# SCILAB TOOLBOX HACKATHON

**An initiative of the FOSSEE Project,**

**Indian Institute of Technology Bombay, India**

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**Open Source Library being implemented**: Point Cloud Library v1.11

**Name of the toolbox being developed** : Point Cloud Toolbox

1. Point Cloud Library is well established and has active development as well as plenty of resources like documentation and an active discussion forum. So users of this toolbox can benefit from this.

2. Scilab or any of its presently available toolboxes doesn't have support for point cloud in our knowledge. Also, there are very few open source softwares that support processing of point clouds. So adding this toolbox will greatly enhance scilab's capabilities as an open source software.

3. The toolbox developed is capable of viewing and generating .pcd files so can also help in visualization of 3 dimensional data captured by cameras.

4. Point Cloud has good scope in 3D technology as visualizing objects as point clouds, makes it very efficient for processing.

5. Scilab doesnt have support for 3D image operations and our toolbox can help overcome that drawback.

6. Point Cloud Toolbox can be used for conversions between png, pcd, vtk, ply, obj and so on, so it can work with other toolboxes developed for the other formats. There is also availability of various filters and options for adding noise. We can also change the orientation or viewpoint of the .pcd file. It can be used to calculate errors and Hausdorff distance which can aid in computer vision.

7. Also, Point Cloud Library takes about 4 hours for compilation and installation (without dependencies). There are also some technical difficulties encountered while installing PCL-1.11.0. By using the toolbox in scilab, time required for installation is cut down significantly since we need not install PCL. Only mandatory dependencies are required to be downloaded and installed for the toolbox to run.

8. Point Cloud are used in metrology, CAD designs and various other fields, so providing an easy way to generate, analyse and perform operations would help the people who have poor internet to download and install PCL and all its dependencies.

9. Point Clouds are also used in face detection, there are operations in our toolbox which support some operations which may prove useful for it. With the right dependencies installed, we can also take in data from kinect and process it which can help rapid prototyping for hobbyists, researchers and so on in the field of computer vision and robotics.

10. These algorithms have been used, for example, for perception in robotics to filter outliers from noisy data, stitch 3D point clouds together, segment relevant parts of a scene, extract keypoints and compute descriptors to recognize objects in the world based on their geometric appearance, and create surfacs from point clouds and visualize them. Autonomous vehicles use it as a format of storing the sensor data since it is easily processable.

## LIST OF FUNCTIONS BEING IMPLEMENTED

### Conversion of formats

1. obj2ply 2. pcd2ply 3. pcd2png 4. pcd2vtk 5. pclzf2pcd

6. ply2pcd 7. xyz2pcd 8. vtk2pcd 9. obj2pcd 10. ply2vtk

11. vtk2ply 12. vtk2obj

### Estimation

1. vfh_estimation 2. fpfh_estimation 3. normal_estimation

### Filters

1. radius_filter 2. passthrough_filter

3. fast_bilateral_filter 4. Progressive morphological_filter

### Sampling

10. uniform_sampling 2. mesh_sampling

### Reconstruction

1. poisson_reconstruction 2. marching_cubes_reconstruction

### Miscellaneous (transformations; random generation; viewer; computing error, hull so on)

1. generate 2. pcd_viewer 3. add_guassian_noise

4. cluster_extraction 5. plane_projection 6.pcd_change_viewpoint

7. grid_min 8. transform_from_viewpoint 9. transform_point_cloud

10. compute_hull 11. compute_crop_to_hull 12. compute_hausdorff

13. outlier_removal 14. voxel_grid 15. gp3_surface

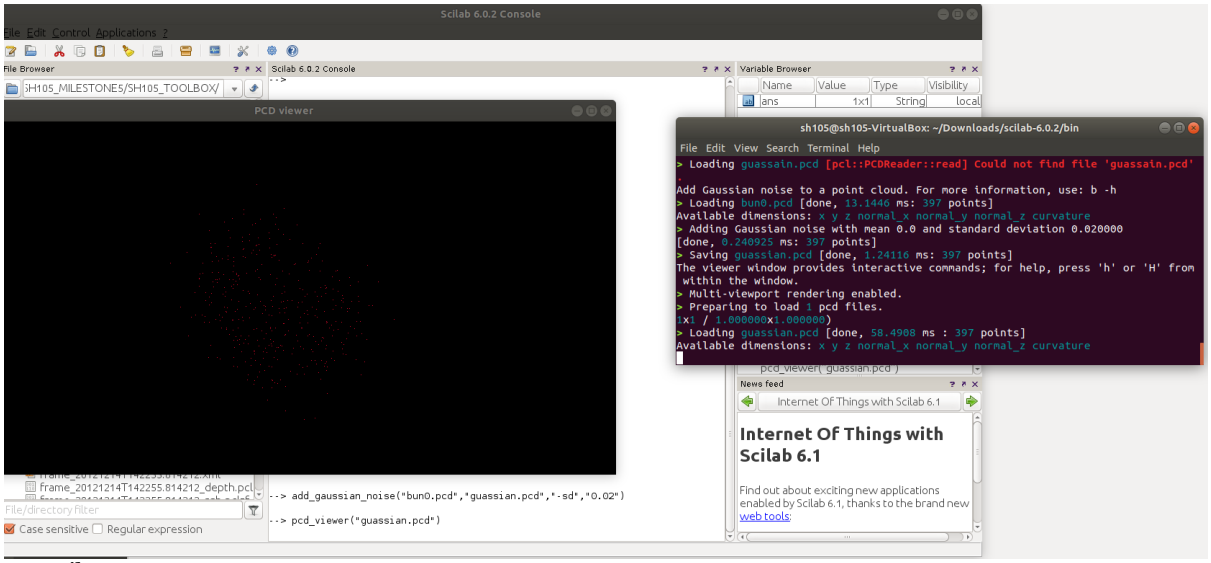
16. compute_cloud_error 17. concatenate_points 18. extract_feature

# COMPARISON OF RESULTS

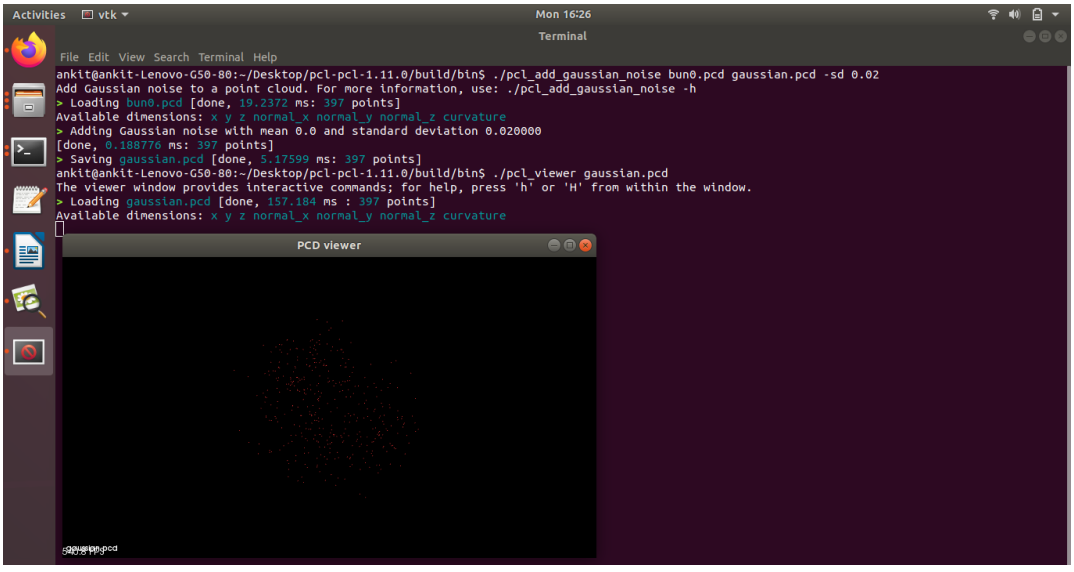
The results obtained from the toolbox are compared to the ones obtained from directly using the library. Output computed from both ways are equal. Some of the compared results are shown below. Note that due to compression, output points may not be visible in images.

**1. add_gaussian_noise**

Scilab output:

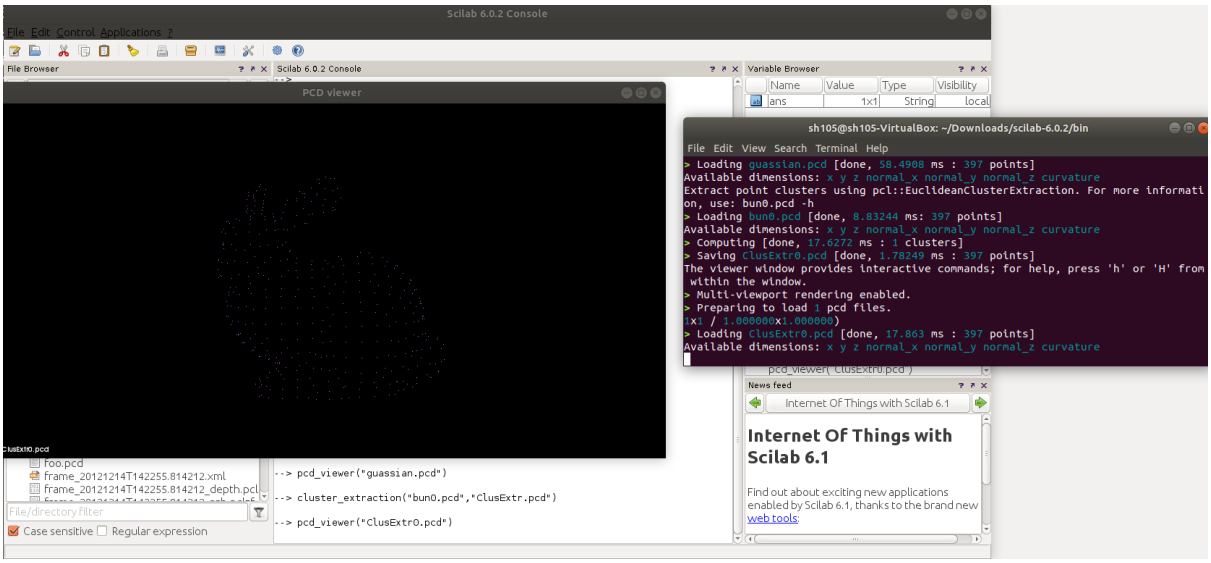



PCL Library output:

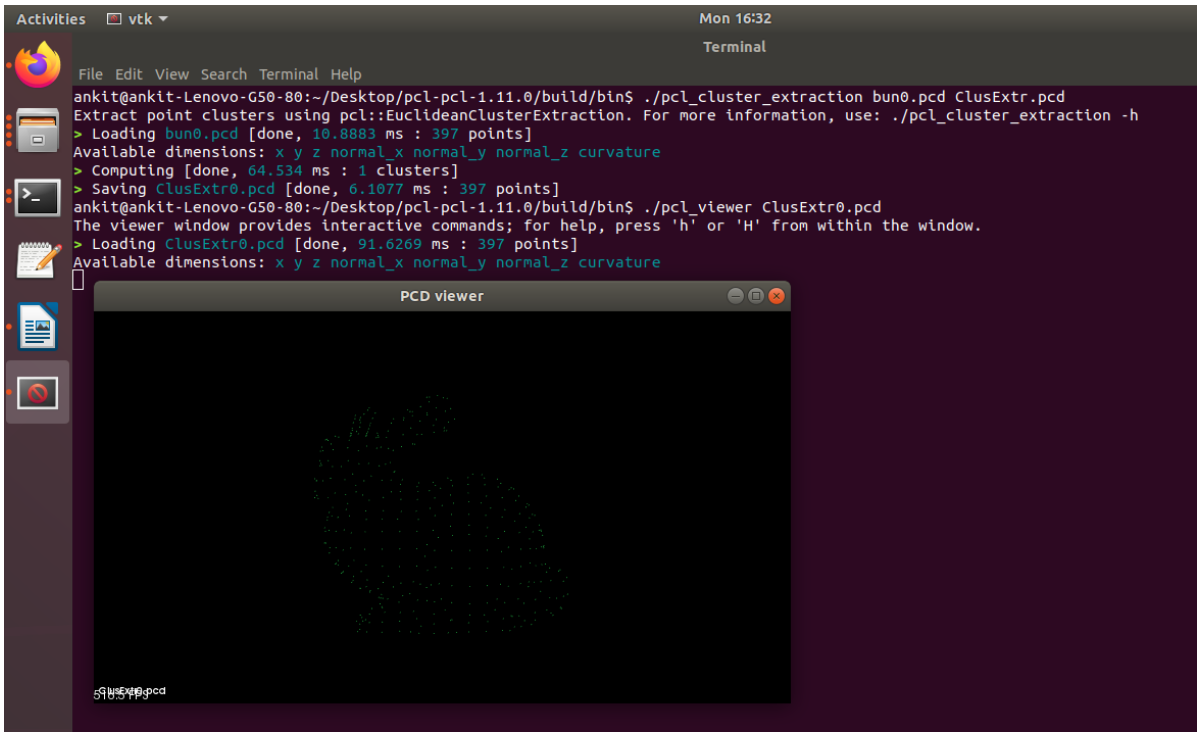


**2.cluster_extraction**

Scilab output:

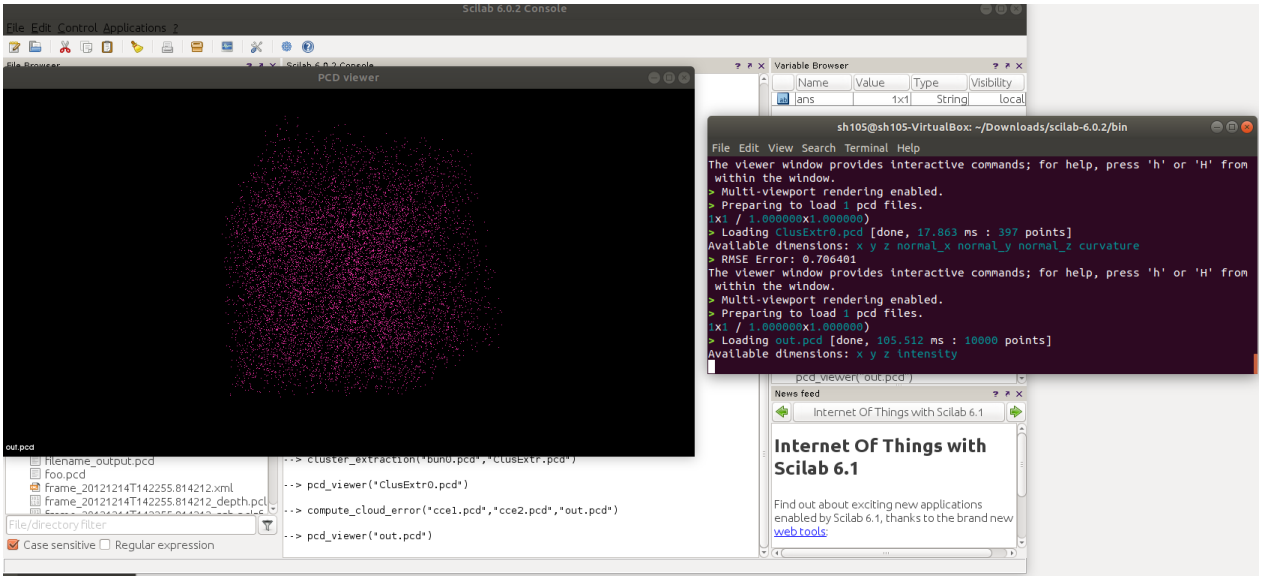



PCL Library output:

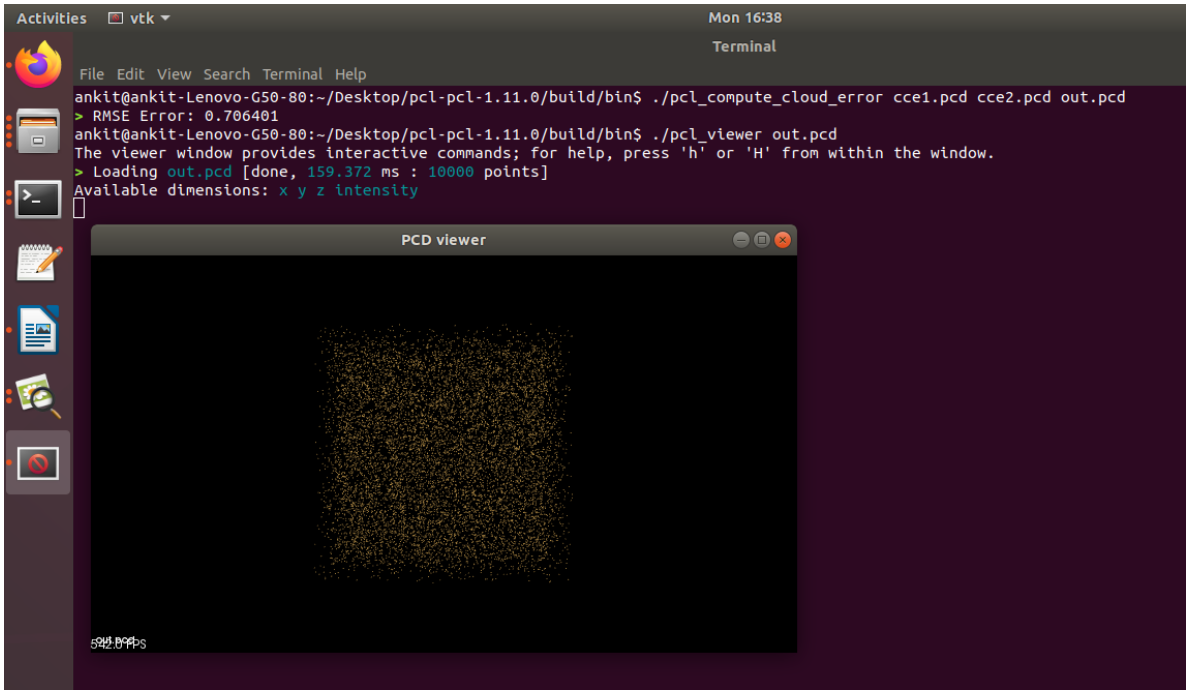


### 3. compute_cloud_error

Scilab output:

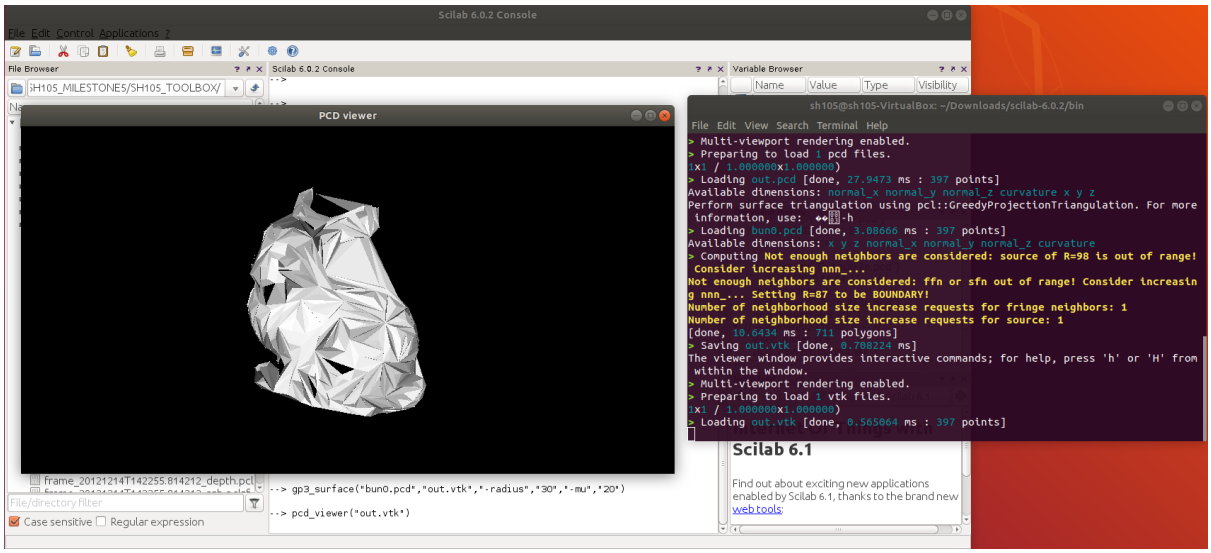



PCL Library output:

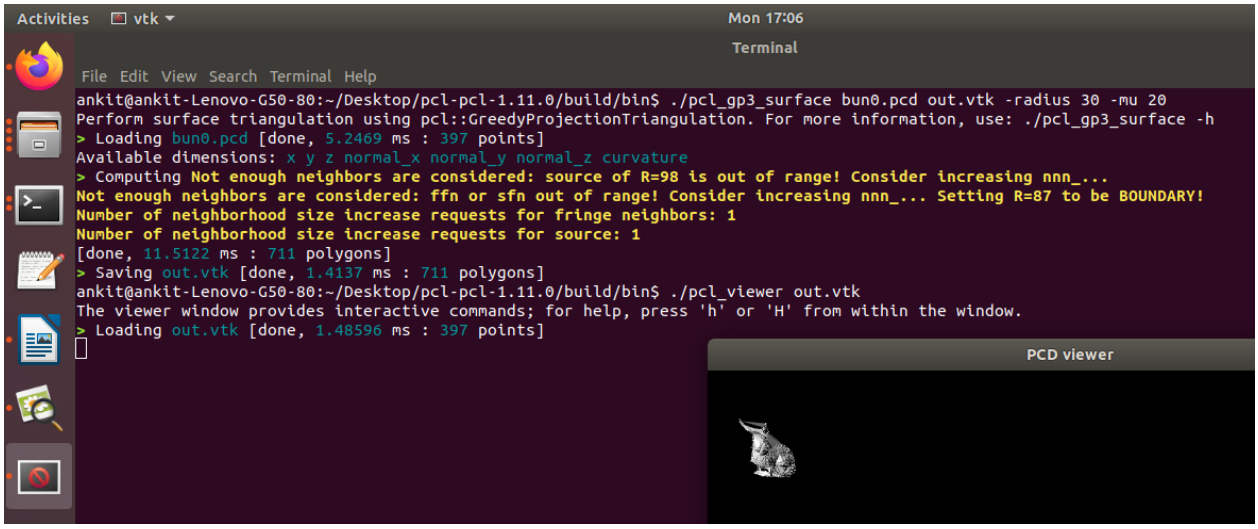


## 4. gp3_surface

Scilab output:

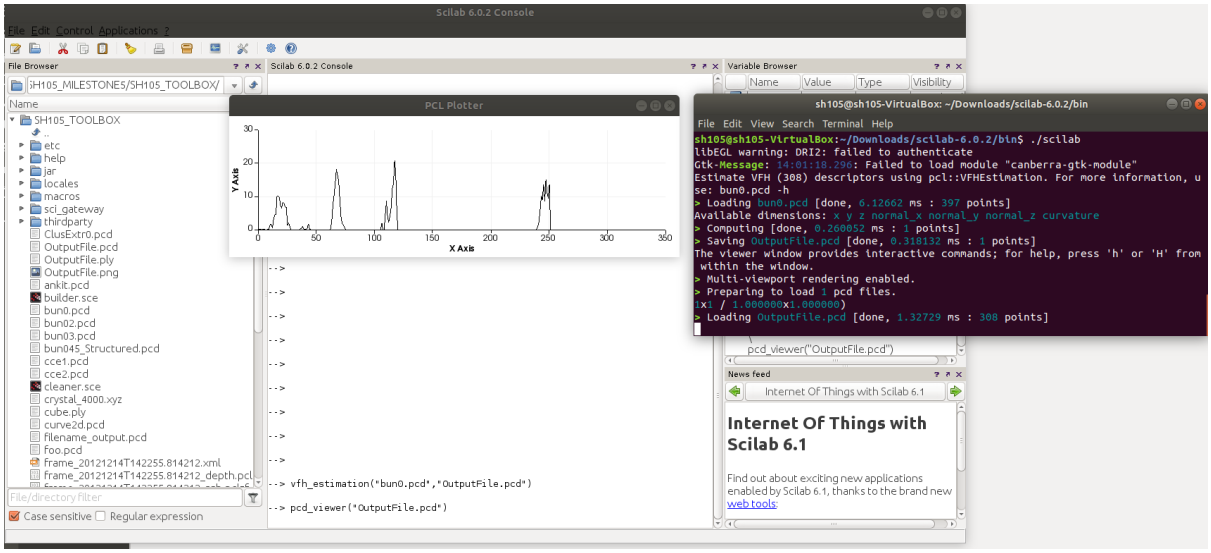



PCL Library output:

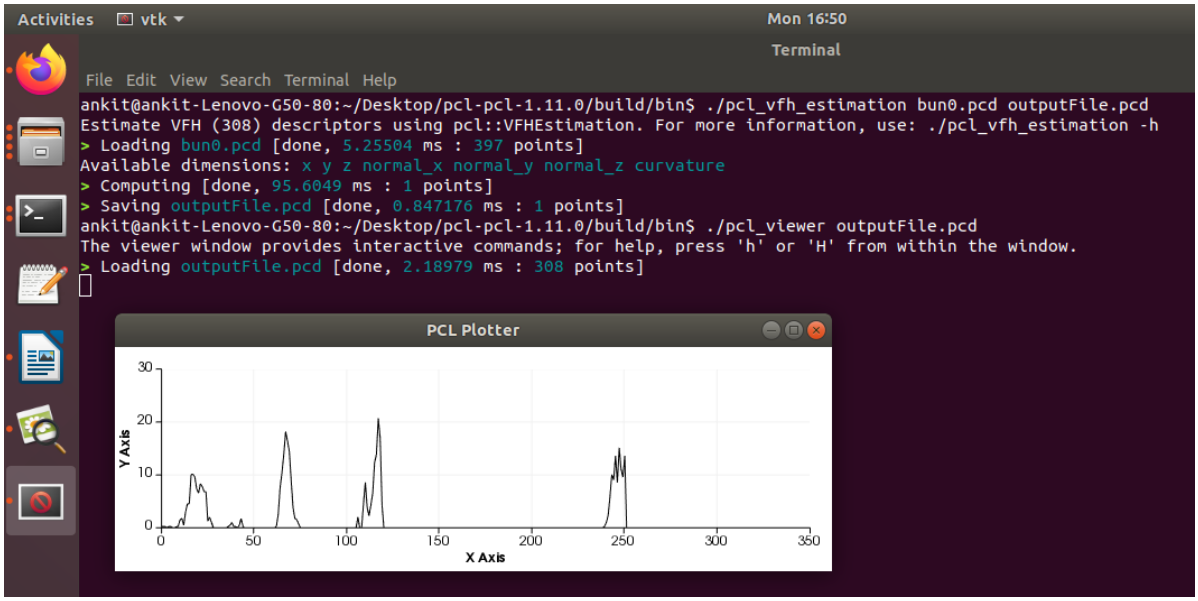


## 5. vfh_estimation

Scilab output:

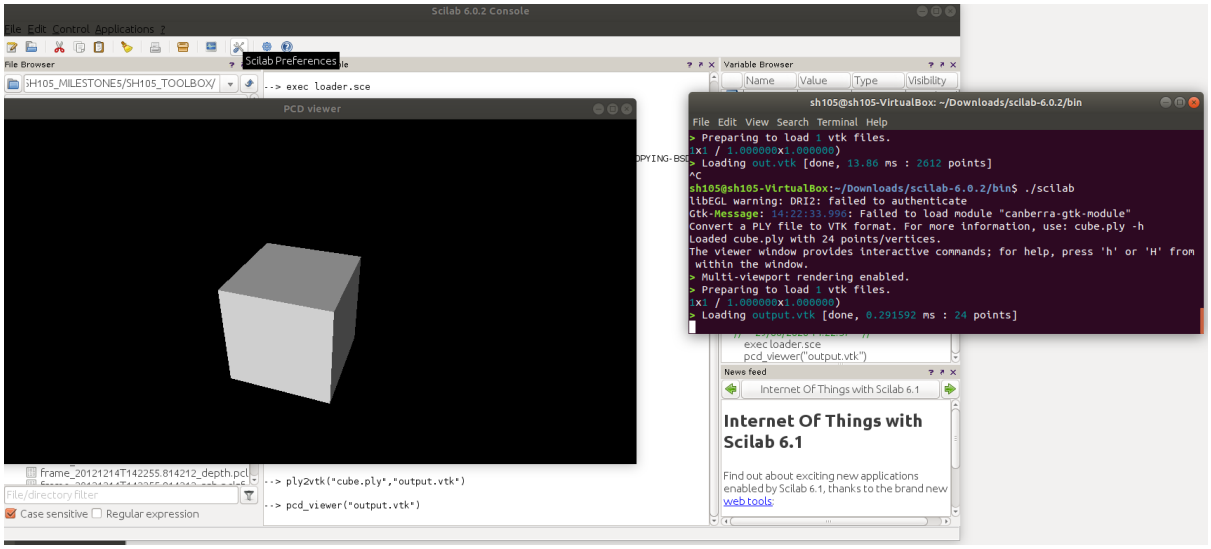



PCL Library output:

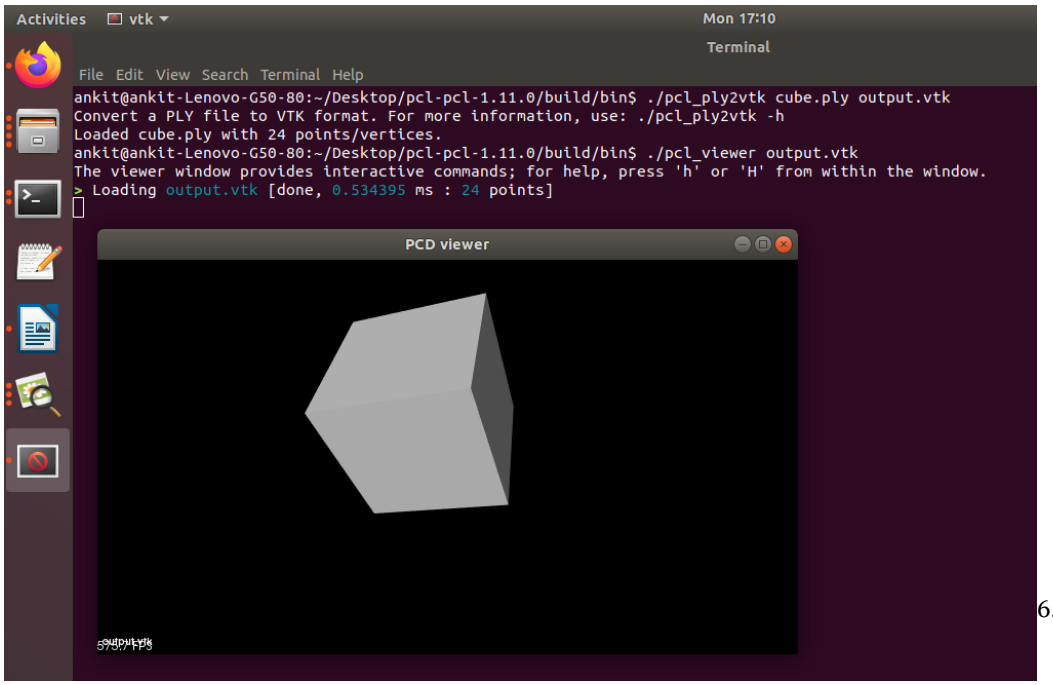


**6. ply2vtk**

Scilab output:



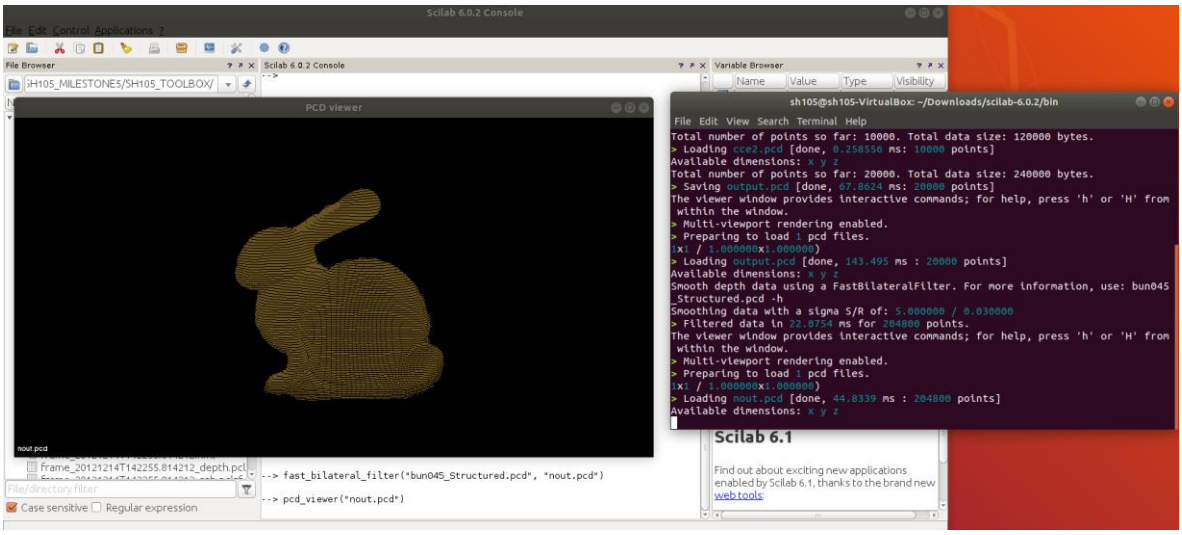

PCL Library output:



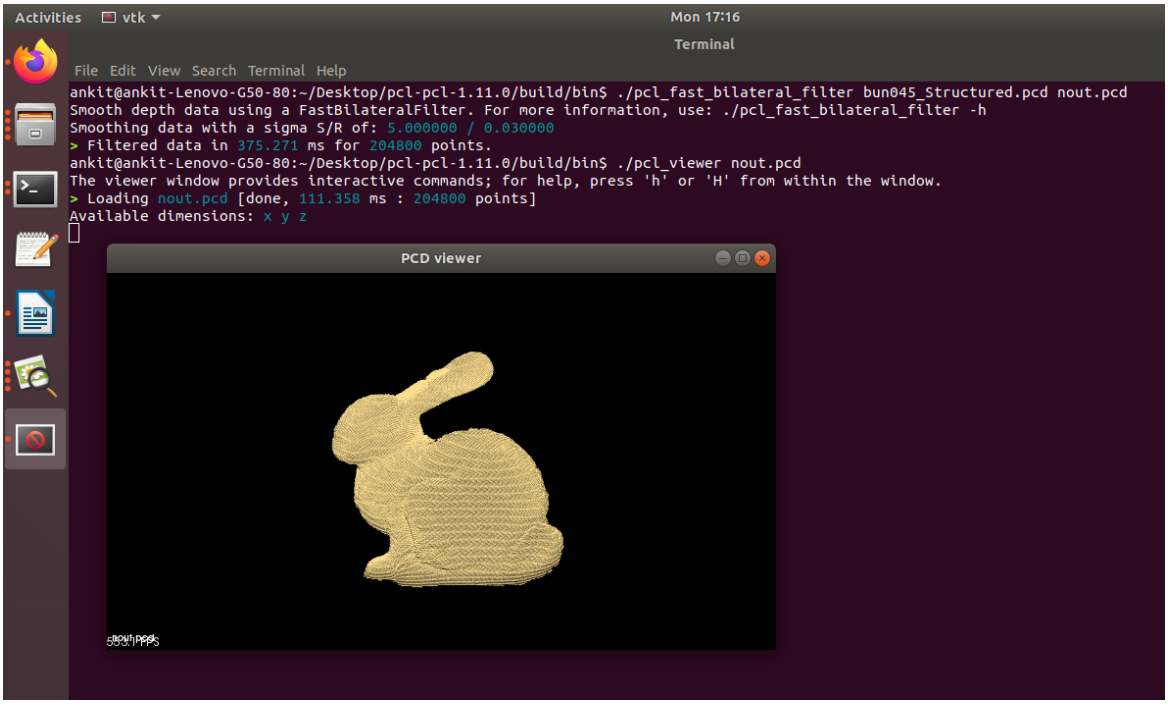

6.

## 7. fast_bilateral_filter

Scilab output:

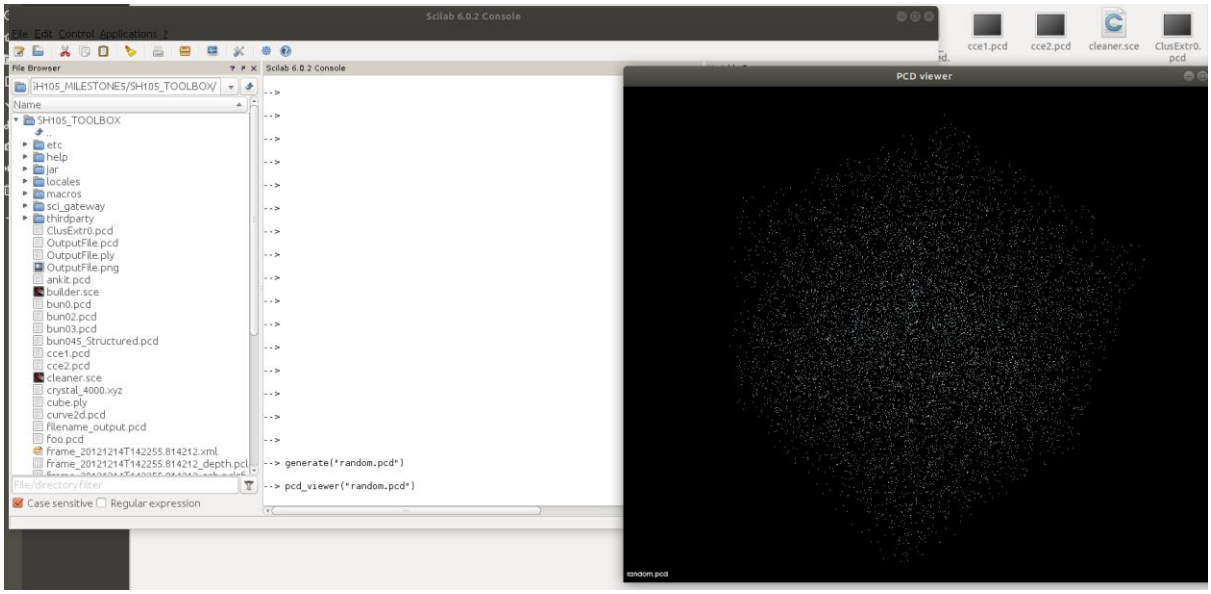



PCL Library output:

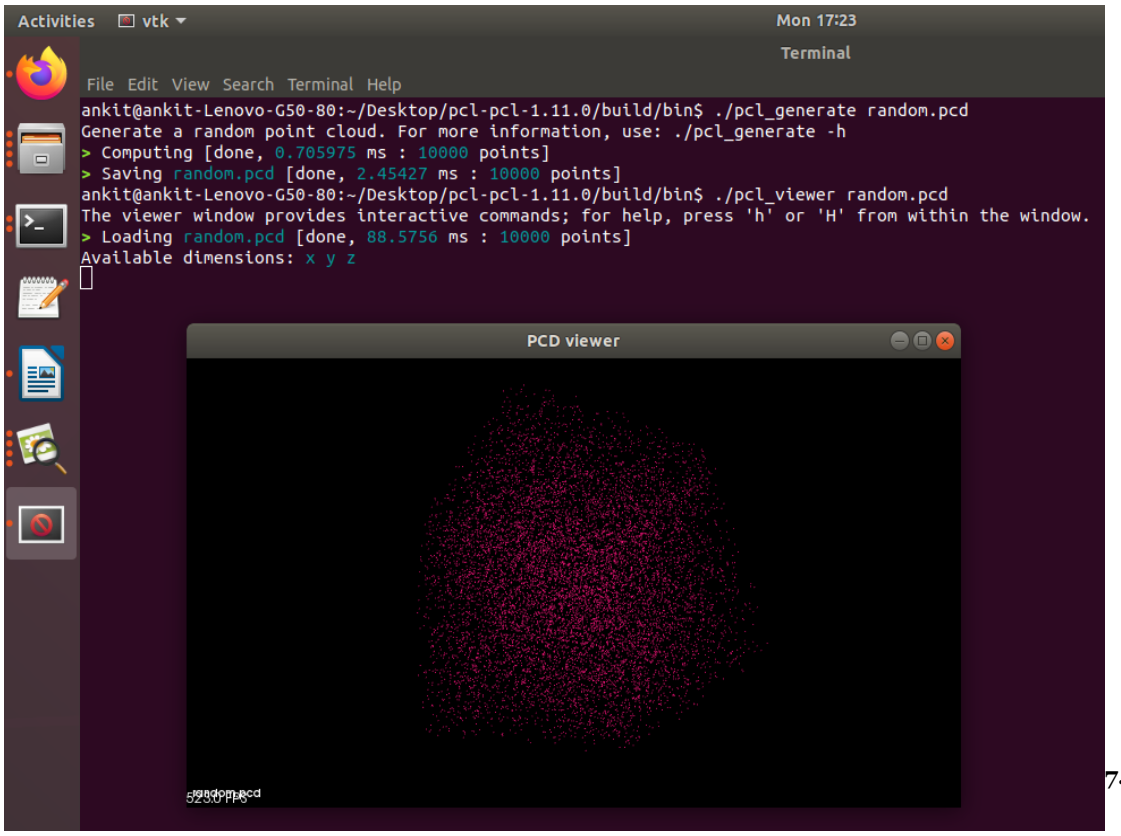


**8. generate**

Scilab output:



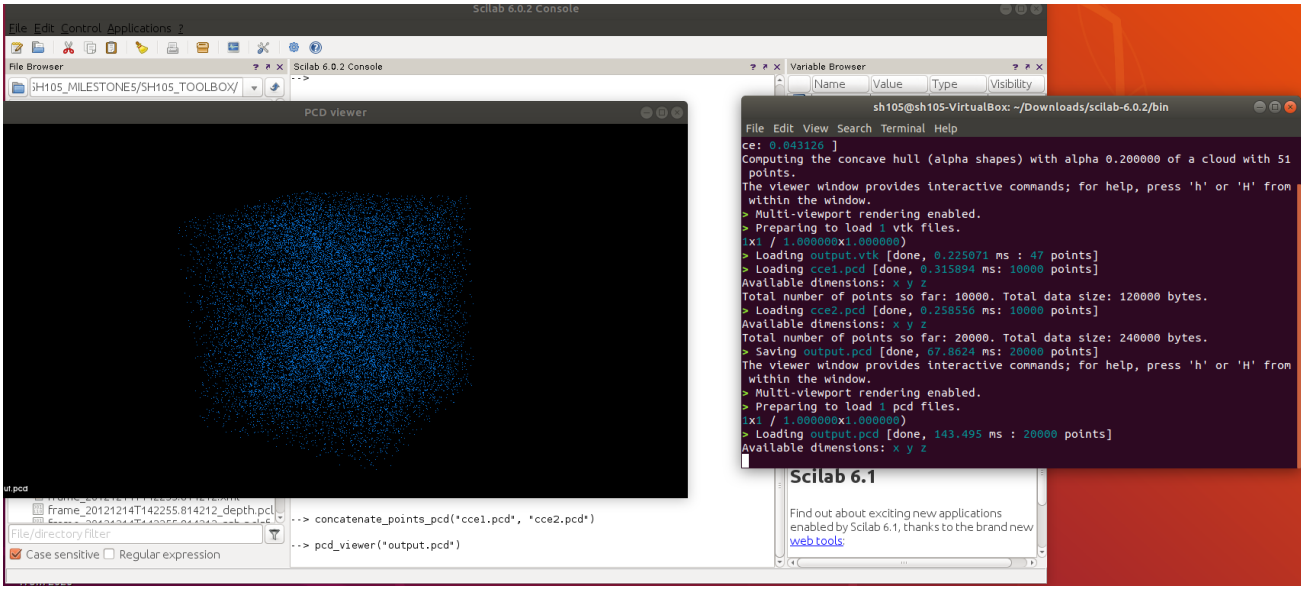

PCL Library output:



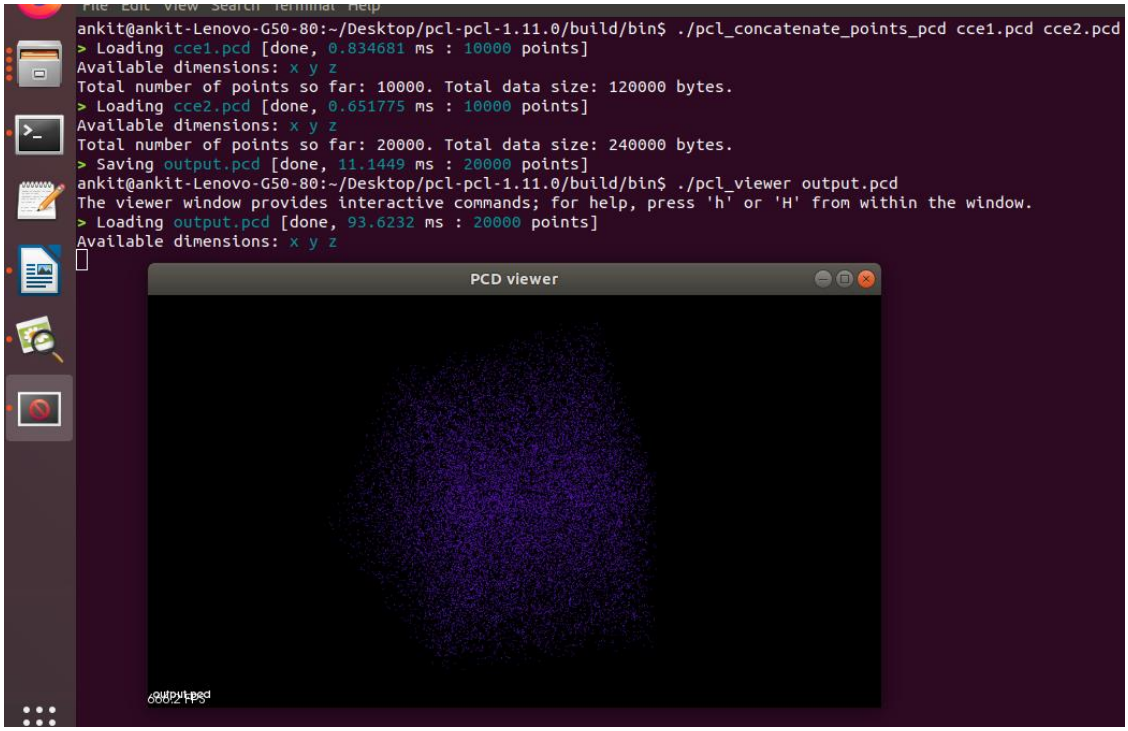

7.

### 9. concatenate_points_pcd

Scilab output:

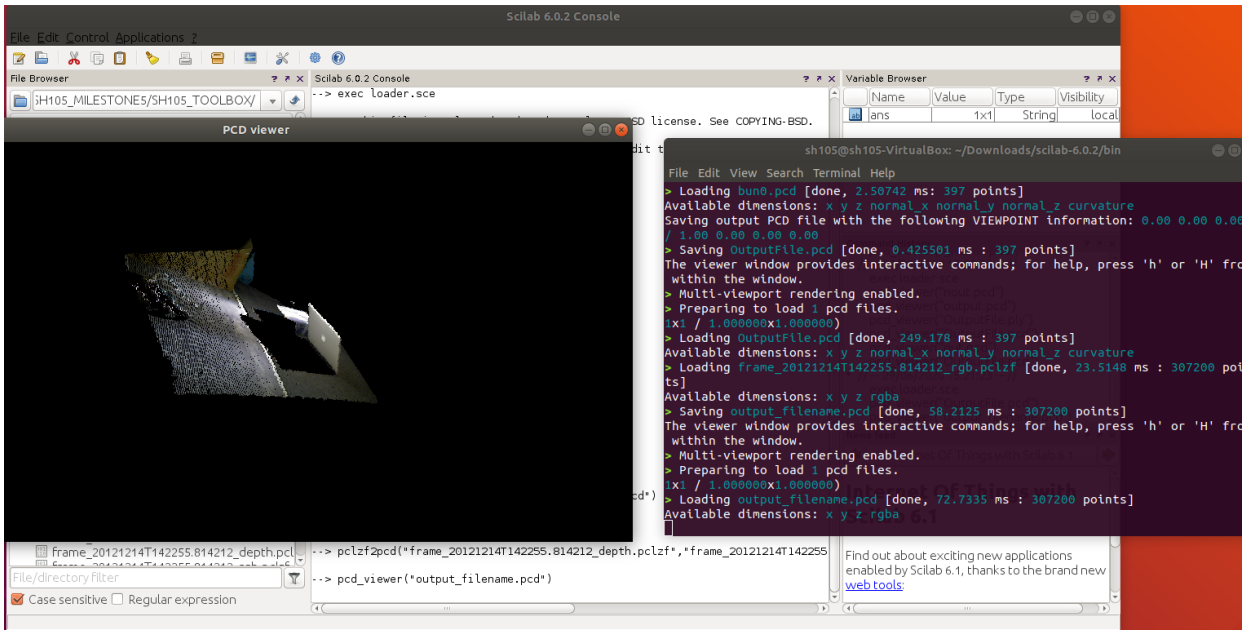



PCL Library output:

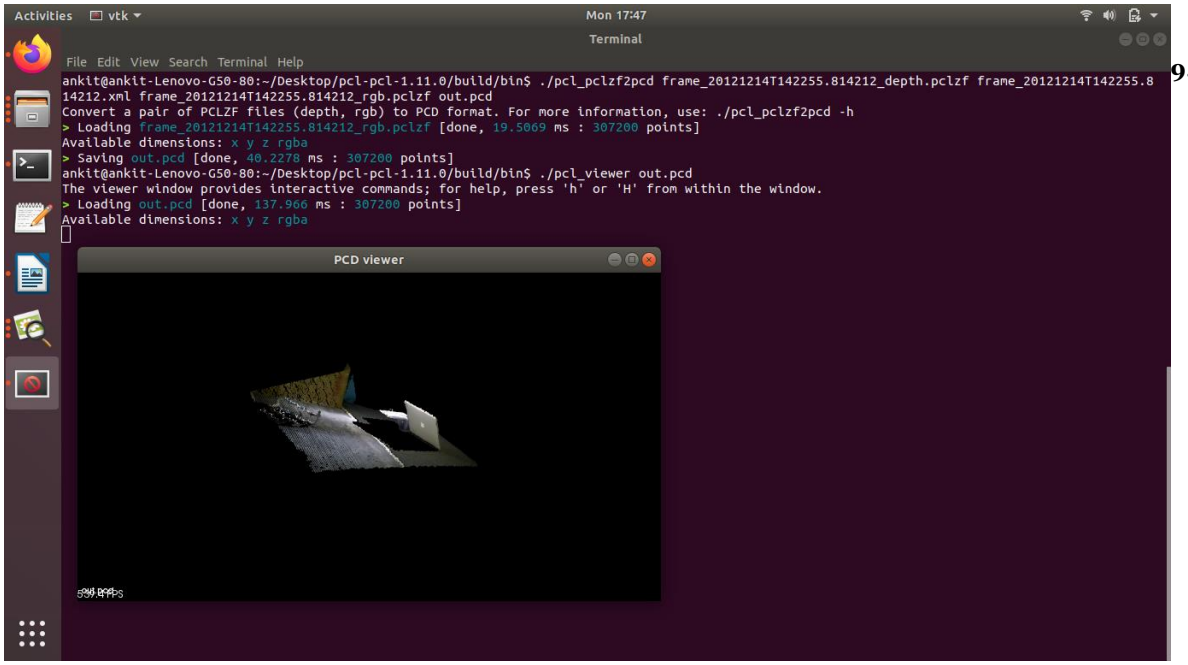


**10. pclzf2pcd**

Scilab output:



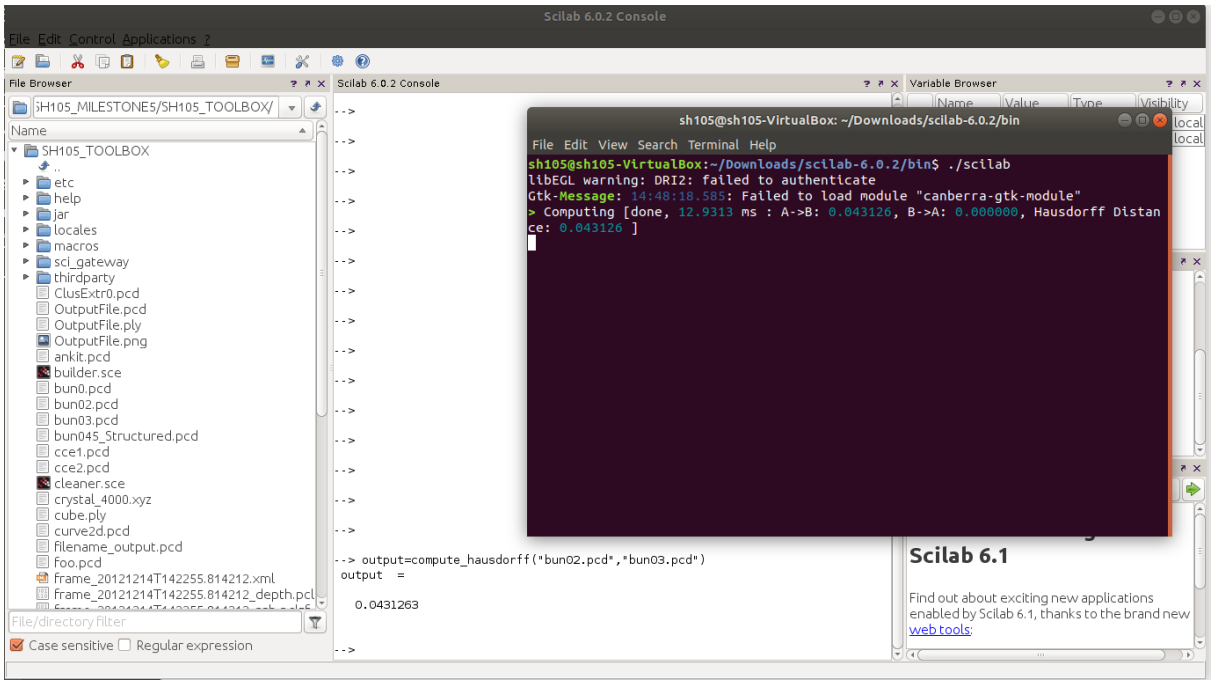

PCL Library output:



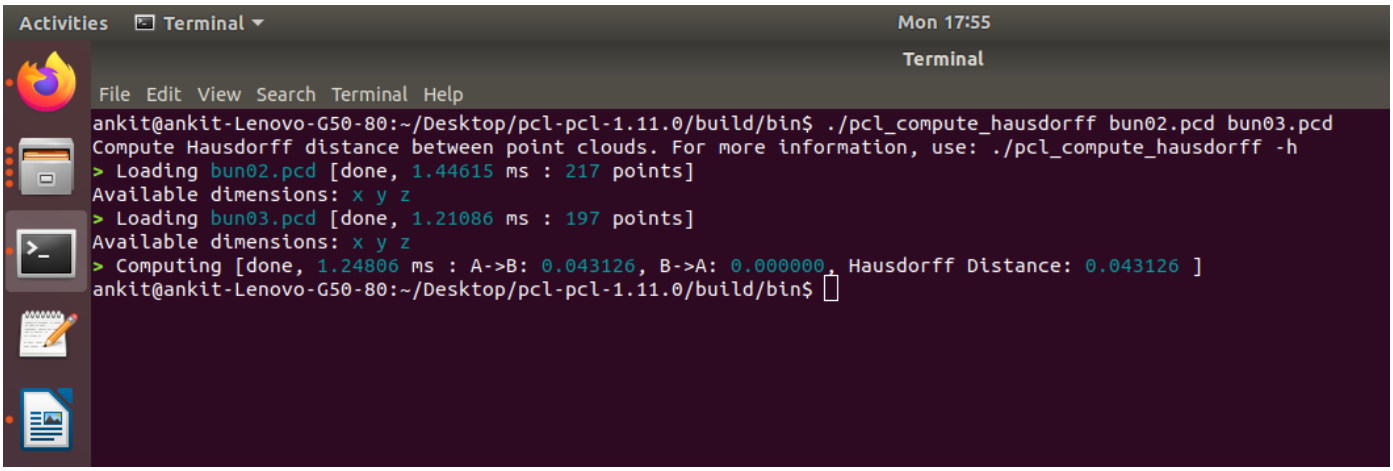

**9.**

### 11. compute_hausdorff

Scilab output:

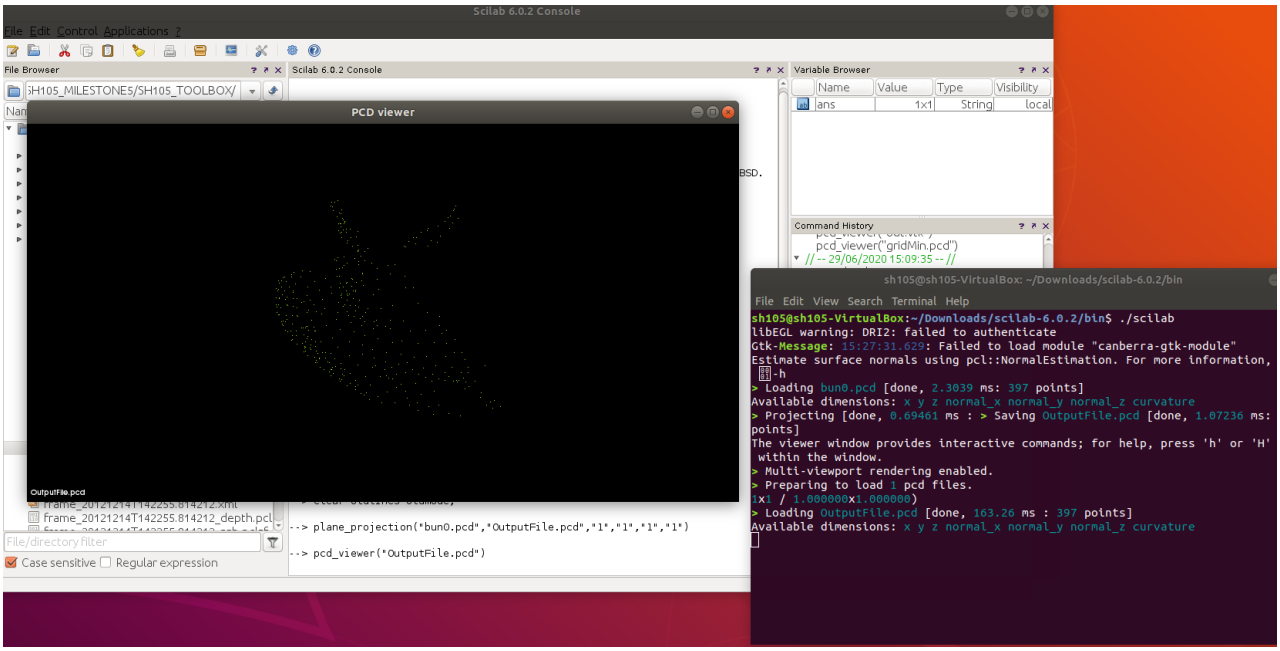



PCL Library output:



## 12. plane_projection

Scilab output:




PCL Library output: