

"SURFER" SOLUTION, TOOL FOR TERRAIN MODELING

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Abstract: *In representing the terrain surface, the digital terrain model (DTM) is one of the most important concept. A DTM is a topographic model of the bare earth –terrain relief - that can be processed by computer programs. The data files contain the spatial elevation data of the terrain in a digital format which usually is presented as a rectangular grid. A model may have a few specific purposes such as prediction and control, in which case, the model only needs to have just enough significant detail to satisfy these purposes.*

Surfer is a full-function 3D visualization, contouring and surface modeling package that runs under Microsoft Windows. Surfer is used extensively for terrain modeling, bathymetric modeling, landscape visualization, surface analysis, contour mapping, 3D surface mapping, gridding. The paper is presenting how the Surfer Application is used to create a DTM for a Hydrographic Basin.

Keywords: *digital terrain model, 3D surface, modeling*

1. Introduction

A *digital terrain model* is a topographic model of the bare earth -*terrain relief* - that can be manipulated by computer programs. The data files contain the spatial elevation data of the terrain in a digital format which usually is presented a rectangular grid.

The digital terrain model data sets are extremely useful for the generation of 3D renderings of any location in the area described. 3D models can be extremely useful and versatile for a variety of applications.[2]

Digital terrain models are used especially in civil engineering, geodesy and surveying, geophysics, and geography. The main applications are:

1. Visualization of the terrain;
2. Reduction (terrain correction) of gravity measurements (gravimetry, physical geodesy);
3. Terrain analyses in Cartography and Morphology;
4. Rectification of airborne or satellite photos;
5. Extraction of terrain parameters, model water flow or mass movement.

2. Materials and Methods

Surfer is a full-function 3D visualization, contouring and surface modeling package that runs under Microsoft Windows. Surfer is used extensively for terrain modeling, bathymetric modeling, landscape visualization, surface analysis, contour mapping, 3D surface mapping, gridding, volumetrics etc.[3]

The start point for creating a digital terrain model in Surfer , is the digital terrain map for the hydrographic basin (Fig. 1 a)) which includes the contour lines and the altimetry

points, rivers and the crest lines represented as 3D lines, the break of slopes and also all the other elements of great importance in mathematical terrain modeling.[1]

Equidistant lines are overlapped on the digital terrain map for obtaining the list of coordinates required for Surfer application. Based on the required precision, the equidistance can be determined (Fig. 1 b)). At the intersection of each line with a contour line are extracted the three spatial coordinates of the intersection point.

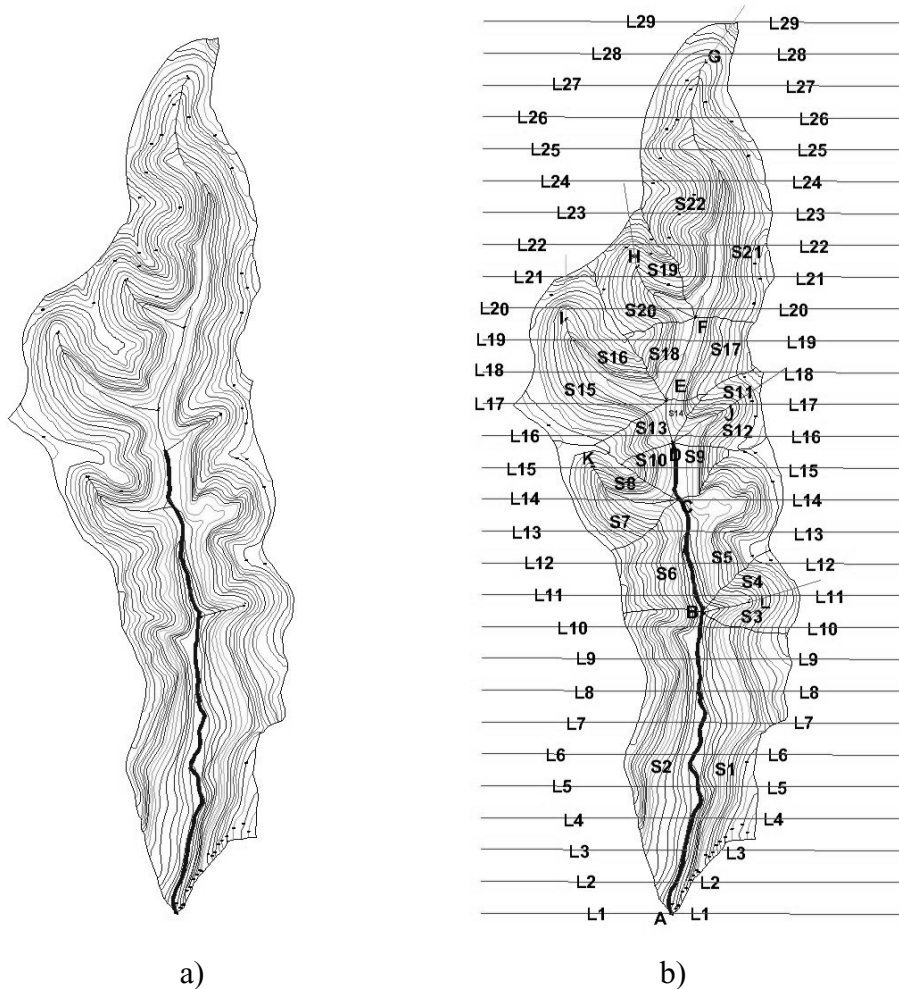


Fig. 1. a) Digital terrain map; b) Equidistant lines overlapped on the digital terrain map for the hydrographic basin

The coordinates (extracted from the digital map) are centralized in an Excel file, which is compatible with Surfer application.

Table 1. The list of coordinates (extract)

Point	X[m]	Y[m]	Z[m]
1	186.912	641.021	228
2	186.385	641.021	225
3	185.569	641.021	220
4	185.112	641.021	215
5	184.793	641.021	210

After creating the list of coordinates we open the Surfer application. In the main menu we select the "Grid" submenu. For importing the coordinates we chose the option "Data"

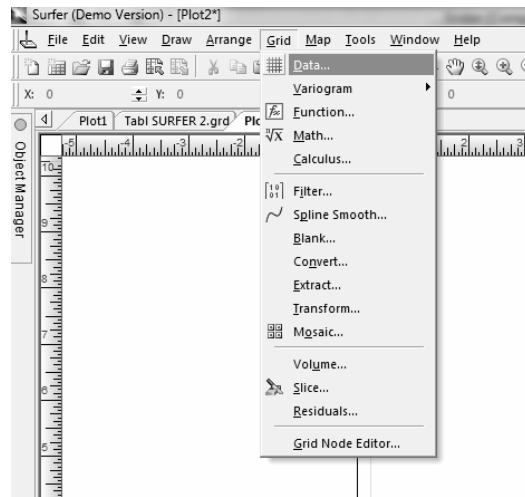


Fig. 2. The coordinates import

Following the selection of the source file, a pop-up window will appear. Here we select the Excel columns from where Surfer will extract data (Fig. 3)

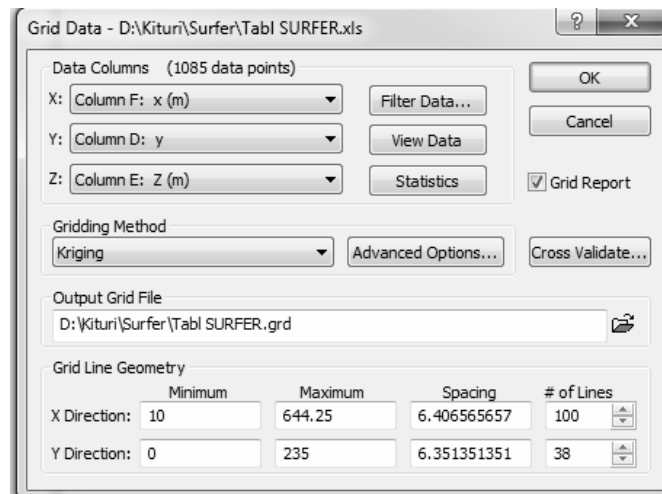


Fig. 3. The coordinates extraction

By pressing "Ok" key the grid will be created. The grid is the base for 3D terrain representation.

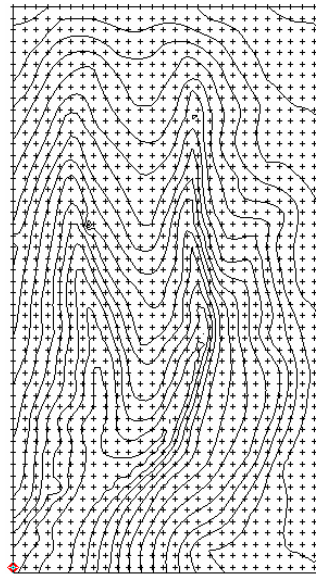


Fig. 4. The grid

After creating the grid we can obtain different maps:

1. Shaded relief map:

Shaded relief maps are raster maps based on grid files. These maps use different colors to indicate surface slope and slope direction relative to a user-defined light source direction. **Surfer** determines the orientation of each grid cell on the surface, and assigns a unique color to each grid cell. The most common use for these maps is in tracking landscape modifications.

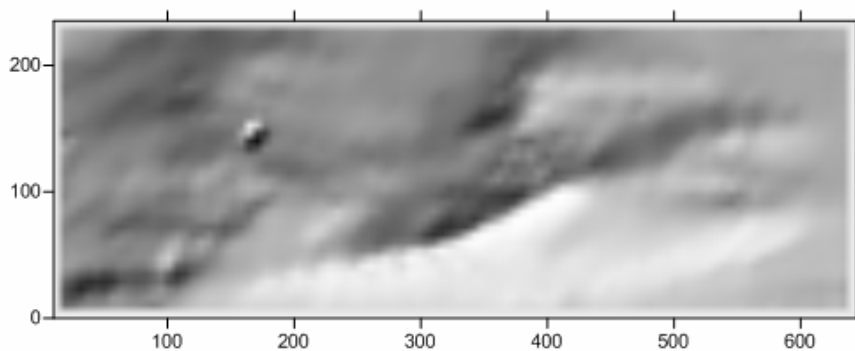


Fig. 5. Shaded relief map

2. Grid vector map:

Vector map information, direction and magnitude, can be derived from one grid. The arrow symbol points in the "downhill" direction and the length of the arrow depends on the magnitude, or steepness, of the slope. A vector is drawn at each grid node for helping oversee earth slides.

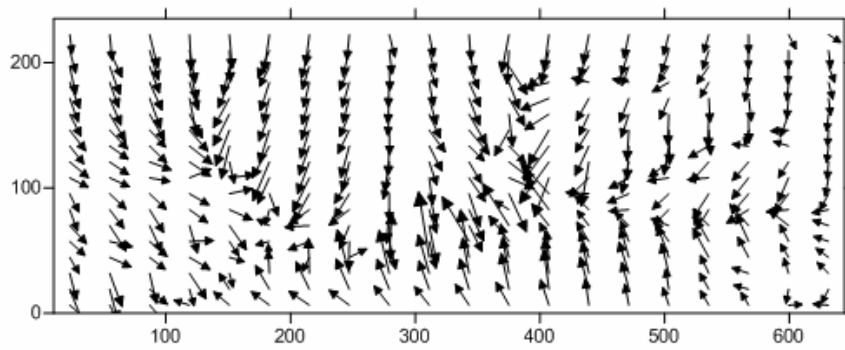


Fig. 6. Grid vector map

3. 3D Wireframe:

Wireframes are three-dimensional representations of a grid file. The 3D wireframe is created by connecting Z values along lines of constant X and Y. At each X-Y intersection (grid node), the height of the surface is proportional to the Z value at that point. These maps are very useful for calculating different types of landscape modifications in order to quantify them for engineering purposes.

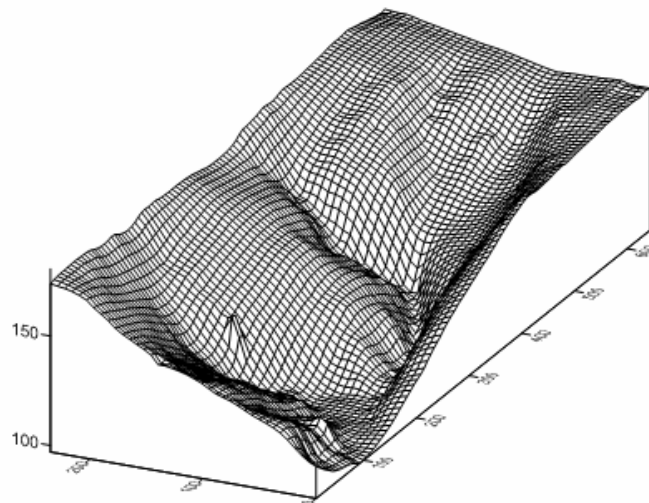


Fig. 7. 3D Wireframe

4. 3D Surface:

3D Surfaces are three-dimensional shaded rendering maps from a grid file. The height of the surface corresponds to the Z value of the associated grid node. More dense grids show better details on the surface

Color can be used to show Z values on surfaces. The colors are blended to form a smooth gradation. Once the color is selected, the lighting can be adjusted, changing the appearance of the map so the user can easily extract terrain information.

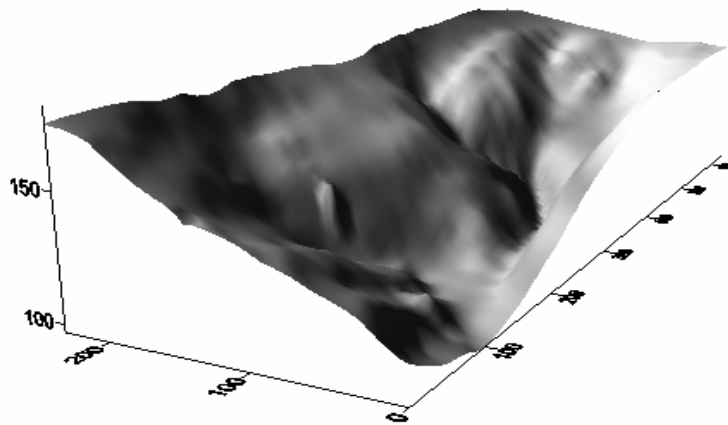


Fig. 8. 3D Surface

3. Conclusions

The digital terrain model has become an important part of a national geospatial data infrastructure. It is used more and more in geospatial information science and technology. Indeed, the digital terrain model has found wide application in all geosciences and engineering, such as:

1. planning and design of civil, road, and mine engineering;
2. 3-D animation for military purposes, landscape design, and urban planning;
3. analysis of catchments and hydraulic simulation;
4. analysis of visibility between objects on the terrain surface;
5. terrain analysis and volume computation;
6. geomorphological and soil erosion analysis;
7. remote sensing image interpretation and processing;
8. various types of geographical analysis.

The digital terrain model and the related technology will be very useful in data management and analysis, allowing the terrestrial processes a better understanding and a better management of human activities for maintaining the world economy vitality and the environment quality.

4. Acknowledgment

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5. References

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