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MODERN 3D SCANNING TECHNOLOGIES AND TOPO-GEODETIC MEASUREMENTS USED IN THE DEVELOPMENT OF URBAN PLANNING DOCUMENTATION FOR MEDICAL INFRASTRUCTURE

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Introduction

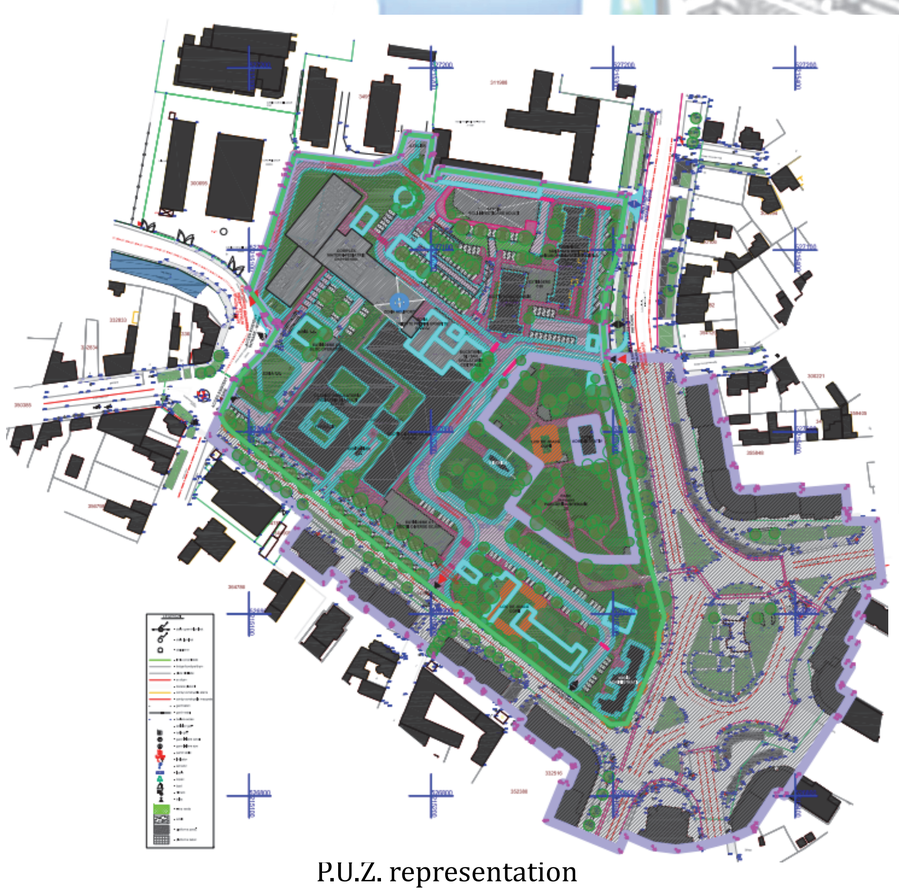
The paper presents the completion of the topo-cadastral works necessary for the development of the Zonal Urban Plan (PUZ) for the expansion and modernization of the Arad County Emergency Clinical Hospital. The main objective of the study is to obtain the technical and topographical support necessary to substantiate the urban proposals and the development of the existing medical infrastructure. The research used modern topo-geodetic equipment and advanced terrestrial laser scanning technologies, such as Trimble R6 and Trimble R8 GNSS receivers, total station and Trimble X7 laser scanner, which allowed for high-precision measurements and the generation of three-dimensional digital models of the site. The data obtained in the field were processed and integrated into specialized CAD and GIS programs, contributing to the development of topographic plans and the analysis of the existing situation within the hospital premises.

Material and method

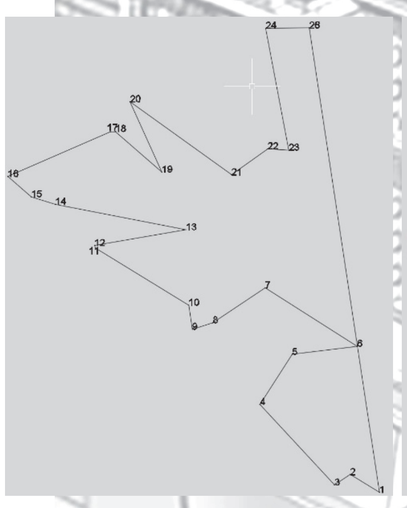
In order to carry out the topographic surveys necessary for the development of the zonal urban plan for the expansion and modernization of the Arad County Emergency Clinical Hospital, modern topographic and advanced scanning and satellite positioning equipment were used. This equipment allowed obtaining precise and rapid measurements, necessary for the creation of the digital technical support used in the development of urban documentation. To determine the coordinates of the characteristic points of the terrain, GPS/GNSS geodetic devices from the Trimble R6 and Trimble R8 series were used. These professional equipment are used in the field of topography, cadastre and geodesy to determine the position with centimeter accuracy. Receivers receive signals from GNSS satellite systems, such as GPS, GLONASS, Galileo and BeiDou, to calculate the three-dimensional coordinates of the measured points.

Result and discussions

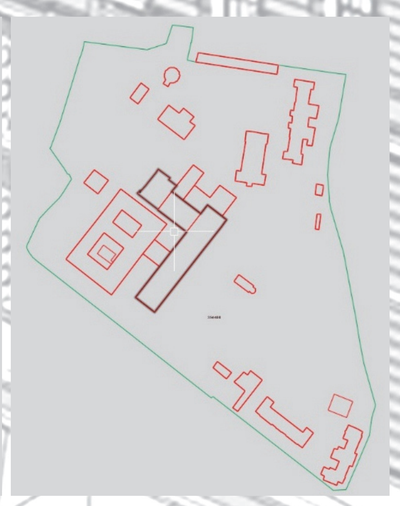
The results obtained from the processing of altimetry data revealed significant differences between digital terrain models generated from LiDAR, SRTM and ASTER data. Comparative analysis is possible from the point of view of the graphic representation (curve of the level, 3D models), which also has a higher value numeric value. Models based on the data of LiDAR also have a low level of detail, allowing identification of a variety of microreliefs in an tropical element. The level curves generated from these data are uniform and precise, faithfully reflecting the real terrain configuration. In addition, different altimetry calculations based on the LiDAR date and time can be achieved in the future. The ASTER GDEM models showed higher surface variability, being affected by noise and local errors. The contour lines generated from these data are less uniform, and in some cases discontinuities or artificial variations in the relief appear. These aspects limit the use of ASTER data in detailed analyses.



P.U.Z. representation



Reference stations



Spatial geometry

59	1.2 mm	46 %	99 %	22.558 m
60	2.1 mm	26 %	100 %	34.120 m
143	7 Links	1.6 mm Avg. Error	45 % Avg. Overlap	33 % Avg. Consistency
Linked Station	Error (mm)	Overlap (%)	Consistency (%)	Distance (m)
38	1.8 mm	40 %	27 %	30.785 m
50	2.4 mm	40 %	30 %	40.443 m
51	2.1 mm	53 %	40 %	28.511 m
52	1.0 mm	59 %	28 %	15.711 m
53	1.3 mm	35 %	27 %	17.054 m
54	1.0 mm	55 %	34 %	16.677 m
55	1.7 mm	30 %	48 %	28.543 m
144	2 Links	1.1 mm Avg. Error	45 % Avg. Overlap	24 % Avg. Consistency
Linked Station	Error (mm)	Overlap (%)	Consistency (%)	Distance (m)
43	1.2 mm	49 %	30 %	14.374 m
44	1.0 mm	41 %	19 %	10.297 m

Stations with the worst values

61	5 Links	2.4 mm Avg. Error	34 % Avg. Overlap	34 % Avg. Consistency
Linked Station	Error (mm)	Overlap (%)	Consistency (%)	Distance (m)
22	2.6 mm	33 %	40 %	27.750 m
23	1.8 mm	38 %	38 %	16.819 m
24	2.1 mm	37 %	34 %	15.621 m
25	3.0 mm	32 %	42 %	29.751 m
34	2.5 mm	27 %	15 %	31.554 m
62	5 Links	2.2 mm Avg. Error	46 % Avg. Overlap	96 % Avg. Consistency

Reference station 61, lowest value.

2 Control Points Matched		0.7 mm Avg. Error			
Control Point	Match With	Error (mm)	Delta N (mm)	Delta E (mm)	Delta El (mm)
2sebi	2sebi	1.3 mm	-0.3 mm	0.0 mm	-1.3 mm
3 sebi	3 sebi	1.8 mm	-1.5 mm	-0.2 mm	1.0 mm

Raw measurement

Conclusions

The use of Trimble R6 and Trimble R8 GNSS receivers, together with the Trimble X7 terrestrial laser scanner, allowed obtaining high-precision measurements and creating a complete topographic support for the analyzed site. The data collected in the field were processed and integrated into specialized CAD and GIS programs, contributing to the development of topographic plans and the detailed analysis of the existing infrastructure. The results obtained from the laser scanning revealed a high level of precision and quality of data recording, the average error of approximately 2 mm demonstrating the reliability of the method used.

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