

# **Applying of the Mobile Versions of Google Earth and AutoCAD for Field Control of a Specialized map of a Large Urban Garden**

**Gintcho KOSTOV, Bulgaria**

**Key words:** geodesy, GNSS, GPS, surveying, map.

## **SUMMARY**

Nowadays the mobile technologies are developing rapidly and increase their applications in various human activities. Smartphones, running with Android OS provide many possibilities, if certain software is used. A number of mobile applications are designed for this OS - such as Google Earth, AutoCAD WS, etc. The mentioned software could be very useful for specific geodetic activities, where application of other method is not appropriate.

The paper studies the practical implementation of the field control of a specialized digital map (containing information for: benches, alleys, pillars and trees) of a large urban garden. In the article are analysed: the results from the conducted geodetic measurements (both classical and satellite), the application and the behaviour of the smartphone, along with the software used to conduct the field control of the map.

Based on the specific requirements for the geodetic measurements, needed for the creation of the map, the results from the field control and the usage of the mobile technologies conclusions and recommendations are done.

## **АБСТРАКТ**

В днешно време мобилните технологии се развиват бързо и увеличават своето приложение в различни дейности на човешката активност. Смартфоните, работещи с ОС Android предлагат много възможности, ако се използва подходящ софтуер. Съществуват голям брой мобилни приложения за ОС Android – напр. Google Earth, AutoCAD WS и др. Последните могат да бъдат използвани при специални геодезически дейности, където прилагането на друг метод не е подходящо.

Тази статия изучава практическото извършване на полската проверка на специализирана цифрова карта (съдържаща информация за: скамейки, алеи, стълбове и дървета) на голяма градска градина. В материала са анализирани: резултатите от геодезическите измервания (класически и спътникови), прилагането и поведението на смартфона заедно със софтуера, използван за извършване на полската проверка на картата.

На база на специфичните изисквания за извършване на геодезическите измервания, използвани за създаване на картата, резултатите от полската проверка и прилагането на мобилните технологии са дадени заключения и препоръки.

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## **1. INTRODUCTION**

Nowadays the mobile technologies have significant influence in our life and various applications are created for hand-held devices. A number of web sites and programmes have versions, designed especially to run under a mobile device and OS. The current tendencies are for increased use of the smartphones as well as other devices especially for professional purposes due to their reduced size and user-friendly interface.

Many web sites (e.g. <http://www.metzgerwillard.us/EarthSurvey.html>, <https://play.google.com/store>, <http://androidapp.lisisoft.com/android-apps/geodetic.html>, etc.) could be found on the Internet, providing possibility for download of various mobile applications (both free and paid) designed for general usage or specific geodetic task.

In this paper will be given one other possible application of the mobile technologies - for field control of a specialized map of a large urban garden. In the field work are involved: smartphone, the mobile versions of Google Earth and AutoCAD, running under Android OS and digital model created from classical and GNSS measurements.

Along with the details for the practical implementation of the aim, the advantages and disadvantages (according to the author's opinion) of the used mobile technology are given.

## **2. APPLICATIONS OF THE MOBILE VERSIONS OF GOOGLE EARTH AND AUTOCAD FOR GEODETIC PURPOSES**

Parallel with the general development of the hardware of the mobile devices like smartphones, tablets, etc., the software, designed for them undergoes continuous updates.

AutoCAD WS has some features, dealing with GPS technology, see [<http://mycoordinates.org/gis-27/>].

Google Earth itself has a number of utilities and many possible applications. Some of them – explicitly for geodetic purposes could be found on the Internet at: [<http://www.smokycogs.com/blog/tag/geodesy/>], [[http://www.amerisurv.com/PDF/TheAmericanSurveyor\\_Davis-GoogleEarthPLSS\\_Vol8No7.pdf](http://www.amerisurv.com/PDF/TheAmericanSurveyor_Davis-GoogleEarthPLSS_Vol8No7.pdf)], <http://www.metzgerwillard.us/EarthSurvey.html>, [<http://seilermapsupport.wordpress.com/2012/02/26/video-is-available-of-february-16ths-ngsds-world-for-viewing-survey-control-and-other-ngs-information-in-google-earth/>], etc.

In this paper special attention is focused on the practical usage of Google Earth together with AutoCAD WS in order to implement field control of a specialized digital map of a large urban garden. Both of the applications are freely available at <https://play.google.com/store>. To apply the mentioned software products for the field checks, source data (digital model created by geodetic measurements) is required.

### **3. TECHNOLOGY AND CONDUCTED GEODETIC MEASUREMENTS, USED FOR THE CREATION OF A SPECIALIZED DIGITAL MAP OF THE LARGE URBAN GARDEN**

#### **3.1 Applied technology in the field**

It should be noted, that due to the specifics of the terrain and environmental conditions both total station and GNSS system were used for conducting the necessary geodetic measurements. Most of the area of the garden was measured by the classical method. The garden, which area was estimated to 82274 sq. m. was separated into parts in order to facilitate the measuring and control processes.

Geodetic network was created in the garden. The network was stabilized, measured and adjusted. The mathematical processing of the geodetic measurements was done using own software PhdPolarSurvey (providing the ability for calculation of various quality criteria, used in chapter 4). The points from the geodetic network were coordinated by GNSS system.

#### **3.2 Classical measurements**

Taking in mind the interior of the garden (presence of significant number of small and tall, broad-leaved and coniferous trees) it was decided, that most of the measurements should be conducted using total station. Based on the created geodetic network, all cadastral objects (benches, alleys, pillars and trees) of the garden were coordinated. The classical geodetic measurements met significant difficulties due to general problems with the visibility between the instrument and the reflector.

#### **3.3 GNSS measurements**

Where it was technically possible, some parts of the urban garden were coordinated using RTK mode for GNSS measurements. It should be noted, that in some places fixing of the solution was done with difficulties, due to the presence of tall trees in very close proximity to the rover. Nevertheless, it was decided, that application of GNSS measurements would be much more convenient in comparison to the classical ones.

#### **3.4 Creation of the digital map of the large urban garden**

The digital model of the specialized map of the large urban garden (containing detailed precise information for the positions of: benches, alleys, pillars and trees) was created by

geodetic measurements, described in points 3.2 and 3.3.

The objects in the garden were represented as: description, point number, x, y and h. These data (in suitable input format) were imported in the specialized geodetic software Mkad, see [<http://kolma.bg>], which was used as a platform for the creation of the digital model. The relevant types of lines and signs for the objects were used in order to enable the correct reading of the content of the map. The final product – the digital map, see fig. 1 was exported in \*.dxf format for further processing and analysis.

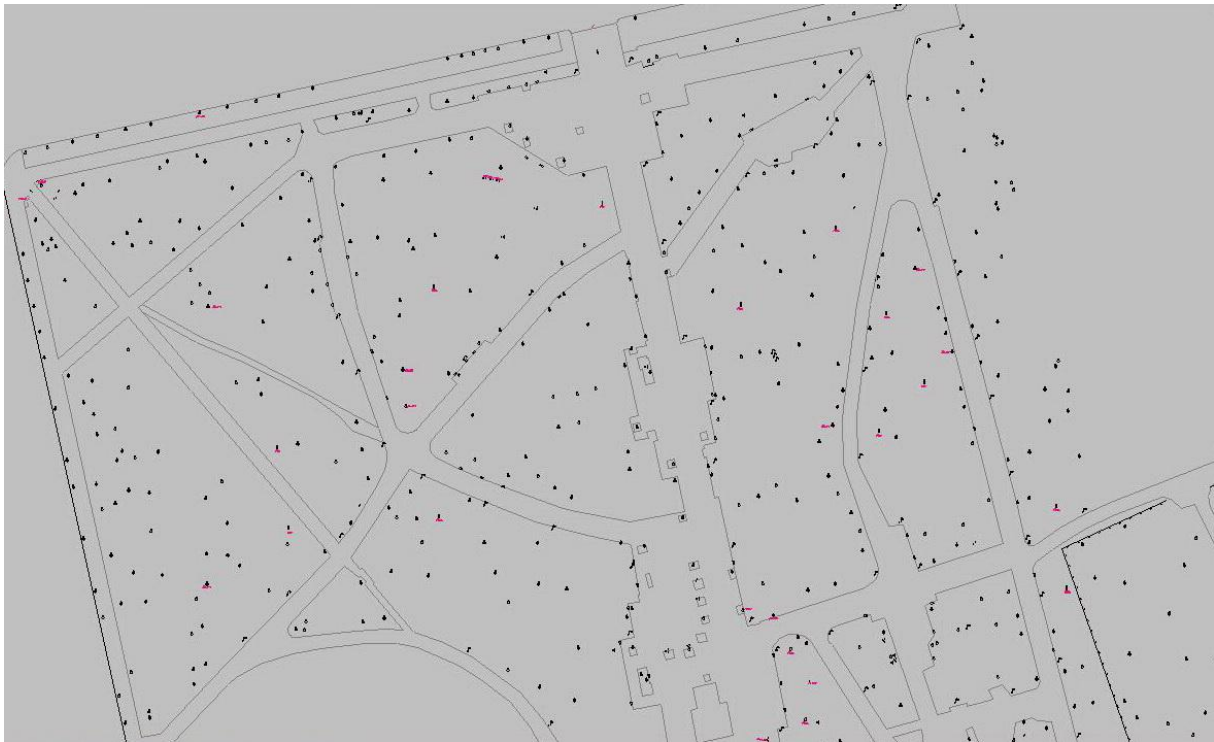


Fig. 1 Window from the map of the large urban garden

#### **4. PROCESSING OF THE GEODETIC MEASUREMENTS. QUALITY ASSESSMENT OF THE RESULTS**

It should be noted, that only the information for the plane coordinates and their quality assessment was necessary for the process of the creation of the map. The relevant values of the quality criteria for the height component are given for completeness of the results.

##### **4.1 Classical measurements**

The conducted measurements were downloaded from the total station and processed. Using the mentioned in point 3.1 application, the coordinates of each detailed point were calculated.

The results from the mathematical processing – the values of the quality criteria are listed in table 1, given below. The measurements were conducted in different days, noted in the first column.

Date	Tr(Q)	M number	N number	Tod's number	condition	M sq. [mm]	M ar. [mm]
19-th of Oct	0.04	3.76	1.36	155.86	6.03E-16	20	20
21-st of Oct	0.21	69.62	5.18	1048.38	6.90E-15	19	19
23-rd of Oct	0.15	17.71	2.64	354.67	2.34E-15	7	7
28-th of Oct -I	0.12	2.06	1.03	35.02	4.57E-16	29	29
28-th of Oct -II	0.04	3.05	1.3	125.19	5.79E-16	11	11
29-th of Oct	0.19	23.04	2.02	553.64	2.69E-15	42	42
20-th of Nov	0.1	28.66	4.85	786.52	4.31E-15	73	73

Table 1 Values of the quality criteria – plane geodetic network

Date	M ar. [mm]	M sq. [mm]	Tr(Q)	N number	M number	Tod's number	condition
19-th of Oct	18	18	3.16	1	1	0.32	2.22E-16
21-st of Oct	23	25	21.66	5.91	29.08	2.11	3.93E-15
23-rd of Oct	9	10	12.59	2.2	8.3	0.82	9.75E-16
28-th of Oct -I	77	77	17.69	1	1	0.06	2.22E-16
28-th of Oct -II	11	11	3.7	1	1	0.27	2.22E-16
29-th of Oct	49	50	11	1.28	6.47	1.44	8.53E-16
20-th of Nov	12	12	2.65	1.2	3.71	2.16	5.32E-16

Table 2 Values of the quality criteria - height geodetic network

Based on the results in table 1, the following facts could be summarized:

- The overall quality of the plane geodetic network could be denoted as “good”, according to the values of the “condition” criterion, which is much smaller than 1, see [Konstantinov et al., 1997];
- In red colour are given the values of the parameters, which have large values, but within the boundaries for accuracy requirements for the map.
- The smaller the values of the other quality criteria, i.e.: M ar. – mean arithmetic error for the whole network, M sq. – mean square error for the whole network, Trace (Q), the better the quality of the network.

The data, given in table 2 shows the results from the adjustment of the height geodetic network. The quality criteria with larger values than expected are given in red colour.

Taking in mind the results from the mathematical processing of geodetic measurements, it could be noted, that they satisfy the quality requirements for the map and it could be proceeded with further analysis.

#### 4.2 GNSS measurements in RTK mode

The results for the quality assessment of the GNSS determinations are summarized in table 3 below:

Date	Ms [mm]	Mh [mm]
24-th of Oct	341	619
	343	596
25-th of Oct	68	77
	25	175
26-th of Oct - I	44	88
26-th of Oct - II	138	50
	87	162
28-th of Oct	572	645
20-th of Nov	34	73

Table 3 Quality assessment of the GNSS measurements in RTK mode

As it was stated in point 3.3 GNSS measurements were conducted in extremely hard

conditions. Despite of this, Ms (quality criterion for position) has acceptable values, except for those coloured in red. These points (in fact situated under large trees), which had larger values for Ms, were re-measured, using total station.

## **5. FIELD CONTROL OF THE SPECIALIZED MAP, USING: SMARTPHONE, GOOGLE EARTH AND AUTOCAD WS**

The created digital model of the urban garden was subject of field checks. The entire situation - benches, alleys, pillars and trees was controlled and compared both on site and in the model. The traditional way of check - creation of a hardcopy was definitely not suitable, taking in mind the area of the garden. It was decided to be proceeded, applying other approach. A smartphone, running under Android OS was used as device for visualization of the map in AutoCAD WS environment, see fig. 2. Google Earth itself was applied as to show the object's contour on the World map along with the current position, see fig. 3.

On one hand, for the convenient processing of the information, the model was divided in parts and generated in \*.kmz files, see fig. 4. The last were imported in Google Earth's environment. The model of the garden was visualized together with the current position of the device in the field.

On the other hand, the model of the map was also imported as \*.dxf file in AutoCAD WS environment. This step was applied parallelly with the usage of Google Earth. The described combination simplified the control process of the map.

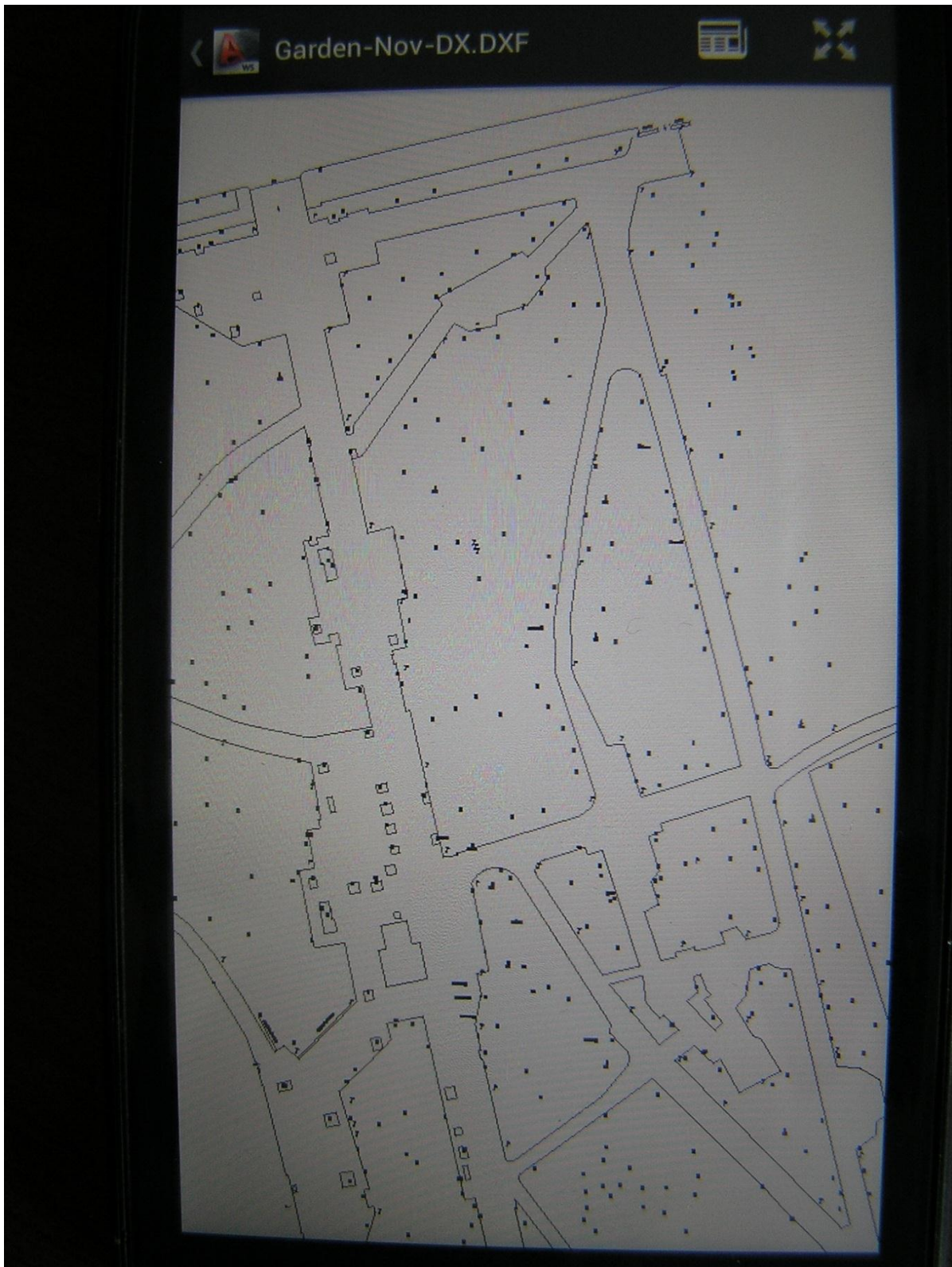


Fig. 2 Part of the urban garden in AutoCAD WS environment



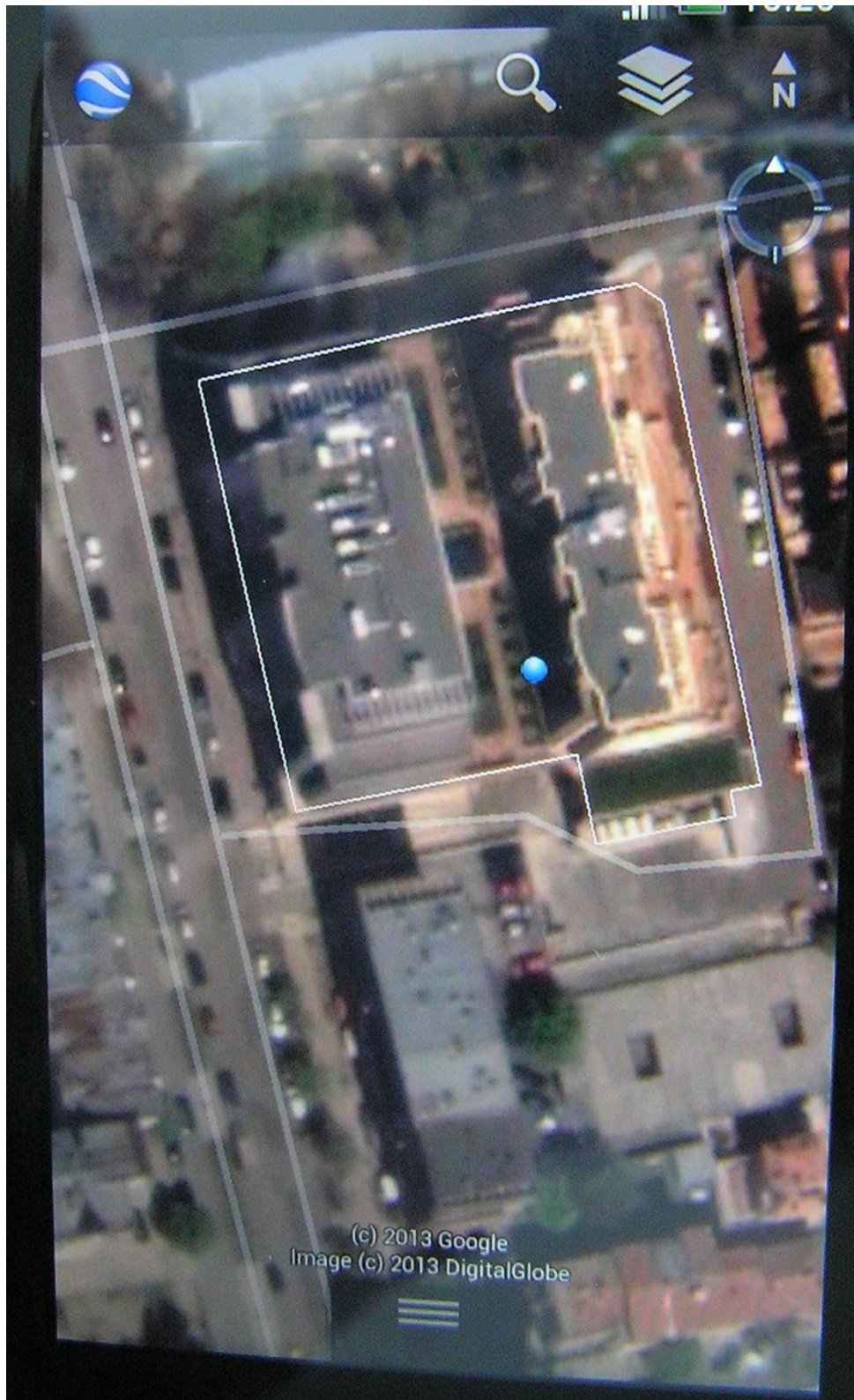


Fig. 3 \*.kmz file and the current position in Google Earth's environment



Fig. 4 \*.kmz files of contours in Google Earth's environment

## 6. ANALYSIS OF THE APPLIED METHOD FOR FIELD CONTROL

Using the mentioned in the previous chapter mobile IT, the field control of the map was completed successfully in an optimal time span. Based on the results from the geodetic measurements, also taking in mind the specifics of the applied IT, several key points could be noted here:

- the values of the quality criteria met the requirements for accuracy of the map;
- the points with low quality (coordinated using GNSS technology under heavy terrain conditions) were re-determined by total station in order to satisfy even the highest accuracy requirements;
- a few numbers of points were re-measured due to primary low quality;
- usage of other ways for coordination of the objects was not appropriate, because of the meteorological conditions and the high density of the trees;
- application of paper plot for visualization and preview of the garden was not preferable, due to the large area;
- the region of the object must be downloaded in the smartphone prior to the control process in order to make possible the visualization onto the World map. In this way Wi-Fi will not be needed on site.

The following *advantages* and *disadvantages* (according to the overall performance of the mobile IT and the opinion of the author) of the used method will be given here.

### 6.1 Advantages:

- easy, convenient navigation within the digital model in the smartphone;
- very small size and low weight of the mobile device;
- suitable use of the mobile applications, taking in mind their small visible size on the display of the smartphone;
- no requirement for Wi-Fi when conducting the control process;
- the used mobile applications are freeware and with a number of functions;

### 6.2 Disadvantages:

- significant power consumption when: using GPS or scrolling within the graphics;
- the visualization on the display of the device is difficult, if working in an open area with (strong) sunlight;
- in some occasions the software worked unstable – it may need improvement;

## 7. CONCLUSION

It should be noted that the listed in the previous chapter disadvantages did not lead to problems with completion of the field control. They could be used for instance as recommendations for future improvements of the mobile IT. The application of the described method significantly simplified and optimized the work process, according to the overall

performance of hardware and software. The field control of the digital map of the large urban garden was completed successfully, using the mobile IT.

Taking in mind the quality assessment of results from geodetic measurements, given in chapter 4, it could be said that the digital map of the garden has very good overall quality.

Based on the usage of the smartphone with running AutoCAD WS and Google Earth, it could be concluded that nowadays the mobile IT could be used successfully not only for general purposes, but also for geodetic tasks.

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## **BIOGRAPHICAL NOTES**

Gintcho Kostov graduated in UACEG, Sofia in 1998. He works in “GEO ZEMIA” Ltd. since 2001. In TU Wien, Austria he completed and defended a scientific project, entitled “Assessment of the Quality of Geodetic Networks Using Fuzzy Logic”. He has teaching activities to the students in UACEG, Sofia. Dr. Kostov holds the following licenses: for performing of activities in the area of geodesy, cadastre, constructing and privatization. He is a member of the Union of Surveyors and land Managers in Bulgaria, Union in Scientists in Bulgaria, Chamber of Engineers in Geodesy and Chamber of Engineers in Investment Design. He is a member (in part Geodesy) of the Councils of Experts in Municipalities: Stara Zagora and Opan.

## **CONTACTS**

Dr. M. Sc. Gintcho Kostov

“GEO ZEMIA” Ltd.

41”Solun” str. ap.9

Sofia

Bulgaria

+359886445540

Email: [geozemia@geozemia.com](mailto:geozemia@geozemia.com)

Web site: <http://www.geozemia.com>