. Its capacity of 180 characters per second has proved to be sufficient. It is primarily used for listing programs, adjustment results and the data transmitted via the permanent computer line. The VDT has a cassette mechanism, which can be very useful, for example, for exchanging programs, safeguarding programs during development and protecting data. This expansion laid the basis for parallel operation, namely plotting in the PLANICOMP as well as program development and checking of plotting work on the VDT.

Another stage in the expansion of the computer-supported aerial plotting system was the purchase of a ZEISS PK-1 Monocomparator. According to the CARL ZEISS company of Oberkochen, the capacity of the HP 21 MX computer was sufficient to connect a further plotter in addition to the C-100 PLANICOMP. The corresponding software was developed by CARL ZEISS: Use of the computer allows program-controlled measurement of two-dimensional comparator coordinates, instantaneous checking and correction of measurement data as well as editing of measurements for automatic processing. This procedure has been used for four months and found satisfactory. The connection of the monocomparator made an expansion of the computer storage capacity to 144 KB indispensable. In order to satisfy the requirements of multi-terminal operation, the operating system was converted to RTE IV.

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A study is presently under way, which is intended to determine whether another photogrammetric plotter can be connected to this system. In heighting work for the digital terrain model, this would make it possible to dispense with operations for the determination of state plane coordinates which at this stage are still necessary. This would reduce production time and also allow an immediate check to be made of the results.

There has been no major down time of the measurement unit, the computer or the periphery up to this date. It is intended to conclude a service contract for the computer. Having the disk unit serviced every three months has been found to be useful.

Up to now, only the DZ 6 Tracing table proved to be very unreliable. Changes in table orientation during a plotting operation may go up to 10 mm, which is inadmissible for the type of work concerned. Up to now, Messrs. CARL ZEISS of Oberkochen have been unable to solve the problem. The table takes about six hours to plot a chart of 3000 spot heights.

Users will find it unsatisfactory that work on the C-100 PLANICOMP is impossible during data transfer, since both the LOOP operating program of the C-100 PLANICOMP and the RJE/1000 data transfer program operate in a privileged-interrupt mode.

The limited capacity of the type 7900 disk unit of only 4.9 Mbytes handicaps work in the aforementioned system.

2. Program developments

Special-purpose programs were developed for the following uses:

- Remote data transmission.
- Job administration.
- Aerial triangulation.

The subroutines developed by CARL ZEISS of Oberkochen for access to the general files and the COMMON data area (data area permanently accessible for all plotting programs) proved to be very useful in this work. For some programming tasks additional information was required from CARL ZEISS. In special cases, the knowledge of source programs was likewise necessary.

2.1 Remote data transmission

Remote data transmission is used for aerial triangulation and heighting for the digital terrain model.

In aerial triangulation work, the image coordinates measured in the PLANICOMP or PK-1 are adjusted on the Siemens computer of the Survey Office with the adjustment program by MÖLLER (block triangulation by the bundle technique). The image coordinates stored in the PLANICOMP system are edited for transmission to the Siemens computer by the C 166 program for remote data transmission and collected on a data medium of the Siemens computer. Next, the photos for the block to be adjusted are assembled and the adjustment is performed. The adjusted state plane coordinates are then available for further computations on the Siemens computer or can be stored in the PLANICOMP system by remote data transmission, if necessary.

In the course of plotting work for the digital terrain model, remote data transmission is likewise required. The state plane coordinates measured in the C-100 PLANICOMP are edited by the C 162 program for remote data transmission and then transferred to the Siemens computer. There, the coordinates are stored in a data bank for the digital terrain model.

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2.2 Job administration

Automatic administration of the jobs processed in the PLANICOMP system became necessary after installation of a second video display terminal and the PK-1 Monocomparator. The basic principle of job administration consists in subdividing the alternate disk into separate logic units (LUs) and assigning each of these units to a job.

2.3 Aerial triangulation

A special program for aerial triangulation in the PLANICOMP was likewise developed with the aid of the ZEISS subroutines. The purpose of this program was to make optimum use of the capabilities which the PLANICOMP offers for the automatic approach of tie points and for on-line checking.

3. Measurement program for aerial triangulation

The Topographic Survey Office of Lower Saxony requires image coordinates for adjustment with the bundle program. The strips are checked with the aid of the Stuttgart strip program. In the aerial triangulation program supplied by CARL ZEISS of Oberkochen, machine coordinates are measured and image and model coordinates formed in several separate steps. In addition, the plotting of cadastral flights gave rise to difficulty in measuring more than 24 points in a model. In such a case, automatic approach of the tie points measured in the preceding model was no longer possible.

The purpose of the program developed by us is the following:

- To combine the different programs of the ZEISS technique in a single program;
- to restore the possibility of automatic approach of all previously measured tie points;
- to offer a maximum of checking during measurement;
- to offer optimum conditions for measuring more than 24 points in a model.

The B 158 program satisfies the majority of these requirements. By measuring two control points, all image coordinates of an adjacent model are transformed into the coordinate system of the model to be plotted and then approached automatically, inasfar as they are tie points. This is how the tie points with all adjacent models are processed. This is followed by measurement of the pass points. An automatic check is made as to whether the point number has already been assigned.

The formation of image and model coordinates and their storage in a general file are automatic. Also, there is a possibility of using the difference between the transformed and the measured machine coordinates for a coarse check on the measurement or for an identification of points. The use of this program in the C-100 PLANICOMP has considerably increased the speed of measurement as compared with the PSK-2 Precision Stereocomparator. Moreover, the number of measurements of tie points is no longer as important for the economy of aerial triangulation as in the past.

4. Outlook

The C-100 PLANICOMP is a very efficient system for plotting aerial photography. It gives new impulses to the development of numerical techniques for photogrammetric purposes. It also allows these to be designed more economically than in the past. As a result, photogrammetry has become more attractive to users.

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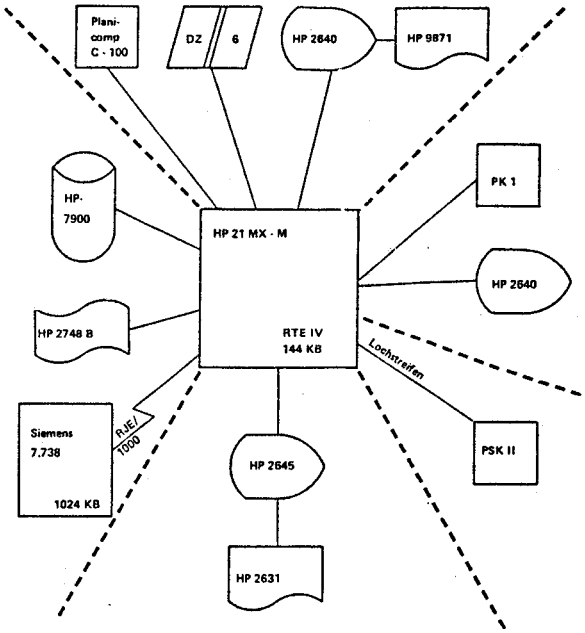

Abb. 1: Planicomp-System

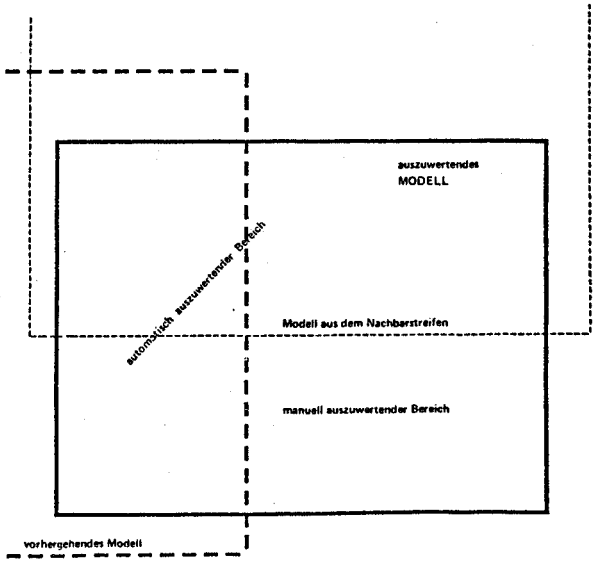

Abb. 2: Automatisches Anfahren
von bereits gemessenen
Punkten (Verknüpfungspunkten)

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Abstract

The paper describes the use of the PLANICOMP in topographic survey offices. It also describes the resulting potential for connecting photogrammetric plotting machines to computers. Finally, a description is given of a measuring technique developed for aerial triangulation in the PLANICOMP, with on-line checking of plotting work and automatic pointing of points previously measured.

Über Erfahrungen mit analytischen Auswertegeräten im praktischen Einsatz in der Landesvermessung

Zusammenfassung

Es wird der Einsatz des PLANICOMP bei der Landesvermessung beschrieben. Ferner werden die hierdurch gegebenen Möglichkeiten für den Rechneranschluß photogrammetrischer Auswertegeräte dargestellt. Den Abschluß bildet ein für die Aerotriangulation mit dem PLANICOMP entwickeltes Meßverfahren mit einer on-line Kontrolle der Auswertung sowie automatischem Anfahren bereits gemessener Punkte.

Les expériences acquises au cours de l'utilisation des restituteurs analytiques dans les levés de terrains

Résumé

L'utilisation du PLANICOMP pour les levés de terrains est le thème de la conférence qui expose également les possibilités de raccordement des appareils de restitution photogrammétrique à des calculateurs. Cette conférence se terminera sur la présentation d'un procédé de mesure développé pour l'aérotriangulation avec le PLANICOMP et comprenant un contrôle on-line de la restitution ainsi qu'un positionnement automatique sur les points déjà mesurés.

Experiencias adquiridas durante la utilización práctica de restituidores analiticos en levantamientos topográficos nacionales

Resumen

Se describe el empleo del PLANICOMP en la agrimensura. Además, se explican las posibilidades así ofrecidas para la conexión de computadoras a restituidores fotogramétricos. Finalmente, se presenta un método de medición desarrollado para la triangulación aérea con el PLANICOMP, con un control on-line de la restitución y el punteo automático de puntos y medidos.

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