INDIVIDUAL LAB REPORT #2

AWADHUT THUBE

Team G - The Pit Crew

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Individual Progress

In the last week, I started testing potential options for detection of pit edges from images. Initially, I started off with simple edge detectors and gradient based techniques on the data set that we obtained from Utah. I found that the results were not reliable and consistent across a large set of images. Later, I tried detecting local extrema in images to see whether we obtain a dense set of points near the edges. But again, this method failed to be consistent across all the images. This caused me to move to an entirely different solution of depth estimation for pit edge detection.

For the purpose of depth estimation from stereo images, I had set up the Intel Realsense using the *pyrealsense2* python library. I used the *OpenCV* python library to perform the stereo matching process. I started off by implementing blocks of code which included streaming video frames from the camera, saving images locally and finding correspondences between images. SIFT was used to find interest points between the stereo pair and the ORB descriptor was used to match the interest points. Figure 1 shows the correspondences between the two images.

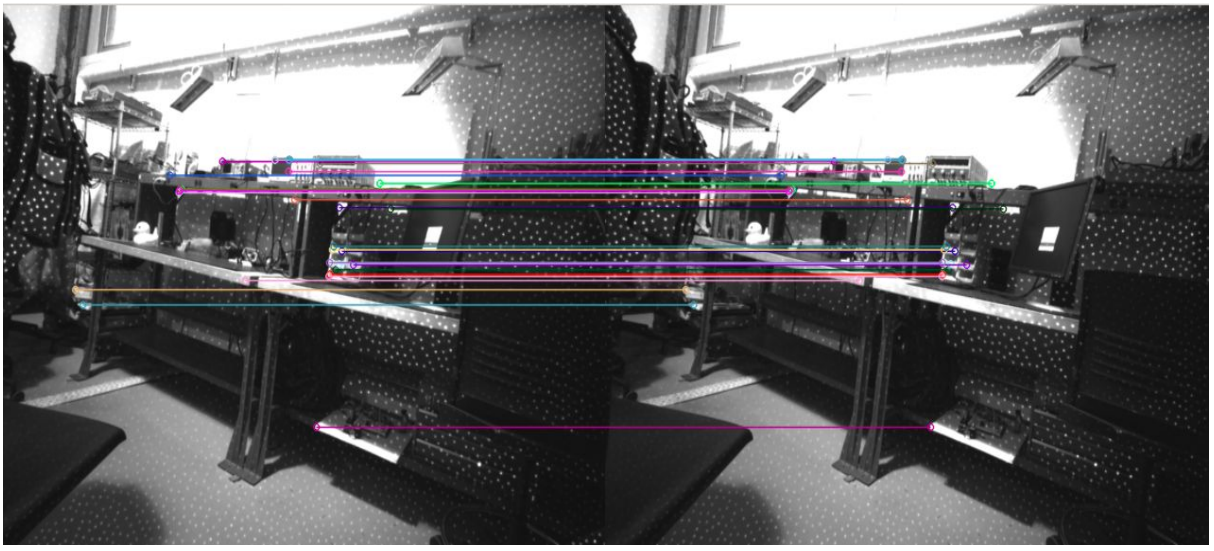

Fig. 1 Stereo Matching

The main aim of performing the stereo matching process was to eventually obtain a sparse reconstruction of the surrounding area. This reconstructed cloud could then be used to determine the presence of a pit. For reconstruction from the stereo images, the first step was to determine the camera intrinsics and the relative position of the stereo pair (extrinsic parameters). This data was accessed using the pyrealsense2 library in python. After obtaining the camera parameters and computing the projection matrices, 3D reconstruction was performed by triangulating the corresponding points in the stereo pair. The resulting points were plotted in 3D as shown in Figure 2.

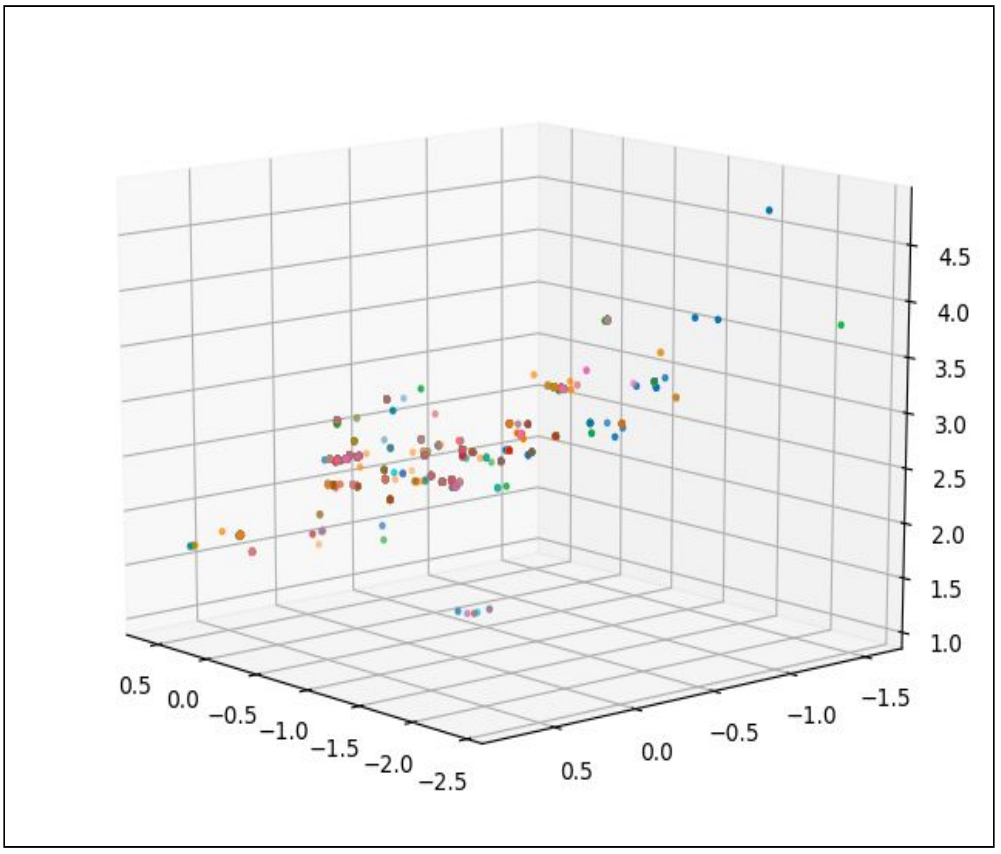

Fig. 2 Reconstructed Points

Challenges

One technical challenge I faced in the reconstruction task was with regards to obtaining the correct correspondences between the images. In cluttered backgrounds, a few noisy correspondences are registered which causes the reconstruction to fail. To avoid this, I reduced the number of correspondences based by thresholding them depending upon the descriptor matching distance. This improved the reconstruction but resulted in a sparse point visualization. The computed average depth of points is very close to the true value despite the sparse reconstruction.

Another problem I faced was with regards to the setup of the realsense SDK for using the library with ROS. I was trying to install the SDK on my personal computer but it failed because of 32 bit Ubuntu whereas the SDK required 64 bit OS as its minimum requirement.

Team Work

Alex Withers - Alex worked on finding the right rad-hardened camera for the purposes of the mission

Justin Morris - Justin directed his efforts to get robot Blue to start with basic navigation capabilities.

Future Plan

1. The next step in the project will be to use Blue and test the reconstruction while moving towards a pit like structure. We plan to move blue on top of a large table and determine how camara data can be used to define a metric which can be used to detect pits.
2. On the other hand, we would like to start testing planning algorithms in simulation which would help us better define the robots behaviour near the edge of the pit.