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PRACTICAL EXPERIENCE WITH ANALYTICAL PLOTTERS IN A CIVIL ENGINEERING COMPANY

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We were requested to give an account of the experience we have made with analytical plotters. First of all it should be mentioned that our experience in this field is limited to a C-100 Stereoplanicomp which was supplied to us on 29th Dec. 1977, installed between 17th and 30th Jan. 1978 and put into operation on 3rd Feb. 1978.

The basic equipment comprises the plotter itself, the control unit, the HP 21 MXE computer with a 48 K words core memory, two terminals and the usual software. In addition, we purchased a tape station as hardware accessory and a PATM-43 program package which was written specifically for the given HP computer capacity. The equipment does not include a tracing table.

Our experience is based on one and a half years of operation (as per 1st Aug. 1979) during which time the Planicomp was in use for 3.209 hours. Compared with equivalent equipment, there have been no major down times. So far we have had two breakdowns - one in the right-hand photo carriage (hardware) and one in the plate area (software) - which could both be repaired within two days.

In our opinion this rate reflects the high degree of development and compatibility of the technical components - mechanical, electronic, optical - on the one hand, and of the programming of the EDP components on the other hand. The aforementioned work load and the worthiness test involved are of course dependent on the orders on hand and the purposes for which the analytical plotter is primarily used. Undoubtedly, the electronic aspect has to be taken into account far more than in conventional photogrammetric instruments; operators have to be given special training and experienced staff has to be available for assistance. We have recognized these prerequisites to be of prior importance so that we can state now that an introductory period of one month only was sufficient which, we think, is remarkably short - again in comparison with other equipment.

Since we have been working with the C-100 Planicomp it has been used primarily for aerotriangulation, image coordinate measurement, orthophotos and digital terrain models - in this order of priority.

1. The experience made in aerotriangulation can be summed up as follows:

In 6 projects covering an area of 2.427 sq. km and varying considerably in image scale, image quality, number and quality of control points, 3.887 models were triangulated in 29 blocks. Regardless of preparation times and extra work, 0.6 hrs. per model were needed on the average for triangulation. It may also be of interest to mention that the number of observations was 33 per model, of redundant observations 12 per model.

The adjustment computations for the Planicomp measurements were made exclusively with the PATM-43 software. In minor projects we used our own program version; for larger blocks the computations were made on external equipment.

In the past the planning of such adjustment computations clearly was the critical point of a triangulation, especially if the follow-up work schedule was tight.

From our point of view, the external processing is, at best, a temporary solution; in the long run it is absolutely essential that computations are carried out in our house. However, in-house computations are limited by the computer capacity and the operating system to 90 control points or tie points and 120 models at present. The second terminal permits photogrammetric work to be done unhampered by one operator while at the same time a triangulation block is being computed by another operator. No loss of time has been noticed to be incurred by such parallel processing. We presume that in future we will be able to handle all in-house tasks by extending the core memory to 96 K words and by installing the RTE IV operating system. Due to the costs involved, the problem ultimately is again an economic one.

The technical aspect of the adjustment can be approached through the accuracy of the results. Making allowance for the wide difference in outward conditions, the following general results are found to be fully satisfactory:

σ_o L	=	7	-	16 cm	at image scale	1 : 4 500
σ_o H	=	16	-	24 cm	at image scale	1 : 4 500
σ_o L	=	9	-	20 cm	at image scale	1 : 7 000
σ_o H	=	16	-	25 cm	at image scale	1 : 7 000
σ_o L	=	17	-	39 cm	at image scale	1 : 12 000
σ_o H	=	24	-	40 cm	at image scale	1 : 12 000

To be able to interpret these results correctly, it certainly has to be borne in mind that the accuracies quoted above represent an average of all measuring, image and control point qualities, in particular in respect to the distribution of control points.

It is difficult to get a clear idea of the work going on "behind the scenes": An accurate assessment of the average measuring quality achieved with the Planicomp is complicated by the tracing of identity errors and gross control point errors.

2. Control points for orthophotos

The Planicomp has proved to be particularly economic and reliable in the determination of control points for orthophoto projection, especially if the control point coordinates are stored after aerotriangulation.

Image coordinates of 1678 orthophotos to be read in for the SORA program were measured and digitally processed right up to creating a magnetic tape containing the off-line control data for orthophoto projection in the Avioplan. The output was 6 photos per hour.

3. Experience with digital terrain models

The following measurements for terrain models had to be handled during the period under review:

3.1 In 933 models covering an area of 601 sq.km a total number of 507 000 spot heights were recorded, the average hourly rate being 533 points. The bulk of the data measured was digitally transferred direct for the projection of orthophoto maps whereas a smaller part was entered in maps or used for ground reliefs. At any rate, the digital data chain is an optimum way of responding to present technical trends.

It must be pointed out in this context that we consider the Planicomp as part of a system and not as an autonomous instrument. We feel that this is a very important aspect considering all the problems involved in making up this function system.

The heighting accuracy is found to be adequate as regards the criteria set above.

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3.2 Only a small amount of incremental contour line mesurement had to be done so that well-founded comments can not be given on this subject.

3.3 Likewise, longitudinal and cross profiles were measured to a minor extent only, although this would have been a fascinating job with the projects to be handled. Priority was however given to triangulation because the orders came in at the same time.

General summary and criticism of the Planicomp

The following summary of our general experience is based upon opinions given by the staff operating the equipment:

1. From the operator's point of view, the Planicomp - as compared with conventional instruments - presents quite a new and special challenge. On the one hand the complex memory and program electronics demand a lot more on the operator's qualifications; on the other hand the Planicomp is judged in our house as being very easy to operate and clearly superior to previous instruments in the conventional plotting process.
2. Further favourable features are the optical system with its large image field, the smooth running of the handwheels and the display dialog. One disadvantage in need of improvement was the space-wasting data structure on the magnetic tapes which we have condensed to one tenth of its original size. The computer section of the hardware was found to be very reliable, whereas there was criticism of the compiler and the RTE III operating system. The memory would be adequate in capacity and structure if it were not for the necessity of in-house block adjustment.

Generally speaking, we believe that the Planicomp has been fully accepted by our staff and that it can be used to full advantage. Economically the price/performance ratio comes up to our expectations. It must be pointed out here that the purchase price of the Planicomp - although an important factor - has to be considered in connection with the preceding staff investment; that finally the overall structure of the company, the peripherals and other technical appliances on hand may be decisive, and that the efficiency of the instrument will of course depend on whether it is used to full capacity. One of the problems we were facing was the question whether it would be sensible to increase the number of computer systems in our house by the instrument's own computer, putting up with the costs involved. However, as we see it now, the additional computer has relieved the other systems and led to a certain degree of decentralization which, on the whole, has had a favourable economic effect.

We would like to congratulate the manufacturer on the design of this instrument and hope that full use will also be made of it elsewhere.

Abstract

An account is given of the experience made with the Planicomp plotter installed early in 1978 in the ROSE/WÜRTZLER/NÜCKEL survey office:

1. Components of basic and additional equipment, down time and operating time.
2. The machine has up to now been used for aerial triangulation, measuring the image coordinates of control points for orthophoto computation and digitizing terrain models.
3. The experience and criticism of the company's staff are overwhelmingly positive with regard to both hardware and software.
4. The economy of the Planicomp as a function of operator training, periphery, work type and work load is considered to be good.

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Ober Erfahrungen mit analytischen Auswertegeräten im praktischen Einsatz bei einem Ingenieurbüro

Zusammenfassung

Ober die Erfahrungen mit dem anfangs 1978 installierten Planicomp im Vermessungsbüro ROSE/WORTZLER/NÖCKEL wird wie folgt berichtet:

1. Bestandteile der Grund- und Zusatzausrüstung, seitherige technische Störungen und Betriebszeit.
2. Bisheriges Einsatzgebiet waren Aerotriangulationen, Messung der Bildkoordinaten von Paßpunkten für die Orthophotoberechnung und digitale Geländemodelle.
3. Erfahrungen und Kritik der Mitarbeiter sind überwiegend positiv hinsichtlich Hard- und Software.
4. Die Wirtschaftlichkeit des Planicomp wird in Abhängigkeit von Ausbildungsstand der Mitarbeiter, Peripherie, Aufgabenstellung des Vermessungsbüros und Auslastung positiv beurteilt.

Les expériences acquises au cours de l'utilisation des restituteurs analytiques dans un bureau d'ingénieurs

Résumé

Les expériences faites par le bureau ROSE/WORTZLER/NÖCKEL avec un Planicomp installé depuis le début de l'année 1978, sont décrites de la manière suivante:

1. Détails de l'équipement de base et du matériel additionnel, pannes techniques survenues et durée d'utilisation.
2. Les domaines d'utilisation du Planicomp étaient jusqu'à présent les aérotriangulations, la mesure des coordonnées-image des points de contrôle pour les calculs sur l'orthophoto et les modèles digitaux de terrains.
3. Les expériences et la critique des collaborateurs ont une importance essentielle pour la mise à profit de l'ensemble du matériel, hardware et software.
4. La rentabilité du Planicomp est jugée positive en fonction du niveau de connaissances des utilisateurs, des périphériques, des tâches à remplir par le bureau et du degré d'utilisation de l'équipement.

Experiencias adquiridas durante la utilización práctica de restituidores analíticiso en oficinas de ingeniería

Resumen

Se presenta el informa siguiente sobre las experiencias hechas con el Planicomp instalado a comienzos de 1978 en la oficina de levantamientos ROSE/WORTZLER/NÖCKEL:

1. Componentes del equipo básico y complementario, perturbaciones técnicas experienciadas y tiempo de operación.
2. Hasta ahora, las aplicaciones han sido triangulaciones aéreas, medición de coordenadas de la imagen de puntos de apoyo para el cálculo de ortofotos y modelos digitales del terreno.
3. Las experiencias y la crítica de los empleados de la empresa son predominantemente positivas en cuanto al hardware y software.
4. Se considera como positiva la economía del Planicomp en función del grado de entrenamiento de los empleados, de la periferia, los trabajos de la empresa y el aprovechamiento.

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