

Computer-assisted stereoplotting system CASP  
 Dr.-Eng. Werner Marckwardt,  
 VEB Carl Zeiss JENA, 6900 Jena DDR and  
 Prof. Dr. Eng. Shunji Murai,  
 University of Tokyo, Tokyo, Japan

A computer-assisted stereoplotting system (CASP) has been developed at the University of Tokyo, which is based on the TOPOCART-D Stereoplotter and the DZT 90 x 120 Digital Plotting Table made by VEB Carl Zeiss JENA and a Japanese microcomputer. These equipments are connected by a purpose-designed interface.

The CASP allows

- digital data acquisition and feeding into the micro-computer,
- geometrical correction of measured lines and polygons,
- generation of map symbols, and
- generation of Japanese and Chinese characters.

Advantages of the CASP system are

- low cost as compared with analytical plotters,
- software flexibility in accordance with user requirements, and
- capability to use Japanese and Chinese characters.

#### Hardware

The CASP system is composed of the following equipment. Interaction between the components is shown in Fig. 1.

#### TOPOCART-D

The TOPOCART-D is one of the most universal analogue stereoplotters. It features both a large continuous focal length range (45 to 310 mm) and a wide Z range (70 to 350 mm), thus permitting plotting from normal, wide and superwide angle photographs taken from air or ground. Thanks to the wide Z range there is practically no limitation as far as height differences in the model are concerned. Its high accuracy and its high-performance optics with three viewing magnifications make the TOPOCART-D applicable to mapping at all map scales. (Instead of the TOPOCART-D, the STEREOGRAPH and STEREOPLOT stereoplotters may be used.)

#### DZT 90x120 Digital Plotting Table

The DZT 90x120 operates by the principle of the "drafting hand". The table is tiltable, and the movements of the drafting head with its two drafting tools are controlled by a multi-microprocessor system. In addition to drawing continuous lines and straight connections with different kinds of lines, the standard configuration of the DZT can also write special symbols in different sizes as well as spot height coordinates.

The DZT 90x120 can be used as

- on-line plotting table in connection with all Jena plotting machines,
- manually operated plotting table for the preparation of map sheets and for drawing simple sketches, and
- off-line system feeding on data supplied by magnetic tape or external computer.

As part of the CASP system, the DZT is operated in the last-named mode.

#### Ai-M16 Microcomputer

The Ai-M16 microcomputer of Ai Electronics Corp., Japan, has a word length of 16 bit and an internal storage capacity of 512 K byte. Peripheral memory units include a 78 M byte hard disc drive and a 1 M byte floppy disc drive. The dialog with the system is conducted through an alphanumeric keyboard and a CRT display unit.

#### Digitizer

The digitizer made by Mutoh Engineering, Japan, has a table size of 1000 mm x 1200 mm. It has an areal measuring system with a resolution of 0.025 mm. Measurement and digitization of the drawing are by moving a cursor.

#### Interface box

The interface box, built by Sankei Engineering, Japan, links the measuring machine to the computer. It has four coordinate counters with preselector switches and digital displays. Data transfer to the microcomputer is released with a pedal switch. An additional keyboard is provided for entering frequently recurring commands into the computer. Fig. 3 shows view of the system hardware.

#### Software

Below, the graphics software of the CASP system is described by its program commands and data structure. Programs are available in BASIC and FORTRAN 77 languages.

#### Program commands

##### 1. Plotting commands

During plotting, the operator has several modes at his command:

P Plotting of points, marking by symbols or alpha-numeric lettering

L Straight-line connection of points measured

T Plotting of curves; drafting tool synchronously follows floating mark movements

M Generation of about 3,500 Chinese, Japanese or Latin characters

CN Orientation of plotting table, i. e. transformation from model to map coordinate system

D Deletion

## 2. Geometric corrections

During plotting, the operator has the possibility to improve the quality of plotting, to increase the degree of completeness, and to reduce the number of points to be measured. The following commands are available for that purpose:

CL, OP Drawing of a closed or open polygon  
 R Correction of a polygon for rectangularity  
 A Rotation of a polygon into a given aligning direction  
 PP, PW Alignment of lines in parallel (Fig. 4c)  
 H Generation of hachures (Fig. 4d)  
 C Smoothing of curves (Fig. 4b)  
 S Generation of various line types, and combination with symbols (Fig. 4a)

These commands can be used one or several at a time.

## 3. Input parameters

Further variation of the plotting and correction commands is effected by special input parameters for

- the size symbols, characters, intervals,
- the plotting table coordinate system,
- the type of drafting tool.
- the basic type of line and
- geometric corrections.

### Data structure

The data format is designed to enable editing, deletion and addition of data, as shown in Fig. 8. The data format is divided into "directory file" and "data file". The data file format differs with specific commands.

### Possible applications

For demonstrating the performance capability of the CASP system, plotting from an aerial stereopair was effected both without and with the CASP system. The improvement in plotting quality is obvious.

### Conclusion

1. The CASP system expands the plotting facilities of the TOPOCART-D and the DZT 90x120 Digital Plotting Table by the integration of a Japanese microcomputer, enabling editing, mapping and digital data recording.
2. The CASP system increases the productivity of plotting, which constitutes the bulk of all photogrammetric compilation work, both by the scope of equipment and number of people employed. With the CASP system, productivity increase is achieved at much lower cost than with existing analytical plotters.
3. The software of the CASP is flexible so as to permit the simultaneous execution of multiple commands as well as the processing of plotting machine data or corrected data files.

### Acknowledgement

The software for the CASP system was developed by Mr. T. Okuda, assistant at the Institute of Industrial Sciences, University of Tokyo. We are grateful to Mr. Okuda for his cooperation.

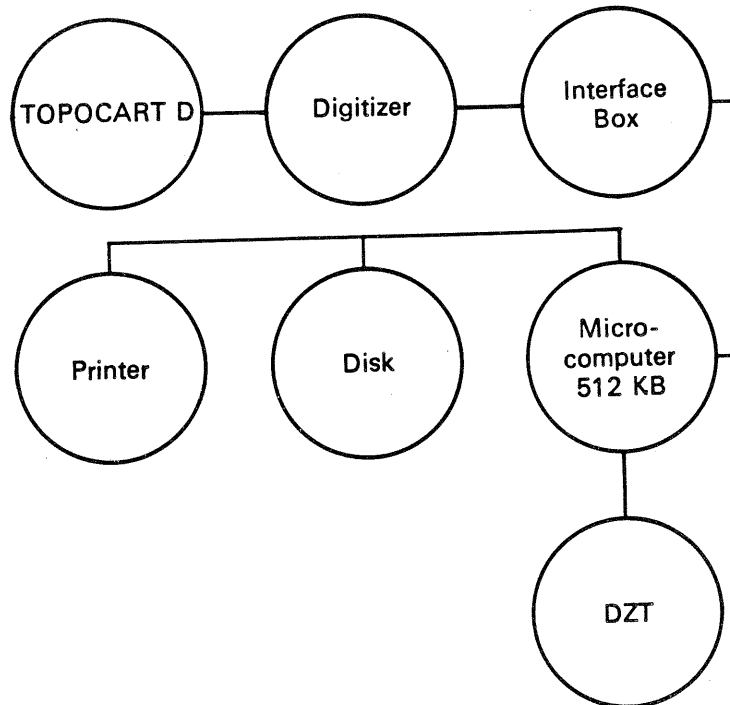


Fig. 1: The CASP hardware system

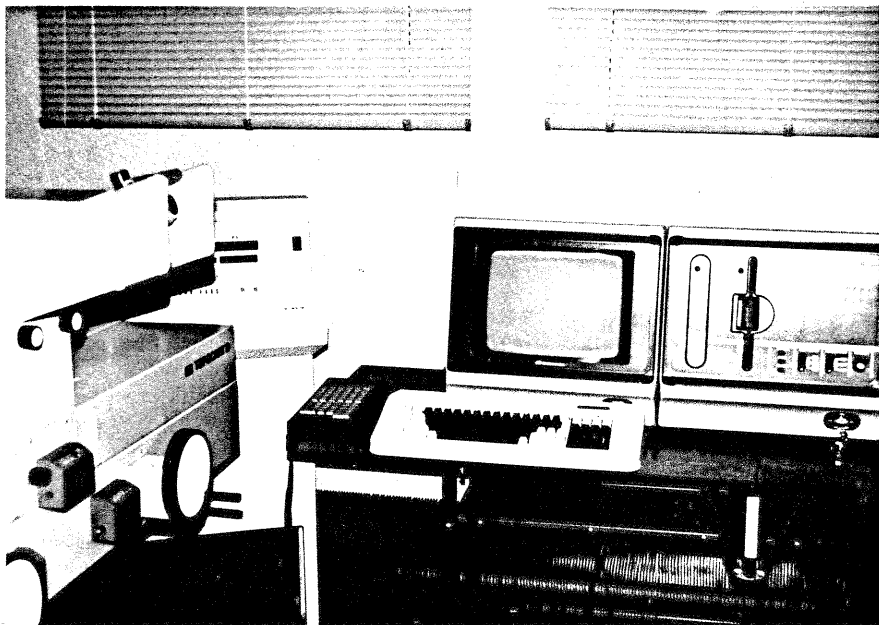


Fig. 3: Topocart D with Interface-box and Microcomputer AI-M 16

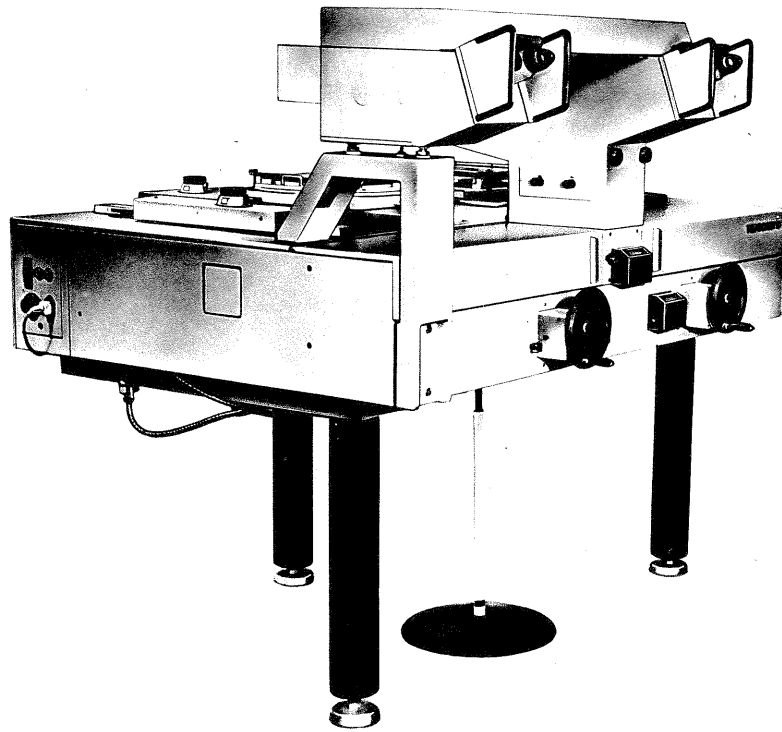


Fig. 2: TOPOCART-D Stereoplotter

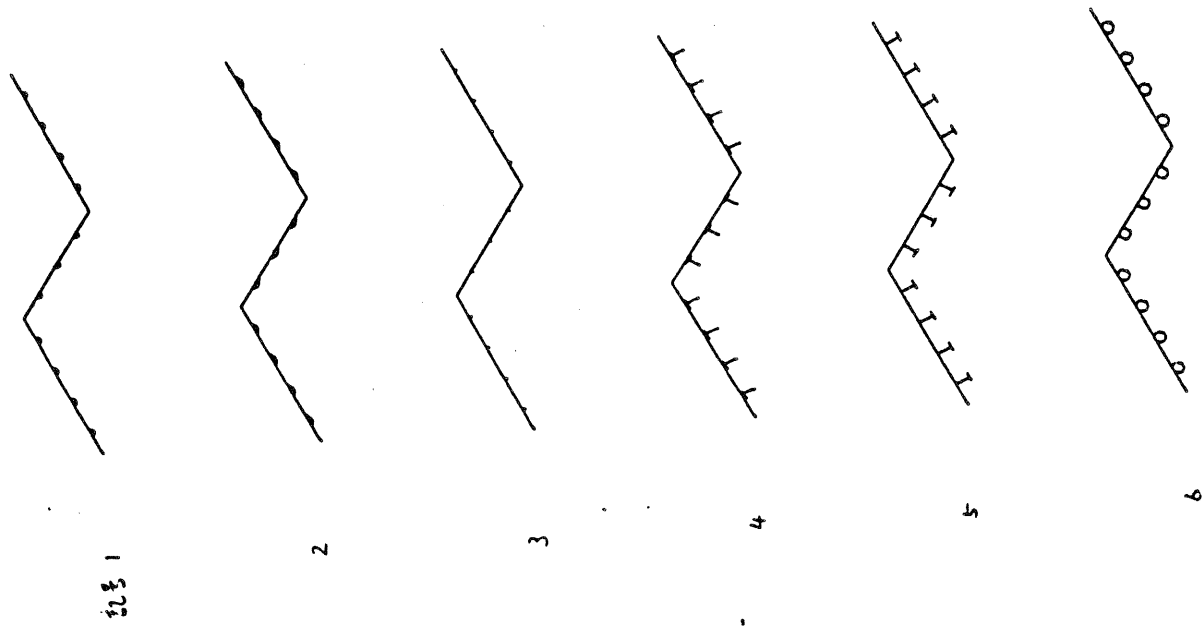


図 1

4-7

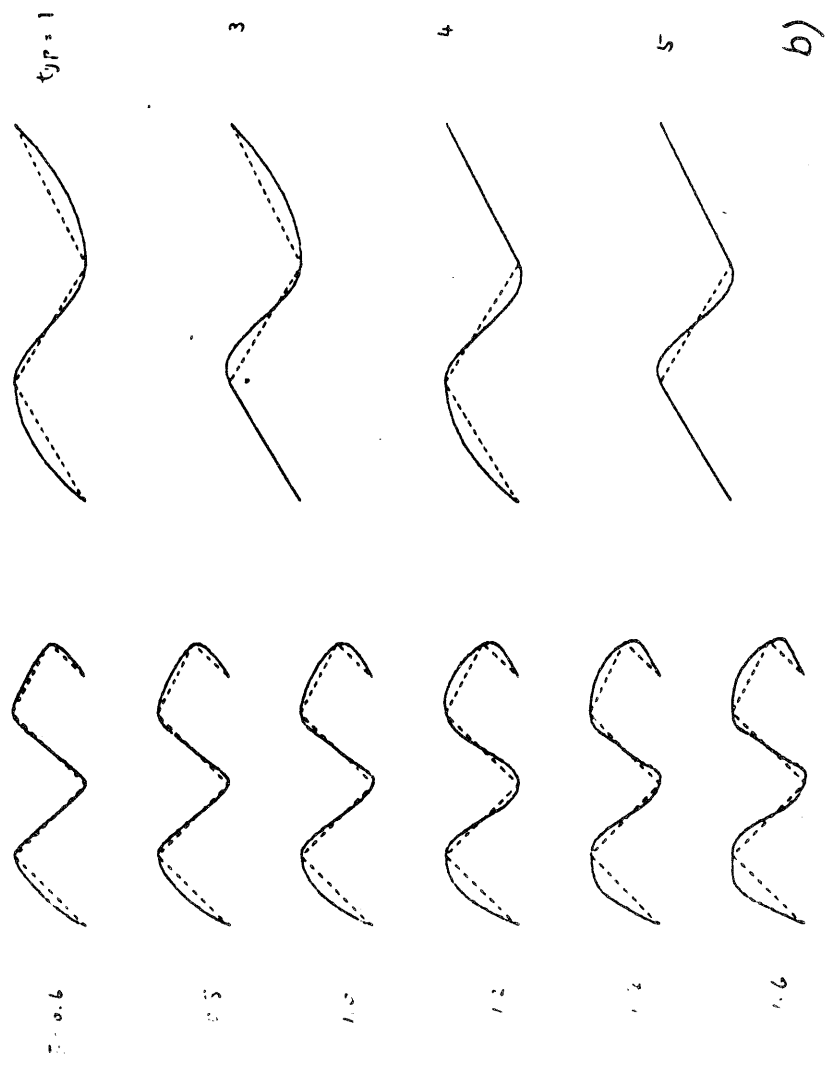


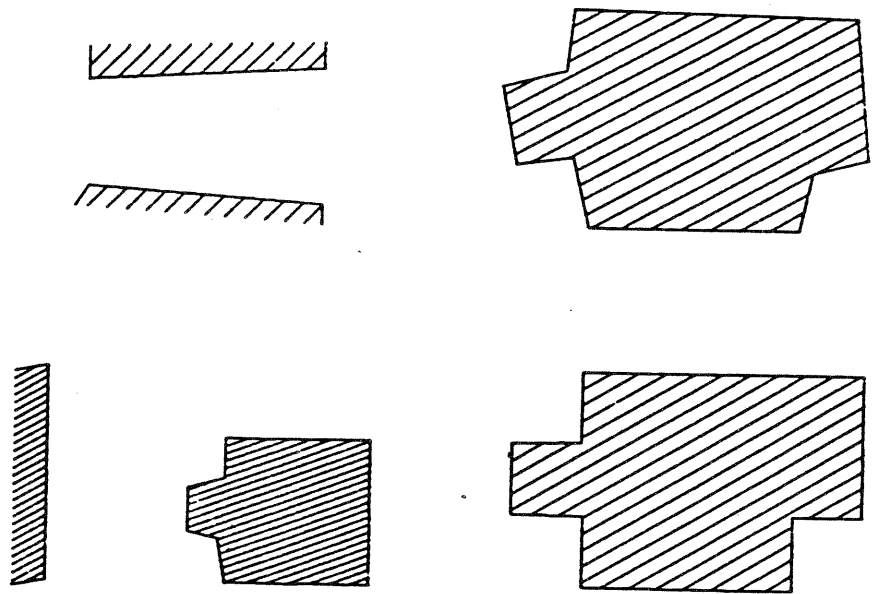
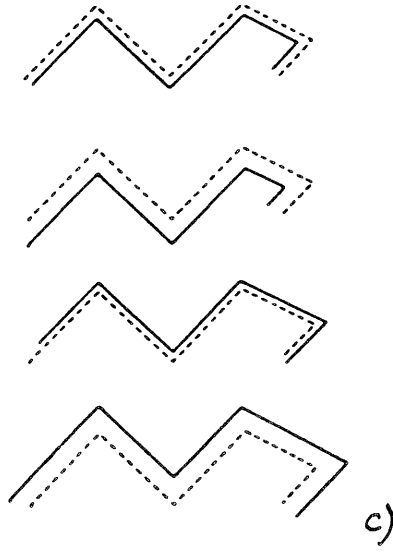
Fig. 4:

Geometric correction (selection)  
 a) line symbols, b) curve interpolation  
 c) parallelism, d) hachure  
 (dotted lines represent input data)

a)

1  
 1.0 1.5 5mm

平行線発生



6-441