Investigation of 3D Models Calculated from Video Sequences

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by

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Abstract

This master thesis investigates the accuracy of a 3D model from video sequences. First of all, camera calibration and reconstructed 3D models have been taken into account to do such an investigation. In this thesis work, camera calibration is done by camera self-calibration procedure. After camera calibration, following the bundle adjustment method, a 3D model of the captured object is constructed using Photogrammetric 3D software. There are three types of objects used and these are “Felge”, “ Felge with coded target” and “3D test field” also three cameras such as Canon EOS 1100D, Nikon D7200 and Somikon UHD4 video camera were used for taking videos and images.

At the beginning of the first investigation, accuracy determination of the 3D model was done by comparison between two photogrammetric software, 3DF Zephyr and Agisoft Metashape, based on point to point distance in the 3D model. From this investigation, it is found that Agisoft Metashape can generate more accurate 3D models than the 3DF Zephyr software due to some limitations of 3DF Zephyr Software. This software is not able to detect point to point distance in the model and for that another software Meshlab is needed. Since Agisoft Metashape is more accurate and stable, for further work I have used Agisoft Metashape software.

In the second part, an object “ Felge with coded target” was used to predict the preliminary 3D coordinates of a point in the 3D model using Agisoft Metashape Software. For particular point matching within different images during making 3D model, absolute orientation technique is followed because of scaling, rotation and translation. Afterward, following the bundle adjustment method, 3D coordinates of points in the model obtained. In this case, I used different number of images with same resolution and finally, found that the model with more number of image frames is more accurate.

In the last part, two experiments were done with two objects. Also, videos and images with varying resolution were used to make the 3D models and different cameras are utilized to take those images and videos. Moreover, I have calculated the difference of point coordinates between different models. According to the calculated values, I compared different models where one model is considered as a reference model. From the first experiment it was found that the 3D model with high resolution is more accurate than the low resolution video model. On the other hand, this finding was not true for the second experiment because a 3D model with high resolution was not that much accurate like a

required 3D model. For this unsatisfactory outcome from the second experiment, I have done a resolution test by Siemens Star to check the manufacturer's provided technical datails of the camera, particularly, the resolution. From the resolution test, for one camera, I found that the pixel size is not correct. Therefore, to get an accurate 3D model from videos, the user should check the calibration and technical details of the camera.

***Keywords*: *Computer Vision*; *3D Model Accuracy Analysis*; *Structure from Motion*; *3D Reconstruction*; *Photogrammetry*.**