

CONTOUR LINES EVALUATED FROM DATA BASE ANALYSIS

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ABSTRACT

The progress of computer technology facilitates the development of data base for various aspects and applications. Although, the photogrammetric plotters were used to produce fancy looking terrain's features, the ground survey is also used to create more precise contour maps. The objective of this research is to establish a data base system so that, the best representation of the terrain relief can be deduced. Three photogrammetric plotters were used to produce contour maps for a semi-flat area. The prespective radiation methodology was used with the aid of digitizing technique to determine the displacement between the contours (contours plotted from photogrammetric plotters and others created by ground survey).

KEY WORDS: Data Base, Digital Systems, DTM, Photogrammetry, Plotter.

INTRODUCTION

The accuracy and the quality of contour lines depend evidently on many parameters: data acquisition (density, distribution, and quality of measured points), data processing (interpolation principle, filtering, ... etc), and measuring accuracy (the sum of the variance and the square of the systematic error, or the square root of the value of this combination).

Although, digital terrain models (DTM's) are based on computer processing and data banks to represent the ground relief numerically, the photogrammetric stereoplotters with high-speed electronic computers lead the scientists to create a reasonable representation of the earth's surface. Three photogrammetric plotters (Wild A 10, Kern PG2, and Wild BC 2) were used to derive elevations and to compile contours from overlapping aerial photographs in order to represent the best terrain relief of a semi-flat area.

The central radiation technique was carried out to obtain a preliminary decision for establishing topographic maps, with high accuracy, from the stereoscopic plotters. The INTERGRAPH Digital Mapping system, had been used to merge the most accurate contour lines, that resulted from different plotters, and compiled them in a new file (Soliman et al., 1992).

CONTOUR LINES EVALUATION

Ground Survey

The study area is located in the North-Western part of the Nile Delta. It extends North-West to South-East of Wadi El-Natroon, with a coverage area of

3.4 Km x 4.5 Km.

Grid leveling was established, in 1986, for the study area with an average patch side length of 250 m approximately. The elevations of the corner points were determined by using the Wild NA 2 automatic level (accuracy of 0.7 mm per 1 Km). The minimum and maximum heights were found to be 5.99 m and 52.53 m, respectively. The cartesian coordinates of each point were determined by using Wild T2 theodolite with accuracy of 1", and an Electronic Distance Measurement device, Distomat DI 20 with accuracy of 1 mm + 1 p.p.m. for 1 Km.

An area of 1.5 Km x 2.5 Km (77 points) was chosen to match the available coverage area of aerial photographs. Contour lines were drawn for the grid leveling by conventional manual interpolation with 5 m contour interval as shown in Figure 1.

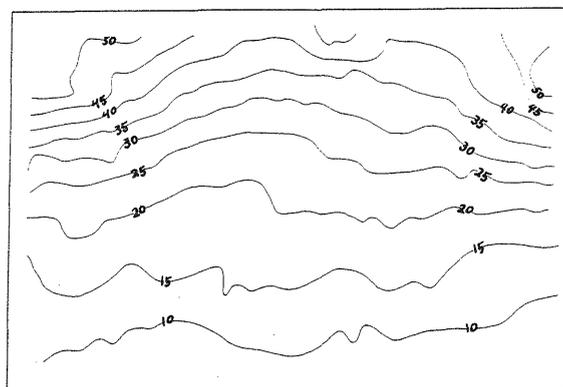


Figure 1 Ground Survey Contour Lines

Photogrammetric Work

The study area was covered by aerial photographs during the spring of 1989, with a scale of 1:30,000. Three stereoscopic plotters (Wild A 10, Kern PG2, and Wild BC2) were used to create the contour lines for the same area. The overall expected sampling, Z-coordinate, accuracy for each photogrammetric plotter was tested. The Z-coordinates for five random points were observed for each stereoplotter and the overall resulted accuracies, given by the standard deviation values were found to be: for Wild A 10, $\sigma = 0.1472$; for Wild BC2, $\sigma = 0.1120$; and for Kern PG2, $\sigma = 0.1322$.

Three contour plots were mapped, with 5 m contour interval, by direct contouring of the stereomodels

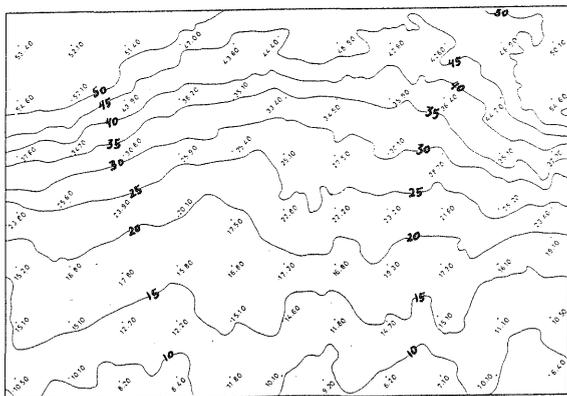


Figure 2 Direct Contouring For The Wild A 10

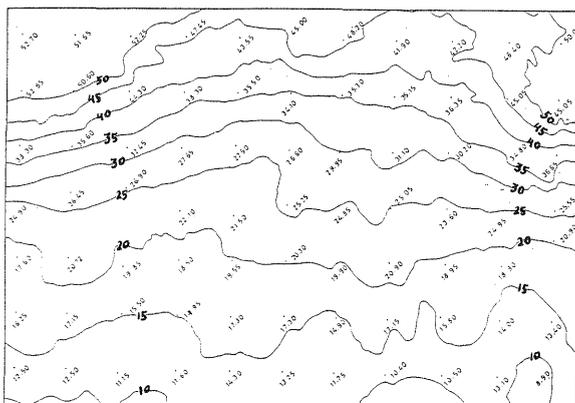


Figure 3 Direct Contouring For The Kern PG 2

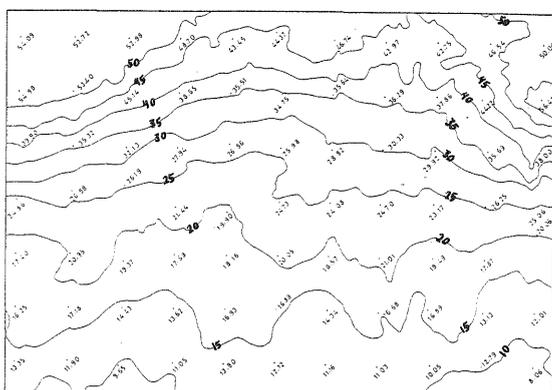


Figure 4 Direct Contouring For The Wild BC 2

which are created by the three stereoplotters as shown in Figures 2, 3, and 4. Each contour plot was digitized and recorded in a database file of the INTERGRAPH Digital Mapping System, installed in the Military Survey Departments.

PRELIMINARY ANALYSIS

Based on the principles of perspective geometry, the central radiation was established on the projected left hand photo's perspective center. The difference between each two consecutive radiation lines was taken 5°.

Contour lines established from the ground survey heights, using manual interpolation, and each one of others, created from the three photogrammetric stereoplotters, were overlaid. The difference between each two contour lines in the overlay plot and along the different radiation lines were measured by the aid of manual digitizer.

The method of least square adjustment was carried out to determine the standard deviation (root mean square error, RMS) for each contour line and for each overlay plot. The resulted values of standard deviations are tabulated in table 1. The minimum

Table 1. Standard deviations (mm) for the three overlay plots

Stereo-plotter	Contour									
	10	15	20	25	30	35	40	45	50	
A 10	13.339	10.985	7.2933	9.0362	3.370	4.597	6.910	8.329	9.3910	
BC 2	28.611	19.369	17.769	8.975	5.666	5.575	7.383	8.431	10.424	
PG 2	34.973	24.032	20.624	14.931	7.928	6.515	6.545	6.770	8.784	

values of RMS are resulted from using the Wild A 10 for the central portion of the map. On the other hand, the RMS values for the farrest boundaries in the overlay plot of Kern PG2 give satisfactory results.

MERGING THE CONTOUR LINES

The results represented in the previous section, after applying the statistical and graphical approaches on the overlaying contour lines, confirmed that the Wild A 10 Autograph has an advantage in representing the terrain relief for the part near the center of the photo, while the Kern PG2 has an accurate representation of contouring in the northern part of the same investigated area.

The INTEGRAPH had been used in merging the most accurate contour lines. Different set of contour lines were compiled and recorded in one database file. Then, this new file contains the contour lines number 10, 15, 20, 25, 30, and 35, bestly represented from the Wild A 10, and contour lines number 40, 45, and 50 from the Kern PG2, with the higher accuracy than the others (see Figure 5).

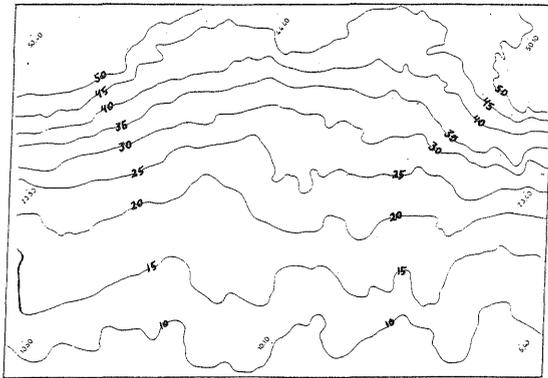


Figure 5 The More Accurate Model After The Merging Process

RESULTS, CONCLUSIONS AND RECOMMENDATIONS

According to the tabulated results, Table 1, the earth's surface can be represented accurately by using the mechanical projection stereoplotters, Wild A 10 and Kern PG 2. These results, were achieved from preliminary analysis that was carried out by applying the prespective radiation methodology and the least square adjustment procedure.

The INTERGRAPH Digital Mapping System shows the valuable use of it in merging the most accurate contour lines which are created from different stereoscopic plotters.

It is recommended to carry out the preliminary analysis through the INTERGRAPH Digital Mapping System so that the most accurate contour lines can be determined with short time consuming.

REFERENCES

Soliman, E.H., El-Ghazaly, M.S., and Moussa, O.M., 1992, Comparative Accuracy Assessment of Height Databases from Various Photogrammetric Plotters, under publishing.