

3D MODEL GENERATION AND VISUALIZATION OF CULTURAL HERITAGE

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ABSTRACT:

This paper describes a study, which aims to generate and to visualize the 3D models of an historical building and surrounding place. For this, the data set of the Fatih Mosque documentation project, which achieved by using digital close range photogrammetry, has been used. In addition, differential rectified images of Fatih Mosque facades have been generated. 2.5D digital photogrammetric map and 1:5000 scaled orthoimage of the Fatih Mosque and surrounding place were used for 3D modelling and visualization. The data set of the Fatih Mosque from digital close range photogrammetry and 2.5D digital photogrammetric map and orthoimage of the Fatih Mosque and surrounding place from Aerial photogrammetry were combined to acquire 3D true information. Finally a precise and an accurate 3D model of Fatih Mosque was generated.

1. INTRODUCTION

The three dimensional computer graphics and visualization techniques have been used for wide range of applications such as manufacturing, industrial design, urban design and analysis, architecture, cultural heritage, 3D city modeling and GIS. The use of three dimensional computer graphics and visualization techniques is becoming more and more popular, because these techniques visualize more realistic object models than graphic based object models. However, in most application of 3D modelling and visualization, large and complex 3D models data are required (El Hakim S., at al., 1998). The process of creating 3D models of objects from real scenes has well-known steps; data acquisition, processing, registration, modelling and rendering. (El-Hakim S., 1998, El-Hakim S. 2000).

Aerial photogrammetry and close range photogrammetry projects, involve similar process steps to that of 3D model generation and visualization. These steps can be characterised as: acquisition of image, determination of interior and exterior orientation parameters of images (local registration) and manual or automatic extraction of geometric features of interest stages. (modelling) (Chapman D., at al, 1998). Because of these parallel stages, it is no surprise that photogrammetrists become interested in 3D modelling and visualization of object. Photogrammetry and digital image processing techniques play important role to make 3D modelling and visualization technology practical and cost effective.

Documentation of cultural heritage is one of the main operations of cultural heritage conversation and restoration. Digital close range photogrammetry successfully used for documentation project of cultural heritage. The products of digital close range photogrammetry are 3D vector data, rectified digital images and ortho images of historical monument. These products can be used for 3D model generation and visualization of cultural heritage. 3D models of cultural heritage help us to better understanding of object, even if they are not accessible for us. 3D models of cultural heritage can be used for

comparing the actual situation with the future situation after restoration.

In this study, operational steps of 3D model generation and visualization of Fatih Mosque are presented. First, methodology for 3D model generation and visualization is defined. Then, details of this methodology for 3D model generation and visualization is explained.

2. METHODOLOGY

Our approach for 3D model generation and visualization of Fatih Mosque consists of following steps:

- image acquisition
- determination interior and exterior orientation parameters of images
- 3D modelling of object and surrounding
- visualization of 3D model (rendering).

First, two steps of our approach are including close range photogrammetric works. Brief information about these works is presented following section. Detailed information about close range photogrammetric works can be found on Yastikli at al, (2003).

3. CLOSE RANGE PHOTOGRAMMETRIC WORKS

The stereo photographs of Fatih Mosque facades were taken in normal case and parallel-averted case with semi-metric Rolleiflex 6008 of Department of Photogrammetry and Remote Sensing, Yıldız Technical University.

For stereo model restitution, the coordinates of signalled points and natural points were measured. For stereo model generation and stereo plotting digital photogrammetric workstation of Department of Photogrammetry and Remote Sensing, Yıldız Technical University have been used. Detailed 3D vector plotting of facades were achieved manually by experienced

operator after generation of stereo models. MicroStation (Bentley) software was used for 3D vector plotting of Fatih Mosque facades as CAD software. These works were done for the Fatih Mosque documentation project and also used for this study. For each facade, differentially rectified images are generated and registered to ground coordinate system. (Figure 1)



Figure 1. Differentially rectified image

4. 3D MODELLING OF OBJECT AND SURROUNDING

The 3D model of Fatih Mosque and surroundings was generated in two steps. First the 3D model of the Fatih Mosque was generated, from 2.5D photogrammetric map and 3D digital vector plotting of Fatih Mosque. Then the 3D model of surrounding was generated from 2.5D photogrammetric maps. Digital terrain model (DTM) of the surrounding was generated by using the 2.5D form photogrammetric map points, which is belonging to the ground as lattice. (Figure 2).



Figure 2. DTM of the Fatih Mosque surrounding

Then, the buildings on the photogrammetric map were extruded down to the DTM to give solid shape. Finally 3D model of the area was completed with true coordinates and scales (Figure 3). It means, it is possible to measure any object in 3D model (Emem O., 2002).

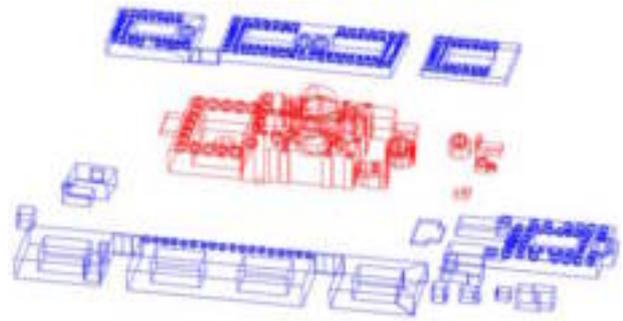


Figure 3. 3D model of Fatih Mosque and surrounding.

5. VISUALIZATION OF 3D MODEL (RENDERING)

After generation of 3D model, next step was 3D model generation and visualization. The texture information of 3D model surface patches is taken from photographs. In this study, differentially rectified images and registered images were used for texture information. 3D model generation and visualization of Fatih Mosque, surface patches of 3D model are rendered with differentially rectified image of facades. The roof of the Fatih Mosque was rendered with different colours. Other buildings were also rendered with colours. The ortho image of Fatih Mosque and surrounding was also available and was used for visualization of 3D model. The ortho image was draped on DTM to visualize Fatih Mosque surrounding. MicroStation J CAD program were used for rendering. As a results, geometrically stable, accurate 3D model of Fatih Mosque and surrounding were generated (Figure 4,5,6,7,8)

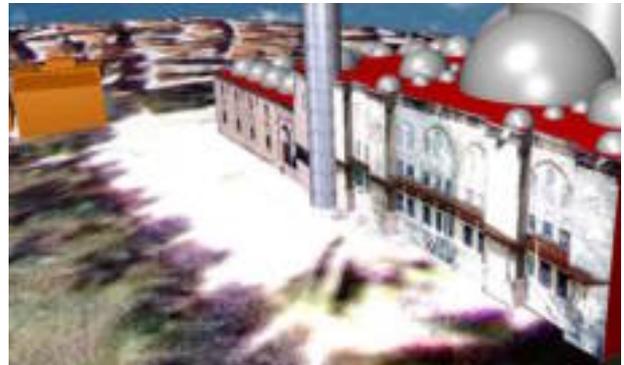


Figure 4. Southwest side of Fatih Mosque 3D model



Figure 5. Northeast side of Fatih Mosque 3D model

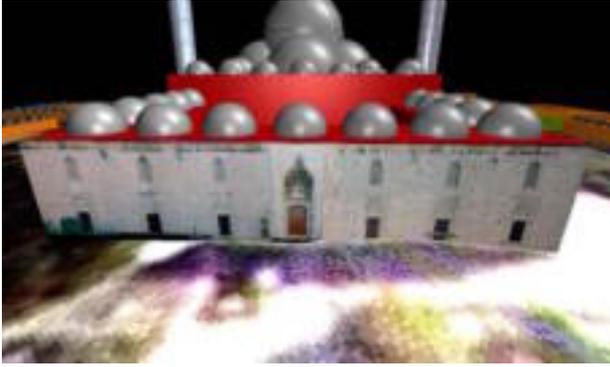


Figure 6. Northwest side of Fatih Mosque 3D model



Figure 7. 3D model of Fatih Mosque and surrounding place

6. CONCLUSION

3D models of cultural heritage are best suited to give a clear and detailed idea of existing situation. Future situation after planned restoration project can be compared with existing situation using 3D model of cultural heritage. By using products of digital close range photogrammetry and products of digital aerial photogrammetry, 3D model and required texture information can be obtain easily. 3D model generation and visualization of cultural heritage has potential for being new product in the area of documentation of cultural heritage and planning of cultural heritage restorations.

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