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P-CAP, THE PC SOFTWARE FOR P-SERIES PLANICOMP

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1. INTRODUCTION

Since their launch in 1987, P-Series Planicomp, the new line of analytical plotters from Carl Zeiss, Oberkochen, have won a significant share of the world market in conjunction with the cartographic system PHOCUS.

The first PHOCUS program systems could only be run on the HP 1000 minicomputers from Hewlett Packard, but since early 1989 it has also been possible to use PHOCUS on the instruments of the VAX family from Digital Equipment Corporation.

The P-Series plotters (P1, P2 and P3 Planicomp) can be connected to the computer either with a IEEE-488 or RS-232 standard I/O interface.

In response to the growing importance of personal computers, Carl Zeiss has decided to also operate the P-Series instruments with program systems which run on **IBM-PC compatible computers with the MS-DOS operating system.**

For this, two main problems had to be solved:

- generation of the orientation software
- connection of existing plotting systems (CAD, GIS/LIS)

The result of this development summarized under the product name P-CAP allows the creation of extremely budget-priced workstations for photogrammetric data acquisition.

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2. THE ORIENTATION SOFTWARE

The complete orientation software has been combined fo form an independent program package developed according to Carl Zeiss specifications at the Ohio State University in Columbus/USA. It is essential for the use of any of the plotting systems with the P-Series Planicomp. The salient features of this software are described in the following:

- the user interface

The entire photogrammetric project and model management and the orientation of a stereomodel are controlled by **WINDOWS**, a product of the company Microsoft. WINDOWS is a powerful, graphics-oriented user interface which also supports simultaneous work with several user programs. Operation is facilitated by standardized procedures. The parameter input, for example, or the calling of functions and the indication of operating errors are identical no matter how different the user programs are.

The wide use of **WINDOWS** and the fact that WINDOWS can now almost be considered a standard user interface ensure that the operator always has the same layout and input options at his disposal, even after changing the operating system or computer type. The user interface of the new OS/2 operating system from microsoft - **PRESENTATION MANAGER** - has been derived from WINDOWS and features the same graphically oriented input functions.

WINDOW is the term for a rectangular area on the display screen through which the user communicates with the appropriate program. Several application programs can be started with overlapping windows, with the active window being automatically displayed in the foreground.

The major control elements of WINDOWS are:

- **title bar**
  Title showing the name of the window or
  some characteristic information on the window

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- **menu bar**
  Main menu with the designations for the
  different functions within a specific application program

- **pull down menu**
  List for further subdivision of a main menu function

Different input techniques are used within a single function:

- **text boxes**
  Input fields for parameters such as point numbers, coordinates, etc.
  The requested values can be entered but also changed very conveniently
  inside these fields.
  Key pressures are not accepted outside these input fields.

- **list boxes**
  A list box is used for the display of several identical elements.
  For specific functions, any of these elements can be selected for further
  processing.

- **command button**
  Field with the name of a command. When called up, the relevant procedure
  is performed.

- **option button**
  Selection of an option to a command.

All input fields can either be activated with the mouse or via the keyboard.

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The **mouse** is used to move the screen cursor to the desired input field which is activated by the pressure of a key.
The proficient user can also enter the individual functions very quickly on the **keyboard**. The specially marked short-cut keys are very useful here: these keys or key sequences permit the direct selection of the commands by avoiding the menu structure. As the short-cut keys are appropriately marked in the designations for the input fields, the operator can gradually familiarize himself with this feature while using the program.

To ensure that the operator has no inhibitions about calling a function, all windows are provided with a cancel functions. All entries inside the window remain ineffective if the window is left with Cancel.

- Project and Model Management

P-CAP enables the management of several projects, a project being understood to mean the combination of several related models. For the definition of the project, parameters which are constant for all models of the project are entered. Projects may be created, called up and deleted after completion of all procedures.

Each model within a project is created in the 'model definition' window.
The parameters to be entered are: the control point file used, the camera data and the photo numbers. Models can be created, processed and deleted in the same way as projects.

This project and model management is based on a directory structure.
The individual subdirectories include the data files pertaining to a project or model. As the data files of all projects, individual projects and also of individual models can be accessed, this feature permits simple and efficient structuring for the data back up procedure which must be performed at regular intervals. During model orientation the operator does not see the MS DOS file hierarchy. For the assignment of the data files, he uses the name of the selected project or model.

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Irrespective of the project management, the control point or camera data files are stored in separate subdirectories and are therefore available for all projects. As the files involved are ASCII files, they can also be transferred from another computer system or from external programs. Simple reformatting procedures may be required for this purpose.

- Model orientation

The complete orientation of a stereomodel is performed in three steps:

- interior orientation
- relative orientation
- absolute orientation

The individual programs are started either via pull-down menus or directly with short-cut keys. Although the window used is adapted to the specific requirements of the type of orientation, all windows have an identical layout with identical operation features.

- **message box**
  The message box is used for the display of status and error messages.

- **list box**
  The list box is used for listing the measured points.
  Apart from the point identifier (point number, code), the list also includes the residual errors relevant for the assessment of the orientation. These residual errors are the criteria which the operator uses to decide on the further treatment of a point or the overall orientation. The computation is performed whenever a new point has been added or an existing point has been changed. This means that the list always reflects the **current** status. The time required for the adjustment is extremely short and barely noticeable to the operator..

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- **P-cursor layout**

No permanent functions have been assigned to the function keys of the photogrammetric cursor. To ensure maximum efficiency of the orientation measurements, the P-cursor is assigned the functions required for measurement with the current program. These functions are displayed in a symbolic key layout.

- **Measuring functions**

Three measuring functions are available altogether:

AUTOMEASURE
MEASURE
CORRECT

AUTOMEASURE is used for the automatic rough positioning of points specified by the program. This is done on the basis of orientation parameters which have been either estimated or provisionally computed from existing measurements.
These parameters are the fiducial marks in interior orientation, the Gruber points in relative orientation and the control points located in the model area in absolute orientation. These control points are picked out from the control point file belonging to the model.

MEASURE permits the remeasurement of a point already included in the list box. In this process, the new measurement and the previously filed measurement are averaged so that any number of measurements can be taken per point.

CORRECT is used to overwrite an existing point with the new measured data.

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- **Editing functions**
  RENAME and SKIP are used for the correction of measured points; RENAME changes the point identifier and SKIP temporarily excludes a point from the adjustment process. This point is, however, also transformed and the difference from the nominal point is displayed. This difference is very convenient for locating any gross errors or for detecting point confusions, especially in absolute orientation.

After final acceptance of an orientation step, the orientation results are transferred to the Planicomp P-processor and stored in files for later use.

After absolute orientation, all data required for orientation are stored in an ASCII file in a defined format (PHOREX format).

This file is used for three purposes:

- It serves as a data interface for the driver if CAD systems are connected.
- It permits the exchange of orientation data with the C100 Planicomp or with instruments of the Planicomp P-Series operated with PHOCUS.
- It permits data exchange with systems from other manufacturers.

This means that the measurement and adjustment of a block triangulation can also be performed, for example, on a C100 Planicomp. The orientation data is then transferred to P-CAP for further processing of the models (mapping).

3. CONNECTION OF CAD AND GIS/LIS SYSTEMS

A range of high-performance CAD program packages which are already successfully in use in the field of surveying are offered on the market for personal computers. Also available are GIS/LIS program packages which have gained worldwide recognition.
An analytical stereoplotter is the ideal data acquisition instrument for these systems. The development of drivers for the connection of these program systems to the P-Series was therefore a logical consequence.

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Carl Zeiss currently supports the connection to the following systems:

- **AutoCAD** from Autodesk
- **MicroStation** from ~~Autodesk~~
- **pcARC/INFO** from ESRI

In all these cases the analytical plotter is fully integrated into the system:

- On the activation of measurements, the floating mark position in the stereomodel supplies three-dimensional coordinates to the system.
- The floating mark can be used for guiding the cursor of the display screen.
- The function keys of the P-cursor are used for both the measurement of points and the calling of functions.
- The P-cursor offers extensive possibilities for incremental recording which have been specially optimized for photogrammetric data acquisition and can be used for digitizing line objects.
- Commands can be called via menus on the Planicomp tablet.
- All measuring and editing functions are at the operator's direct disposal because the Planicomp behaves like an input instrument supported by the system.

The CAD and LIS systems are designed for high flexibility and can be adapted to the user's special requirements. The menu design makes it easier to call up the great variety of functions.
The basic functions can be combined into complex macros. The range of functions can be almost infinitely extended by additional programming in a higher-level language which allows the functions to be called up like standard commands via the keyboard or menus.

Examples of upgrading of this type are:

- measuring program for buildings, with right-angle generation
- measurement of conteur lines, including annotations
- measurement of slopes with automatic slope hatching
- generation of symbols along lines
- mapping of symbols as a function of the object size
- profile measurement

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The company DAT/EM, USA, has implemented these upgrading possibilities in AutoLISP language for data acquisition with AutoCAD. They are supplied in conjunction with the driver for Planicomp.

4. PERSONAL COMPUTER AS A PHOTOGRAMMETRIC WORKSTATION

A PC-supported analytical plotter constitutes a fully-fledged workstation whose connection with other systems is ensured by a large variety of interfaces.

Data exchange with other computers (PC, minicomputer or mainframe) may be performed by means of on-line computer connections. One possibility is coupling via an RS232 interface at virtually no additional cost, permitting both file transfer and terminal emulation.

More convenient solutions include the use of a network such as Ethernet, where the PC forms a complete node which is able to access other sources in the network. This system allows the use of large mass storage units and the output of processed maps on plotters or of files on a central printer.

A considerable range of programs for personal computers is available, permitting further processing of data acquired with P-CAP. Programs exist for

- block triangulation
  (e.g. PATM-PC, PATB-PC, BINGO)
- digital terrain models
  (e.g. SCOP(PC), HIFI 88)
- geodesy
- architecture
- road and railway design
- cartography

A number of defined formats is available for the data exchange between the software packages. One of the most common is the DXF format from AutoCAD which is used for the exchange of graphic information.
Carl Zeiss supports the data exchange between PHOCUS and several major systems, e.g. from Intergraph, Siemens etc. /5/.

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The exchange of orientation data between the analytical systems from Carl Zeiss (C100, PHOCUS/P-Series Planicomp, P-CAP/P-Series Planicomp) is performed by the use of the above-mentioned PHOREX format.

This wide range of data interfaces ensures that a PC-supported stereoplotter is not merely an isolated unit but is excellently suited as a workhorse in photogrammetric data acquisition.

REFERENCES

/1/ Zilberstein O. : A Modern Man-Machine Interface for the
Greenfield, J. S. Planicomp Analytical Plotter
Schenk, A. F. ACSM-ASPRS Annual Convention,
Toth, C. K. Baltimore, 1989

/2/ Schenk, A. F. : A PC-Based Version of the Planicomp
Toth, C. K. Analytical Plotter
ACSM-ASPRS Annual Convention,
Baltimore, 1989

/3/ Saile, J. : P-Series Planicomp - The New Ergonomic and
Intelligent Planicomp Family from Carl Zeiss,
Oberkochen
ACSM-ASPRS Annual Convention,
Baltimore, 1987

/4/ Menke, K. : The New Universal Photogrammetric and
Cartographic System from Carl Zeiss,
Oberkochen
ACSM-ASPRS Annual Convention,
Baltimore, 1987

/4/ Braun, J. : The Current Status of the PHOCUS Development
Proceedings of the 42nd Photogrammetric Week
at Stuttgart University, Vol. 13, Stuttgart 1989

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ABSTRACT

A P-Series Planciomp plotter and the software components presented here can be combined to form an economy-priced, powerful workstation. The integration of existing, widely used software packages makes a great variety of data acquisition and editing functions available to the operator. As a result, the relatively small group of photogrammetric users fully benefit from the new and further developments in the field of CAD systems. The variety of data interfaces and the wide range of software available permit the PC/Planicomp combination to be optimally tailored to the user's specific requirements.

P-CAP, DIE PC-SOFTWARE FÜR DIE PLANICOMP P-SERIE

ZUSAMMENFASSUNG

Mit einem Gerät der Planicomp P-Serie und den vorgestellten Software-Komponenten kann eine kostengünstige und leistungsstarke Arbeitsstation zusammengestellt werden. Durch die Integration vorhandener und verbreiteter Softwarepakete stehen dem Operateur vielfältige Erfassungs- und Editierfunktionen zur Verfügung. Neu- und Weiterentwicklungen auf dem Gebiet der CAD-Systeme kommen dadurch voll dem relativ kleinen photogrammetrischen Benutzerkreis zugute. Durch vielfältige Datenschnittstellen und ein breites Software-Angebot kann die Kombination PC und Planicomp optimal den Bedürfnissen des Benutzers angepaßt werden.

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