MODERN DATA COLLECTION TECHNIQUES AND TECHNOLOGIES LiDAR - SPATIAL DATA PROCESSING

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***Abstract:** The purpose of the project is to build a broadband infrastructure in disadvantaged areas, using structural funds, located in the counties of Caraș-Severin, Timiș, Arad, Bihor, Hunedoara, Sălaj, Satu-Mare. The objective of the project is the design of the distribution network, the construction of the distribution network and the operation of the distribution network. To carry out the topographic measurements, the Trimble MX2 device was used, with two sensors, which combined high-resolution laser scanning and precise positioning to collect a georeferenced point cloud, implemented on the platform of a car. For data processing, the corrections given by an own GNSS station are needed, for trajectory correction the APPLANIXMOBILE MEPPING program was used. The processing of the new points is done with the program TRIMBLE TRIDENT. Based on the collected data, the following topographical plan will be drawn up with the presentation of the relief through measured points of the long route of the road between the property limits, a plan drawn up in the 1970 Stereographic Projection System and the 1975 Black Sea Elevation Reference System and will contain elements of planimetry. The drawn parts will be developed with the help of the AUTOCAD 2006-2010 program.*

***Key words:** Infrastructure, Trimble MX2, GNSS, topographical measurements*

INTRODUCTION

Since the most distant times, man has posed the problem of terrestrial measurements, different methods being discovered and invented over the centuries, but there was greater development in this field, in the research and discoveries that took place in the 19th century, when all topo grids are displayed, the Gauss system is entered for maps and plans and photometry. The notion of geoid appears only in the 20th century.

LiDAR technology is a laser scanning technology, it is a state-of-the-art remote sensing technology, it is based on the laser measuring technique associated with a high-precision GPS system, all of which is packaged on an aerial or ground platform, providing accurate results. raised on the topography of the land (SMULEAC ET AL., 2019; PASCALAU ET AL., 2020).

MATERIALS AND METHODS

The purpose of the project is to build a broadband infrastructure in disadvantaged areas, using structural funds, located in the counties of Caraș-Severin, Timiș, Arad, Bihor, Hunedoara, Sălaj, Satu-Mare.

The objective of the project is the design of the distribution network, the construction of the distribution network and the operation of the distribution network, including the infrastructure associated with them in white areas of Romania, for the provision of broadband electronic communications services.

CSF estimated that 783 localities in the above areas possess the economic potential to generate a local loop business with positive NPV, for broadband internet access services, in a period of at least 7 years, thus the 783 located have become eligible for the construction of distribution networks through the intervention of public funds, they being called target areas.

Figure 1. Geographical representation of the 7 balanced eligible regions

After the specialized studies carried out by the specialist, in accordance with the laws in force, the CSF estimated that 783 localities located in the counties of Caraș-Severin, Timiș, Arad, Bihor, Hunedoara, Sălaj, Satu-Mare, called target localities, are eligible for construction to some distribution networks through the intervention of public funds (figure 1).

For the topographical measurements, in the case studied, the Trimble MX2 scanner was used. It is a vehicle-mounted spatial imaging system that combines high-resolution laser scanning and precise positioning to collect geo-referenced point clouds for a wide range of requirements. Available with single head, dual head or tilt head (MX2t), the system contains a combined Trimble Applanix GNSS and inertial geo-referencing module for precise positioning (SMULEAC ET AL., 2020, 2022; POPESCU ET AL., 2016; PASCALAU ET AL., 2021). The system can be rapidly deployed on all sizes of on-road and off-road vehicles and significantly reduces project field time and operator skill level compared to traditional techniques. The MX2 comes with Trimble's proven Trident software to quickly extract and analyze raw data to turn it into actionable geospatial intelligence (CASIAN ET AL., 2019; HERBEI ET AL., 2013, 2018).

LiDAR sensors use an active, light signal to measure the position, given by the X, Y, Z coordinates and reflective properties of a point on an object. In practice this results in a cloud of points with image qualities similar to other remote sensing technologies.

The accuracy of the point cloud data decreases as the distance from the LiDAR sensor increases. The distance that the LiDAR sensor covers is determined by the manufacturer's specifications, the precision sensors (MITA ET AL., 2020, PASCALAU ET AL., 2020).

The density of the point cloud is determined by the measuring speed of the sensor together with the speed during the measurement of the platform on which it is mounted. The density of the point cloud must be sufficient to identify and extract the physical details with the precision specified in the project.

LiDAR datasets are available in either LAS or ASCII format (PAUNESCU ET AL., 2020).

The model for using LiDAR - Mobile Mapping technology for detailed topographic surveys, both in urban areas and in other locations, involves following the workflow below:

1. Field reconnaissance of the studied area to determine how many scans are needed, in our case two scans were done.

2.Scan the area of interest using the Trimble MX2 scanner and a GNSS reference station (figure 2).

Figure 2. Scaner laser TRIMBLE MX2
(https://www.geo-spektr.ru/data/big/trimble-mx2.jpg)

3. Processing the cloud of points, this is done using the Trimble Trident program

4.Post data processing and obtaining data of interest

5. Providing the final result - the drawn parts will comply with the requirements and will be executed with the help of the AutoCAD program 2006-2010.

RESULTS AND DISCUSSION

In the studied case, the acquisition of data was created with the help of the Trimble Mx2 scanner (figure 3), attached to the platform of a car.

Figure 3. Trimble Mx with 2 sensors (https://scontent.ftsr1)

In terms of performance, the device meets the following criteria:

• Stop temperature from -100C-+500Claser type Dual SLM -250 CLASS1 LASERS
• Coverage up to 250 m
• 3600 field of view
• Accuracy of +/-1cm at 50m
• Measurement rate 72.000 points /s

Two series of data were collected, at different speeds of the platform, the resulting measurement contains files containing the entire trajectory of the machine - POS, files with the actual measurement - TRIDB, together with the cloud of points and the images taken by the camera – CAM (Cartis et al., 2019; Popescu et al., 2020).

Figure 4. Base station - Trimble Navigation - Construction Division
(*https://img.directindustry.com/images_di/photo-g/38313-16217854.jpg*)

Data processing requires the corrections given by a GNSS reference station (figure 4), for the case studied using an own reference station. The correction was applied to the car's trajectory in the APPLANIX POSPAC MOBILE MAPPING program, after which the POS information and the data from the reference system containing the corrections were entered (figure 5).

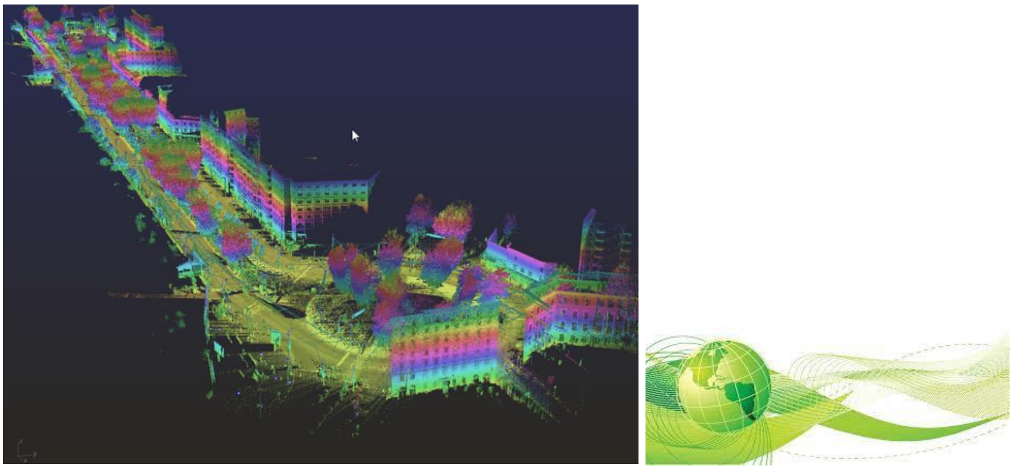

Figure 5. Trimble Applanix: Applanix LiDAR QC Tools (*https://www.applanix.com/img/products/city-modelling-lidar.png*)

Following the data processing, two sets of measurements resulted, and the cloud of points was exported to the LAS1,2 program, to be used in other programs as well (Simon et al., 2018; Barliba et al., 2014).

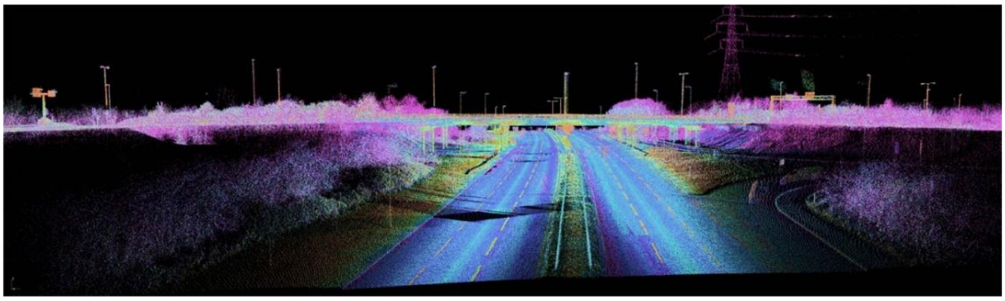

Figure 6. Trimble Applanix Mobile Mapping *(https://images.squarespace-cdn.com)*

CONCLUSIONS

Based on the collected data, the following were prepared:

• Situation topographical plan with the representation of the relief at points measured along the axis of the road between the property limits.

• The plan is drawn up in the 1970 Stereographic Projection System and the 1975 Black Sea Elevation Reference System and contains planimetry elements, wooden posts, kilometer markers, as well as toponymy elements.

The drawn parts were made with the help of the AutoCAD 2006-2010 program, preparing the following panels:

• The framing plan in the area at a scale between 1:1000 and 1:10000, so as to include the objective of the investment and the location around it

• Situation plans in detail in which elements necessary for the installation of optical fiber will be represented over the topographical support

• Main plans representing the sewage construction

• Panches regarding the construction of new air support.

BIBLIOGRAPHY

BÂRLIBA LIVIA, LUMINIȚA, L. DRAGOMIR, C. BARLIBA, A. ŞMULEAC, AND CIOLAC VALERIA. "Achieving the topographical works necessary to establish a poultry farm, International Multidisciplinary 14th Scientific GeoConference SGEM, Albena-Bulgaria." In Conference Proceedings, vol. 2. 2014.

CARȚIȘ, TRAIAN, ADRIAN SMULEAC, AND MIHAI SIMON. "Topographic Measurement And Construction Stake Out P+ 2f, Territorial Administrative Unit (Uat) Giroc, Village Giroc, County Timiș." Research Journal Of Agricultural Science 51 (2019): 65-74.

CASIAN, ALEXANDRU, ADRIAN ŞMULEAC, AND MIHAI SIMON. "Possibilities of using the UAV photogrammetry in the realization of the topo-cadastral documentation." (2019): 96-106.

HERBEI, M., ROXANA HERBEI, L. DRAGOMIR, AND A. SMULEAC. "The analysis of cartographic projections used in Romania." Research Journal of Agricultural Science 45, no. 2 (2013): 127-136.

HERBEI, MIHAI VALENTIN, ADRIAN ŞMULEAC, AND COSMIN-ALIN POPESCU. Cartografie digitală & Mobile GIS. Mirton, 2018.

MIȚĂ, R., M. SIMON, LOREDANA COPĂCEAN, A. ȘMULEAC, M. V. HERBEI, AND G. POPESCU. "Using geographical information systems in order to achieve the urban cadastre in the subcetate neighborhood of Arad with the help of modern technologies." Research journal of Agricultural science 52, no. 4 (2020).

PAȘCALĂU, R., S. STANCIU, L. ȘMULEAC, AND A. ȘMULEAC. "AHMADI KHOIE M." FEHER A, SALĂȘAN C., DANCI, M., BAKLI M., AMARA M (2020).

PAȘCALĂU, R., S. STANCIU, LAURA ȘMULEAC, A. ȘMULEAC, C. SĂLĂȘAN, AND ALINA-ANDREEA URLICĂ. "Protecting nature through languages." Research Journal of Agricultural Science 53, no. 2 (2021).

PAȘCALĂU, R., S. STANCIU, LAURA ȘMULEAC, A. ȘMULEAC, MIRELA AHMADIKHOIE, ANDREA FEHER, C. SALĂȘAN, M. DANCI, M. BAKLI, AND M. AMARA. "Academic vocabulary in teaching english for agriculture." Research Journal of Agricultural Science 52, no. 2 (2020).

PAUNESCU, ROXANA-DENISA, M. SIMON, LAURA ȘMULEAC, R. PAȘCALĂU, AND A. ȘMULEAC. "Topocadastral works regarding the realization of the gas distribution network in the locality of Constantin Daicoviciu." Research Journal of Agricultural Science 52, no. 3 (2020): 145-152.

POPESCU, G., C. A. POPESCU, M. HERBEI, AND A. SMULEAC. "Measuring the parameters that influence the phenomenon of displacement and deformation of the ground at Mina Livezeni." (2016): 147-155.

POPESCU, GEORGE, COSMIN ALIN POPESCU, MIHAI HERBEI, LUCIAN DRAGOMIR, ADRIAN SMULEAC, AND SILVIU DOROBANTU. "Monitoring of Excavation Works Using Modern Measuring Technology." Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture 76, no. 2 (2019): 236-244.

POPESCU, GEORGE, COSMIN-ALIN POPESCU, MIHAI-VALENTIN HERBEI, ADINA HORABLAGA, AND ADRIAN SMULEAC. "3D modeling of waste dumps in order to ecology of mining areas." AgroLife Scientific Journal 9, no. 2 (2020).

SIMON, M., ANCA TODIRUȚĂ, C. POPESCU, LOREDANA COPĂCEAN, AND A. ȘMULEAC. "The geodesic network thickening by satellite measurements in Bara commune, Timis County." Research Journal of Agricultural Science 50, no. 1 (2018).

ȘMULEAC, A., C. POPESCU, LAURA ȘMULEAC, AND CARMEN AURELIA PEPTAN. "Processing LIDAR information to increase precision in field numerical models." Research Journal of Agricultural Science 47, no. 2 (2015).

ȘMULEAC, ADRIAN, HERBEI MIHAI, GEORGE POPESCU, TIBERIU POPESCU, COSMIN ALIN POPESCU, COSTEL BARLIBA, AND LAURA ȘMULEAC. "3D modeling of patrimonium objectives using laser technology." (2019): 106-113.

ȘMULEAC, ADRIAN, LAURA ȘMULEAC, TEODOR EUGEN MAN, COSMIN ALIN POPESCU, FLORIN IMBREA, ISIDORA RADULOV, TABITA ADAMOV, AND RAUL PAȘCALĂU. "Use of modern technologies for the conservation of historical heritage in water management." Water 12, no. 10 (2020): 2895.

ȘMULEAC, L., C. RUJESCU, A. ȘMULEAC, F. IMBREA, I. RADULOV, D. MANEA, A. IENCIU, T. ADAMOV, AND R. PASCALAU. "Impact of climate change in the Banat Plain, Western Romania, on the accessibility of water for crop production." Agriculture 10, no. 10 (2020): 437.

ȘMULEAC, LAURA, FLORIN IMBREA, IOANA CORODAN, ANIȘOARA IENCIU, ADRIAN ȘMULEAC, AND DAN MANEA. "The influence of anthropic activity on Somes River water quality." AgroLife Scientific Journal 6, no. 2 (2017).

ȘMULEAC, LAURA, HORTENSIA RĂDULESCU, A. ȘMULEAC, R. PAȘCALĂU, M. AMARA, M. BAKLI, AND ALINA LAȚO. "The impact of agricultural, industrial and household activities on the Surduc Lake Water." Research Journal of Agricultural Science 54, no. 3 (2022): 2022.

https://scontent.ftsr1-1.fna.fbcdn.net

https://www.geo-spektr.ru/data/big/trimble-mx2.jpg

https://img.directindustry.com/images_di/photo-g/38313-16217854.jpg

https://www.applanix.com/img/products/city-modelling-lidar.png