**Archeologia e Calcolatori**
**28.2, 2017, 457-467**

# GEOMATICS APPROACH TO SURVEYS FOR LATE ANTIQUITY BUILDINGS. THE EPISCOPAL PALACE IN SIDE, TURKEY

Side is one of the best preserved cities of the antiquity in the historical Pamphylia area of Anatolia, current Antalya, Turkey. This archaeological site shows numerous standing structures and monuments spanning from the 7th century BC to the 12th century AD. The aerial and terrestrial survey conducted in 2016 for the Institute for the Study of Ancient Culture (IKAnt) of the Austrian Academy of Sciences (ÖAW), was centred on the so called Episcopal Palace and the Fountain area. Located between the Byzantine Hospital and the Eastern Byzantine Gate, a total surface of 5,900 m² was surveyed. The aim of the works was to analyse and recreate the existing archaeological remains on a 3D environment to help in later research questions like architectural features, building construction design and upgrades or location of the palace within the urban area. This paper intends to highlight the value of an accurate ground control point network using Total Station (TS) and Global Positioning System (GPS) to record an ancient urban site using Structure from Motion (SfM) and its advantages when using CAD and GIS software. Besides, it will also focus on the methodology used to capture the data and the processing after the survey campaign.

## 1. Methodology

For this second campaign, the idea was to implement a permanent control network around the main buildings of the so called Episcopal Palace, and use it as a reference for the coming interventions as well as a base to add to previous surveys done in the area. The second objective was to use this network as Ground Control Points (GCPs) for our aerial survey and the later SfM processes. The Leica TS11 R1 1000, the Leica GPS GNSS GS14, the Leica CS15 controller and the DJI Inspire I Pro were the main instruments used for one week surveying 2016 campaign. The post processing works will involve the use of Agisoft Photoscan for its well documented value and accuracy in archaeological surveys (Doneus *et al.* 2011, 87; Verhoeven, Taelman, Vermeulen 2012, 1127) and the Leica Geo Office 8.4 and LISCAD software to process and adjust the TS and GPS surveys. Using the georeferenced Agisoft Photoscan files, orthoimages, Digital Elevation Models (DEM) and 3D meshes of the structures were exported to be used for different purposes in AutoCAD (plans and elevations), Blender (visual reconstructions), and ArcGIS/QGIS (DEM and archaeological record).

## 2. Fieldwork

The first step prior to the capture of the aerial photos was to stablish a network of GCPs. This is necessary before archaeological information can be extracted from the SfM because the aerial images must be georeferenced (Verhoeven *et al*. 2012, 2062-2063).

Light conditions were one of the first concerns about the aerial data capturing. It is very important for a good quality model in SfM to have consistent light conditions[1]. These were only available during dawn or at dusk. To save as much time as possible, the first flights were dedicated to capturing data without the targets because of the reduced time available for the whole survey (one week). Then, these photos would be used to complete the areas where the photos containing the GCPs targets were captured. This saved the time to create the net of GCPs. Therefore, we needed to be sure that we had enough time to capture photos with targets and these were already placed on the area to be aerially surveyed.

Some 6,000 photos (JPEG+RAW) were taken by the Unmanned Aerial Vehicle (UAV) which covered the main area of interest. The flexibility of this technique allowed us to take photos not only from above but even close range photos flying inside the structures within a distance of 1 to 1 ½ m. The DJI Inspire I Pro allows to capture photos up to +35°[2] making the survey of door frames or gates much more efficient, avoiding gaps on the 3D data.

A total of one day and a half was dedicated to create the control network around the main compound. This task was undertook during the time between the end of the dawn to dusk while the drone was not flying and taking photos. Most of this time was dedicated to create a net of points and stations surrounding the main targeted archaeological remains (Bishop Palace); the rest, to check surveyed points from previous campaigns. An arbitrary local grid was used for the TS survey. The targets help to increase the accuracy of the 3D Photo survey (Remondino, Guarnieri, Vettore 2005). A total amount of 45 targets were fitted into the main compound and 12 control stations located around to collect then.

Two different approaches were used for the control network creation, which are the most widely used polar coordinates using the TS and kinetic methods (using Real Time Kinetic connection, RTK) (Schofield, Breach 2007, 24). The first ones create the control points for the network using random traverse and resection. The traverse technique permits to move the

[1] *AgiSoft PhotoScan User Manual: Professional Edition*, Version 1.3.0, 2017 (http://www.agisoft.com/downloads/user-manuals/; accessed: 10/03/2017).

[2] *DJI* 2016, *DJI Inspire 1 Pro/RawSpecs* (http://www.dji.com/inspire-1-pro-and-raw/info; accessed: 20/03/2017).

instrument around the working area allowing to set up stations everywhere and reaching most of the compound, even to areas where the RTK connection can be lost (under trees, close to walls and structures). This technique is recommended if the points to be surveyed cannot be reached from the settled up station (Ghilani, Wolf 2013, 204). The resection method permitted to go back to a specific location, set up the station and record more GCPs or survey archaeological features. A different selection of Electronic Distance Measuring (EDM) was used depending on the ongoing needs of the survey, switching from reflectorless, to mini prism or round prism. To eliminate instrumental errors and increase precision, the repetition method was used; the angle observations were repeated an equal number of times in each of the direct and reverse modes and the average compute by the station software (Ghilani, Wolf 2013, 205).

The coordinate system in which the GPS data was captured was WGS84 on a GRS80 ellipsoid (*Turkish Report* 2007-2011, 7). 30 Photoscan targets were surveyed as GCPs on the ground using RTK network and 4 TS station positions as well (to be used as a link between coordinates systems). No geoid model was used due to lack of information for the working area and scarce time to create a local one. Therefore the heights from the GPS were ellipsoidal, a matter than in the next surveying season will be resolved. 4 control stations were surveyed with this method as well, selecting 50 positions instead of 1 position when taking the readings; this will increase the accuracy of the measurement as the Leica CS15 controller will make a statistical mean of all of them.

The GNSS Leica GS14[3] receiver was set to an accuracy of 0.030 m, usually the vertical and horizontal accuracy is 0.010 to 0.040 m (Erol, Erol, Çelik 2008, 4; Roosevelt 2014, 44). The network of points is intended to be durable and permanent, allowing the use the same GCPs and stations set ups on a long time project on the archaeological site. Some authors have already spoken about the accuracy of the GPS measurements under RTK network (Featherstone, Dentith, Kirby 1998; Schofield, Breach 2007, 351). One of the main objectives of the surveying season was to set the ground control network to reduce the errors surveying with the GPS as the TS maximum vertical and horizontal error was set up to 0.003 m, more accurate than the GPS RTK ones (Rooselvelt 2014, 46).

Both sets of data will be processed and combined using two software Leica Geo Office and LISCAD. The idea was to see the different approach from two commercial to the processing of the data and set up the templates to export the survey to CAD.

[3] Leica Geosystems. 2017. Leica Viva GNSS GS14 receiver Datasheet (http://leica-geosystems.com/products/gnss-systems/smart-antennas/leica-viva-gs14/; accessed: 28/03/2017).

## 3. Processing the surveys

### 3.1 *Aerial*

The process of the SfM data was done with the commercial software from Agisoft, Photoscan. This process is well documented by other authors in relation to its accuracy (Zhang 2013, 79; Goosens 2015, 84; Jaud *et al*. 2016, 16) and its suitability for archaeological surveys (Grussenmeyer *et al*. 2008, 1; Doneus *et al*. 2011, 87; Verhoeven, Taelman, Vermeulen 2012, 1127). The processing time varied from 5 to 6 hours to 1½ days of processing between around 300 to 1,300 photos. This was possible thanks to the extensive use of two workstations 2x Intel Xeon E5-2640 v4 10-Core CPU, 128 RAM and 2x NVIDIA GeForce GTX 1080. The quality of the point cloud generated was high and ultra-high quality exported on .xyz files to be used in an external software to digitize and vectorise archaeological features (in our case AutoCAD). The mesh quality was set to high to have the most accurate model of the surface surveyed (Jaud *et al*. 2016, 6).

### 3.2 *Terrestrial*

The survey of the TS and the GPS was processed with two different software, Leica Geo Office 8.4 and LISCAD. Both allow the surveyor to import, check, modify, adjust or transform coordinates and export the capture data (.txt, ASCII, dbx, .dxf, dwg, shp, etc.). The advantage of this approach is to create a well defined control network, with accurate and precise coordinates for: control points, station set up, resection points, traverses stations, etc. In control surveying, measuring and computing coordinates of points from those measurements is one part of the surveyor work, while the other is to set the quality of the undertaken survey (Schofield, Breach 2007, 249-250). The average mean for the horizontal and vertical errors with the TS was set to 0.003 m on the process settings in both LISCAD and Leica Geo Office. The Least Squares Adjustment Method was employed to process the TST survey. It is the most widely used and powerful method because it enables all observations to be simultaneously included in an adjustment, and each observation can be weighted according to its estimated precision (Ogaja 2010, 36; Ghilani, Wolf 2013, 422). With both software, the instrumental errors can be removed before compute this method (Fig. 1).

Two different coordinate sets for the GCPs were created. One with the local grid created from TS, and another ground based with the WGS84 datum and GRS80 ellipsoid for the Turkey area of Antalya. With these two different sets, the data can be used in: a small scale, more local for excavations and small 3D surveys, or a medium scale to georeference 3D models or undertake spatial analysis on GIS (cost surface, visual and light analysis). The WGS84

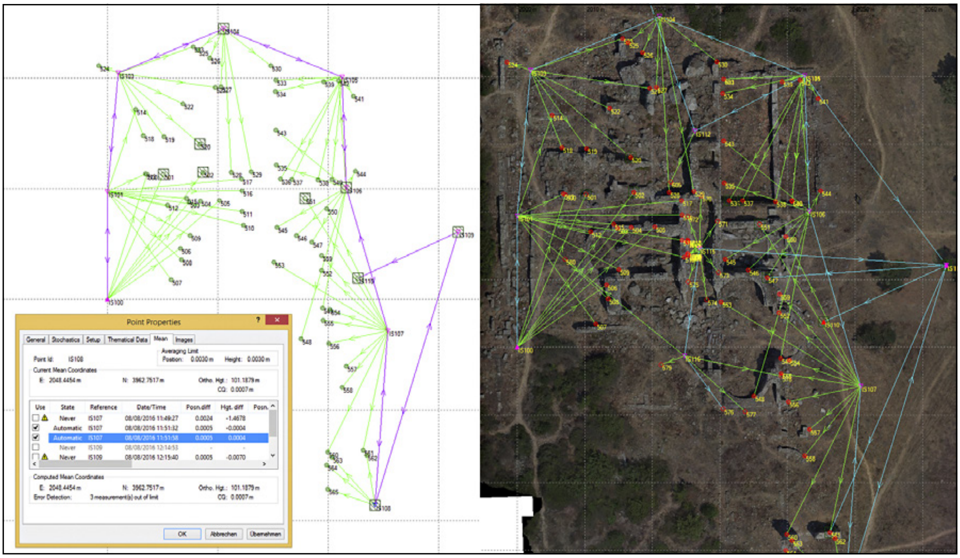

Fig. 1 – Traverse and surveyed points on Leica Geo Office 8.4.

Fig. 2 – Pointcloud and orthophoto exported to AutoCAD of the northern chapel wall, Bishop Episcopal Palace, Side, Turkey.

would provide in case of needs of a wider coordinate system that can be used to include the survey data into a regional, national or international dataset.

Once the surveyed data were processed, we could apply both sets of coordinates to our SfM files on Photoscan. This allowed the availability of the georeferenced data into two coordinate systems and made possible to export reliable and accurate data for archaeological needs in three different ways:


Fig. 3 – Northern chapel wall, Bishop Episcopal Palace, Side, Turkey.

1) As point clouds to be imported into AutoCAD (up to 25 mm) to create plans and elevations of the structures (Figs. 2-3).
2) .ply, obj. models of the areas to make reconstructions and visualizations of the areas surveyed on AutoCAD, Blender and 3D Studio Max (Fig. 4).
3) .tif and COLLADA files (.dae) to be used on GIS software to record archaeological features (Landeschi *et al.* 2015, 3-4) avoiding the traditional bidimensional limitations for archaeological recording in GIS (Llobera 2003, 29). Although it has its limitations on level of detail and accuracy, Google Earth can only handle about 20,000 polygons (Schön *et al.* 2016, 8) and ArcScene up to 3,000,000 polygons.
4) Orthophoto to be exported into CAD or GIS software. This output from Photoscan is more than sufficiently accurate for archaeological large-scale photo mapping (Verhoeven *et al.* 2012, 2068).

## 4. Future works, enhance the workflow

### 4.1 *Local Geoid Model*

One of the problems on the survey season 2016 was the lack of time to complete all the steps to connect our network to the Turkish geoid network. The heights obtained by GPS are ellipsoidal heights surface (Sanlioğlu Maras, Uysal 2009, 1-2) and not orthometric ones, which are the ones normally used in archaeology. These are the differences between the ellipsoidal

Fig. 4 – Chapel on the main compound of the Episcopal Palace, Side, Turkey (.ply model on Photoscan).

heights and the geoid model. A geoid model is the closest and stable surface running under the land matching the mean of the ocean surface (Yilman, Karaali 2010, 1829). It is an idealized equilibrium surface of sea water (Torge 1980, 76-114). The geoid surface is more irregular than the ellipsoid of revolution often used to approximate the shape of the physical Earth, but considerably smoother than Earth's physical surface (Sanlioğlu, Maras, Uysal 2009, 2). It can differ globally 110 m. Therefore, the geoid model related to your geographical area is necessary to have the most accurate orthometric height.

The last gravimetric geoid model for Turkey is the Turkey Hybrid Geoid Model-2009 (THG-09), with orthometric heights from the GNSS instrument of an accuracy level of ±0.090 m (Avsar, Kutoglu, Erol 2013, 2). This information was not supplied by the GPS network company so we opted for calculating our own local geoid model. There are different methods to calculate it but in cases of relatively small networks (100 km²) two-dimensional transformation model is often used (Başçiftçi *et al.* 2006, 4). This function is available on the Leica Smatworx Viva software on the CS15 controller of our GPS and in the software Leica Geo Office 8.4. This method uses already known values on the coordinate system we want to convert to our local control network station points, and uses readings from the GPS on the same points to do the calculations and convert the orthometric heights. Because we know the orthometric height points around the site and from plans created by Arif Müfid Mansel on the 1960s, a local geoid of the ancient city can be calculated. Once we have this, we will process all the GPS RTK positions based in our own local geoid.

## 5. Conclusion

The main aim of this work was to show the application of two classic methods employed in survey works (TS and GPS) together with a very common tool nowadays in archaeology (SfM). Some authors already pointed that the results of a high accuracy of SfM in horizontal and vertical positioning (Doneus *et al.* 2011, 86; Lo Brutto, Meli 2012, 6) are highly dependent on the quality and distribution of GCPs (Jaud *et al.* 2016, 2). The successful combination of both gives to the archaeological survey enough level of accuracy to undertake further analysis of the data; its accuracy is similar to the terrestrial laser scanner (Doneus *et al.* 2011, 87). GPS and specially the RTK network present a real advantage on positioning and surveying on the field while increasing the accuracy of the archaeological surveys combined with the TS (Rooselvelt 2014, 32). GNSS/levelling can be considered as a reliable alternative for practical height determination (Erol 2011). The three dimensional network done with satellite technique is more rapid, more accurate and presents fewer difficulties than terrestrial techniques (Başçiftçi *et al.* 2006, 2). If positions are successfully recorded using RTK then it will not be necessary to post-process the data (Schofield, Breach 2007, 351) providing accurate data to the surveyor in real time (Roosevelt 2014, 32). GPS can be used in any weather condition and solves inter-visibility problem between the instrument and the target (Yilman, Karaali 2010, 1829-1830). This method would reduce some inconveniences when linking different coordinates system and surveys done before or after the network was set up. The object scale, the local scale and regional scale (Campana, Sordini, Remondino 2008, 2) can be linked together in a more accurate way.

If there is a problem with the RTK connection an alternative workflow can be undertaken traversing with the TS where a link with cadastral information, engineering/topographical surveys or previous archaeological jobs exists (like the case of Manzel plans on Side). If no georeferenced point can be found, a local coordinate network can be created, leaving at least two permanent station points marked on site for a possible later GPS survey.

The low-cost workflow for excavation recording using SfM can be executed by technically low-trained archaeologists (Doneus *et al.* 2011, 87) but the creation of a well stablish control network of this type requires both training and experience to produce data of acceptable quality. They both require working comfort with computers, a working knowledge of GIS, and some basic geospatial processing skills (Roosevelt 2014, 40). This highly specialized job does not fall within the normal experience geophysicists or most field archaeologists have and needs to be done by trained operators (Hessen 1999, 166). The survey needs to be done professionally, in a reduced period of time as the project usually is largely depending on a timeframe (Pacina 2015, 7).

Processing the surveyed data from the GPS and the TS does not require too much power computer but generating high-quality models from large datasets does require adequate computing resources (Doneus *et al.* 2011, 86). This can be an issue for the quality check of the SfM data after a surveying day if we need to process big quantity of imagery. Chunks of 400/500 photographs were processed in 5 hours giving medium quality point clouds and models in our field laptop (Intel Core i7-4710HQ 2,50GHz 16GB RAM Geforce GTX 860M). Therefore, better and more optimised algorithms are needed to allow the time-efficient processing of large image sets on standard computers (Verhoeven *et al.* 2012, 2068).

Moisés Hernández Cordero
Austrian Academy of Sciences
Institute for the Study of Ancient Culture
moises.hernandez.cordero@oeaw.ac.at

## REFERENCES

Avsar N.B., Kutoglu S.H., Erol B. 2013, *GNSS/Levelling data in assessing the fit of the recent Global Geoids in Turkey*, in *International Symposium of Global Navigated System (ISGNSS) 2013 "Connecting Continents through GNSS where Europe and Asia meet" (Istanbul 2013)* (http://geomatik.beun.edu.tr/avsar/files/2015/07/ISGNSS2013_avsar_kutoglu_erol.pdf; accessed: 15/03/2017).

Başçiftçi F., Çağl H., Ayten T., Akkuş S., Yalcin B., Şanlıoğlu I. 2006, *Determination of geoid and transformation parameters by using GPS on the region of Kadınhanı in Konya*, in *Shaping the Change XXIII FIG Congress (Munich 2006)*, TS 53, 1-15 (https://www.fig.net/resources/proceedings/fig_proceedings/fig2006/papers/ts53/ts53_04_basciftci_etal_0568.pdf; accessed: 15/03/2017).

Campana S., Sordini M., Remondino F. 2008, *Integration of geomatics techniques for the digital documentation of heritages areas*, in *Advances in Remote Sensing in the Archaeology and the Management of Cultural Heritage. EARSEL Workshop (Rome 2008)*, Roma, Aracne (http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.542.252&rep=rep1&type=pdf; accessed: 15/03/2017).

Doneus M., Verhoeven G., Fera M., Briese Ch., Kucera M., Neubauer W. 2011, *From deposit to point cloud – A study of low-cost computer vision approaches for the straightforward documentation of archaeological excavations*, «Geinformatics FCE CTU», 6, 81-88.

Erol B. 2011, *An automated height transformation using precise geoid models*, «Scientific Research and Essays», 6, 6, 1351-1363.

Erol B., Erol S., Çelik R.N. 2008, *Height transformation using regional geoids and GPS/levelling in Turkey*, «Survey Review», 40, 307, 2-18.

Featherstone W.E., Dentith M.C., Kirby J.F., *Strategies for the accurate determination of orthometric heights from GPS*, «Survey Review», 34, 267, 278-296.

Ghilani C.D., Wolf P.R. 2013, *Elementary Surveying: An Introduction to Geomatics*. 13th Edition, New Jersey, Prentice Hall.

Goosens E. 2015, *Low cost 3D modelling of a complex archaeological site using aerial photography in the hinterland of Petra, Jordan*, «The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences», 40-5/W4, 77-84.

Grussenmeyer P., Landes T., Voegtle T., Ringle K. 2008, *Comparison methods of terrestrial laser scanning, photogrammetry and tacheometry data for recording of cultural heritage buildings*, «Intenational Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences», 37, 5, 213-218.

Hessen A. 1999, *Multi-parametric survey for archaeology: How and why, or how and why not?*, «Journal of Applied Geophysics», 41, 2-3, 157-168.

Jaud M., Passot S., Le Bivic R., Delacourt C., Grandjean P., Le Dantec N. 2016, *Assessing the accuracy of high resolution digital surface models computed by PhotoScan® and MicMac® in sub-optimal survey conditions*, «Remote Sensing», 8, 6, 465 (www.mdpi.com/journal/remotesensing; accessed: 02/03/2017).

Landeschi G., Dell'Unto N., Ferdani D., Leander Touati A.-M., Lindgren S. 2015, *Enhanced 3D-GIS: Documenting* Insula *V 1 in Pompeii*, in F. Giligny, F. Djindjian, L. Costa, P. Moscati, S. Robert (eds.), *CAA2014. 21st Century Archaeology. Concepts, Methods and Tools. Proceedings of the 42nd Annual Conference on Computer Applications and Quantitative Methods in Archaeology (Paris 2014)*, Oxford, Archaeopress, 349-360.

Llobera M. 2003, *Extending GIS-based visual analysis: The concept of visualscapes*, «International Journal of Geographical Information Science», 17, 1, 25-48.

Lo Brutto M., Meli P. 2012, *Computer vision tools for 3D modelling in archaeology*, «International Journal of Heritage in the Digital Era», 1, Issue 1, 1-6.

Ogaja C.A. 2010, *Geomatics Engineering: A Practical Guide to Project Design*, London, CRC Press, 36-39.

Pacina J. 2015, *Geodetic surveying as a tool for discovering the prehistoric settlement in Sudan (the 6th Nile cataract)*, «Geoinformatics FCE CTU», 14, 1, 47-64.

Remondino F., Guarnieri F., Vettore A. 2005, *3D modeling of close-range objects: Photogrammetry or laser scanning*, in J.-A. Beraldin, S.F. El-Hakim, A. Gruen, J.S. Walton (eds.), *Videometrics VIII. Proceedings of Electronic Imaging Science and Technology 2005 (San Jose 2005)*, Series 5665, Bellingham (Washington), SPIE, 216-225.

Rooselvelt C.H. 2014, *Mapping site-level microtopography with Real-Time Kinematic Global Navigation Satellite Systems (RTK GNSS) and Unmanned Aerial Vehicle Photogrammetry (UAVP)*, «Open Archaeology», 1, 29-53.

Sanlioğlu I., Maras S.S., Uysal F. 2009, *Determination of orthometric heights with real time kinematic surveying, Konya sample*, in *Proceedings of the FIG Working Week 2009. Surveyors Key Role in Accelerated Development (Eilat 2009)*, Israel (http://www.fig.net/resources/proceedings/fig_proceedings/fig2009/techprog.htm; accessed: 12/11/2016).

Schofield W., Breach M. 2007, *Engineering Surveying*, 6th Edition, Oxford, Butterworth-Heinemann.

Schön S., Ingwer P., Fischer A., Schafföner M., Hasche E., Creutzburg R. 2016, *3D reconstruction of buildings and landscapes – Evaluation of quality parameters and optimization of mission planning using RPAS*, in R. Creutzburg, D. Akopian (eds.), *Mobile Devices and Multimedia: Enabling Technologies, Algorithms, and Applications 2016. IS&T International Symposium on Electronic Imaging 2016 (San Francisco 2016)*, Springfield, Society for Imaging Science and Technology, 295.1-9.

Torge W. 1980, *Geodesy*, Berlin-New York, Walter de Gruyter (www.fgg.uni-lj.si/~/mkuhar/Zalozba/Torge-Geodesy(2001).pdf; accessed: 03/03/2017).

*Turkish Report* 2007-2011, *Term Report of Turkish Report of Geodesy* 2007-2011*, National Report of Geodesy Commission of Turkey for 2007-2011*, *XXV General Assembly of the International Union of Geodesy and Geophysics (Ankara 2011)* (http://www.iugg.org/members/nationalreports/2007-2011%20IUGG%20National%20Report_TR.pdf; accessed: 10/09/2016).

Verhoeven G., Doneus M., Briese C., Vermeulen F. 2012, *Mapping by matching: A computer vision-based approach to fast and accurate georeferencing of archaeological aerial photographs*, «Journal of Archaeological Science», 39, 2060-2070.

Verhoeven G., Taelman D., Vermeulen F. 2012, *Computer vision-based orthophoto mapping of complex archaeological sites: The ancient quarry of Pitaranha (Portugal-Spain)*, «Archaeometry», 54, 1114-1129.

Yilman N., Karaali C. 2010, *Comparison of global and local gravimetric geoid models in Turkey*, «Scientific Research and Essays», 5, 14, 1829-1839.

Zhang P. 2013, *3D Modeling and Visualization of Archaeological Data*, Master Thesis. Technische Universität München, Munich (http://129.187.45.33/CartoMasterNew/fileadmin/user_upload/Zhang_Report.pdf; accessed: 20/10/2016).

## ABSTRACT

Side is one of the best preserved cities of Antiquity in the historical Pamphylia area of Anatolia, current Antalya, Turkey. This archaeological site shows numerous standing structures and monuments spanning from the $7^{th}$ century BC to the $12^{th}$ century AD. The aerial and terrestrial survey conducted in 2016 was centred on the so called Episcopal Palace and the Fountain area with a total surveyed surface of 5,900 $m^2$. The aim of the work was to analyse and recreate the existing structures in a 3D environment to help in later research questions like architectural features, building construction design and upgrades or location of the palace within the urban area. This paper intends to highlight the value of an accurate ground control point network to record an ancient urban site and its advantages when using CAD and GIS software. Moreover, it will also focus on the methodology used to capture the data used on the area of the Episcopal Palace to create an accurate 3D reconstruction of the remaining structures (with Structure from Motion) for further analysis and interpretations; merge classic survey methods (Total Station and Global Positioning Systems) with relatively new methodologies and hardware (Unmanned Aerial Vehicle); check and test the accuracy and the derived errors (data surveying gaps, traversing adjustments, coordinate and projection systems) that arise during post-processing (ellipsoid/geoid highs differences, noise reduction, fusion between datasets). Possible uses of the created/resulting data from the georeferenced point clouds, the model as a visual tool (orthophotos and 3D Mesh) for classic planning (elevations and sections) and its utility in a GIS environment (ArcScene) are also discussed. At the end of the paper report, some questions about the utility of the 3D reconstructions and models in Heritage as well as their utility for the archaeological record will be discussed.