

KARTOFLEX, A NEW SYSTEM FOR MAP REVISION

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1. Introduction

During the last decades new maps have been made in different scales in many countries. Due to natural forces, but even more due to human influence on nature, the shape of the earth surface changes permanently which means that maps become rapidly outdated. As topographic maps only serve their purpose if they coincide with local realities, map revision is increasing in importance. The methods of map revision differ with conditions and requirements. Information is mostly obtained by new aerial photos and processed by photogrammetric stereoplotting, orthophotography, rectification. For these methods, a great variety of instruments is available, whereas special instruments for map revision are few. The parameters and designs of such instruments are determined by several major requirements:

- Easy, convenient operation, even by less trained operators
- Simultaneous viewing of photo and map
- Stereoscopic viewing of photos
- Rapid correlation of map and photo with correction of perspective and affine distortions
- Continuous magnification setting for photo and map viewing within wide limits
- Easy updating of maps

In consideration of the above requirements the new map revision instrument KARTOFLEX was developed. It is offered in two versions for better adaptation to different tasks. The standard outfit includes the optical-mechanical machine either alone or, in an expanded version, with a micro-computer system, coordinate measuring system, optical correction device, operator keyboard and foot switch.

2. Range of application

KARTOFLEX represents a special instrument for map revision and the production of thematic maps, simultaneously complying with all main requirements for visual interpretation and permitting a direct transfer of interpretation results into a map. Air photo pairs up to the size of 30 cm x 30 cm taken with cameras of any focal length are the preferred input materials for map revision, but mosaics, orthophoto mosaics, stereocorthophotos and map sections of other scales may also be used for this purpose.

The maximum magnification ratio of 1:15 from photo to map permits the transfer of photo information from super-small scale photos to small-scale maps.

The 12X viewing magnification for photos permits visual interpretation of photo contents by stereoscopic viewing with good recognition of details. Thematic maps are prepared by the direct graphical transfer of interpretation results to base map sheets.

Magnification of the two photos can be set separately and continuously. This permits the interpretation of air photo pairs of scales differing as much as 1:5.

Colour filters screwed on the objectives permit visual interpretation (additive colour viewing) of multispectral black & white images in two or three channels with a binocular head.

The expanded version permits the solution of the following tasks in addition:

Rapid correlation of photos and map by means of an orientation program with 3, 4 or 5 setting points. Computer-controlled, approximate correction of perspective and affine distortions up to ± 10 mm which may exist between photo and map.

Partial displacements of ± 1 mm for both coordinate directions may be entered into the running correction programme.

Area and distance computation, which can be made simultaneously with the updating of land use or content.

Digitization of map or photo points, even in a time-dependent automatic mode and display of coordinate by a serial standard interface.

With these facilities, the KARTOFLEX can be used not only for map revision but also for interpretation, area and distance computation, and digitization with data output. Main fields of application are agriculture and forestry, geology, hydrology and environmental protection.

3. Description

The standard outfit consists of the optical-mechanical machine. It is designed as a bench-top unit with almost horizontal arrangement of the photo carriages.

Photos may be positives (film, paper) or negatives (film) sized up to 30 cm x 30 cm.

The two photo carriages can be jointly moved in x- and y-directions by hand; after actuation of a lever each, fine adjustment is possible in both directions. A balance weight has been provided for the y-carriage guaranteeing easy freehand motion. The distance of the two photo carriages from each other can be changed in x-direction by freehand shift and fine adjustment in such a way that an overlap area of the stereo model of 50 % to about 80 % can be viewed and plotted.

The left photo carriage can be moved relative to the right one in y-direction with a fine adjustment by ± 15 mm. Both photos can be swung in kappa through $\pm 10^\circ$.

The lamps can be fitted in different places to permit illumination of the photos by transmitted and incident light. The map is illuminated by incident light. On request a light box can be supplied for map illumination by transmitted light. Brightness can be separately controlled for each photo and the map by potentiometers.

Inserted in the drawing area of the table top is a glass plate; the light box can be mounted below. Metal strips applied on top and permanent magnets inserted in the underside of the table top hold the map in place. Care has been taken to provide a large movement range for the map.

The power supply unit and the microcomputer unit (for the expanded version) are located in the base frame on an inserted plate; so that no additional area is required.

The viewing unit with the required controls is fixed to a bracket. Viewing magnifications of air photos can be continuously set between 2.4X and 12X by means of zoom systems. By zooming in opposite directions, magnification differences between the two photos of up to 1 : 5 can be compensated. The viewing magnification for the map can also be varied by a zoom system between 0.8X and 4X. Accordingly, a ratio between photo and map viewing ranging from 1 : 0.6 to 1 : 15 can be implemented.

The following modes of viewing are possible by switch-over:

- Photos stereoscopic + map in right eyepiece } map can be
- Photos stereoscopic + map in left eyepiece } occluded
- Right photo and map binocular, alternately occludable
- Left photo and map binocular, map occludable
- Binocular viewing of two multispectral photos
and map, or binocular viewing of three multispectral
photos

Map revision is made with binocular, superimposed viewing of one of the two photos with the map. Photo and map are adapted to each other by identical points in sections by means of magnification compensation, rotation and shifting. For better interpretation, temporary switch-over to stereoscopic viewing is possible and the map can be occluded. The map to be revised lies on the table before the operator, entries can be made conveniently. Viewing of multispectral black & white photos for additive colour viewing (visual colour composite image) can be made in 3 channels with max. 4X magnification. The colour filters to be placed in front of the objectives are available on request.

The expanded version comprises the basic machine, a coordinate measuring instrument, a permanently programmed microcomputer system with operator keyboard and foot switch and an optical correction device actuated by the micro-computer through stepping motors.

The coordinate measuring instrument, a cross slide with linear measuring systems, has a measuring range of 300 mm x 300 mm, a resolution of 0.05 mm and can be alternatively equipped with the drawing or measuring system.

The measured values of 3 to 5 identical setting points measured on the map and on the photo are fed to the computer by a forward-backward counter. The computer calculates the approximate correction values for the compensation of distortion which may be present between photo and map; the calculation considers the x-, y-position of the drawing system of the coordinate measuring instrument.

The correction values are applied to two stepping motors controlling an optical correction system and consequently providing coincidence of photo and map at the point set. The optical correction system has a range of ± 10 mm for both coordinate systems and influences the optical ray path of the map.

The keyboard comprises a 6-digit LED display, program pre-selector pushbuttons, a decimal keyboard, a correction button and four direction buttons to feed small, partial correction values. Commands are entered with another button or with the foot switch.

The permanently wired programs of the microcomputer system include

- an orientation program (correlation of photo and map and correction of distortions between both),
- an area computation program (computed area can be read on display),
- a distance computation program (computed distance is displayed) and
- a facility for the output of coordinate values measured point-wise or with automatic timing area and distance computations to peripheral units through a serial standard interface.

Specification

- Basic machine
 - o Max. photo format 30 cm x 30 cm
 - o Photo viewing magnification 2.4X to 12X continuously
 - o Map viewing magnification 0.8X to 4X adjustable
 - o Magnification compensation between left and right photo up to 1 : 5
 - o Ratio of magnification between photo and map 1 : 0.6 up to 1 : 15
 - o Field diameter 210 mm : magnification
 - o Diopter setting range + 5 D
 - o Eyepiece distance adjustment 55 mm to 75 mm
 - o Photo swing (mechanical) + 10°
 - o Photo illumination incident or transmitted light (convertible)
 - o Map illumination incident light (transmitted light on request)
 - o Common photo shift freehand and fine adjustment
 - x' - left - 110 mm to + 150 mm
 - x' - right - 150 mm to + 110 mm
 - y' ± 150 mm

- o Shift of left photo carriage relative to right one
 - px freehand and fine adjustment 40 mm to 170 mm
 - py fine adjustment \pm 15 mm
- o Viewing modes (switch-over):
 1. Stereoscopic viewing of photos with map superimposed in right or left eyepiece (map can be occluded)
 2. Binocular viewing of one of the two photos with map superimposed
 3. Binocular viewing of two multispectral images with map superimposed or binocular viewing of three superimposed multispectral photos
- o Weight 140 kg
- Expanded version
 - o Optical-mechanical data as in basic version
 - o Coordinate measuring range x, y in the map plane 300 mm x 300 mm
 - o Resolution of measuring system 0.05 mm
 - o Correction range Δx , Δy \pm 10 mm
 - o Display (LED) 6 digits
 - o Input voltages 110, 127, 220 or 240 V, 50 or 60 Hz
 - o Power input max. 450 VA
 - o Dimensions (width, depth, height) 1050 mm x 820 mm x 1660 mm
 - o Weight 157 kg

Summary

The KARTOFLEX equipment for map revision is also applicable for visual interpretation, for the calculation of areas and distances as well as for digitization with output of coordinates via a serial standard interface. The instrument allows the simultaneous observation of both the photographs and the map. Use is made of aerial photopairs up to the size of 30 cm x 30 cm taken with any camera focal length. Magnification can be chosen between 2.4 X and 12X for the photos and between 0.8X and 4X for the map. A microcomputer system approximately calculates correction data for affine and perspective distortions and enters them into an optical correction device.

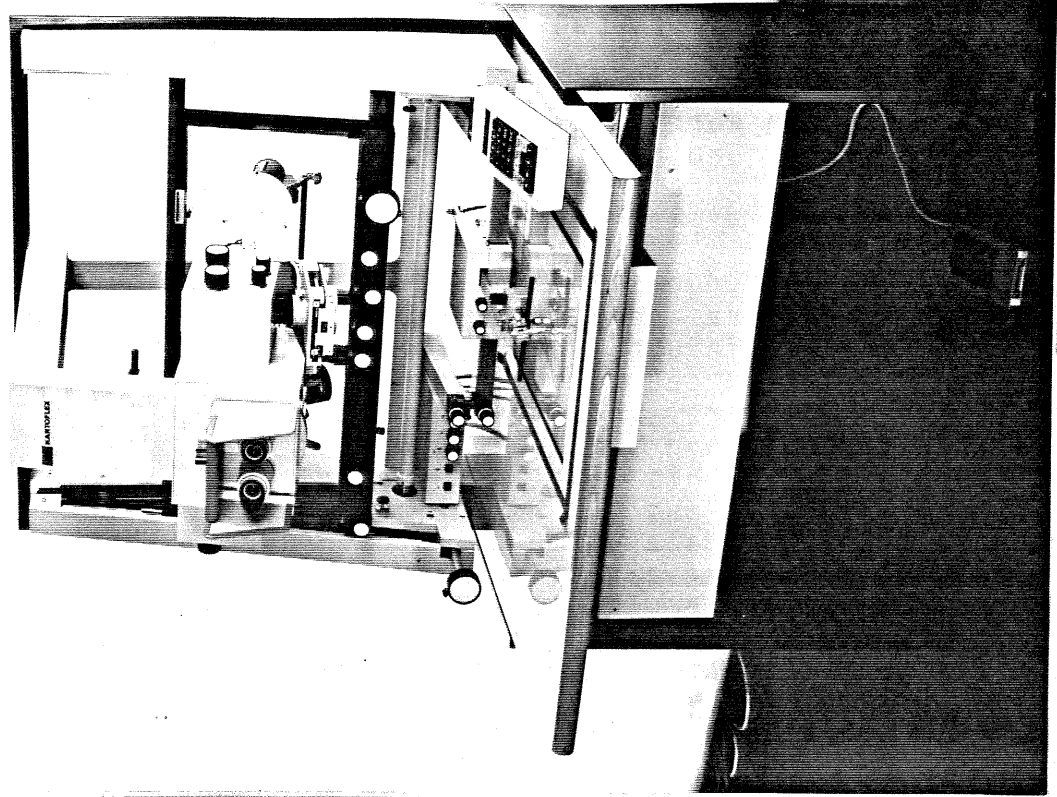


Fig. 2 KARTOFLEX, expanded version

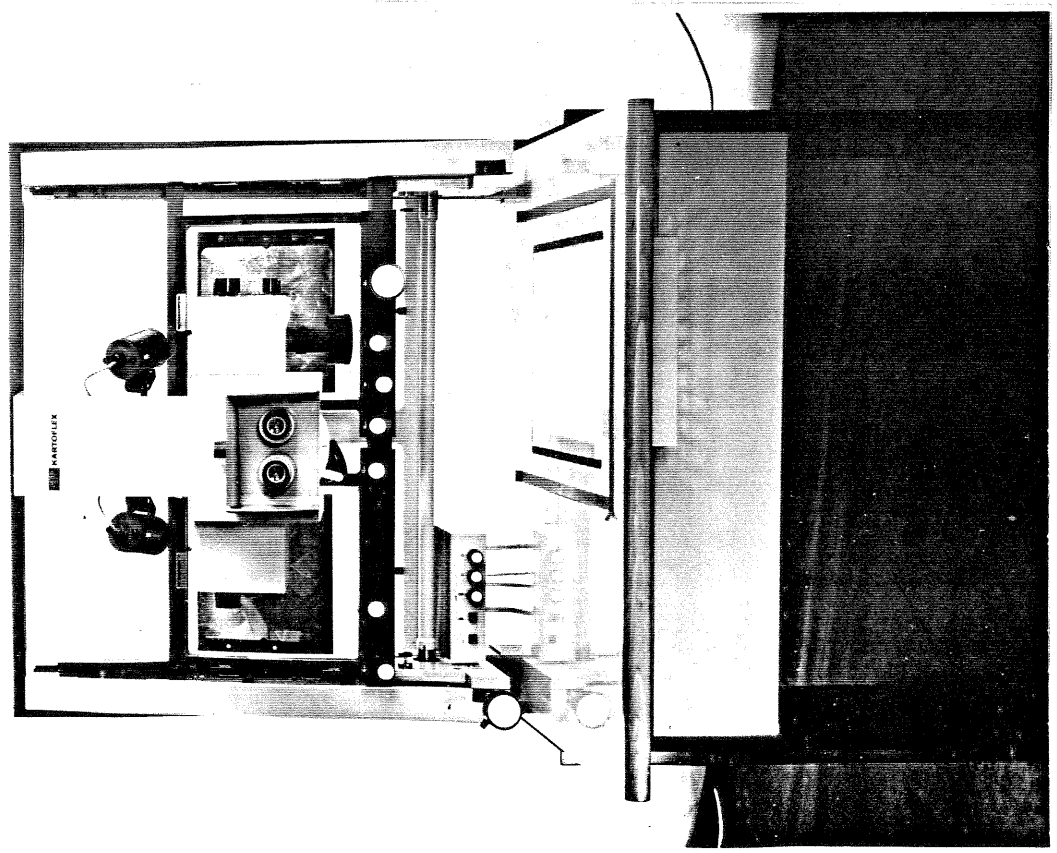


Fig. 1 KARTOFLEX, basic version