DIGITAL TERRAIN MODEL – OVERVIEW AND DRAW UP

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***Abstract**: Since a long time ago people studied the Earth's terrain: geologists study its structure, geomorphologists study its forming process, civil engineers construct on it, architects design on it and geodetic engineers, measure and present its surface in different ways such as maps, orthoimages, perspective views, etc. The common interest of all these specialists is that the terrain surface to be represented in an accurate form. This representation can be made through the digital terrain model which offers quickness and high productivity both how the data is collected (technologies such as Laser Scanning and Stereophotogrammetry) and as well as the existing software solutions.*

This paper presents the digital terrain model of a stone quarry, from Arad County, regarding information about surface texture and elevation.

***Keywords:** digital terrain model, 3D model, surveying, stone quarry.*

1. Introduction

Digital **T**errain **M**odel (DTM) is a term commonly used interchangeably with digital elevation model (DEM). Strictly speaking a DTM refers to a model of reality which includes information relating to factors such as surface texture as well as elevation. [1]

Digital terrain modeling is a process to obtain desirable models of the land surface. Such models have found wide applications, since its origin in the late 1950s, in various disciplines such as mapping, remote sensing, civil engineering, mining engineering, geology, geomorphology, military engineering, land planning, and communications. [2]

Originally, terrain models were physical models, made of rubber, plastic, clay, sand, etc. But, when the computer has been introduced (in the late 1950s) the terrain surface modeling has been carried out numerically or digitally, leading to digital terrain modeling.

Along with the computing systems development the DTM made its presence felt increasingly, and established itself as a basic concept in many areas, due to the huge advantages it presents:

- a variety of forms can be represented: level curves, sections, 3D representations and others;
- they don't lose their accuracy over time, unlike paper plans that deform and lose their sharpness over time;
- feasibility in automation and processing in real time: digitally integrating new data and also updating the oldest ones is much faster and easier than in the case of analogical representations;
- easily representation in several scales: MDT can be easily adapted to the scale requirements.

The DTM data sets are extremely useful for the generation of 3D renderings of any location in the area described. 3D models rendered from DTM data can be extremely useful and versatile for a variety of applications.

DTMs are used especially in civil engineering, geodesy & surveying, geophysics, and geography. The main applications are:

- the terrain visualization;
- the terrain correction (reduction) in gravity measurements (Gravimetry, Physical Geodesy);
- the terrain analyses in Cartography and Morphology;
- the airborne or satellite photos rectification;
- the terrain parameters extraction;
- the water flow model or the mass movement. [3]

2. Case Study: the digital terrain model for Baratca stone quarry

The stone quarry, for which the digital terrain model was made, is located in Baratca village from Arad County. Arad County is situated in western Romania and covers Crisana and Banat territories.

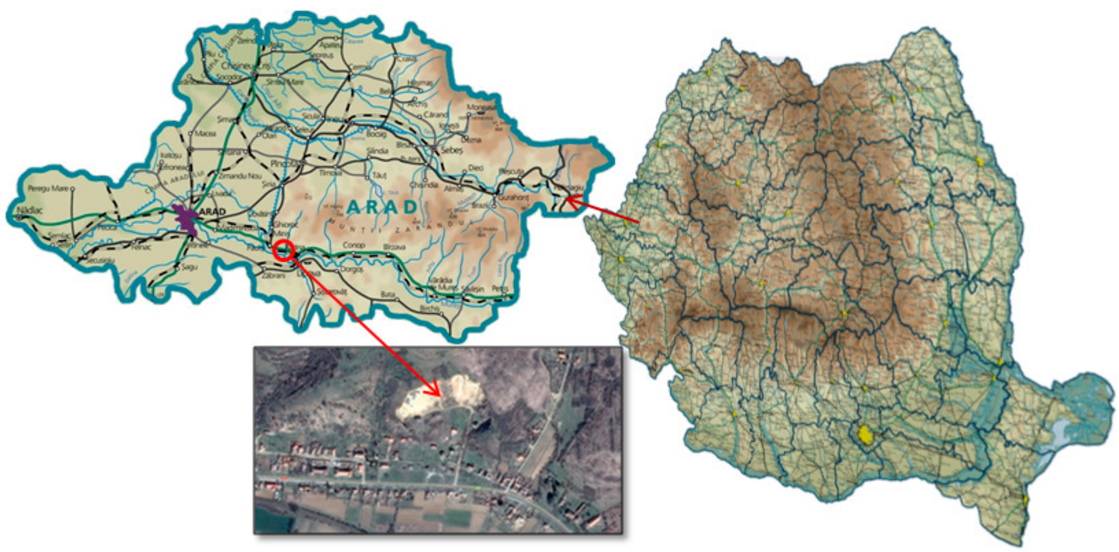

Fig.1. Barațca stone quarry location

In order to obtain the field data needed for the DTM of the quarry from Baratca village, were used the following devices: the GNSS System Rover Stonex S9 and Trimble S6 Total Station.

As for the data processing software, they are numerous, complex and very efficient, their data processing results being very expressive. Next will be presented software used to obtain the digital terrain model for the case study objective:

- AutoCAD is a computer aided design software used for designing plans and not only. It was developed and marketed by the US Autodesk Company;

- Terramodel (Terramodel® Trimble Software) is a software component of Trimble Office products. It offers a solution for data processing from measurements and is used for a editing digital terrain model.

The field data acquisition constituted a primary stage in obtaining the DTM. For this purpose the first step was choosing the station points (we've chosen only two station points because they were enough for the surveyed area). Their coordinates were determined in the national system of coordinates, using the GNSS technology (Fig. 2.).

Fig.2. Determining the first station point coordinates

Next, in each station point the instrument was installed and the actual measurements were made, as described in the following.

For every station point the coordinates, obtained with the GNSS technology, were introduced in the total station newly created job (Fig. 3.).

Fig.3. The station points coordinates introduction

After that the studied terrain surface' limits were established, selected on the total station display screen, targeted and measured using the laser function of the total station (Fig. 4.).

Fig.4. The terrain surface' limits establishing

In the next step, using internal software of the total station, there were determined the measurement characteristics: the point code, the distance to the points that were to be measured, the distance between points on the vertical and horizontal axis, the size of the selected area, the number of points that were to be measured and the total scan time.

During the scanning process, on the total station display screen, the evolution of the measurement was followed closely (Fig. 5.).

Fig.5. The measurements following up in real time

After the field data acquisition followed the data processing stage, which started with the data transfer from the total station to the computer using an USB cable. The Terramodel software was used firstly: a new job was created where the raw data was imported from a .csv extension file, as ASCII points.

Once the data was imported, the data input mode, the setting details for points and textual data were selected. At the end of this process the software summarized the steps, related to the field data importing, to be confirmed to complete the final phase of the import. Following confirmation into the workspace the points, determined on the field stage, can be seen (Fig. 6.):

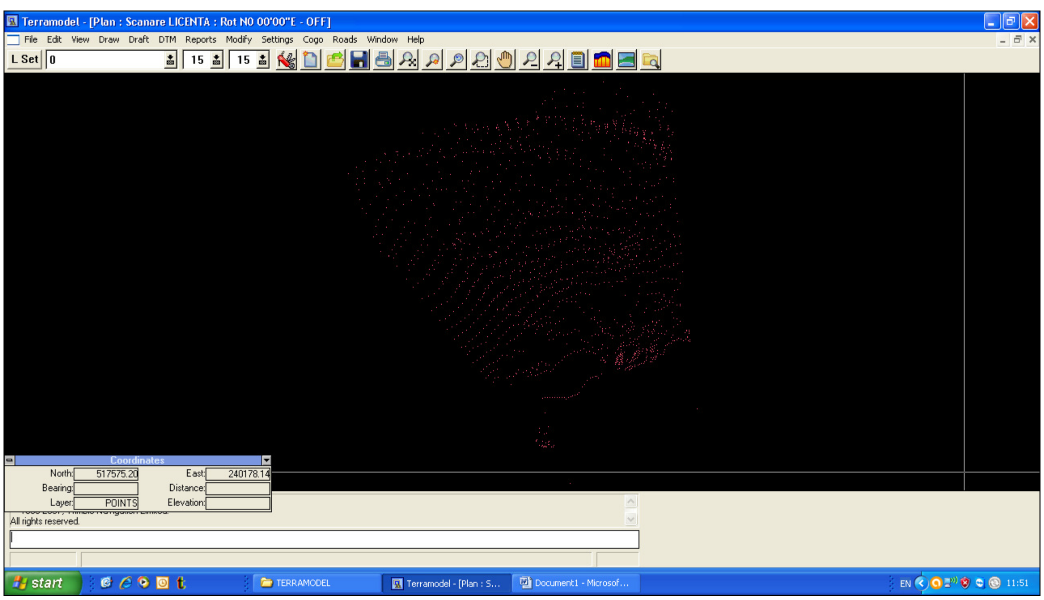

Fig.6. The imported field data

After obtaining Terramodel plotting data, they were exported in AutoCAD software because it allowed an easier data manipulation. So, it was created a file with .dwg extension. To complete the data export, were introduced some specifications such as: 3D option, the base layer setting and the points to be exported selection. Following, the data handling in AutoCAD software, the points were imported again Terramodel software for viewing digital terrain model using 3D Visualiser option.

In the figure below is present the DTM of the studied objective, from different perspectives.

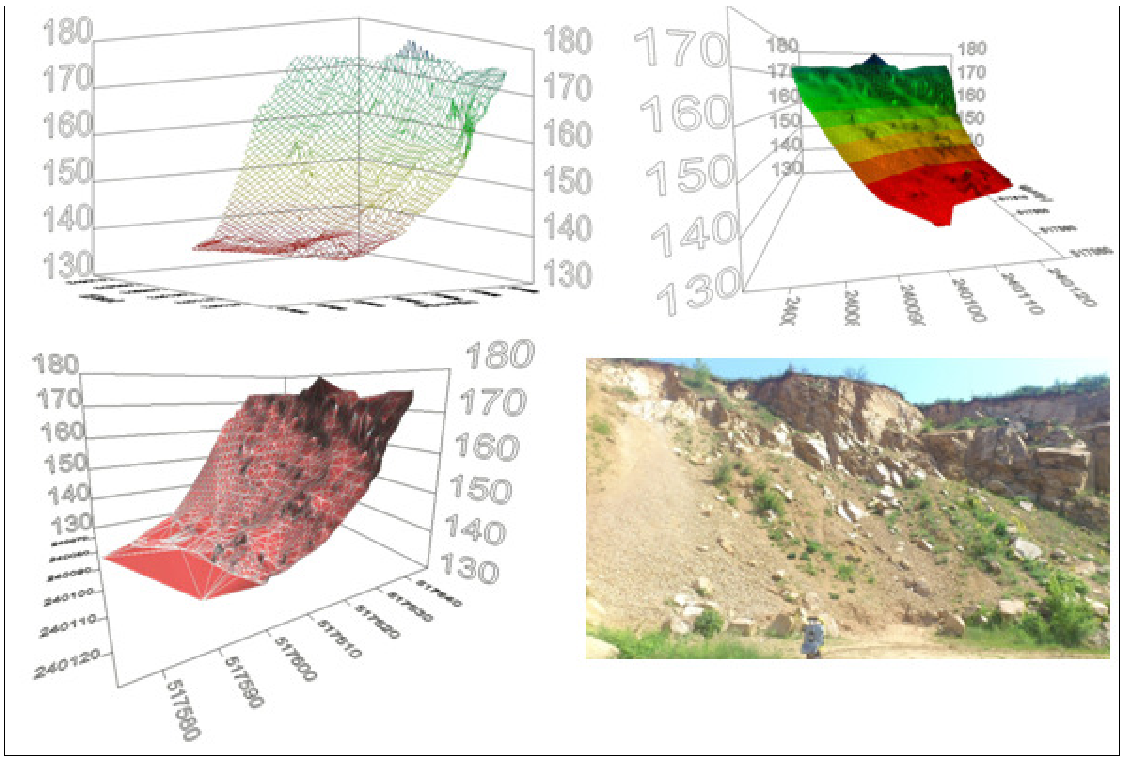

Fig.7. The real surface and its DTM

The DTM obtained from field data processing represents a first stage of the stone quarry monitoring. Comparing the DTMs from the future monitoring cycles with this current one, considered as the base monitoring cycle, we will obtain the extracted stone volume and also a monitoring for preventing the natural disasters, like landslides, will be accomplished.

3. Conclusions

Now, that scientific communities recognize the consequences of human activity on the environment the DTM is an essential tool in the effort to understand the global changes. [4], its use being found increasingly more branches of science, the limit being set the level of technology: both in terms of equipment for collecting and processing data and creating new methods and specialized software for each case.

DTM is becoming increasingly necessary, the benefits of its use being major ones, particularly in current market conditions, when production cost, material and allotted time reductions are very important factors which influence the work productivity. And precisely this is what the DTMs offer: speed and high productivity through both how data is collected (technologies such as Laser Scanning and Stereofotogrammetry) as well as existing software solutions.

Technological development was achieved by introducing digital tools and computer data so, major changes affected permanently the DTMs. This was a real advantage particularly for the land morphology data recording speed and accurate detailing, with lower costs.

Like any automation solution, the purpose of using DTM is to facilitate human labor, especially for repetitive and long-term tasks (i.e.: cross sections creating and quantities calculation) and those of involving sets of complex analyzes on large surfaces (i.e.: hydrological modeling).

However, although the methods of processing and analyzing field data will certainly be increasingly more complex and efficient, the human factor will not disappear from the work process because it alone can establish new criteria both for existing processes as in the case of new situations and/or unforeseen.

4. References

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