MONITORING SURFACE BY GPS SURVEYING, 3D SCANNING, PRAID, HARGHITA ”

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Abstract: *2 SCANSTATION laser scanning system manufactured by Leica is a terrestrial scanning system, which is used mainly in static measurement that can be used in a wide range of topography Engineering works such as: Documentations in civil engineering, construction management, industry (industrial sites - re / construction) monitoring in various fields of industry structures, underground constructions (tunnels, galleries, etc.). Mines, Geology (eg stock analysis / volume); Documentation for technical installations (petrochemical, thermal power plants, nuclear power plants), architectural, archaeological, historical restoration situ-tion, monitoring disaster in virtual reality applications, technical documentation for the forensics, traffic accident reconstruction site, and so on, urban plans (2D, 3D); The instrument used to measure distances principle of measurement time (time of flight - TOF) principle for measuring angles oscillating mirror has a 360 ° scan field horizontally and vertically. Each of these measurement methods may lead to technical problems required specialized designer and can deliver specific products (topographic), which provide design support for the modernization of mines and construction of art of this kind. The difference between these methods, I wish to emphasize in this work, consists of a series of related parameters:a. Network design features lift;b. Carrying out their field work; c.The number of points collected; d. Advantages and disadvantages of the three approaches; e. Accuracy of determining the topographical characteristic points of detail required; f. Easy to obtain specific products; Processing of measurements made with ScanStation 2 were performed with software produced by Leica Geosystems Cyclone v. exclusively dedicated processing and measurements made with this system scan. Processing for laser scanning in many ways involves assembling clouds of points obtained in each point of the station, which coordinates in a local instrument. This operation is called registration. Registration on or georeferencing, when spoken by a single coordinate system (national in this case) is the process of combining results from different positions of the laser scanner or transform these results into a common coordinate system for the point cloud result after all scanning operations can be used to define the object or area scanned in a single system. Name of work: "Monitoriarea surface by GPS surveying, scanning, City mine, Harghita” Object of study: The aim of this project is to create a digital model, three-dimensional terrain current through modern 3D scanning technology for time tracking movements and settlements of land Aim: time tracking of movements of land mine salt mine village, county. Ground location: salt mine in the Black Mountains Gurghiului is contained in Salt Hill, County mine.*

Key words**:** *GPS, GeoReference, ScanStation 2,* scaning system, *cloud points, registration,* 3D section, digital model

INTRODUCTION

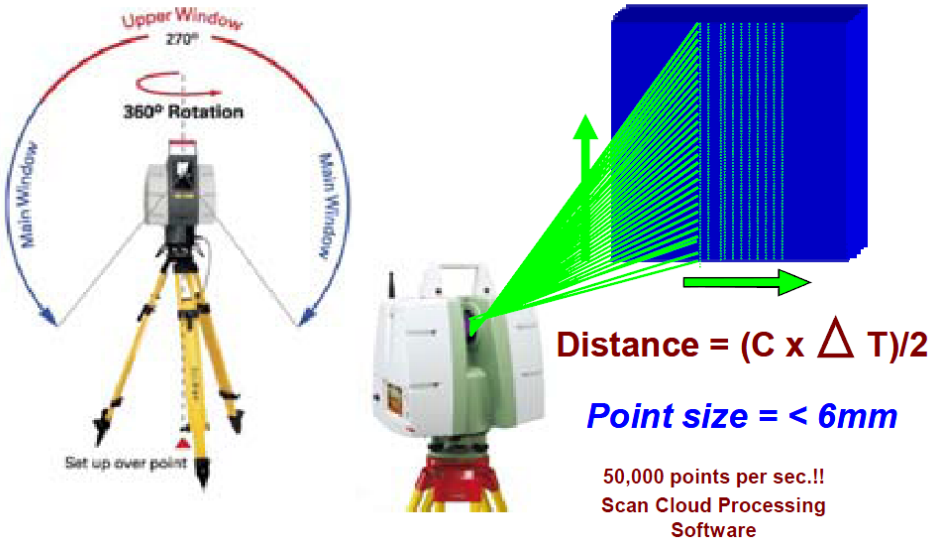
Laser scanning is a new geodetic technique, through which can be weighed fully automatic (more or less) the geometry of land or a structure without a reflective environment, high precision and high speed. The measurement result is represented by many (significant) points, called point cloud. In addition to the coordinates x, y, z of points, the scanner delivers scanned surface reflectivity values. 3D Cartesian coordinates of each point measured is provided through measuring distances, angles horizontally and vertically. This is the principle of land measurement technique known as the method of polar coordinates. It is important to note that these coordinates have a local reference system defined (x, y, z) of the instrument,

which then, through georeference can be placed in the national coordinate system. In general, data acquisition is done in a very short time, which confers a significant advantage of this technique compared to conventional methods (total station, GPS). Post-processing of data, however, can take longer, given the huge volume of data that can be bought in a scanning campaigns (eg can be tens of millions of points contained in a cloud of points).

Advantages of 3D Scanning

- reduce the time and cost measurements
- high speed data recording
- high precision
- fully automated measurements
- 3D visualization
- can perform spatial analyzes
- remote data logging

LEICA HDS Scanstation C-10



Surveying equipment used for 3D scanning

Description of topographic and geodetic works

Scanning was performed with Leica 3D laser scanner C10. As reference points were used in the existing network points planted in 2011, when he made the 0 (zero) measurements. Support of existing network points were determined by measuring RTKs (Real Time Kinematic Survey ie real-time kinematic measurement).

Old inventory coordinate points

Points	Y(m)	X(m)	H(m)
205	508571.9169	560246.5331	412.7556
A7	508699.8943	560166.5793	414.5361
PR50	508621.1709	560165.7844	410.1279
P1	508725.7141	560182.2689	414.4379
T15	508808.4799	560188.5923	417.2832



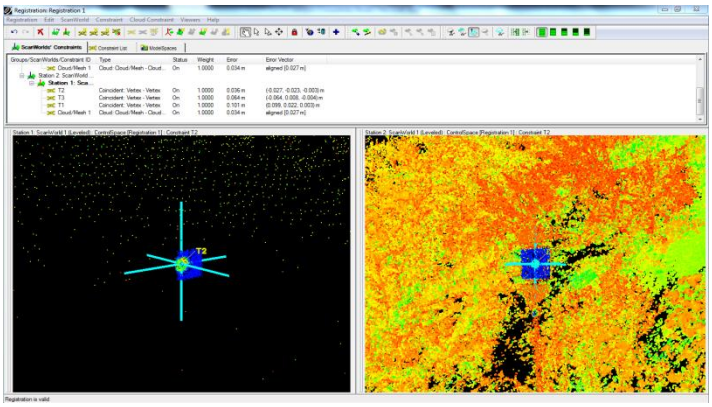
Scanning itself requires some preliminary operations:

- Placing the station the unit with all required operations (centering on horseback);
- Definition 3D section to be scanned;
- Selecting specific scanner software for the job;

Scanning was performed with a resolution of 5 cm to a radius of 80-130 m All scans had a common local coordinate system (made by a method traverse points supported by retrointersecție).

Post-processing of data

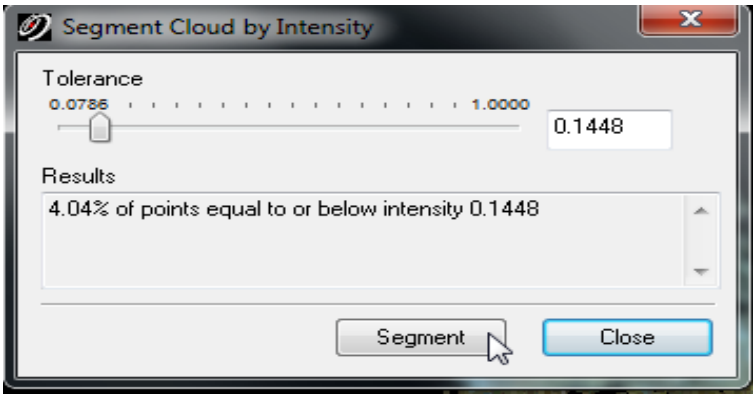
From data acquisition to create many clouds of points each time you press the Scan button. Clouds of points were subjected to operation constraints imposed registration and Cyclone software 7.4.



View T2 target two different station points

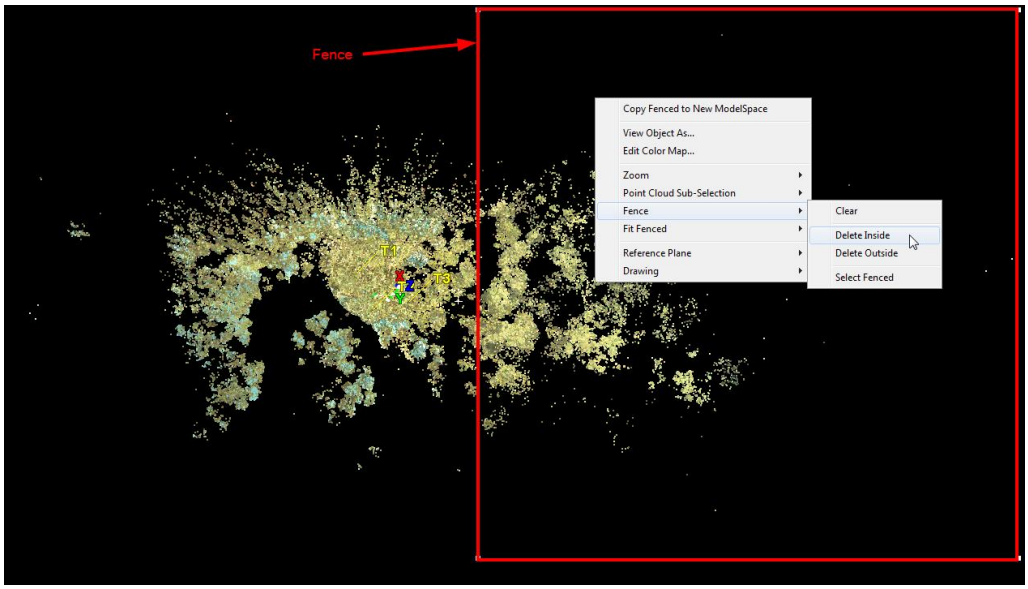
Unifying data: is designed to facilitate working with point clouds and to facilitate their visualization by bringing all clouds of points within a single cloud, which you can easily

manage PC in terms of memory required. Cloud segmentation option menu points - depending on the intensity.



Point cloud segmentation based on intensity

Another method of eliminating useless data is the data selection and deletion Fence.



Measurement noise removal in manual mode

Resulting point cloud was exported in. PTG. Columns in the file. PTG correspond to X, Y, Z, I (intensity), R (red), G (green) B (blue). Are local coordinates system, the first point of plant origin (X = 0, Y = 0) and Z = 0 at the point of construction scanner with which to measure its height.

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67.243240 67.286392 44.112656 -1396 84 77 61
67.878433 67.608139 44.199326 -1467 55 54 24
67.523483 67.540817 44.183914 -1463 42 41 36
67.919876 67.900742 44.331772 -1486 52 53 45
67.907150 67.377487 44.979538 -1521 127 161 134
67.949509 67.289810 44.959274 -1416 64 70 42
67.948196 67.671219 44.719650 -1506 94 139 136
67.935898 67.529404 44.583817 -1652 84 107 89
67.817947 67.678391 44.914108 -1359 50 54 39
69.734451 66.201370 45.170700 -1447 45 42 25
68.065201 64.454971 45.835220 -1424 119 127 88
69.640335 65.872238 44.281448 -1614 68 63 34
69.400681 65.667435 44.007614 -1630 91 88 55
69.275284 65.936539 44.554611 -1609 72 75 56
69.377090 65.895737 44.575760 -1434 90 102 66
69.769272 65.605972 44.737015 -1576 125 127 80
69.951279 65.512131 44.772263 -1370 112 117 76
69.772324 66.362656 45.002090 -1550 30 33 22
68.140030 66.362473 44.180161 -1508 77 71 39
68.033707 66.609268 44.412003 -1370 77 71 49
68.818863 66.290817 44.836349 -1627 36 34 21
68.035721 66.732559 44.669449 -1483 89 90 50
68.419357 66.950729 44.906509 -1629 87 83 48
69.606216 66.092453 44.370590 -1539 54 60 32
69.594925 66.965744 44.635788 -1429 67 70 41
68.978043 67.188187 44.209396 -1593 98 92 58
68.006241 67.212509 44.339218 -1496 70 92 45
68.102768 67.427383 44.944260 -1431 76 103 84
68.001511 67.588181 44.865158 -1511 157 207 158
68.473862 67.246933 45.131424 -1442 171 188 178
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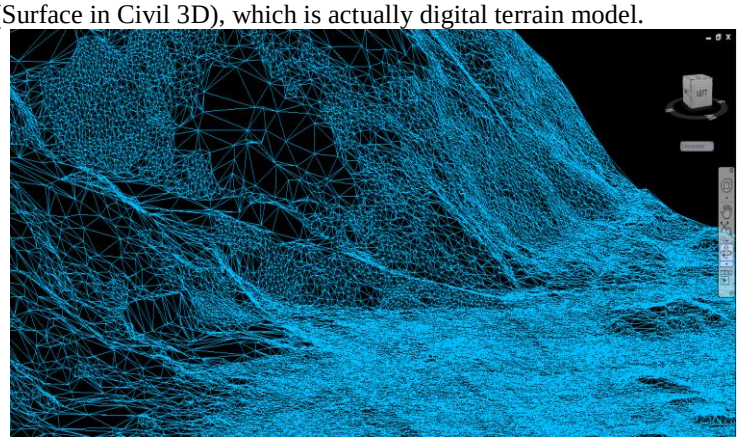
The. PTG was converted to. PCG and imported into AutoCAD Civil 3D 2013 for further processing of the surface.

Scanned digital terrain model was obtained by using a data filtering algorithm. It provides point cloud filtering of those points which are relevant to creating the desired surface. Is achieved by setting a rectangular network, the fairness specified user. Around the points of intersection of the lines rectangular grid (grid) will develop (automatically by the software function) cylinder within which a search is made of the points with the smallest share. All points with the smallest share, found inside cylinders will be added to a surface (Surface in Civil 3D), which is actually digital terrain model.



Digital terrain model after noise filtering

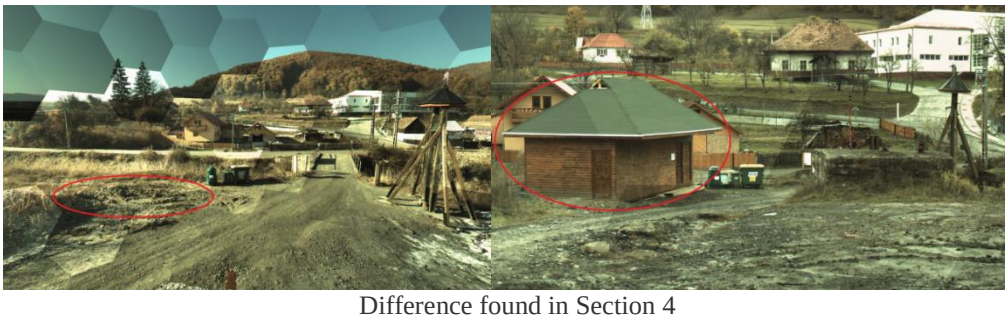
In AutoCAD Civil 3D digital models overlapped scanned the land in 2011 and 2012. Of the pattern were extracted transverse and longitudinal sections to highlight changes while the land.

RESULTS AND DISCUSSIONS

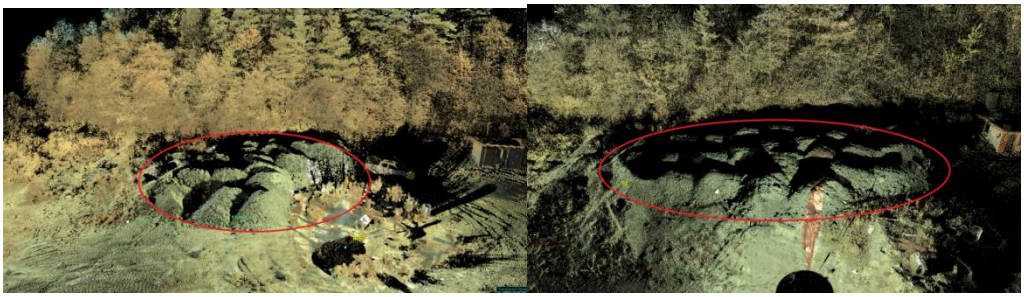
After superposition of two digital surface (scanned in 2011 and 2012) showed a volume filler = 5525.25 m and a volume of excavation = 7064.12 m.c. Also created a virtual grid of 44 points, so just thought densely cloud of points to be use for virtual locations to achieve maximum precision.

Punct	Anul 2011 Cota (m)	Anul 2012 Cota (m)	Diferenţă 2011-2012 (cm)
1	409,809	409,808	0,1
2	412,013	412,015	-0,2
3	415,106	415,062	4,4
4	409,914	410,366	-45,2
5	414,336	413,049	128,7
6	411,002	410,994	0,8
7	413,358	413,350	0,8
8	414,212	414,201	1,1
9	418,000	418,015	-1,5
10	411,016	411,015	0,1
11	413,568	413,560	0,8
12	413,810	413,800	1,0
13	414,802	414,807	-0,5
14	415,972	416,011	-3,9
15	410,397	410,421	-2,4
16	413,020	413,012	0,8
17	414,232	414,188	4,4
18	416,208	416,216	-0,8
19	409,618	409,611	0,7
20	413,411	413,408	0,3
21	411,390	411,369	2,1
22	414,842	414,832	1,0

Punct	Anul 2011 Cota (m)	Anul 2012 Cota (m)	Diferenţă 2011-2012 (cm)
23	417,240	417,184	5,6
24	434,000	434,002	-0,2
25	445,020	445,003	1,7
26	410,005	410,000	0,5
27	412,798	412,800	-0,2
28	413,814	413,798	1,6
29	414,226	414,196	3,0
30	419,218	419,213	0,5
31	408,627	408,633	-0,6
32	413,895	413,878	1,7
33	412,799	412,794	0,5
34	415,391	416,433	-104,2
35	415,655	415,636	1,9
36	423,008	422,992	1,6
37	433,984	433,996	-1,2
38	408,202	408,211	-0,9
39	410,607	410,591	1,6
40	411,867	411,867	0,0
41	413,414	413,400	1,4
42	415,000	415,000	0,0
43	424,954	424,975	-2,1
44	440,028	440,019	0,9



Difference found in Section 4



Difference found in Section 5

Difference found in Section 34

CONCLUSIONS

Although 3D scanning technology remains behind aeroscanării ground, it has a great potential to be used for landslide investigation even larger scale.

The biggest disadvantage of this technique is that it provides information about changes in the vertical plane, not in the horizontal, but in combination with classical methods (terminals, total station) can provide very good results.

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