REDUCING THE PROBLEM OF OCCLUSIONS IN LASER-TRIANGULATION RECONSTRUCTION

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ICVSS 2011
Sicily ~ 11-16 July
International Computer Vision Summer School

Abstract

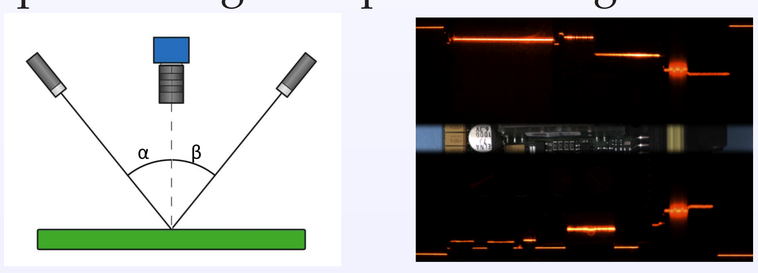
This poster presents a method for reducing the problem of occlusions in a laser-triangulation system for 2.5D models creation.
It is focused on reducing occlusions in the direction of movement of the camera by exploiting two laser projectors instead of one and providing the corresponding calibration and registration algorithms.

Introduction

We apply this technology to quality inspection for electronic boards.
In this context 2.5D models allow to use depth information as a fundamental tool for checking the completeness (presence/absence of parts, correct type, position, orientation) of assemblies. Laser occlusions represent the main issue, because the presence of many vertical components induces holes in the 2.5D model.

Image acquisition

For image acquisition we use two laser line projectors located at the opposite sides of a downlooking camera as illustrated in Figure 1a.
Images are taken in dark lighting conditions in order to better detect the laser points. A collimated white light is used to enlight a small part of the scene for collecting the texture of the object from the central part of the image. An example of acquired image is reported in Figure 1b.



a)

b)

Figure 1: 2.5D scanner at UNIPD.

Calibration

In this work lasers-camera calibration estimates the extrinsic parameters of the lasers respect to the camera. Some calibration images are taken, as shown in Figure 2, then the laser is detected in the images and the 3D laser points position is found by intersecting the camera rays with the estimated chequerboard planes.

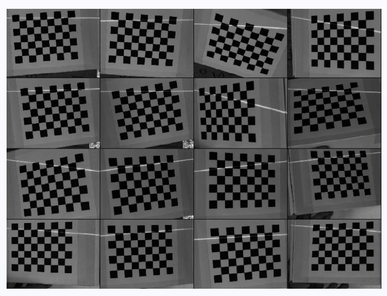


Figure 2: Calibration images.

Finally, the plane that best fits all the laser points is estimated by least squares applying a RANSAC algorithm. This plane, shown in Figure 3, represents the laser plane referred to the camera frame.

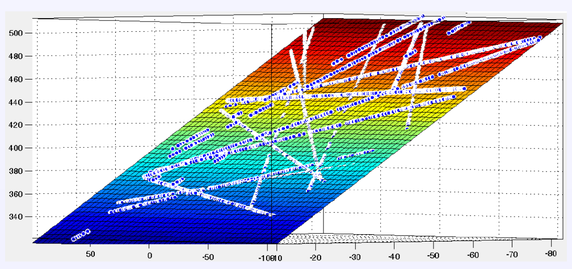


Figure 3: Laser plane estimation.

This procedure is repeated for both lasers indipendently.

Reconstruction steps

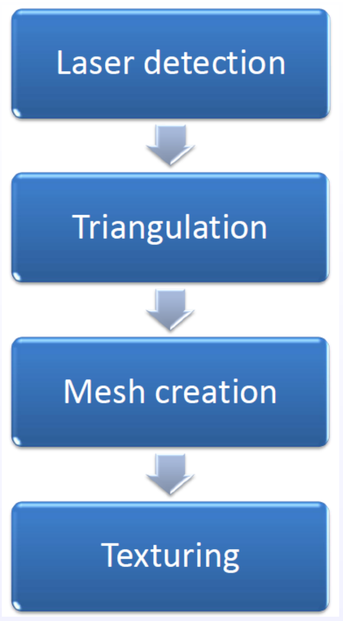


Figure 4: Reconstruction steps.

Two lasers registration

A point cloud is found for every laser, but calibration errors make these two point clouds not to match perfectly, as it can be seen in Figure 5 (red: cloud from 1st laser, green: from 2nd laser).
A ICP algorithm is then applied in order to better register the point clouds. The result is shown in Figure 6.

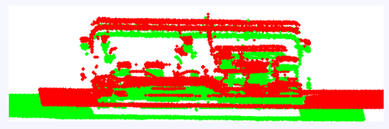


Figure 5: Point clouds before ICP.

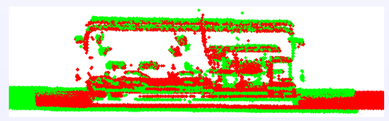
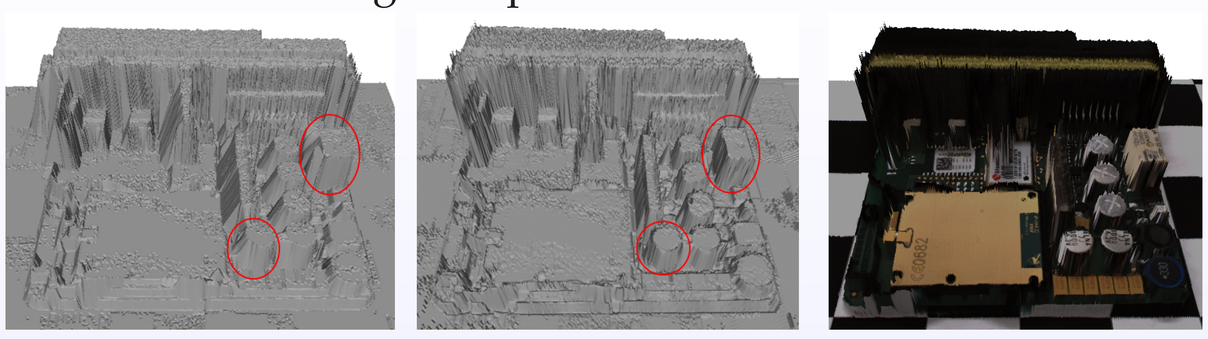


Figure 6: Point clouds after ICP.

Results

Occlusions in the direction of movement are significantly reduced, but further work is needed to better align the point clouds estimated from the two lasers.



a) b) c)

Figure 7: Models composed with one (a) and two lasers (b) and textured model obtained with two lasers (c). The camera moved from right to left during the scan.

References

[1] L., Brignone, M., Munaro, AG. Allais, J. Opderbecke. First sea trials of a laser aided three dimensional underwater image mosaicing technique, in *Oceans'11*, 2011.

Acknowledge

This research has been partially funded by the European Commission under grant No. 262009, project *3D Complete*, http://www.3dcomplete.eu.