TUITION CONCEPT AND LEARNING AIDS IN MODERN APPLICATION SOFTWARE USING PHOCUS AS AN EXAMPLE

By Hartmut Rosengarten, Oberkochen

ABSTRACT

PHOCUS and the Zeiss P-Series Planicomp are a versatile and comprehensive system for photogrammetric and cartographic data processing. The general handling and efficient use of this sophisticated application software require an advanced tuition and training concept. Integrated learning aids (tutorials and help functions) are used in addition to the traditional learning aids like reference manuals and operating instructions. The general training concept provides for the training of operators, project managers and application programmers.

1. DEMANDS ON MODERN PHOTOGRAMMETRIC/CARTOGRAPHIC APPLICATION SOFTWARE

The continuously increasing computer performance accommodates the users' desire to collect, store and process even 3D data in digital form. Terms like land information system (LIS) and geographical information system (GIS) are nowadays everyday terminology in cartography and photogrammetry.

Centralized or distributed software systems for creating and managing land information systems have already been set up in several countries. The number of these systems, some of which differ widely in performance, is increasing continuously.

Topographic data acquisition by means of analytical photogrammetry plays an ever greater role in this development. The current methods of cartographic on-line processing of photogrammetrically collected data considerably reduce the time required for converting aerial survey photos into (digital) maps. If open input and output interfaces are also available (3D and 2D data, tacheometric data, attributes, data exchange format), an enhanced photogrammetric/cartographic information system is obtained that affords both

- comprehensive processing of topographical data right up to digital and/or analog output and
- data interchange with other information systems.
However, a future-oriented software system for photogrammetry and cartography must not only provide a comprehensive range of functions but also user-friendly and easy handling. These apparently contradictory demands are detailed in Fig. 1.

<table>
<thead>
<tr>
<th>COMPLEX RANGE OF FUNCTIONS</th>
<th>EASY HANDLING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible project and system environment (variable user coordinate system, flexible hardware configuration and operator environment)</td>
<td>Uniformity</td>
</tr>
<tr>
<td>Versatile data acquisition (3D-, 2D-, geo-input)</td>
<td>Flexible input concept</td>
</tr>
<tr>
<td>Free object code definitions</td>
<td>Menu system</td>
</tr>
<tr>
<td>Geometry data and attributes processing</td>
<td>Built-in intelligence (default values error tolerant input)</td>
</tr>
<tr>
<td>Data storage and management in a data base (DB)</td>
<td>Integrated learning aids</td>
</tr>
<tr>
<td>Data editing and revision</td>
<td>Training environment</td>
</tr>
<tr>
<td>Independent flexible graphics tables</td>
<td>...</td>
</tr>
<tr>
<td>Demand-oriented data output (graphics, listings, data exchange format)</td>
<td>Enhanced Photogrammetric Cartographic Information System</td>
</tr>
<tr>
<td>Alternative &quot;classical&quot; acquisition/mapping methods</td>
<td></td>
</tr>
<tr>
<td>Custom application programming</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1: Performance and Handling Demands on Modern Software

The demands for a comprehensive range of functions and easy handling are of particular significance if a software product is to be accepted and used all over the world by users with different backgrounds. The tuition concept of the PHOCUS software system developed by Carl Zeiss, West Germany, is used to illustrate how the handling of complex application software can be learnt quickly and efficiently in an operator-friendly environment.
2. UNIVERSAL PHOTOGRAMMETRIC/CARTOGRAPHIC DATA PROCESSING WITH PHOCUS

Carl Zeiss has gained experience in the design and marketing of photogrammetric instruments for decades. The development of modular application programs that led right up to the PLANIMAP digital mapping system began when the C 100 Planicomp analytical plotter was introduced at the 13th ISP Congress at Helsinki in 1976.

A milestone in this development came in 1987, when the data-base-oriented PHOCUS photogrammetric and cartographic information system was introduced together with the P-Series Planicomp, the second generation of analytical plotters.

The PHOCUS software product fully satisfies the demands listed in Fig. 1. The fields of application listed in Fig. 2 illustrate the current range of functions.

| Photogrammetric measurement and related editing | General editing | Cartographic data base |
| 2D digitization and related editing Editieren | Data base for the management of geometric data and attributes | Map production |
| Entry of alpha-numeric and geodetic data | Graphical output | Map revision |
| | | Digital elevation models |
| | | Point measurement by block triangulation |
| | | Close-range photogrammetry |

Fig. 2: Major Current PHOCUS Applications

PHOCUS is based on the structured management of geometric and non-geometric data in a data base (DB). The PHOCUS software structure is characterized by the fact that all functions are activated and controlled by the integrated PHOCUS operating system.

The software system can be used on HP 1000 A Series and DEC MicroVAX workstation computers. PHOCUS supports the following general hardware environments:
- P-Series Planicomp (including additional periphery, in particular graphics equipment) for photogrammetric data acquisition and editing by means of the VIDEOMAP optical superimposition system.

- PD digitizing subsystem (including additional periphery, in particular graphics equipment) for collecting 2D data, and

- PE editing subsystem for editing PHOCUS object data.

A major PHOCUS feature is its user-friendliness. The tuition and training concept that ensures this user-friendliness is described in the following.
3. PHOCUS TUITION CONCEPT

Fast familiarization and efficient handling are major performance assessment criteria for a highly functional software product. The development of PHOCUS was therefore based on a versatile tuition concept that ensures fast and efficient familiarization with the software by different users and for different tasks (e.g. data acquisition by operators, project management by system managers).

The overall concept provides for two training areas:

- Productive use of PHOCUS
- Application programming in the PHOCUS environment

This differentiation is required because each area places different demands on the users' background. The result is the tuition concept shown in Fig. 3. Details on the tuition methods for the productive use of PHOCUS are given in section 4.

![Tuition Concept for PHOCUS Training](image)

Fig. 3: Tuition Concept for PHOCUS Training
The operators responsible for the PRODUCTIVE USE of PHOCUS need only little EDP training and no detailed PHOCUS system knowledge. They are first of all required to master the application tasks.

- Use of the P1, P2 or P3 Planicomp analytical plotter for topographical data acquisition and editing, for measuring digital terrain models, and for photogrammetric point measurement for block or model adjustment.

- Digitization of 2-dimensional data.

- Graphical data output with drum plotters or precision tracing tables as a preparation for map production.

The project and system environment for the operator is established by the PHOCUS project manager. This work requires some familiarity with electronic data processing (file management, screen editor) and profound familiarity with photogrammetry and cartography. Some project manager tasks are listed below:

- System management (PHOCUS system files, device tables, project and operator names).

- Project installation (user coordinate system, object code table, data base).

- Preparing menus.

- Establishing graphics tables.

- Data interchange e.g. with the PE editing subsystem or with other information systems

If trained properly, the operator can perform some or all project manager tasks. Introduction to and training in these fields are the subject of the training courses integrated in the tuition concept (refer also to section 4.3). If desired, Zeiss specialists can establish an initial custom project and system environment in the field.

The high functional versatility of PHOCUS opens up a comprehensive range of applications in photogrammetry and cartography. Even so PHOCUS is an open software system that affords user APPLICATION PROGRAMMING of special tasks. This work requires programming experience and computer knowhow (HP, DEC). The additional knowledge of the PHOCUS software structure (operating system, interfaces, program libraries) is given in special courses.
4. PHOCUS LEARNING AIDS

The tuition and work methods for the productive use of PHOCUS are most certainly the major components of the tuition concept (Fig. 3). They comprise:

- Direct use of PHOCUS and its integrated learning aids.
- The manual.
- Training by specialists in training courses.

The targets and contents of these methods, which differ from the conventional ones, are exemplified below.

4.1 DIRECT PHOCUS USE

When he starts PHOCUS, the user is confronted with an operating system-like environment in which he can call and process individual tasks (Fig. 4). The project and system environment used last is re-established each time PHOCUS is started.

CMD> (Command prompt of the PHOCUS operating system)
- Parameter entry and function specification (i. a. HELP)
- Normal termination (EX) or abortion (AB) of PHOCUS
- Entry of temporary computer commands in the PHOCUS environment
- Calling application functions (INOR, REOR, ABOR etc.)

Example: CMD> MEOD (Measure object data)

MEOD> (Command prompt of the application function)
- Parameters and functions (i. a. also HELP, TUTORIAL)
- Work (measuring and editing in this instance)
- Temporary PHOCUS and computer commands
- Application program termination:

MEOD> EX

CMD>

Fig. 4: PHOCUS Input Concept

Task handling is facilitated considerably by system-specific features and integrated learning aids. The intelligence and wealth of help information built into PHOCUS largely replace the continued use of manuals required by other systems.

The flexible but uniform input concept enables the user to enter all or individual parameters for an application program either in the command mode or in the dialog mode. The readiness of the system to accept entries is indicated by a program-specific prompt (e.g. INOR>, REOR>, ABOR> for the PHOCUS program components for interior, relative and absolute photo pair orientation with the Planicomp; refer also to Fig. 4).
The intelligence of the command interpreter also ensures error-tolerant input. Input requests are backed up by appropriate default values.

Efficient input means are

- menus (especially for object-structured data acquisition and editing),
- macro commands for frequently recurring operations, and
- manual entry.

The menu system in particular is a user-friendly entry method. The photogrammetric operator or cartographic editor can concentrate on the task on hand without concerning himself with input commands or object structures. PHOCUS therefore contains a versatile menu system. It comprises:

- The TABLET menu, an overlay that can be arranged freely on the tablet of the P1/P3 Planicomp or the PD digitizing subsystem (up to 4 overlays).
- The Planicomp menu for defining the soft keys of the Planicomp P-Cursor (Fig. 5) or the foot switches, if available.
- The DIGITIZER menu for defining the soft keys of the so-called D-Cursor of the PD digitizing subsystem.
- The GRAPHICS menu, a menu line on a graphics screen.
- The PANEL menu for defining the soft keys of an additional command panel (PHOCUS Panel).
- The SOFT-KEY menu for defining the soft keys of an alphanumeric terminal (e.g. the system console).

At system installation time, the user is provided with a large number of ready-made menus that facilitate general handling (calling application functions, parameter entry, help) and support special applications (e.g. measurement and editing functions).

Fig. 5: The P-Cursor -
The main control element for the P1/P3 Planicomp Operator
The **PHOCUS** input concept is furthermore characterized by permanently available integrated learning aids like tutorials and help functions. The tutorials in particular enable the **PHOCUS** novice to directly request information on the purpose and execution of an application task. The help functions provide

- a survey of the existing and currently available functions and parameters of an application program, and
- detailed information on the purpose, range and syntax of each command.

The help functions can be called both in the command mode and in the dialog mode. Fig. 6 shows an example.

<table>
<thead>
<tr>
<th>INOR&gt; ?</th>
<th>(call of HELP information in &quot;interior orientation&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIDUCIALS NF : PARAMETER</td>
<td>to set the number of fiducials</td>
</tr>
<tr>
<td>TYP TY : PARAMETER</td>
<td>to specify the type of transformation</td>
</tr>
<tr>
<td>SETTINGS NS : PARAMETER</td>
<td>to specify the number of settings</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>REJECT RE * : FUNCTION</td>
<td>to reject this fiducial</td>
</tr>
<tr>
<td>CALCULATE CC * : FUNCTION</td>
<td>to calculate the interior orientation</td>
</tr>
<tr>
<td>SET SE * : FUNCTION</td>
<td>to set parameters</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INOR&gt; SE</th>
<th>(set parameter in INOR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARRIER CA = &gt;BOTH</td>
<td></td>
</tr>
<tr>
<td>FIDUCIALS NF = &gt;4</td>
<td></td>
</tr>
<tr>
<td>TYP TY = &gt;1</td>
<td></td>
</tr>
<tr>
<td>SETTINGS NS = &gt;/H</td>
<td>(call of HELP information for NS)</td>
</tr>
<tr>
<td>Usage : NS = par</td>
<td></td>
</tr>
<tr>
<td>par : Number of settings for each fiducial</td>
<td></td>
</tr>
<tr>
<td>Purpose : If NS = 2, then the programm expects two settings of each fiducial. ...</td>
<td></td>
</tr>
<tr>
<td>SETTINGS NS = &gt;1</td>
<td></td>
</tr>
<tr>
<td>TORES TO = &gt;0.010</td>
<td></td>
</tr>
<tr>
<td>CAMERA CM = &gt;/E</td>
<td>(to terminate the dialogue)</td>
</tr>
</tbody>
</table>

**Fig. 6:** **PHOCUS** Help Functions (Example)

An important component of the **PHOCUS** system are ready-made training projects, i.e. installed work environments for both the operator and the project manager (menus, system files) for different applications:
### Project - Application

<table>
<thead>
<tr>
<th>Project</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMO</td>
<td>Object-oriented data acquisition and editing; data output with specialized graphics tables</td>
</tr>
<tr>
<td>PLOTTING</td>
<td>Graphics-oriented editing and output (simple digital mapping)</td>
</tr>
<tr>
<td>TRAINING</td>
<td>Establishment of a project environment by the user with the &quot;Typical Applications&quot; described in the manual.</td>
</tr>
<tr>
<td>...</td>
<td>Further projects are being prepared for &quot;DTM Measurement&quot; and &quot;Aerotriangulation&quot;</td>
</tr>
</tbody>
</table>

The training projects are provided not only for initial familiarization with PHOCUS and for training courses, but also for direct productive use.

#### 4.2 THE MANUAL

The PHOCUS input concept and the integrated learning aids have changed the conventional role of the manual considerably. This is why the PHOCUS operating manual does not list the complete range of functions and parameters of all PHOCUS application programs. Instead it describes:

- **General handling** (starting and terminating, PHOCUS Base, input and output, system files).
- **Practical handling of typical applications** (model orientation, work preparation; collecting, editing and outputting data).
- **Project and system management** by the project manager.

The manual thus provides the required information on the appropriate use of the PHOCUS application programs. In combination with the installed training projects (see above), the numerous examples assist in learning and consolidating major procedures.

#### 4.3 TRAINING BY SPECIALISTS

As a complement to the learning aids described in sections 4.1 and 4.2, there are optional training courses for

- operators and
- project managers

that provide intensive training in the general handling and productive use of PHOCUS. These one-week courses are given by application specialists.
To ensure efficient training, only a limited number of participants are admitted to each course. Direct training at the customer's site is also possible.

The training targets correspond to the operator and project manager tasks detailed in section 3.

Courses for application programmers by PHOCUS development specialists are available upon demand. They confer PHOCUS system knowhow for programming special applications in the PHOCUS environment.

5. PROSPECTS

Important criteria for the assessment of modern application software are not only its high functional versatility but also short training times and user-friendly handling. The tuition concept of the universal PHOCUS photogrammetric and cartographic information system meets these requirements. The sophisticated tuition concept includes comprehensive integrated tuition aids, a manual, and training courses.

Even so, the general handling and the work environment will be further improved, e.g. by adding further training projects and project environments tailored to regional particularities like national coordinate systems and object code tables.

LITERATURE


/4/ MENKE, K.: Map Production and Map Revision by PHOCUS Presented paper 16th ISPRS Congress, Commission IV, Kyoto 1988