

ON THE INTERACTIVE PHOTOGRAMMETRIC SYSTEM ACHIEVEMENTS

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The general interactive photogrammetric system framework and the interactive photogrammetric system in use within the Institute for Geodesy, Photogrammetry, Cartography and Land Management are presented. The topographic map compilation and updating methods, as well as, the automatic mapping are considered. Some concerns related to the general land cadastre are also given.

Key Words: Analytical, CAD/CAM, Digital System, Integrated System, Photogrammetry

INTRODUCTION

Any photogrammetric system (either analogical or analytical) is, in fact, an information processing system or constituent parts of such a system.

Information to be processed is an analogical one being found within a photogrammetric image or other images taken by various sensors. In our view, to accomplish an interactive photogrammetric system, three main photogrammetric concerns should be taken into account, i.e.

- analytical aerial triangulation and analytical stereo plotting;
- analogical stereo planimetric plotting;
- analogical stereo levelling plotting (D.T.M.).

The first item has been explicitly dwelt on in (Corcodel, 1988). The system is consisting in six working stations. A distributive procedure has been used, Now, each station has a PC micro-computer. All information processing is made individually, at each working station. Finally, all output data are input in the host computer through an asynchronous way. These concerns are also covering analytical plotting, thus, large scale topographical maps over settlements have been compiled, using an on-line regime. These maps are used in cadastral works.

The second concern will be dwelt on below. A deliberate difference between the planimetry plotting and the levelling one will be made which, in fact, is our system concept. The automation of the general process compiling and updating topographical maps should be approached considering the present-day analogical equipment we have at our disposal, later on, to be integrated into an interactive photogrammetric system. Irrespective the proposed interactive photogrammetric system, it requires a process

computer, as well as, a system to display measured data automatically. Within an interactive photogrammetric system, the interactive data collection could be made either tridimensionally, using an analogical stereo plotter, or two-dimensionally using a digitizing table. Geodetic information and other ones derived from other sources should be processed by both procedures. The Digital Map having a data base for the required digital processing, and being used in various purposes (general cadastre, engineering applications, a.s.o.) is thus compiled. The diagram of the interactive data collection when a general interactive photogrammetric system is envisaged (Kröll 1981) is presented in Figure 1.

When IGFCOT specialists have started to establish an interactive system, they had already considered, on the one hand, the great many stereo plotters that had to be integrated into an interactive system and, on the other hand, a lot of analogical topographical maps to be changed into digital ones. So, the digital map could be compiled using data collecting programmes on-line connected to the proposed digitizers and analogical stereo plotters, respectively.

IGFCOT interactive photogrammetric system (Figure 2) has four working stations equipped with stereo plotters and a micro-computer, eight digitizing tables coupled to a minicomputer and two working stations in the field with their output on magnetic tapes. All these working stations are controlled by a host minicomputer to compile digital maps and/or to represent them on an automatic drawing table, or any special digital processing. Depending on the equipment we have at our disposal, we use a PC microcomputer on-line interfaced to a stereo plotter to digitize within a photograph plane (analogical stereo plotting), and a minicomputer on-line interfaced to a "time-sharing" multistation system to digitize within a map plane (Petrie and Adam, 1980).

HARDWARE STRUCTURE

The system hardware has a set of equipment and devices proper to the three sources collecting the measured data interactively (Figure 2). In analogical stereo plotting, each working station has a stereoplotter (in our case,

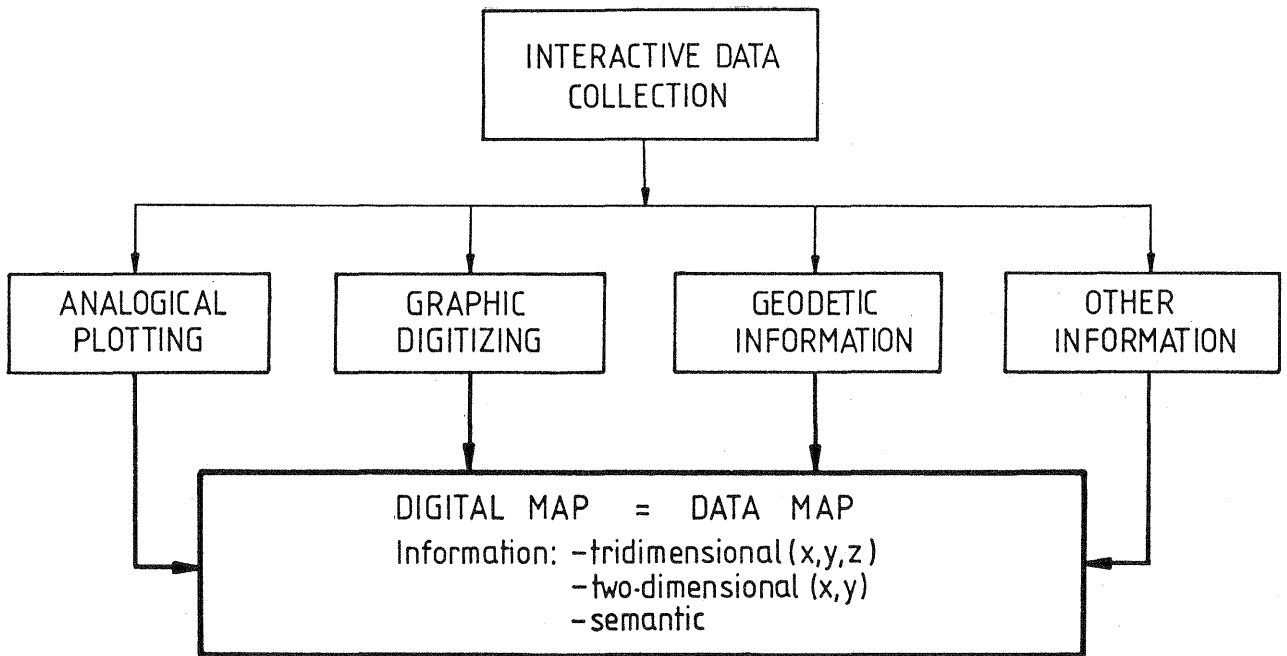


Figure 1. The Working Procedure of the General Interactive Photogrammetric System

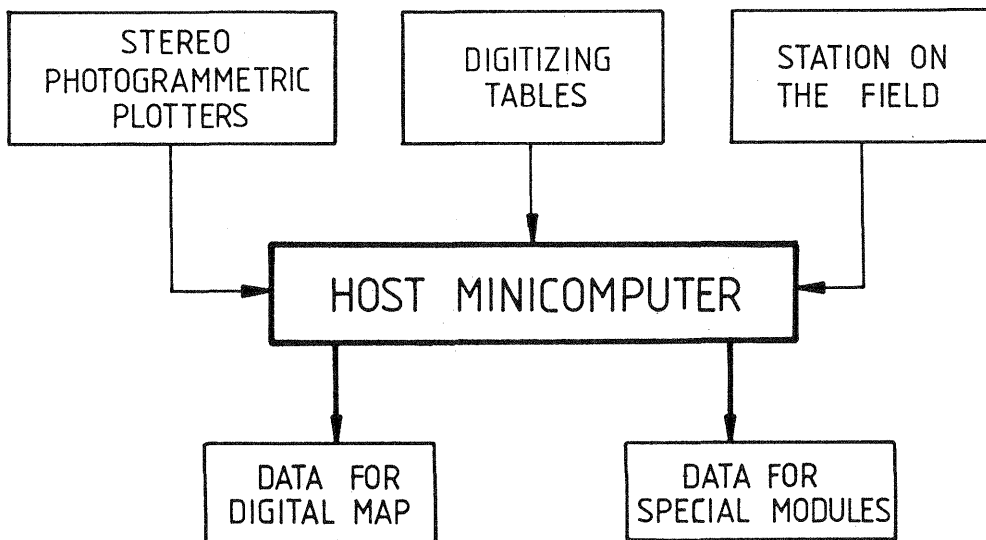


Figure 2. IGFCOT Interactive Photogrammetric System Concept

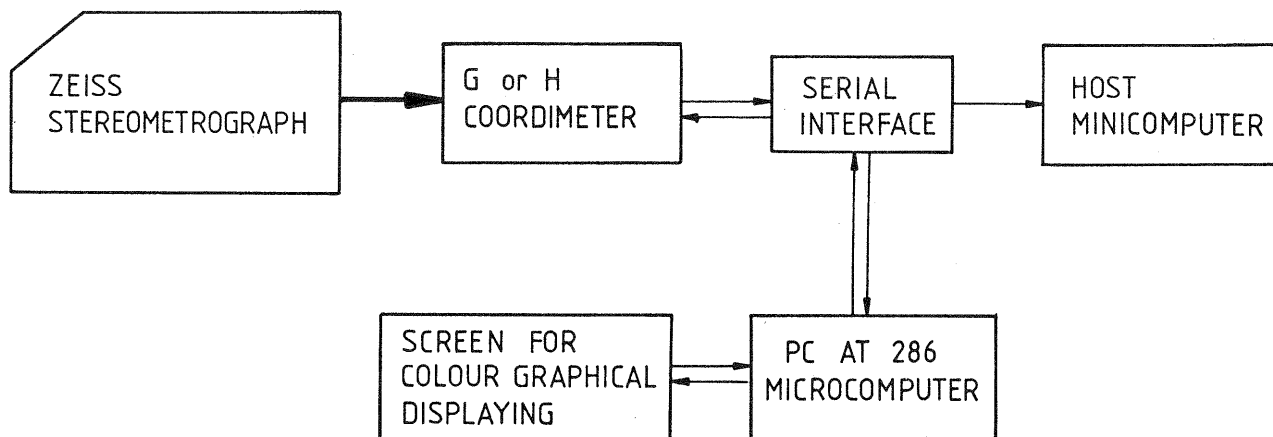


Figure 3. Hardware Structure of a Working Station in Analogical Plotting

a Zeiss Stereometriograph) and a Coordimeter (three G Coordimeters and a H one) a PC (AT-286) micro-computer, serial interfaces, displays and colour graphical display. Both G and H Coordimeters are equipped with measuring equipments depending on time and range. The constituent parts of such a station are illustrated in Figure 3.

A serial interface facilitates a serial way multiplexing to a host minicomputer developing a data information bank for an interactive editing.

An on-line interfacing eight digitizing tables to a I-102 F minicomputer has been established for digitizing purposes. Those Polish digitizing tables have a graphical impulse converter and a display. The working stations in the field are equipped with two Zeiss-RECOTA automatic Tacheometers. The measured data are registered into external storages. They can be used in subsequent processings, using special interfaces.

SOFTWARE STRUCTURE

Special software for each interactive procedure collecting the measured data (Figure 2) has been completed.

A flow line chart of the main programmes used in an interactive photogrammetric system is presented in Figure 4.

There are three main programme types, i.e. programmes for interactive data collection, programmes for data editing, and programmes for data processing (see Figure 4). Those programme functions are well-known, and we do not insist upon them at all. But, more stations in an operational mode to achieve the above mentioned functions need a longer period of time. To manage such a drawback, we also included a PC microcomputer into a working station and derived advantages from G or H Coordimeters taking facilities, as well. The first operations of an interactive working procedure are, on the one hand, the interactive stereo model orientation and, on the other hand, sheet orientation on the digitizing table.

As the relative stereo model orientation is still an empirical one, the absolute orientation is made automatically, using either a G or H Coordimeter of the above mentioned system or a PC microcomputer with its spatial transformation software in real-time. The exterior element orientations, after the computations have been completed, have proved to be an important advantage in stereo model orientations (Matton and Cor-codel, 1988).

The sheet orientations on the digitizing tables are made using an affine transformation or a plane orthogonal transformations, based on the known point coordinates and on some control grids (sheet corners, rectangular kilometre grid, a.s.o.). Both transformation parameters (plane or spatial transformations) are adjusted employing the statistics procedure eliminating the gross errors.

To a proper data editing (to compile and up-to-date maps or to implement some special data modules, e.g. to be used in cadastrie), an interactive graphical editing programme has been accomplished. So, a "windowing" procedure is used, and zone(s) to be checked or validated before input it/them into an interactive data and information bank is/are displayed on a screen. There have been also completed softwares carrying out a lot of special functions, such as, a geometrical figure tracing, when one of its points is unseen but its shape is presumed to be a rectangular one, parallel line tracing, an area hatching, a.s.o.

The above mentioned interactive system is based on an usual technological outlook, so that, both operational mode and its flexible configurations enable to develop and achieve new variants.

Such a planimetric approach gives the possibility to make some qualitative measurements, i.e. range and area computations. Besides the polygon and parcel delineations, an interactive process establishes also data for area computations, just to give an example.

To this aim in view, a computational soft-

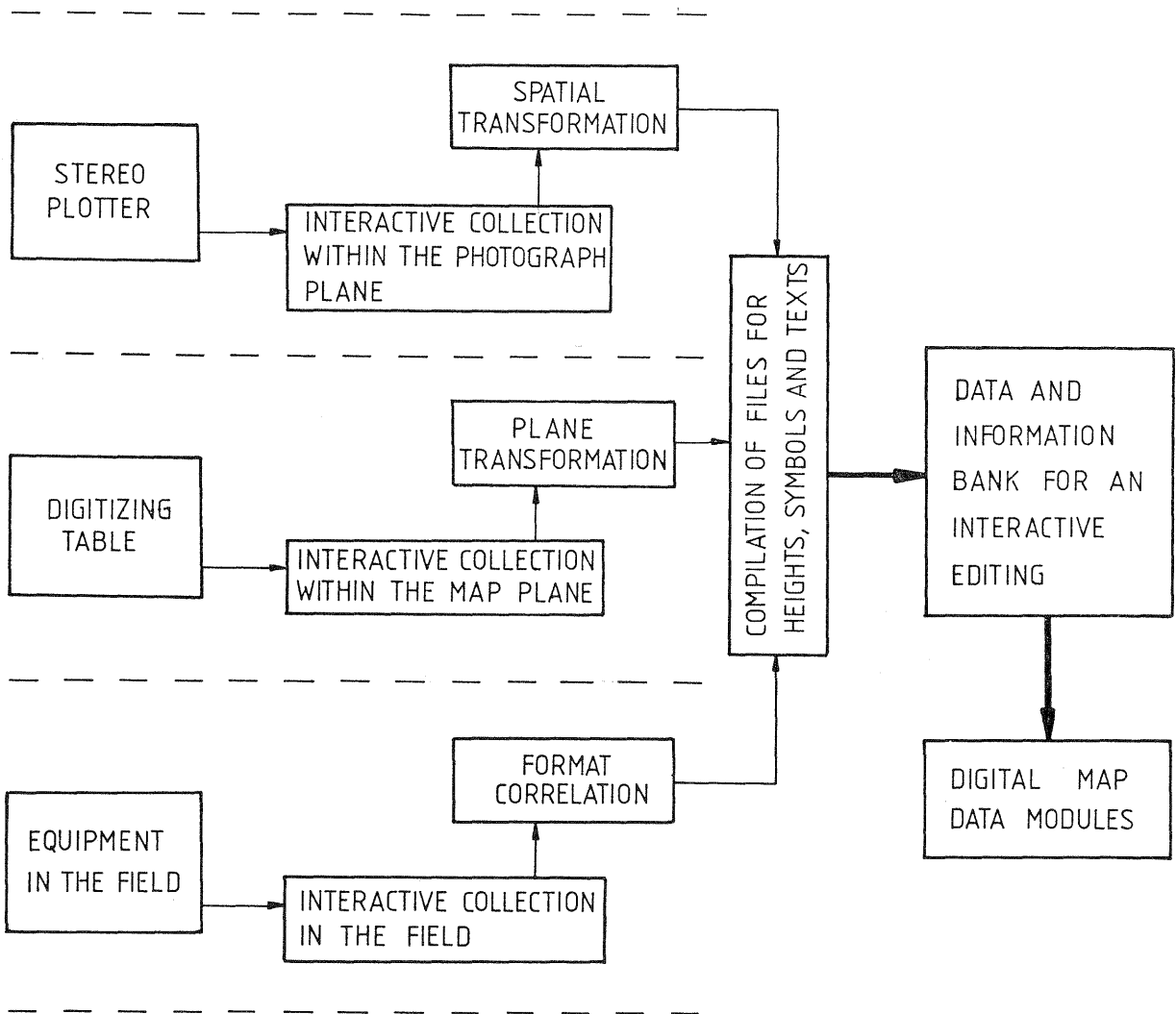


Figure 4. A Flow Line Programme Chart of IGFCOT
Interactive Photogrammetric System

were computing polygon and parcel areas, adding them, comparing them with the theoretical area on the sheets, and adjusting them according to their sizes has been conceived and implemented.

Obviously, there are many other applications of the technical-engineering fields of activity, but they are not the subject of this paper. To assure an outstanding use of the information, which a digital map can show, it is important that the output should be generated as a standard data format for various applications.

CONCLUSIONS

Undoubtly, an interactive photogrammetric system brings about an obvious improvement of the accuracy in topographical mapping. At the same time, some operations, such as, exterior stereomodel orientations, which are carried on using both additional measurements or orientation parameters derived from analytical aerial triangulation, could be made in a shorter period of time.

The most important achievement, which is

worth mentioning, is the digital data generation for more general uses and various purposes.

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