

TOPCON'S PI-3000 IN THE INVENTORY OF DATA RELATING TO SCULPTURAL AND PORTABLE ARTIFACTS

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ABSTRACT:

This paper examines the potential of Topcon's 'Image Surveying Station Software' (PI-3000) for the inventory of data relating to sculptural and portable artefacts. This was achieved through the generation of a three-dimensional model in the form of triangular irregular network (TIN), using a set of 3 images taken with a calibrated camera (Kodak DCS Pro SLR/n) and analysing the accuracy of the final product.

Within the analysis, the capability of the software has also been evaluated through a comparison of two TIN models, supplied from two different techniques: photogrammetry and terrestrial laser scanning. In that case operations, which help to define properties of a three dimensional object, have been carried out: the creation of cross sections, computation of volume difference, upper/lower volume, computation of surface area and creation of contour lines. A key point was to demonstrate that PI-3000 allows the high fidelity recovery of shape, dimension and detailing. Additionally, research proved that it is a good tool not only for basic photogrammetric measurements (orientation, building 3D models, creating orthophotomaps) but also for making a comparison between two 3D models derived from different surveying approaches.

1. INTRODUCTION

The author's interest in capabilities of the Topcon's software led her to explore its principles in her thesis (Kazana, 2008). The work explores in depth PI-3000 software functions. A brief summary of the key aspects of the investigated techniques is presented here.

2. METHODOLOGY

The aim of this work was to examine the potential of Topcon's PI-3000 photogrammetric software for the inventory of data relating to sculptural and portable artefacts. This was achieved through the generation of a 3D model, represented by a TIN (triangular irregular network) and the performance of various operations that help to define the properties of model. Information about application of PI-3000 have been also reported by Paul Bryan (Bryan, 2008).

2.1 PI-3000

Topcon's 'Image Surveying Station Software' PI-3000 is software developed for generating three-dimensional models and two-dimensional photogrammetric products such as ortho-images. As this paper shows, it also allows analysis of the final products through the performance of various measurements. The model can be generated from photogrammetric data (images + control) and a separate set of 3D coordinates as might be derived through laser scanning. 3D measurements can be obtained whilst working in mono or stereo mode and besides the functions mentioned above, PI-3000 can also perform image orientation, point, line and surface measurements, contour lines, cross section creation and volume calculation.

2.2 Data used for research

The artefact selected for research was an Annunciation Stone from Fountains Abbey, located near Ripon in North Yorkshire, UK (Figure 1).

Digital photogrammetric processing and TIN creation were performed using data supplied by the English Heritage Photogrammetry Team based in York, UK. This contained three images taken with a calibrated Kodak DCS Pro camera equipped with a 28mm lens. 3D points coordinates, in OBJ format, were also supplied derived through laser scanning.



Figure 1 Fountains Abbey Annunciation Stone (English Heritage)

2.3 TIN generation

A 3D model was generated from 3 images taken from different angles, with a calibrated camera Kodak DCS Pro SLR/n. Positions of the camera and base length ($b_1=0,3791m$, $b_2=0,3744m$) are shown in figure 2.

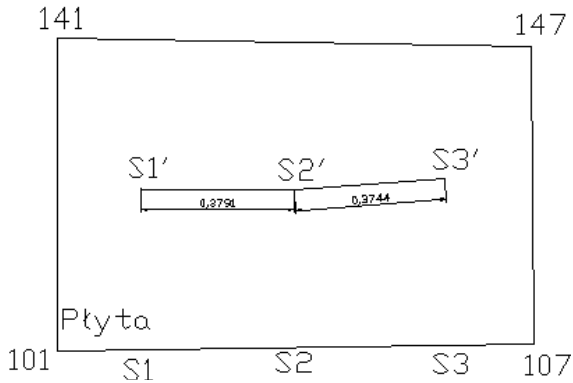


Figure 2 Camera positions and base length

The camera axis has been oriented orthogonally to the measured panel (Figure 3).



Figure 3 Camera position while registration (Paul Bryan)

Before taking the images, a series of 47 small control targets were attached to the stone prior to measurement by total station theodolite.

Building the 3D model was preceded by performing a suitable orientation which within PI-3000, is calculated in one computation process. After orienting two stereopairs independently, the area for TIN generation was 'marked' through stereo-plotting. The final step was to generate the triangular network for each stereo-pair. The final product was a 3D model derived from combination of two independently generated models (Figure 4).

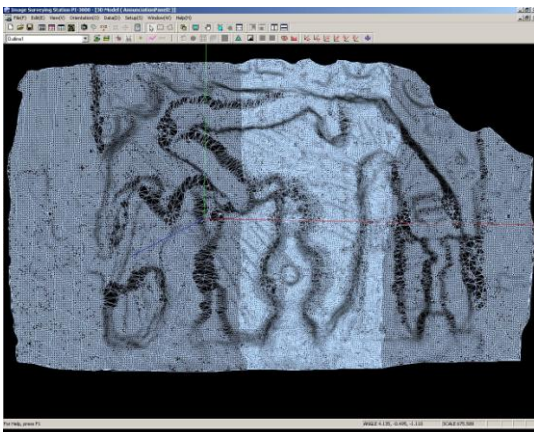


Figure 4 3D model represented by TIN

2.4 3D model analysis

The accuracy of the derived 3D model has been subsequently analyzed by carrying out a series of operations. This included creation of a series of cross section, contour lines, and the computation of volume and surface area. These were performed on the central part of the panel, delineated by a 3D polygon (Figure 5).

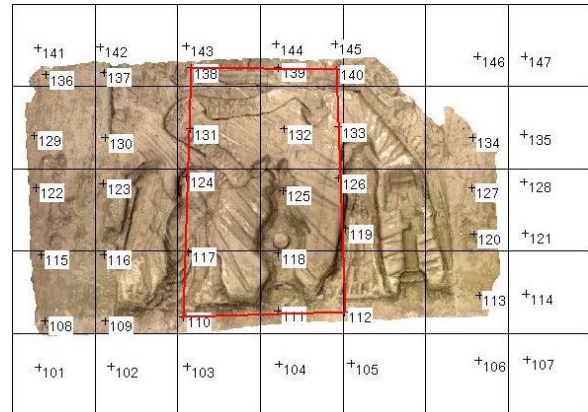


Figure 5 ortho-image with polygon

Through performing those measurements it was possible to evaluate shape (cross sections, contour lines), dimensions (computation of volume and surface area) and detailing (contour lines, cross sections). Moreover, Topcon's software proved to be suitable for defining the properties of three dimensional model.

2.5 Terrestrial laser scanning data and PI-3000

Topcon's 'Image Surveying Station Software' also allows measurements to be performed on data derived from laser scanning. The only difficulty the author experienced was the format of the scan-point data and the size of the file supplied. Once the file had been loaded, it was possible to generate a TIN and all the similar operations connected with the examination of model. Comparison was done through analyzing cross sections and volume difference achieved from photogrammetric data and scan data.

3 Conclusions

Topcon's PI-3000 software, now known in its updated form as ImageMaster, allows operations to be performed which were significant in analyzing 3D model. Moreover, it was able to perform measurements based on external data (points' coordinates from laser scanning) and achieved results that were highly satisfactory. Considering Topcon's software capabilities, it is possible to apply PI-3000 to inventory of data relating to sculptural and portable artifacts such as the Annunciation Panel.

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