COMPARATIVE STUDY OF REALIZATION AND INTERPRETATION METHODS USED BY A TERRAIN DIGITAL MODEL

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Abstract*. In this paper we have approached one of the problems faced by a specialist in this domain, choosing a software program that could help him realize a three-dimensional model of the terrain. The purpose of the paper is to make the 3D model of the terrain using specialized software based on a topographic elevation of the terrain studied. The importance of the paper is given by the conclusion obtained from comparing the studied software programs used in the model generating.*

Keywords: *3D Model, Geodesy, Topography, Software*

INTRODUCTION

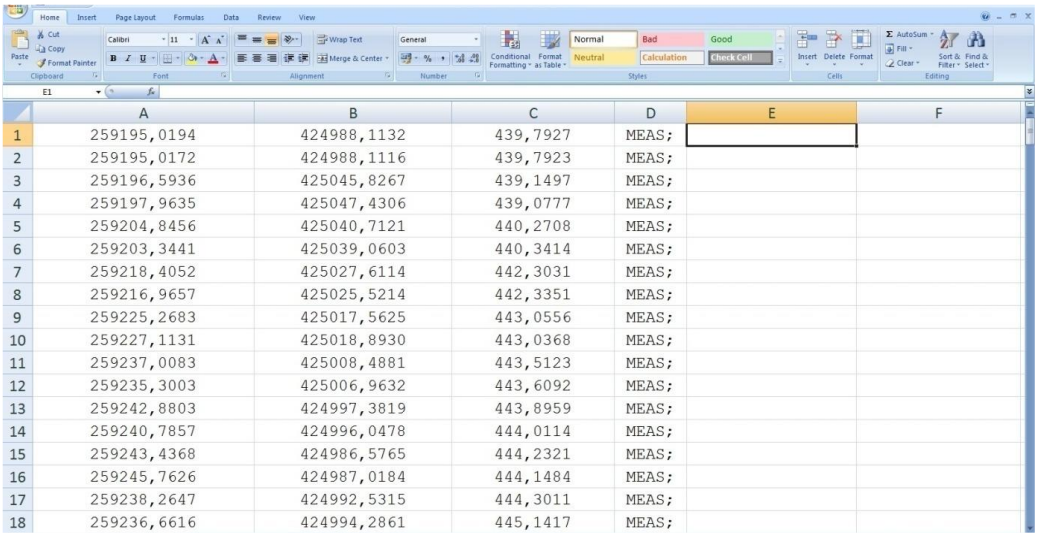
Terrestrial surface modeling is a particular case of surface modeling that takes into account specific issues related to the representation of Earth or some portions of the earth.

For Digital Terrain Model (HERBEI, 2015), field data can be used by various methods: remote sensing (HERBEI ET. AL., 2015, HERBEI AND SALA, 2016), photogrammetry (HERBEI AND SALA, 2014), topography (SMULEAC ET. AL., 2016) etc. Their processing can be done in various ways using specialized software: AutoCAD, Surfer, Global Mapper, ArcGIS, TopoLT, etc.

The digital terrain model is an information tool comprised of land and software data that is a basic component of a GIS (CALIN ET. AL., 2015). A GIS is a technical and organizational set - people, hardware (hardware), software (software), algorithms and procedures (HERBEI ET. AL., 2015) that provide management, processing, manipulation, analysis, modeling and visualization of spatial data in order to solve a complex planning and management problem territory (DRAGOMIR AND HERBEI, 2012).

In the representation of the land surface, the digital land model is one of the most important concepts. A digital terrain model (DTM) is the topographic model of the "golas" field, ie the landless surface of land or vegetation in digital format. A model is generally designed for a certain purpose. Depending on this purpose, it is working to a certain degree of accuracy.

In order to achieve the three-dimensional model of the land, a collection of surface data is required. In this case, data collection was done using the Leica TC 805 Intelligent Total Station, using classical measurement methods.



	A	B	C	D	E	F
1	259195,0194	424988,1132	439,7927	MEAS;		
2	259195,0172	424988,1116	439,7923	MEAS;		
3	259196,5936	425045,8267	439,1497	MEAS;		
4	259197,9635	425047,4306	439,0777	MEAS;		
5	259204,8456	425040,7121	440,2708	MEAS;		
6	259203,3441	425039,0603	440,3414	MEAS;		
7	259218,4052	425027,6114	442,3031	MEAS;		
8	259216,9657	425025,5214	442,3351	MEAS;		
9	259225,2683	425017,5625	443,0556	MEAS;		
10	259227,1131	425018,8930	443,0368	MEAS;		
11	259237,0083	425008,4881	443,5123	MEAS;		
12	259235,3003	425006,9632	443,6092	MEAS;		
13	259242,8803	424997,3819	443,8959	MEAS;		
14	259240,7857	424996,0478	444,0114	MEAS;		
15	259243,4368	424986,5765	444,2321	MEAS;		
16	259245,7626	424987,0184	444,1484	MEAS;		
17	259238,2647	424992,5315	444,3011	MEAS;		
18	259236,6616	424994,2861	445,1417	MEAS;		

Figure 1. Field book

MATERIAL AND METHOD

The realization of a 3D model using the Surfer program

Starting terrain data collected (SMULEAC ET AL., 2017), an input file is created in order to be able to realize a tri-dimensional model. In order to create a map using the Surfer program, one needs to start from a grid (. grd) type file. This file is created inside the software.

After choosing the Kriging interpolation method and after checking the space that allows the creation of the mode on the area demanded, a grid is created as base for the 3D model.

The creation of the grid file is confirmed by a report which contains details regarding the creation of this file.

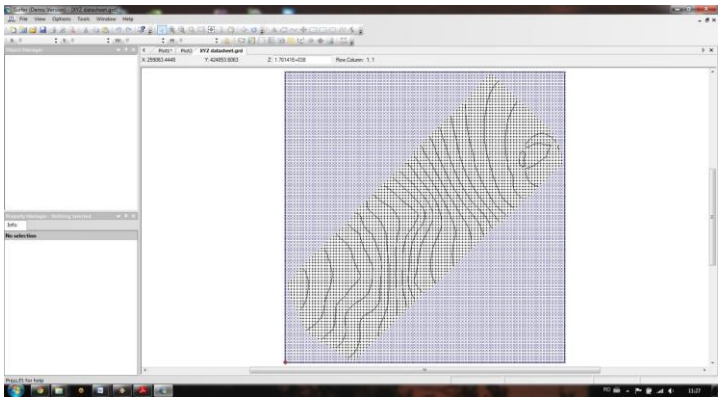


Figure 2 Grid of the aimed model

Based on the previous grid, the 3D surface model is created. After the file is imported

the model is automatically created for the terrain, with pre-defined settings (colors palette, background, settings regarding coordinates axes etc.)

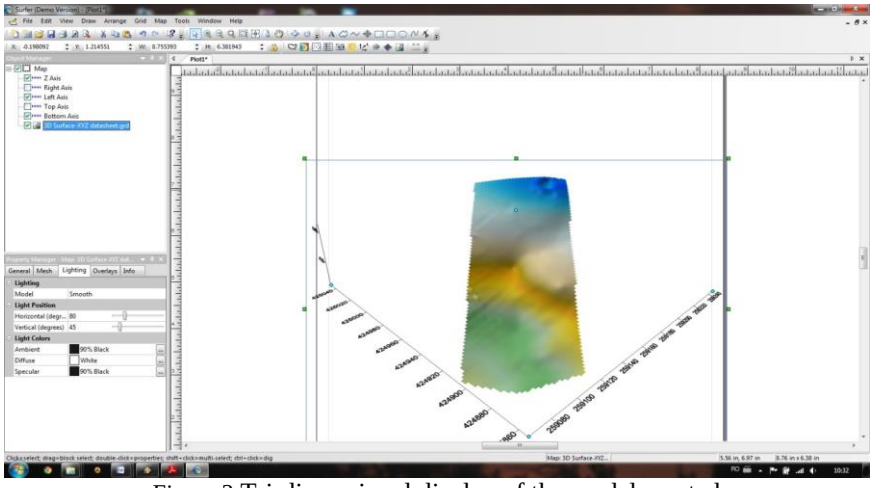


Figure 3 Tri-dimensional display of the model created

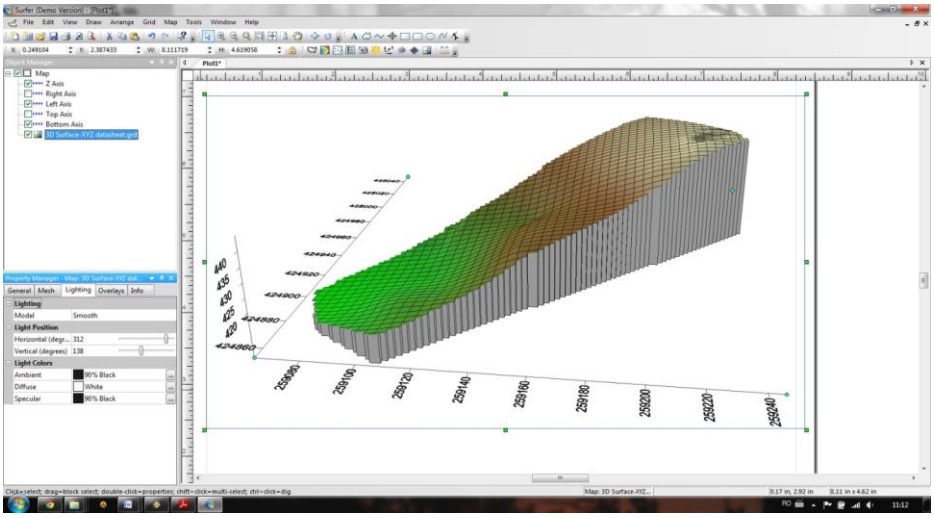


Figure 4 Modifying the model lighting

The realization of a 3D model using the TopoLT and AutoCAD programs

The realization of the 3D terrain model with the help of TopoLT and respectively of AutoCAD programs is realized by first creating a file with XYZ coordinates, gathered from the field.

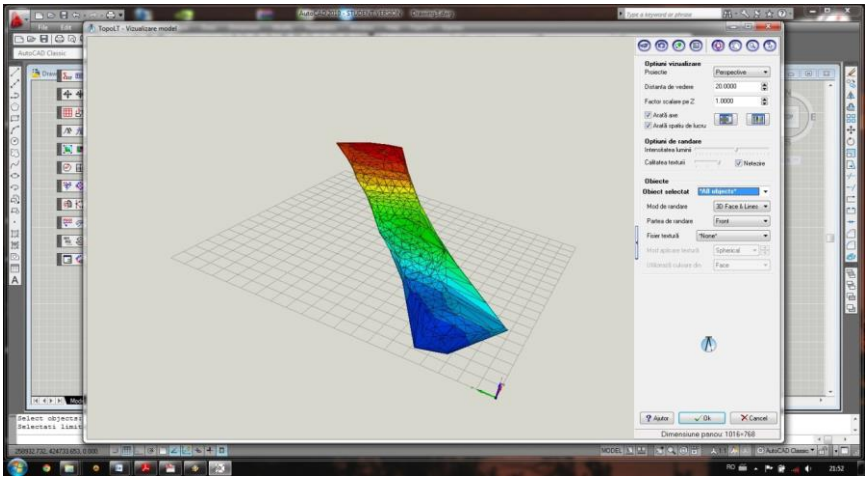


Figure 5 D model realized

Thus is when visualization options may be modified, together with rendering options, as light and texture quality. The Tools menu also offers the possibility to modify the rendering modalities and the cover for these rendering options, the latter allowing only a rendering of the model cover, in order to use fewer resources.

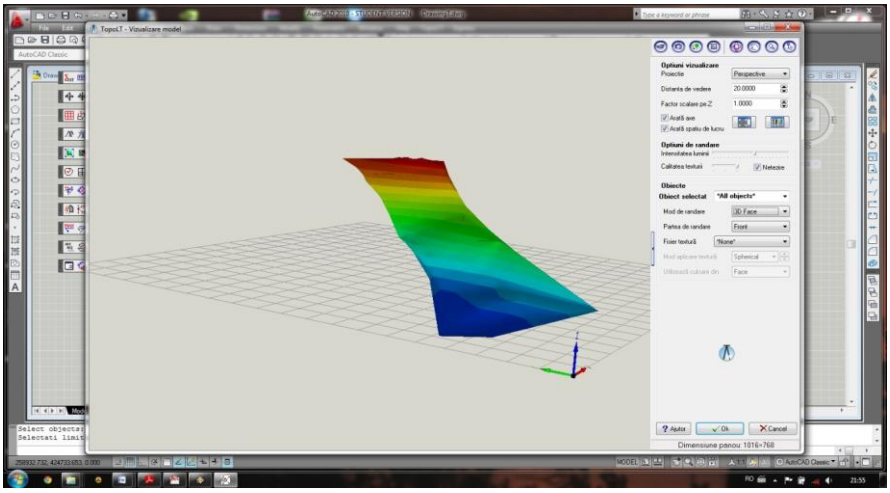


Figure 6 Rendering settings editing

The realization of a 3D model using the Global Mapper program

In order to be able to realize a tri-dimensional model of the terrain using the Global Mapper program a file is created with XYZ coordinates, measurements disposed in a manner recognized by the software.

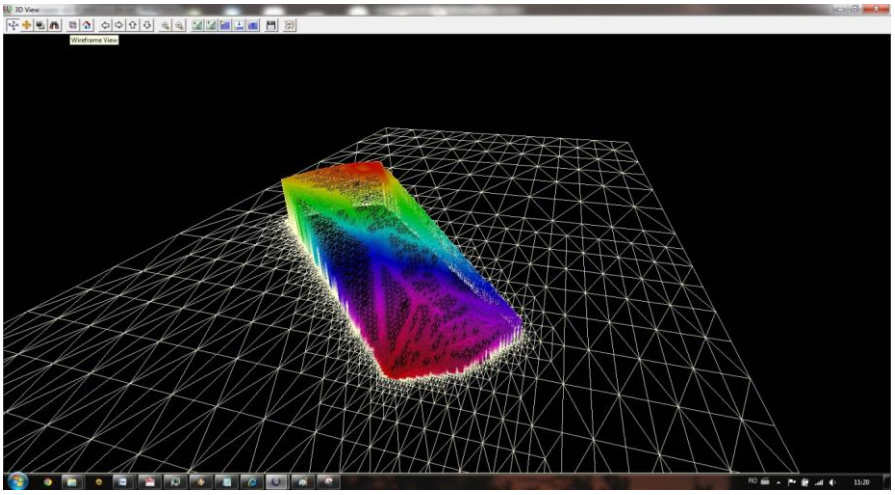


Figure 7 "Wireframe View" mode view

Another interesting characteristic of this program is the "Water Display" one, which allows people to view water on the surface measured. Another characteristic allows a setting for the water level. A useful tool is also the ne regarding water infiltration levels in excavation areas.

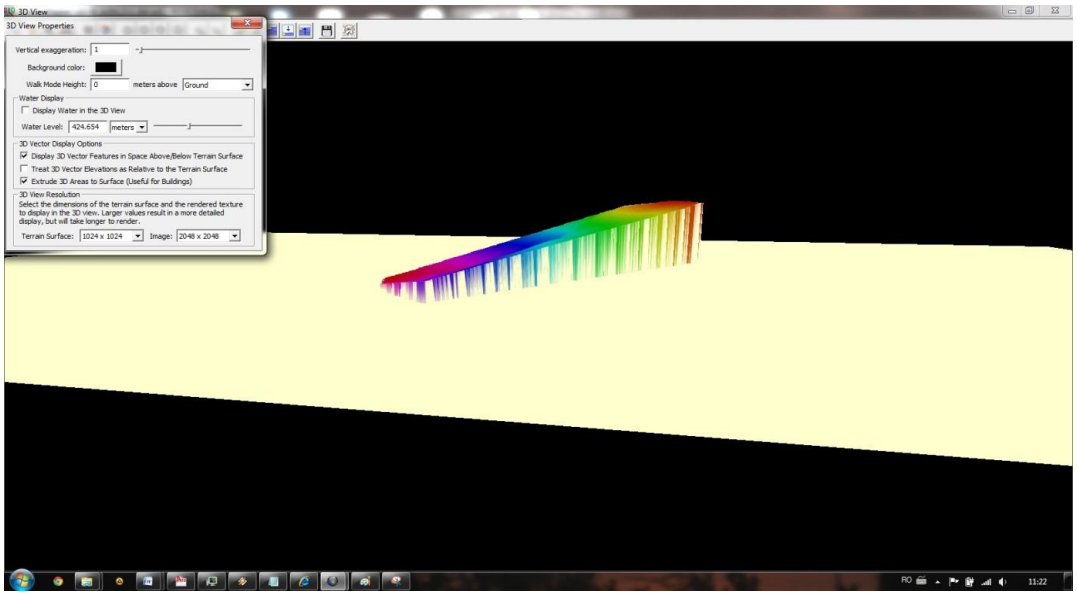


Figure 8 "Water Display" Settings Editing

RESULTS AND DISCUSSIONS

A S.W.O.T. analysis is also presented, based on characteristics of these programs in order to add more information to the differences already mentioned.

Software program	Surfer	AutoCAD + TopoLT	Global Mapper
Strong points	- it is easy to use even by beginners; - it can generate more types of maps; - it doesn't demand the use of a supplementary software to run; - it hold complex interpolation methods; - it allows the viewing and editing of all map parameters; - it doesn't require an updated hardware system program to run.	- it offers a variety of editing manner for model generated; - it hold the advantage of the model generated of being directly exported to the AutoCAD working space and it can be viewed and edited in the 3D working space; - TopoLT is a software specialized in the realization of topographic maps; - its menu is easy to learn and use; - it allows the calculation of volumes between 2 surfaces : tri-dimensional (filling volume, excavation volume); - it allows the rapid and easy report for working points in the AutoCAD space and in the interpretation of codes.	- it holds option for geo-referencing; - it recognises more file formats for inputs and outputs; - it allows geo-referencing; - it offers a large maps date base and of spatial references; - it allow the optimisation of more settings and the import of files and interpolation; - the export in the AutoCAD working space is realized with the help of Z data, which can be edited completely; - it has a reasonable pricing, (399$ for one working instrument)
Weak points	-high price (699$ package for one working instrument); -the impossibility of exporting more formats; -it is limited from the settings point of view, of projections and of altimetry references; - it is a weak program when taking into consideration the rapport quality/price.	- High pricing due to a need to also acquire the AutoCAD package (TopoLT 400€+ AutoCAD 4195$) - It doesn't allow the viewing of different formats; - it isn't a program that can run on its own; - a block export in the AutoCAD space is not a proper one; - it doesn't offer details on interpolation manners used in the realization of a tri-dimensional model.	-it is difficult to use by beginners ; -as a GIS application is weaker than the ArcGIS pack; -it holds a less intuitive interface.
Opportunities	-if the price is lowered, a larger market could be accessed; - due to the variety of maps generated it could find buyers in different domains; - the elaboration of a spatial data base could lead to a huge increase in commercial interest.	-through a continuous renewal of characteristics, the topographic and land market could be developed; - by creating a version which could run on its own, more users could access CAD platforms; -the development of tri-dimensional work characteristics.	-a proper promotion, due to low pricing, could cover a large frame of application and a large market; - by simplifying the menu and by creating a plan for students, a new development could be realized; - the development of a spatial data base for Global Mapper -promotion by highlighting its applicability.

Software program	Surfer	AutoCAD + TopoLT	Global Mapper
Threats	- Due to high investments in the alert development of new versions and of the high price, the mother company profits could decrease; - competition, through a complexity of their programs applicability : ArcGIS, Global Mapper etc.	- the introduction on the new AutoCAD platforms of more facilities that resemble the TopoLT ones, could lead to a decrease of the need to acquire this program; - the continuous modification of demands in the domain of terrestrial and land measurements, leads to an out of date characteristics of this program.	- the greatest threat of this program is represented by competition, for example the one coming from the ArcGIS program, which offers a larger applicability in the GIS domain - a weak promotion in certain countries could lead to the total market exclusion of this program.

CONCLUSIONS

Even if all software programs presented are capable of generating a tri-dimensional model of the terrain measured, each of them is unique. This characteristic results from the fact that each of these programs is conceived to fit certain demands, slightly different from one program to another.

The TopoLT program is specialized for topographic works, containing characteristics that help in the realization of terrain plans. It holds a number of characteristics and options for the generating of a model and for its editing. It is a useful program in this domain, especially in the processing of terrain data and in the elaboration of situation plans, sketches, reveals etc.

Even if the Golden Software program, Surfer, is just a mapping tool, with bi-dimensional and tri-dimensional viewing, it contains a large frame of applications, even if it isn't a specialized software for special works. It helps in the creation of a different maps.

From the point of view of applications variety that can be realized, the best program seems to be the Global Mapper. This one, besides the multitude of maps which can be created with its help, it can also be used as a GIS application, applied in different domains. It can also be used as an integrative part of a network of a geographic information data base, used in different domains as: regional development, tourism, financial and baking domains, military, crimes, social sciences, geology, environment etc. Another of its advantages is the space data base include in its memory.

After a details analysis one could state that in this domain the most useful program remains TopoLT, even if there are some drawbacks when working in a 3D spacing.

BIBLIOGRAPHY

CALIN, M., DAMIAN, G., POPESCU, T., MANEA, R., ERGHELEGIU, B., & SALAGEAN, T. 2015. 3D modeling for digital preservation of Romanian heritage monuments. Agriculture and Agricultural Science Procedia, 6, 421-428.

DRAGOMIR, L. O., & HERBEI, M. V. 2012. MONITORING THE SUBSIDENCE PHENOMENON IN PETROSANI CITY USING MODERN METHODS AND TECHNOLOGIES. Environmental Engineering & Management Journal (EEMJ), 11(7).

HERBEI M. 2015. Gis Si Modelare Cartografica. Universitas, Petroasn.

HERBEI M. V., HERBEI R. C., POPESCU C. A., BERTICI R., Domogled – Valea Cernei National Park Monitoring Using Satellite Technology, 2015, Ecoterra 12(3):73-78.

HERBEI M., SALA F., 2014. Using Gis Technology In Processing And Analyzing Satellite Images – Case Study Cheile Nerei Beusnița National Park, Romania. Journal Of Horticulture, Forestry And Biotechnology, 18(4), P. 113-119.

HERBEI, M.V., SALA, F., 2016 - Biomass Prediction Model In Maize Based On Satellite Images. In Aip

Conference Proceedings, Vol. 1738, No. 1, 350009, Aip Publishing.

HERBEI, M. V., HERBEI, R. C., & RADULOV, I. 2015. Topology of spatial data. In SGEM2015 Conference Proceedings, Book2(Vol. 2, pp. 1175-1182).

ŞMULEAC A., POPESCU C., IMBREA F., POPESCU G. AND ŞMULEAC L.I. 2016 Topographic And Cadastre Works For The Establishment Of An Animal Farm With Nprd Funds, Measure 12, Varadia, Caras – Severin County, Romania Geo Conference Sgem 2016 Sgem Vienna Green Extended Scientific Sessions, Sgem 2016 Conference Proceedings 3 685-692 Isbn: 978-619-7105-79-7 2 - 5 November, Book 6

ŞMULEAC, A., NEMEŞ, I., CREŢAN, I. A., NEMEŞ, N. S., & ŞMULEAC, L. 2017. Comparative Study of the Volumetric Methods Calculation Using GNSS Measurements. In IOP Conference Series: Materials Science and Engineering (Vol. 245, No. 5, p. 052020). IOP Publishing.