ON-LINE TECHNOLOGY IN ANALYTICAL AERIAL TRIANGULATION

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ABSTRACT: A digital photogrammetric data collecting, checking, processing and representing system has been developed and implemented within the concerns related to analytical aerial triangulation process automation. The system contains six analytical instruments connected to a I-102 F minicomputer. The basic software, as well as, operational software are both presented. The economic-technical efficiency data are presented as against the off-line analytical aerial triangulation.

Introduction

On-line analytical aerial triangulation is undoubtedly the most important achievement within the present-day photogrammetry. It has the following main purposes:
- the immediat preliminary collected data processing (this processing includes both corrections necessary to eliminate systematic errors and statistic test use to eliminate gross errors);
- aerial triangulation adjustment as an integral part of the on-line process as much as possible;
- aerial triangulation work efficiency increasing.

There are two possibilities to approach on-line aerial triangulation in practice (Kratky 1980). The first approach is related to on-line independent method, when the system can be used to collect measured data, having a continuous controlled quality, followed by an off-line independent adjustment. The second approach is implemented as an on-line simultaneous method, in which the adjustment belongs to the on-line process, and output results are available to be immediately used for the purpose we have envisaged.

The first method is more suited for practical use, because an independent adjustment is more efficient, especially when large blocks are considered (Kratky 1979). This is the method we have used in our own system.

The second method is used when we have not a medium computer for independent adjustment at our disposal or when the output results are immediately required.

We shall try to further on present the on-line analytical aerial triangulation system outlook, hardware-software structure and its economic efficiency.

System Outlook

On-line analytical aerial triangulation system was so designed

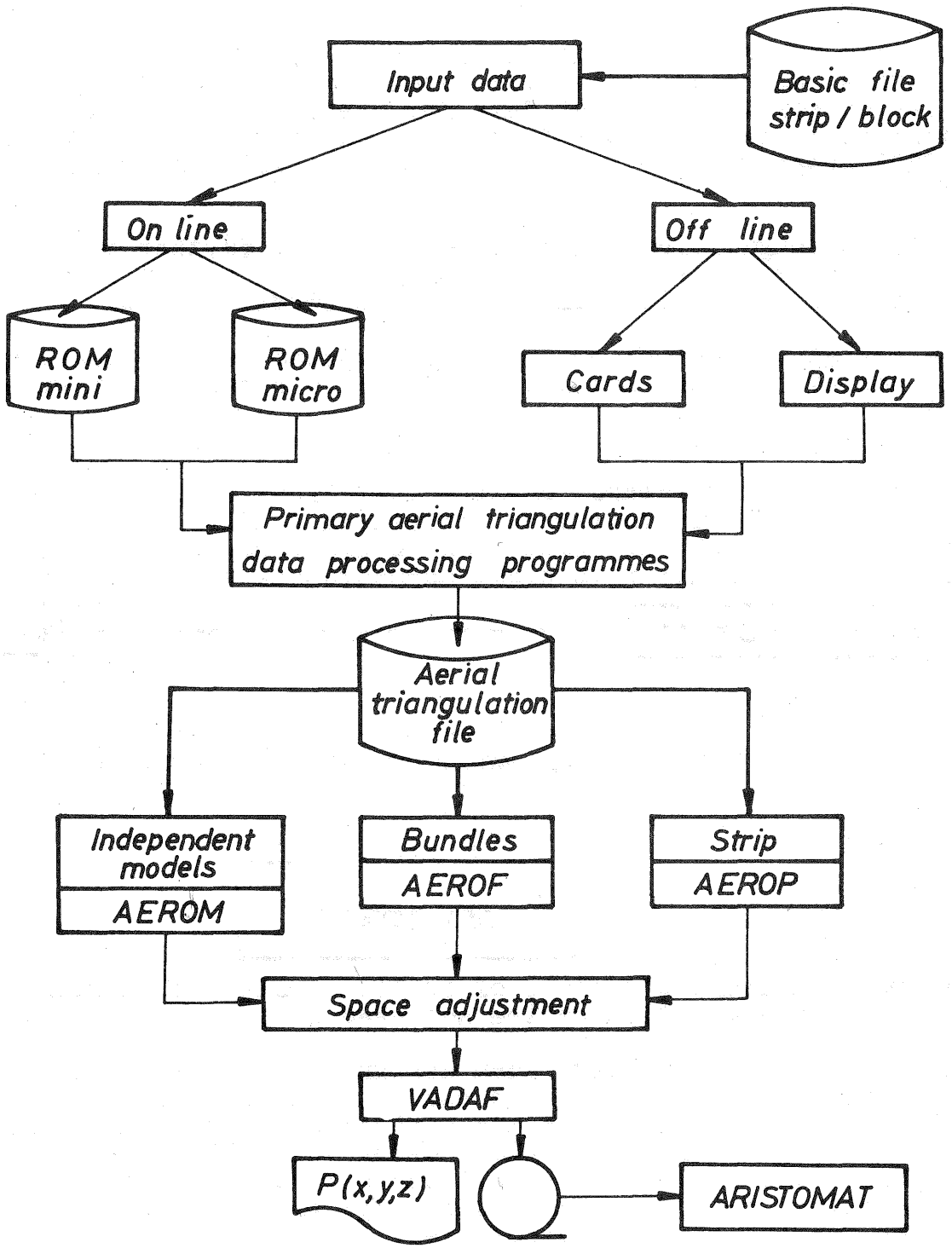

Figure 1 Analytical Aerial Triangulation System Used in Our Institute

and achieved that photogrammetric measurements could be processed in strip or block, thus establishing an aerial triangulation point file. This file is established on-line by working stations or off-line using information support (cards or alpha-numerical display). This file output data of the aerial triangulation points are input data for space adjustment, using independent models (AEROM programme), photogrammetric bundles (AEROF programme) or independent strips (AEROP programme), as well.

Aerial triangulation point coordinates are further analysed and validated by VADAF special programme to obtain input data to be used in drawing files, using ARISTOMAT plotter.

The analytical aerial triangulation system outlook designed and achieved in our Institute is briefly presented in Figure 1.

Hardware Structure

As regards its hardware, on-line analytical aerial triangulation system of our Institute contains a I-102 F minicomputer (compatible to PDP-11) connected to eight working stations, using a multiplexer with eight asynchronous ways (Figure 2).

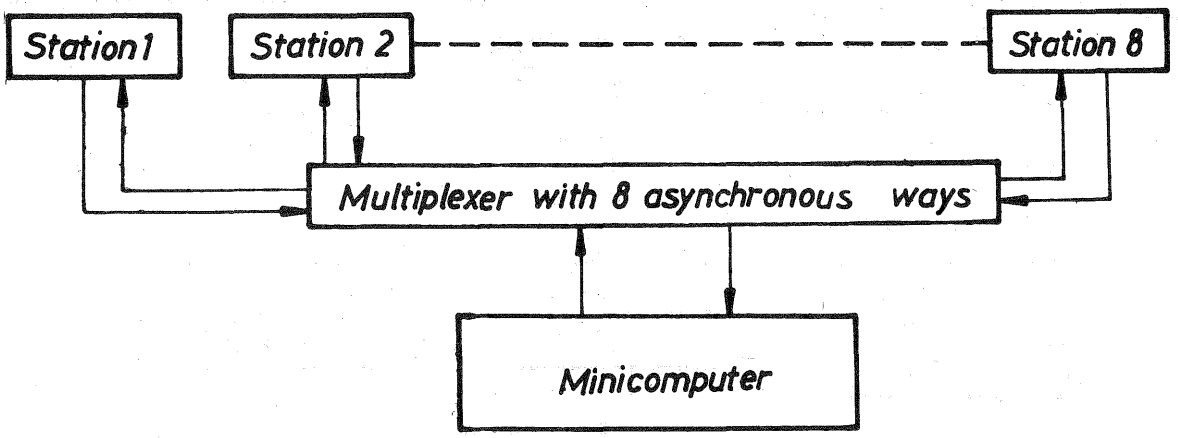

Figure 2 Hardware structure of on-line analytical aerial triangulation system achieved in our Institute

The working stations have been designed and achieved in two versions. A version, in which each station has an interface to allow the connection among the minicomputer and a coordimeter and an alpha-numerical display, using the multiplexer plate (Figure 3 a). In this case, all photogrammetric data processing (processing, validation and recording) are supervised by a programme running on the minicomputer. This programme was "event-driver" designed; any time the human operator from the station display initiates an action, a software interruption occurs and it is entered the supervisor, where a special treatment takes place.

The second version (Figure 3 b) is a distributive one, in which processings are carried out on the microcomputer of each station, the eventual complex processings to be carried out on the minicomputer. This version has the following advantages:

- coordimeters as registering devices are eliminated;
- system flexibility is increased, microcomputer connexion could be on-line, off-line via floppy-disks or a local area network;
- system facilities are increased.

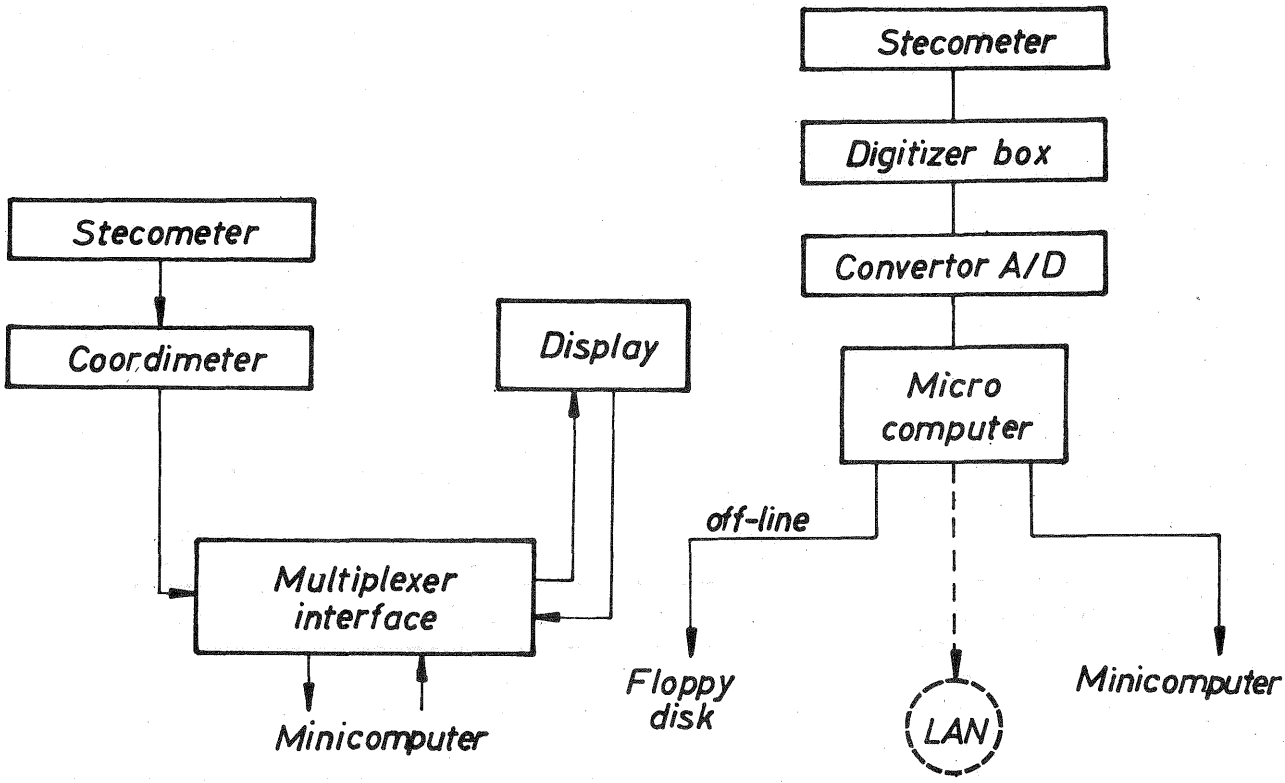

Figure 3 The working station structure
a) centralized station
b) distributing station

Software Structure

Technological software contains, on the one hand, the basic software collecting data and, on the other hand, the applicable software processing these data. The basic software contains two programme packages, i.e. ROMBIM and ROMBIX, when data are collected by minicomputer or microcomputer, respectively. Validation programmes for measured data on reference indices (VAR programme), orientation points (VAO programme) and model connection (VAM programme) and incorporated in both programme packages.

These primary programme functions are referring to: coordinate reduction and transformation into index system, systematic error correction , relative orientation, coordinate computation on photograph, model or double model coordinate computations, and general model coordinate computations, as well. These programme are used to make aerial triangulation file (Figure 1).

The applicable software contains three AEROM programme packages

for computation and adjustment using independent models, AEROF for photogrammetric bundles, and AEROP for independent strips. Just a mention, the proper computation can be made on strip or block based on sequential or quasi-sequential principle, using any one of the above mentioned programme packages (Gruen 1985). The block can be made up of independent or double models, bundles or independent strips . AEROP programme package uses polynomial computation and adjustment in strip or block, employing I,II and III order polynoms (Schut 1962).

Technical Economic Efficiency

Some parameters related to a strip and a block off-line and on-line achieved respectively, have been analysed to evaluate technical economic efficiency. The strip contains 8 models, and the block contains 5 strips of 8 models each. This comparison results are presented in Table 1.

Table 1

		Operation time x) (hours)	Value (lei)	Labour productivity (per cent)
Strip	off-line	12	1,675	100
	on-line	7	919	142
Block	off-line	60	8,350	100
	on-line	35	4,743	142

x) Operation time comprises the whole process (design, photograph preparation, measurement, processing, final documentation preparation)

Analysing these parameters, we can find a greater efficiency of the on-line technology as against the off-line one. Some other advantages can be mentioned:
- an unitary aerial triangulation data collection, validation and processing process achievement;
- the complete elimination of all error resulting from off-line process;
- an important decreasing of data collection and processing time;
- a real increase of accuracy and result feasibility;
- a close connection among photogrammetric plotting process stages; the aerial triangulation results can be directly used in this process for relative and absolute stereomodel orientations.

RÉSUMÉ: Parmi les préoccupations concernant l'automatisation du procès de l'aérotriangulation analytique on a élaboré et réalisé un système d'acquisition, de contrôle de validité, de traitement et de représentation des données photogrammétriques di-

gitales. Le système est formé de six appareils analytiques connectés à un miniordinateur I-102 F. On présente le software de base et le software applicatif qui concerne l'aérotriangulation analytique. On présente aussi des données d'efficience technique et économique par comparaison à l'aérotriangulation analytique off-line.

ZUSAMMENFASSUNG: Um den Prozess der analytischen Aerotriangulation zu automatisieren, wurde ein System der Erfassung, Richtigkeitsprüfung, Verarbeitung und Darstellung der photogrammetrischen digitalen Daten entworfen und realisiert. Das System umfasst sechs analytische Geräte mit einem Kleinrechner I-102 F verbunden. Das Software für die analytische Aerotriangulation wird beschrieben und es wird die technisch-ökonomische Leistungsfähigkeit gegenüber der analytischen off-line Aerotriangulation studiert.

REFERENCES

Gruen, A.W. 1985. Algorithmic Aspects in On-Line Triangulation. Photogrammetric Engineering and Remote Sensing 4.

Kratky, V. 1979. On-Line Analytical Triangulation. The Canadian Surveyor 2.

Kratky, V. 1980. Present Status of On-Line Analytical Triangulation. International Archives of Photogrammetry, Commission III, Hamburg.

Schut, G.H. 1962. The Use of Polynomials in the Threedimensional Adjustment of Triangulated Strips. The Canadian Surveyor 3.