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1 Working with PCL

This chapter includes the installation guide, first steps with the PCL for learning how to use it and the tasks you have to do.

1.1 Installation guide

In Ubuntu the version 1.7. is as pre-build available and can be installed by using the command line.

```
sudo apt-get install libpcl-dev pcl-tools
```

It includes all necessary parts, but there is a problem with the new Ubuntu and vtk using the PCL. To fix this type following command:

```
ln -s /usr/lib/x86_64-linux-gnu/libvtkCommonCore-6.2.so /usr/lib/libvtkproj4.so
```

For more information open `https://github.com/PointCloudLibrary/pcl/issues/1594`

Note: If you find an other way to fix the errors while compiling PCL-projects with cmake, please tell me.

1.2 First project

Now we use the pcl in our own cmake project to test the installation. Create a folder and call it however you want to call your project. In this example it is called „firstSteps“.

Follow the steps shown at `http://pointclouds.org/documentation/tutorials/using_pcl_pcl_config.php`

1.3 Visualize a point cloud

This is a small Project to visualize a first point cloud including a transformation. The sample code and explanation can be found at `http://pointclouds.org/documentation/tutorials/matrix_transform.php`

Copy the code understand how it works and run it.

Notes:

- Remove everything about „*.ply“ files
- To see the point cloud click and hold in the visualization window and move the mouse.
- Try different transformations and see what happen.

1.4 Filtering

Pointclouds are often scanned with noise. To remove you must remove the outlires. We will try a tutorial from PCL to remove them in a given pointcloud.

`http://pointclouds.org/documentation/tutorials/statistical_outlier.php`

Read and understand the code and make it run. Expand the example by the viewer from exercise before to see the result. Use for testing the files in „Scans“ folder from Ilias.

After running it answer the following questions:

- What does the value $setMeanK$ mean?
- What is set with $setStddevMulThresh$?

1.5 3D Features and Normal Estimation

So let's start with some features. First learn how 3D feature in pcl work and test it with the tutorial `http://pointclouds.org/documentation/tutorials/how_features_work.php`

Read and understand it and try to run the example code.

It is not only copy and paste this time. You need to write the reading of the .pcd file and the visualization on your own. Use the old code of the last task.

After running the example, answer following questions:

- What is the rigid transform?
- What is a kdTree and where is it used in the feature detection?
- What is the normal estimation and why is it using here?

1.6 Plane Segmentation

For some projects it is required to segment som planes in Point Clouds. To do this PCL gives an example to segment a table and the floor. You find it under `http://pointclouds.org/documentation/tutorials/planar_segmentation.php#planar-segmentation`

Run this code first with the generated cloud like it is done in the example and then change it to detect a plane in the scan of the FH.

Answer the following questions:

- How does the SACSegmentation work?
- What is done with „setOptimizeCoefficients“ ?
- What do the ModelCoefficients and PointIndices mean?
- What is the „distance threshold“

1.7 Region growing

An other way to do segmentation ist region growing. It is used do get a set of points that belongs to one region. Use the tutorial to understand and implement this algorithm.

`http://pointclouds.org/documentation/tutorials/region_growing_segmentation.php`

Answer following questions:

- What does region growing mean?
- What is the neighbour finding function?
- What are Curvature and Angle threshold used for and where are they set in the code?

1.8 Surface reconstruction

Till now there are only points and not a surface for objects. Now you have to reconstruct a surface on an object. Use again the tutorial of pcl and understand and run it.

`http://pointclouds.org/documentation/tutorials/bspline_fitting.php`

Answer following questions:

- In the initialization are some parameters, explain what they are used for.
- how does this algorithm works basically?