GRAPHICAL REPRESENTATION OF SURVEY DATA.

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Introduction.

The work described in this paper was carried out as a final-year undergraduate project by one of the authors (NDS) under the supervision of the other. The software is implemented on the DEC20 computer at the University of Birmingham and uses the T5684 Sigma colour graphics terminal. It is written in Fortran IV and uses the GINO-F graphics package as well as certain subroutines produced at Birmingham to allow use of the special properties of the terminal. The latter mean that it is not easy to transfer copies of the software to other installations, but so long as the GINO-F package ignores the existance of raster graphics some such addition will be necessary. The routines to allow a choice of pen-colour for the shading and contouring routines and the extra speed of the hardware polygon fill are too useful to be omitted.

The project specification required the software to apply to any set of data which is provided as a rectangular array of spot heights. Such data arises in many applications, archaeological surveys being only one of these. Those of archaeological interest include resistivity and magnetometer surveys as well as measurements of surface height and the set of test data used in this project was actually readings from a magnetometer survey carried out in 1972. The data is verified during the input stage, zeros being interpreted as missing values, and if necessary a constant is added to all the non-zero values to ensure that they are all positive. Isolated missing points are replaced by an average of the surrounding points, but larger area of missing data are left as zeros and so appear as holes in the surface.

Four methods of representation are supplied, some of them in colour as well as grey-scale. No attempt is made in this publication to reproduce the colour representations. Because the University already has the GINO-Graf package with its black and white versions of contour and isometric projection drawings of surfaces, it was decided that the project should concentrate on other representations first. In fact it has proved possible in the time (equivalent to three months full-time work) available to implement a version of contouring, but no attempt has been made to provide an isometric projection view of the surface.

Mosaic Representation.

This is provided in grey-scale only and is the initial method of presenting the data to the user. The data is scaled to twelve equal steps from minimum to maximum value and each step is assigned to one level on the grey-scale output, the lowest being black and the highest white. Then each data point is represented as a square of the appropriate level of grey. Although this is a fast,crude method of representing the data, it gives a remarkably good overall impression of the shape of the surface. The user is then invited to adjust the values chosen for maximum and minimum of the grey-scale. For each choice of maximum and minimum, the scales of grey are mapped onto equal steps from minimum to maximum, with

any values outside the range being mapped onto either black or white respectively.

The first form of editing which is allowed is the "half-mosaic" representation. This reduces the square surrounding the data point to a quarter its previous area and uses linear interpolation to calculate the levels of grey-scale for the intervening squares. This has the effect of sharpening up the the features. From either the mosaic or half-mosaic representations, it is possible to choose a square of 20 by 20 data values within the data array to which the other methods of representation may be applied. Because of the time taken, both to calculate and to output the representations, and because of the storage requirements of some of the methods, it was decided that the remaining representations should be applied to a 20 by 20 array of values chosen from within the whole data array.

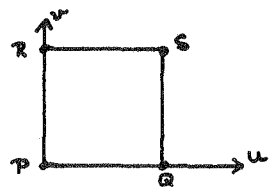
Smooth Surface Representation.

The smooth-surface representation fits a bi-linear surface patch to each rectangle of four data points and uses this equation to calculate the colour or grey-scale value of each pixel output.

To fit a bilinear patch to the rectangle PQRS, take new coordinates u and v parallel to the original mesh lines of the survey and with the origin of the new coordinates at P. Scale the coordinates so that u and v take values from 0.0 to 1.0 over the area of the patch. Then the height H(u,v) at any interior point is given by the equation :

$$H(u,v)=(1-u)(1-v)P+u(1-v)Q+v(1-u)R+uvS$$

This method is provided in both colour and grey-scale and provision is made for further adjustment of maxima and minima should this appear desirable.



Contour Representation.

This is provided in both grey-scale and colour. The contour lines are not drawn, but the whole area between one contour line and the next is shaded in the appropriate colour.

Pillar Representation.

In this case, a three-dimensional histogram of the data is provided and the effect of distance is enhanced by making the intensity of the nearer edges brighter than those at the back. No attempt is made to scale the width of the pillars and so give a projective view and the intensity cue is perhaps a little too successful in giving the impression of depth so that some observers have asked why the pillars at the back appear larger than they should do.

This is not the most appropriate representation for a magnetometer survey, but there are other types of data for which it is ideal. For example, if we have a large site divided into grid squares and we wish to present the total numbers of some type of artifact per grid square, then

this type of histogram is a very good method of presentation.

The software allows the user to generate views from any of the four sides and so present a complete picture of the data.

Conclusion.

The project was completed in March 1983 with the four representations described above. It is intended to extend this package in the future and any suggestions for additional representations would be welcomed by SL.