

Short project

Computer Vision (CV)

Design and implementation of a 3D
reconstruction from stereo images.

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1. Introduction

This project has as main goal the 3D reconstruction of a scene making use of two fixed stereo cameras using MATLAB. All steps from the camera's calibration, image rectification, 3D reconstruction and final point-cloud management will be studied and analyzed. Furthermore, some basic techniques to reconstruct and localize known objects will be considered to obtain better information of the scene.

1.1 Calibration

To start acquiring data for the project and decide the scopes of the project, a stereo camera calibration was done to see the difficulties when calibrating cameras and how to improve it on the course of this project.



Figure 1.1: Calibration of multiple cameras with checkboard.

Several images from both cameras were extracted manually at almost the same time, as the ones shown on figure 1.1. A script to capture those images at the exact moment must be done due to some big pixel errors we found when holding the check board at freehand.

Furthermore, most of the images uploaded on the calibration toolbox gave errors due to the illumination and quality of the image as it can be seen on figure 1.2, where the corners of the checkboard are not clearly defined.

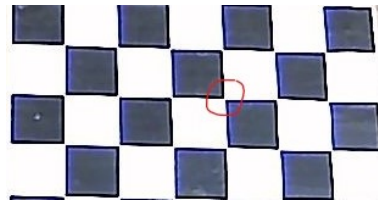
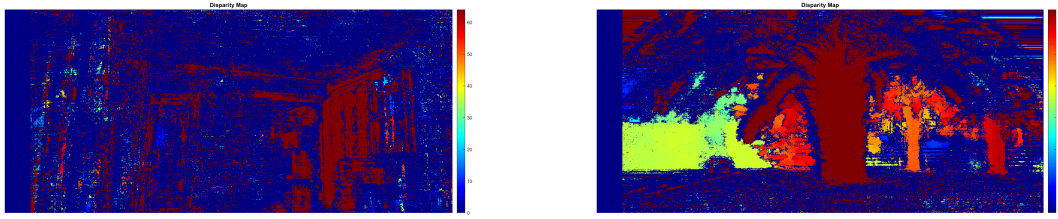


Figure 1.2: Error on the checkboard pattern due to overexposure of the image.

1.2 Rectification

To make a good reconstruction a good image rectification must be done. MATLAB gives us the tools to make the rectification and compute the disparity maps. As we can see on figure 1.3 the exterior image that we have taken gives a better disparity map than the one on interiors, this might be done to the separation between cameras. Further research on this must be done on the final report.



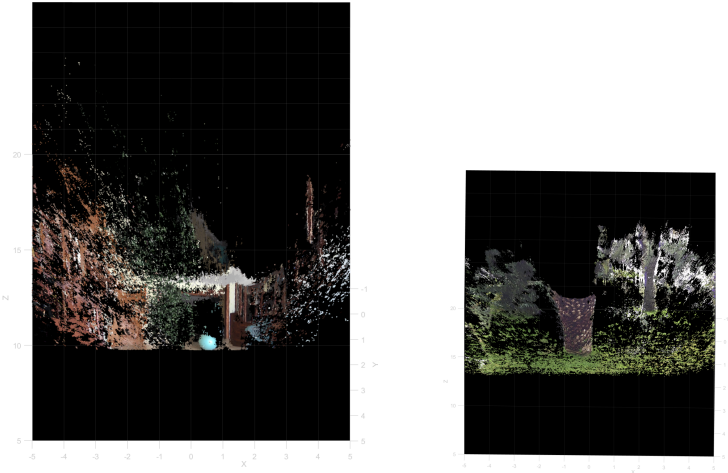
(a) Bad colour map on interior.

(b) Good color map on far distances

Figure 1.3: Color map of the depth.

1.3 3D Reconstruction

The final reconstruction of the environment will be done with the images and the camera parameters (intrinsic and extrinsic) to triangulate the image points.



(a) Bad 3D point-cloud on interior.

(b) Good 3D point-cloud on far distances

Figure 1.4: Disparity map.

1.4 Point-cloud management

To go further on this work, once the final point-cloud of the images is computed and the results are as expected, some point-cloud manipulation will be done in order to recognize point-cloud patterns and make 3D fitting of those patterns.