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MODERN TECHNIQUES AND TECHNOLOGIES FOR DATA ACQUISITION AND PROCESSING USED IN THE GENERAL CADASTRE OF CRISENI, SATU MARE COUNTY

BIANCA MARIA CRET¹, LUCIAN ADRIAN MOICA², GEORGE POPESCU¹, ADRIAN ȘMULEAC¹,

¹University of Life Sciences" King Mihai I" from Timisoara, 300645, 119, Calea Aradului, Timisoara, Romania

e-mail: adrian.smuleac@usvt.ro

Abstract: The topographic-cadastral measurements conducted in this study focus on all field and calculation operations necessary for representing the earth's surface on a plan or map, in a specific cartographic projection and at a designated topographic scale. The general cadastre is a unified and mandatory system for technical, economic, and legal records that identifies, registers, and describes all land areas on topographic maps and cadastral plans, regardless of use or ownership, across the entire country. This article aims to illustrate and test the proposed model, evaluating the data accuracy regarding predictive measurements for topographic surveys conducted in Crișeni, UAT Craidorolt, Satu Mare County. The area was analyzed using mobile scanning with the Leica Pegasus: Backpack equipment, combined with two GNSS devices, the Leica GS 14 and the Leica GS 08 Plus. In developing the general cadastre for this administrative-territorial unit, modern technology was also employed—specifically UAV technology, which enables high-accuracy surface measurements with reduced work time. The data collected from the flight were downloaded and subsequently post-processed using specialized software: Pix4D Mapper. The results obtained are stored in digital format, and after export, are saved as .dxf files, allowing access in either digital or analog form through the AutoCAD processing program. The generated orthophotoplan is exported in .ecw file format. Using the Leica Pegasus equipment, the data are stored digitally and subsequently undergo post-processing with the Pegasus Manager software, while the point cloud processing is carried out using Cyclone software. In this case, processing resulted in the delineation of property street fronts and existing structures on the terrain. GNSS equipment was used to perform detailed topographic measurements.

• Introduction

This work aims to track the stages of systematic registration within the locality of Crișeni, Satu Mare County, as it represents an essential process for the organization and management of real estate properties. The use of modern technologies significantly contributes to improving the accuracy and efficiency of this process (Popescu et al., 2015). The cadastral system refers to the unified and mandatory system of technical, economic, and legal records through which the identification, registration, and representation on cadastral maps of all property units are carried out, regardless of their purpose or owner, across the entire country. It was necessary to collect field data in order to determine the coordinates of each property (land or building) and to create an accurate cadastral map (Șmuleac et al., 2015).

To shorten the study time for this area, state-of-the-art technologies were used, acquired through both traditional and modern methods, so that, in the end, we could achieve the most precise results (Barliba et al., 2013). Mobile mapping technology has revolutionized the mapping and management of our area of interest, providing precise data, quick results, and significant time and cost savings for the authorities and companies involved in managing these critical infrastructures. Leica Pegasus: Backpack is a high-performance mobile mapping solution developed by Leica Geosystems, which uses a combination of advanced sensors, including a LiDAR laser scanning system, allowing for the collection of highly precise topographic data essential for creating detailed 3D maps and analyzing environmental structures. Precise measurements can be made using GNSS technology, GPS (RTK), alongside modern drone technologies and geodetic data processing (Șmuleac et al., 2020).

• Material and method

Topographic-cadastral measurements play an important role (Leu et al., 2022; in topographic and cadastral activities, which may include field measurements (in both undeveloped and urbanized areas), mapping property boundaries, measuring infrastructure elements (roads, utility networks, buildings, etc.), as well as preparing detailed plans and maps. The case study was conducted in the locality of Crișeni, Satu Mare County, Romania. It is a rural commune, located in the historical region of Transylvania, and is part of the Satu Mare Metropolitan Area, being relatively close to the county capital, the city of Satu Mare. As the Master Base, we used the Leica Pegasus Backpack equipment, which recorded Rinex data at one-second intervals throughout the scanning process.



Image1. Leica Pegasus Backpack Equipment



Image2. WingtraOne drone



Image3. GPS Leica GS08 Plus



Image4. GPS Leica GS 16

From a topographic-cadastral perspective, the terrain recognition was carried out using UAV technology. Thus, properties within the built-up area of the locality were digitized according to their use, taking fences into account. For this equipment as well, a base station was used to obtain Rinex data throughout the flight. The images obtained from flights with the WingtraOne can be processed using most of the well-known photogrammetry software to create high-precision orthophotos and 3D models. After completing the scanning and flight, we proceeded with detail measurements. For all properties, RTK-determined control points were collected using GNSS equipment. These points verify the graphic representations made using the orthophoto map generated from the drone flight. In this case, we used two GPS devices, one being the Leica GS 08 Plus and the other the Leica GS 16 (figure 4 and 5).

• Conclusions

The completion of the general cadastre involves a series of important steps and aspects. This work requires the integration of engineering skills, advanced legal knowledge, the use of information technology, and database management. The completion of the technical systematic cadastre works will lead to the opening of new land books, thus replacing the old cadastral records with updated documents.

• Results and discussions

The practical part focuses on the general cadastre in the administrative-territorial unit (UAT) Craidorolt, Satu Mare County, a cooperated area, but with various challenges in identifying property owners and property documents.

To start the information campaign regarding the administrative-territorial unit Craidorolt, Satu Mare County, informative materials (leaflets, posters) were printed, distributed, and published according to the format provided by the "ANCP" (National Agency for Cadastral and Land Registration).

Additionally, the collected data is compared with existing cadastral plans. At this stage, a detailed verification is carried out to ensure that all properties are correctly identified and that property boundaries are well defined.

Data acquisition was performed using the Leica Pegasus: Backpack equipment, along with the GNSS equipment, used as the Master Base, which recorded Rinex data throughout the scanning process (figure 7 and 8).

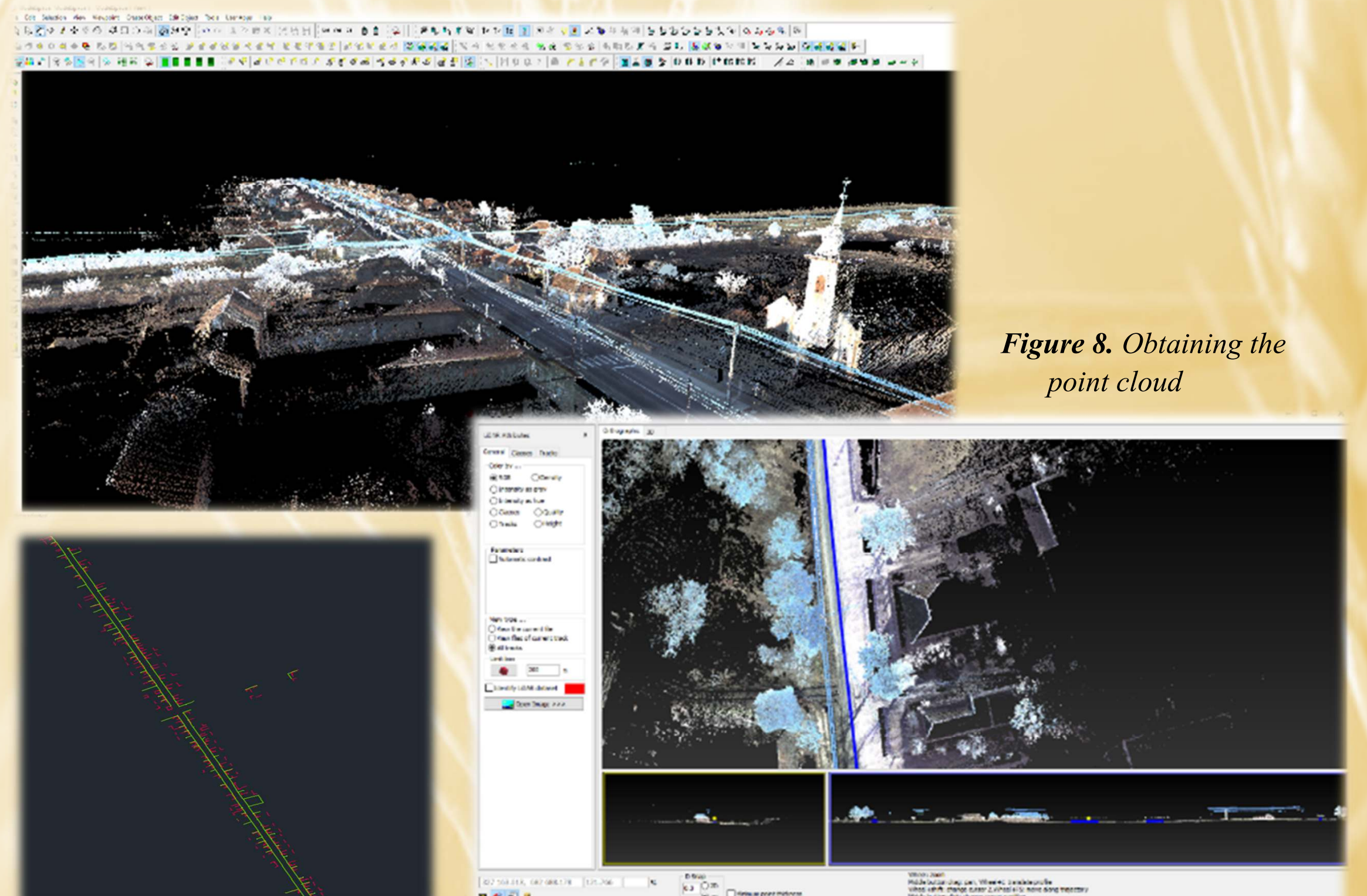


Figure 8. Obtaining the point cloud

NovAtel Inertial Explorer is a software specialized in collecting trajectories and analyzing inertial data obtained during mobile data collection, such as data from the Leica Pegasus Backpack equipment (figure 9).

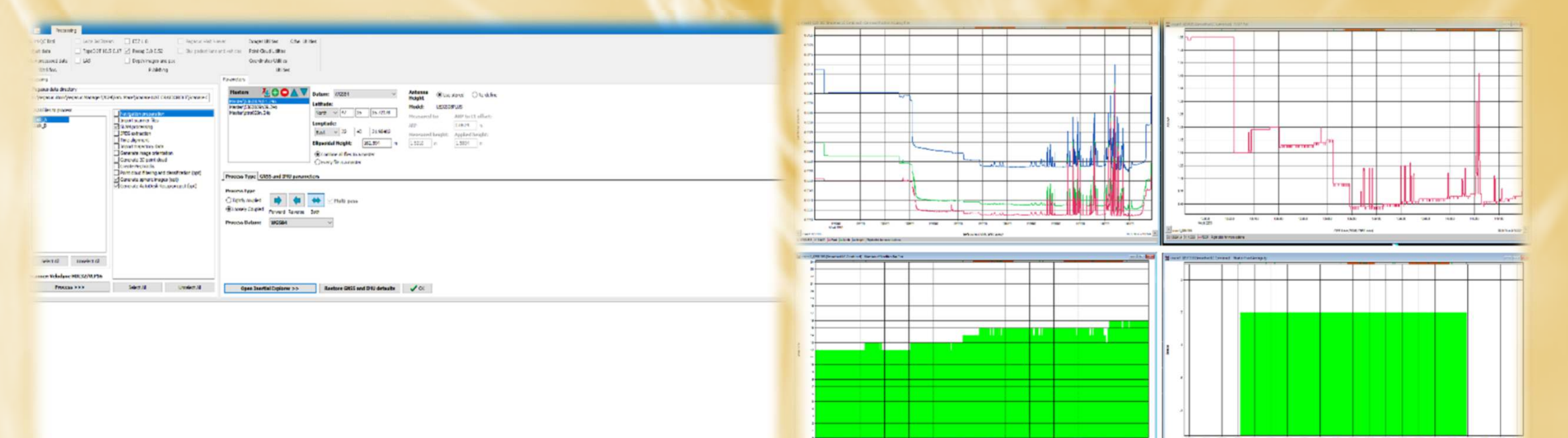


Figure 9. The interface of the Pegasus Manager software

Figure 10. Quality Control

After introducing the parceling into Mapsys, topological errors were corrected to avoid overlaps between properties or gaps. Topological errors were corrected for each layer individually in order to generate the cgxml files (figure 10, 11 and 12). After completing the registrations, the final step is to generate the "CGXML" files and upload them, along with the Property Data Sheets, to the "ANCP" - E-terra" platform (figure 13).



Figure 11. Cadastral Plan

Figure 12. Topographic Plan

Figure 13. Writing down the plan the informations from the CF