

CREATING A DIGITAL TERRAIN MODEL FROM PAPER MAPS

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Abstract. *The present study aim to create a Digital Terrain Model by using one of the most common and available source of information: paper maps. Digital Terrain Models are an important component in several fields of engineering, Geographical Informational Systems, hydrology, and many others, where a three dimensional representation of the terrain is important. Data acquisition for our purpose requires either detailed topographical surveys which requires a long period of time, or using a three dimensional scanning technology which in most cases is a very expensive solution. By digitizing the contours from paper maps, using lines, we create vertexes that store the tridimensional position of the point. All this vertexes will be exported as three dimensional points, in a text format with three columns: the X coordinate, the Y coordinate and Z which represents the point elevation. After creating this file using computer software we can generate a digital terrain model. Upon this created model we can make several analysis, like profiles, line of sight between points. The model can be exported in a digital format and used in other fields of interest.*

Key words: *contours, digitize, digital terrain model, surface modeling*

INTRODUCTION

Many fields of activity require a good representation of the terrain, especially in the areas where a future investment will take place. The digital elevation model can provide a good representation of the area helping in taking design and project decisions. One of the methods used for acquiring the necessary data is to digitize the existing data.

MATERIALS AND METHODS

The L-34-095-D-A paper map was scanned and the resulted image was the inserted into Autocad Map. For georeferencing the image the Rubber Sheet function was used. A vector grid was created and using the Rubber Sheet function a relation between the intersections of this grid and the raster grid was created. By using the a 2d polyline all the contours of the maps were digitized and after that the proper elevation for each digitized contour was set. The resulted model was exported into a text delimited format, with the coordinates of each contour vertex. The exported text format was used to generate a digital elevation model using the software Global Mapper. The resulting model is a mathematical approximation of the topographic surface. Digital terrain models can be used in volume calculation, contours representation and it is used in several Geographic Information Systems (GIS) applications that require a spatial representation of the topographic surface. The program is using an interpolation method to generate points between the areas where information isn't available. There are several methods of interpolation, some of most used are : "Triangulation with linear interpolation", "Natural Neighbor", "Nearest Neighbor". To test the result of the each of this methods a digital representation was made using the Surfer Software.

RESULTS AND DISCUSSION

The result of the digitized map is displayed in figure number 1 in comparison with the original raster image. The digitizing process and all the operation for the preparation of the digital map required one month with a total working time of 75 hours. In figure number 2 we can see an isometric view of the three dimensional map.

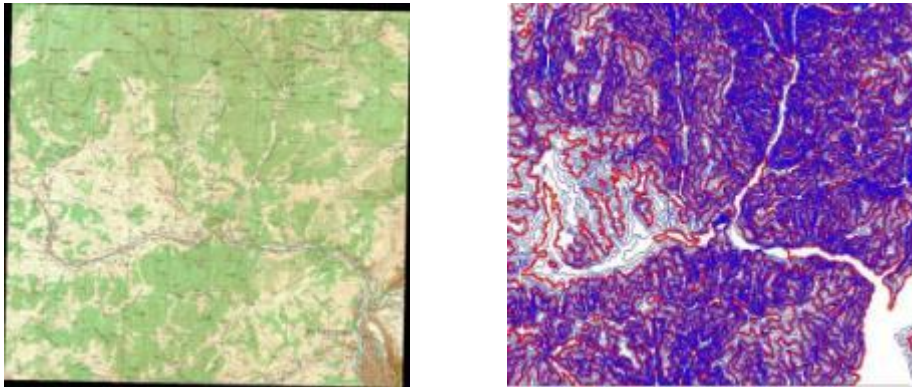


Figure 1 The Raster image and the result of the digitizing process

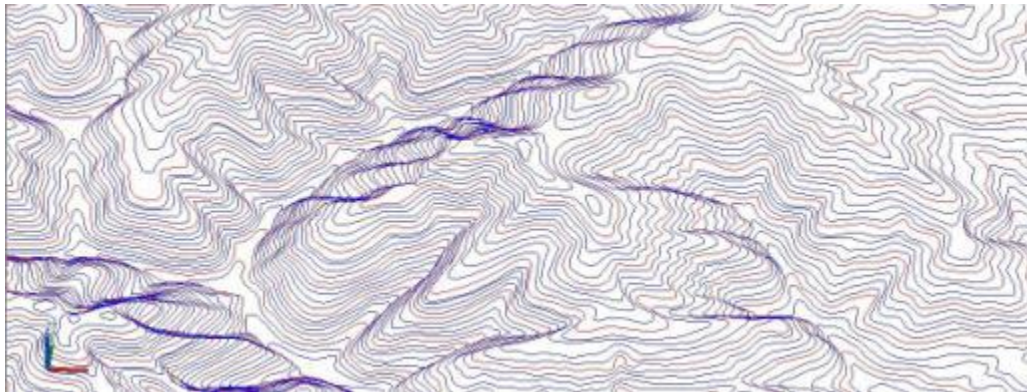


Figure 2 – Isometric display of the digitized contours

Using the data point extracted from the digital map a surface representation was made using the following methods: "Triangulation with linear interpolation" (figure 3), "Natural Neighbor" (figure 4), "Nearest Neighbor" (figure 5). The method most often used for the three dimensional representation of the landforms is the triangulation with linear interpolation, because it provides an accurate representation with a low computing time and without requiring a powerful hardware configuration system.

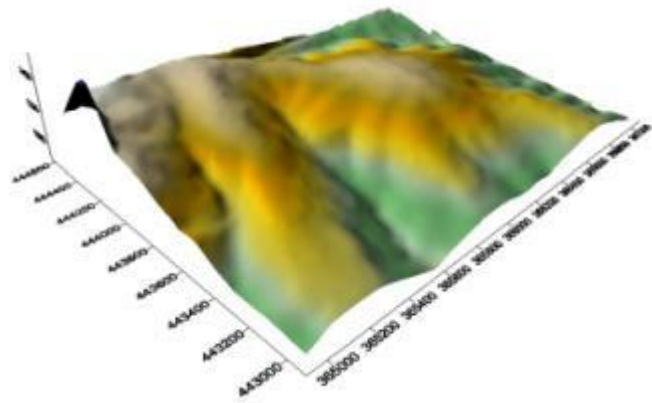


Figure 3 : Triangulation with linear interpolation

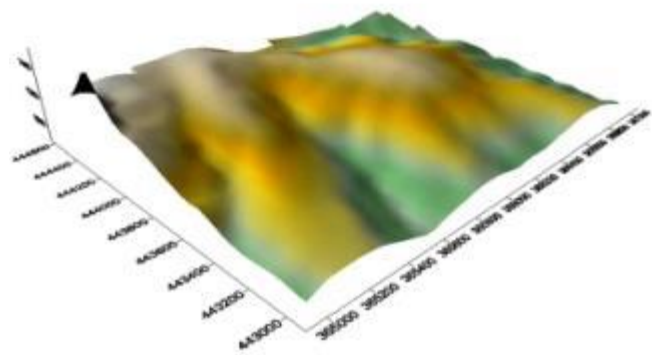


Figure 4 : Natural Neighbor

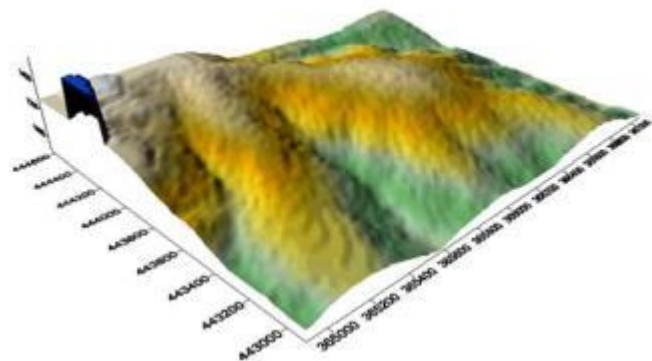


Figure 5 : Nearest Neighbor

Analysis of the digital model

Upon the created model, there are several analysis that can be performed. Using Global Mapper Software the model digital terrain model was generated and the following functions were performed upon:

1. Generate watershed

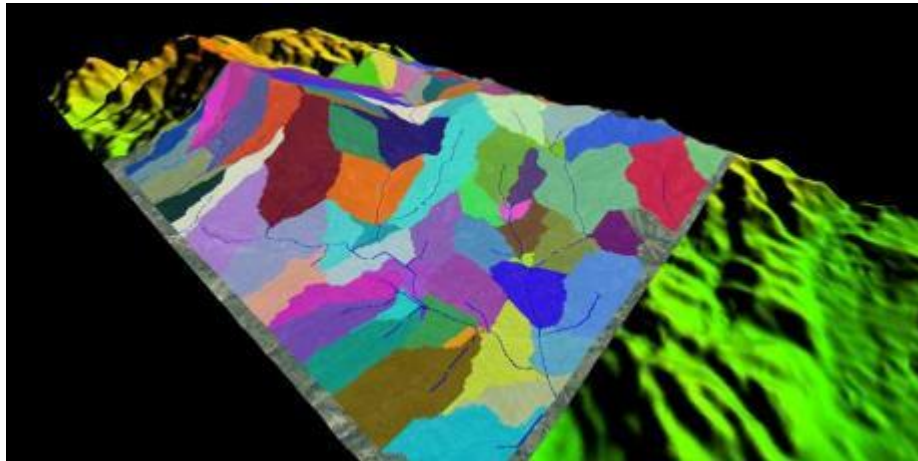


Figure 6 : Generate Watershed result

2. Profile representation. A profile between two points of the digital terrain model can be displayed

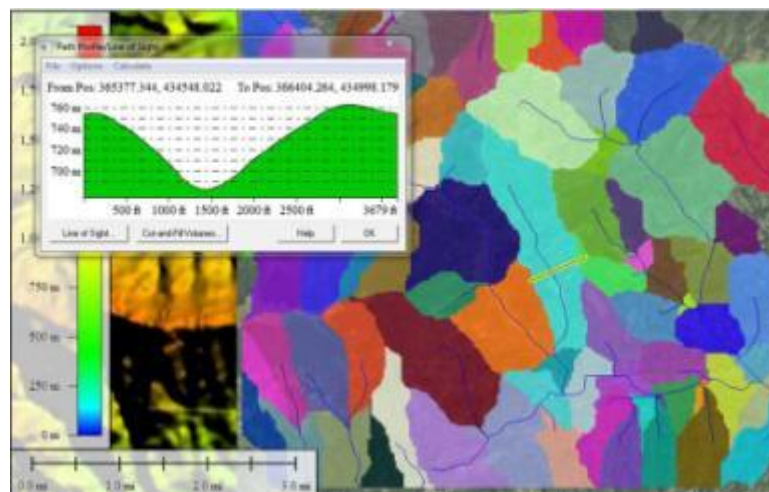


Figure 7 :A profile representation

3. Line of Sight. By selecting two points from the digital terrain model we can check if there is visibility between them

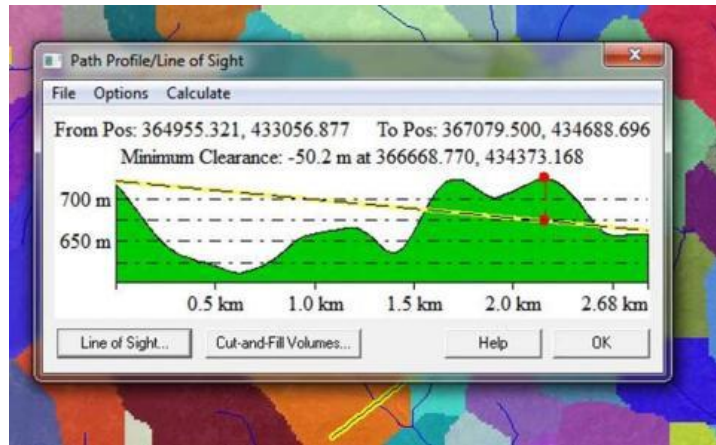


Figure 8 : Line of Sight between two points

CONCLUSIONS

Due to the major development of the software solutions, today we can extract valuable information from all sort of analogical information. By using the tools build within the software we can generate valuable information that can help in a better understanding, planning and decision. We cannot underestimate the importance of the analogical maps, but in several situations when quick access to the information is needed and obtain a better and a faster solution the digital representation can provide the best answer. By storing the data in a digital form, it can be accessed much faster and by more users at the same time.

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