

EDUCATION ON CULTURAL HERITAGE DOCUMENTATION AND TERRESTRIAL PHOTOGRAMMETRY AT ITU DEPARTMENT OF GEOMATICS ENGINEERING

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Abstract:

Cultural heritage; from artifacts to historic buildings, monuments to archaeological sites, is the witness of human life. Cultural heritages of civilizations, which are guidance to people to create a mutual culture, are significant gifts not only to their own generations, but also to the rest of the World. A complete documentation data should be sufficiently acquired, detailed, manageable, shareable, distributable, presentable and easy to be visualized. With its accuracy, time saving, economy, texture, high resolution, three dimensional and geo-referenced data. Terrestrial Photogrammetry is the most efficient way for Documentation of Cultural Heritage. The academic educational program of photogrammetry in universities is training students to perform tasks in all fields of the photogrammetric profession. The aim of this study is to present the state of Numerical and Terrestrial Photogrammetry education in terms of Cultural Heritage Documentation, given by the Geodesy and Photogrammetry Department of ITU. Completed Bachelor and Master of Science degree theses, subjected Close Range Photogrammetry, will be addressed with their achievements for the students.

1. INTRODUCTION

According to the Higher Education Law numbered. 2547, Higher education is defined as a process within the national education system, including all levels of education, research and social activities, covering at least four semesters and ending generally with a given academic degree or diploma [1].

In Turkey, Geomatics (Surveying) engineering education has begun in Yildiz Technical University in 1949, and continued Black Sea Technical University in 1968, Istanbul Technical University in 1969 and Selcuk University [2]. In present, it is continuing in undergraduate and graduate level in various Universities/Institutes as given in Table 1. In this table departments currently have students are represent with A and others represented with P. Education and research activities in these departments realized in Geodesy, Photogrammetry, Surveying Techniques, Cartography, Remote Sensing, Public Land Surveying and Geographical Information Systems.

Table 1: Institutions Providing Geomatics Engineering (+/- shows the existence of education, A/P shows the existence of students)

University Name	Undergraduate	Graduate	Doctorate
Aksaray University	+ (A)	+ (A)	-
Afyon Kocatepe University	+ (A)	+ (P)	-
Boğaziçi University	-	+ (A)	+ (A)

Cumhuriyet University	+ (P)	-	-
Çanakkale 18 Mart University	+ (P)	-	-
Fırat University	+ (P)	-	-
Gaziosmanpaşa University	+ (P)	-	-
Gebze Institute of Technology	-	+ (A)	-
Gümüşhane University	+ (A)	+ (P)	-
Hacettepe University	+ (P)	-	-
Harran University	+ (P)	-	-
İstanbul Technical University	+ (A)	+ (A)	+ (A)
İstanbul Okan University	+ (A)	-	-
Karadeniz Technical University	+ (A)	+ (A)	+ (A)
Kayseri Erciyes University	+ (A)	+ (A)	+ (A)
Kocaeli University	+ (A)	+ (A)	-
Muş Alparslan University	+ (P)	+ (P)	-
Niğde University	+ (P)	-	-
Ondokuz Mayıs University	+ (A)	+ (A)	-
Middle East Technical University	-	+ (A)	-
Selçuk University	+ (A)	+ (A)	+ (A)
Yıldız Technical University	+ (A)	+ (A)	+ (A)
Zonguldak Karaelmas University	+ (A)	+ (A)	+ (A)

Cultural heritage can be defined as portable or immovable objects located in an underground or on the ground; like buildings or remains of buildings, human lives objects, historic and artistic works, that survived from ancient times until today. Documentation is the first stage of protecting of these monuments and transferring them to future generations. For a complete documentation; data must be produced with sufficient accuracy, must be in details, should be manageable, should be transferrable and should be visual. Terrestrial Photogrammetric technique is the best way of producing the data for proper documentation based on the accuracy, time and economy.

In this study, inferences on the basis of the above outlined, taught methods and terrestrial photogrammetry education for the documentation of the cultural heritage at the Department of Geomatics Engineering, Istanbul Technical University were discussed in details.

2. EDUCATION OF TERRESTRIAL PHOTOGRAMMETRY FOR DOCUMENTATION OF CULTURAL HERITAGE

In this section of the study, the education given in the department related to the Documentation of Cultural Heritage is discussed within the course plan of the Terrestrial and Numerical Photogrammetry. It is going to be followed by the completed design projects realized in graduate and postgraduate level.

2.1 Objectives and Scope of Terrestrial and Numerical Photogrammetry Course

Terrestrial and Numerical Photogrammetry Course is given in 7th semester as 2 credit elective course in English since 1998. According to the current academic plan; Photogrammetry I and Photogrammetry II courses which covers the basic concepts of photogrammetry, fundamentals of mathematics of photogrammetry, are prerequisite of this course.

This course basically covers; cameras widely used in terrestrial photogrammetry, calibration techniques, projection equations, interior and exterior orientation, normal case, tilted case and convergent photogrammetry, parallax photogrammetry, error equations, measurement and usage of image coordinates and coordinate systems used in the close range photogrammetry. Also, application areas of terrestrial photogrammetry are explained along with examples, particularly cultural heritage and historical documentation are discussed and facilities and methods of terrestrial photogrammetry in those areas are examined [3].

In this course content, students are required to perform a term project; carried out in teams of 2-4 students, to achieve practical application of theoretical knowledge. Term project aims to gain the ability to do a project before graduation, including work/project proposal preparation in accordance with the determined object and work planning, camera calibration, performing land surveys, taking pictures of the object, the production of 3D data, model production and cost analysis of overall works. Term project is completed with the presentation of the work. The students are free on choosing working object, but depending on the chosen object; a realistic goal, scenario and tender conditions must be described.

Selected objects and written scenarios of the teams; took the course in the fall semester of 2010-2011, are given as follows:

- Akbil Machine of The Istanbul Metropolitan Municipality; producing base of models for increasing their ergonomic usage,
- ATM device; producing base of models for increasing their ergonomic usage,
- Backgammon; producing virtual reality model for online gaming sites,
- Safranbolu House, which are in the World Heritage List; a documentation project of Ministry of Culture,
- Various building facades located in ITU Maslak Campus, restoration projects.

Students generally follows the steps as; Exploration (exploration of the field and the object, determining the optimum camera, determining the measurement instruments, calibration of the camera), Fieldwork (determining of the position and the number of the control points, polygonasiton, measurements for intersection, taking the pictures) and Office work (compute the coordinates of the control stations, inner orientation of the pictures, outer orientation of the model, evaluation of the pictures, visualization). Studies carried out generally in local coordinate systems, but necessary information are taught in order to perform transformation to desired coordinate system as well.

Students are expected to deliver and present their project with at least graph data. Additional data and models production can be realized depends on their own interests and skills. Students are free to choose the software package for the evaluation procedures. Depending on the chosen software the basic user manuals are supplied during the course. Some examples of models produced by the students in the last semester are given in Figure 1.



Figure 1: Results from Term Project Examples

2.1 Undergraduate and Graduate Design Projects

The documentation of the cultural heritage research topic has been adopted as one of the major area, since the foundation of Department of Geomatic Engineering at Istanbul Technical University. Beside the large number of performed projects in this field by the department up to now, the department supervised many undergraduate and graduate design projects as well. In this section, some recent design projects are illustrated.

Kapuağası Bridge, which was built by Architect Sinan in 16 century, was studied as an MSc design project in 2006. In this study, digital terrestrial photogrammetry technique is applied for the documentation of a historic bridge from the images. Also, building surveys are produced on various scales as a result of photogrammetric evaluations and three-dimensional modelling of the monument, videos in a variety of resolutions of bridge model are produced using virtual reality and visualization techniques (Figure 2) [4,5].



Figure 2: Examples of the Bridge, and the Generated Model

In the scope of completed MSc design project in 2007, capability of mobile phone cameras for producing building survey was investigated. Single image photogrammetry methods and ortho-rectification technique were used. For this purpose images of the building's front facade were obtained with both mobile phone camera and a digital camera and images were ortho-rectified. Afterwards, obtained two different sets of data compared for the accuracy analyses (Figure 3) and results were given in Aydar, 2007 and Aydar et al, 2007 [6,7].



Figure 3: Examples of Building's Front Facade and Ortho-Rectified Images

In 2008, another 3D model and visualization study was completed as undergraduate design project for sanctuary of Apollo Smintheus. Formal excavations and restoration studies of this temple have been carried out by Geography Faculty of Ankara University and Ministry of Culture. Building surveys at various scales and 3D models were produced as result of evaluation of the structure using terrestrial photogrammetric technique. Producing this kind of 3D models are very difficult and time-consuming task using conventional methods which are used for documentation of cultural heritage. On the other hands, performed work in this study reveals the advantages of the specified techniques compare to conventional methods. (Figure 4) [8,9].

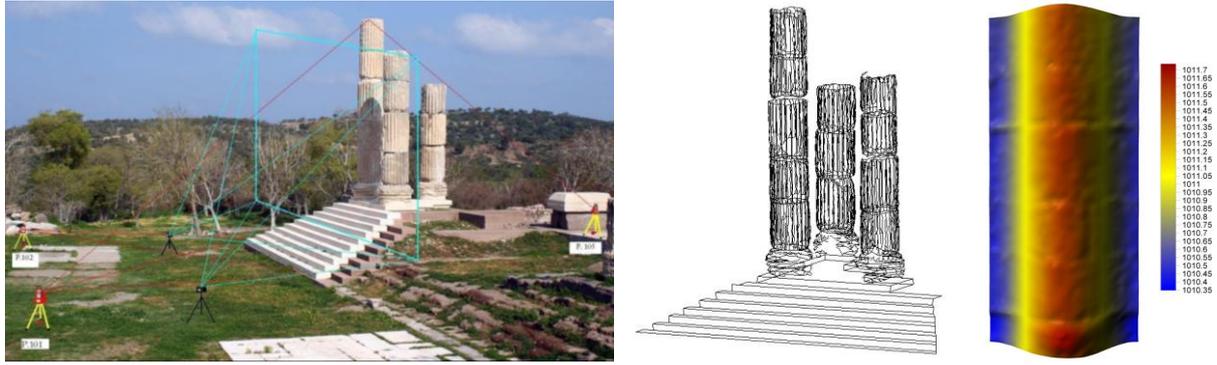


Figure 4: Examples of the Temple Columns, Linear Model and Column Surface Model

3. CONCLUSIONS AND RECOMMENDATIONS

The above given examples and followed course plan are sufficient enough to understand the given importance to the education on the documentation of cultural heritage at Geomatic Engineering Department of Istanbul Technical University. Regarding both undergraduate and graduate design projects and Terrestrial and Numerical Photogrammetry course plan following results and outcomes can be reached;

- The creativity ability of the students was improved with the freedom given for project designing. Different gaps and problems were observed during the proposal preparation and cost analysis phases. In this context, another elective course named “Project Planning and Management” was added to the education plan in the 6th semester.
- It was observed that Students were having problems on intersection method, which is considered one of the main phases of the field studies for the calculation of control points coordinated. Thus, it was decided to add more applications related to this subject to the course plan for the upcoming semesters.
- During the application and model productions of the term project, hardware and software infrastructure of Photogrammetry Laboratory of the department was used. In this context, the vendors of the companies, whose software are available on the market which can be used for the projects, have been talked over to get support to increase the level of infrastructure of the laboratory.
- With the presentation of the term project; the report preparation and presentation and effective communication and time planning ability of the students can be improved.
- Obtained results showed that undergraduate and postgraduate studies support and improve each other in term of complexity and quality.
- Students get familiar to follow national or international events and improve themselves with their outputs. Thus, the ability of the students to understand economic, environmental and social problems was improved [10].

As a result of the assessments it can be said that education on Documentation of Cultural Heritage at the Department of Geomatics Engineering of Istanbul Technical University in a adequate level and still developing.

4. REFERENCES

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