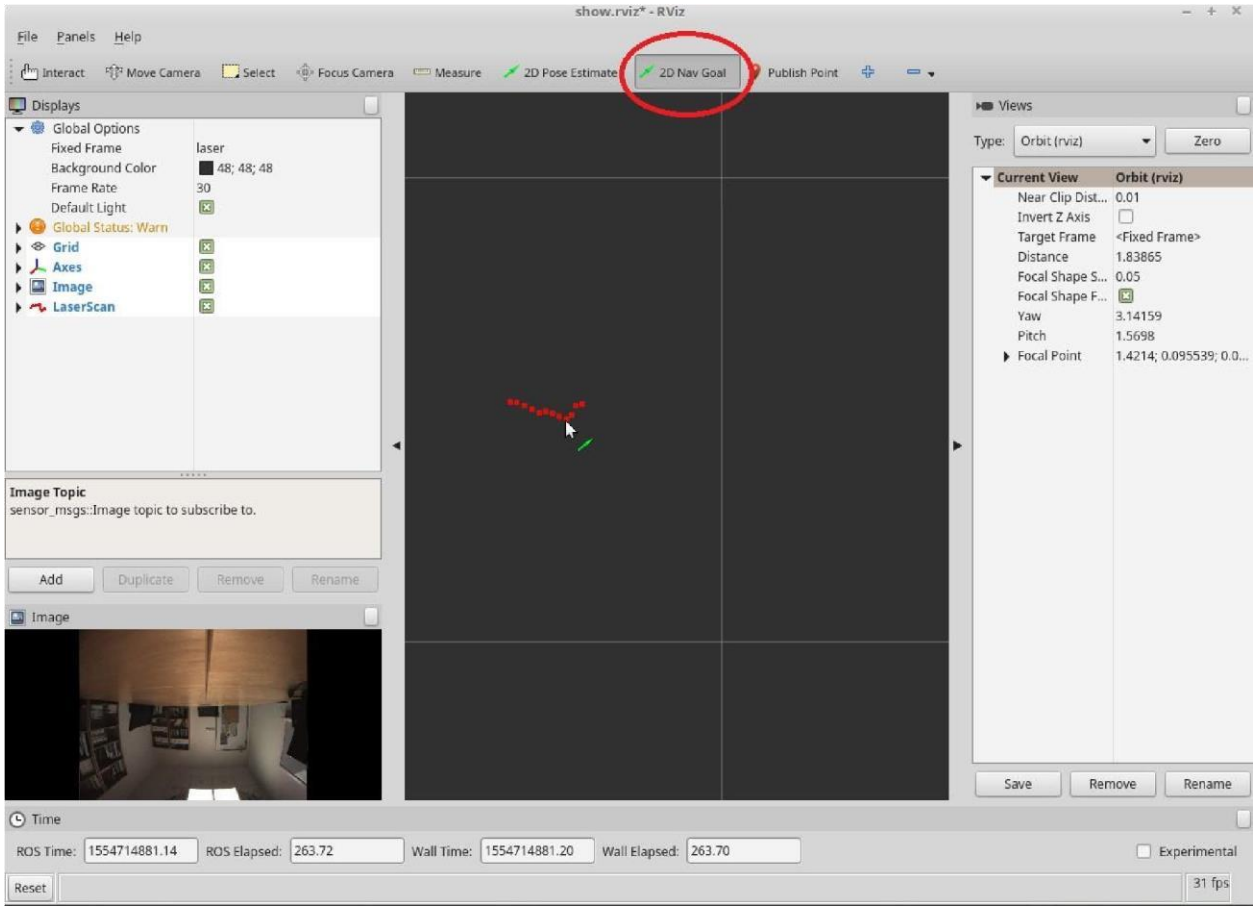
Data Collection

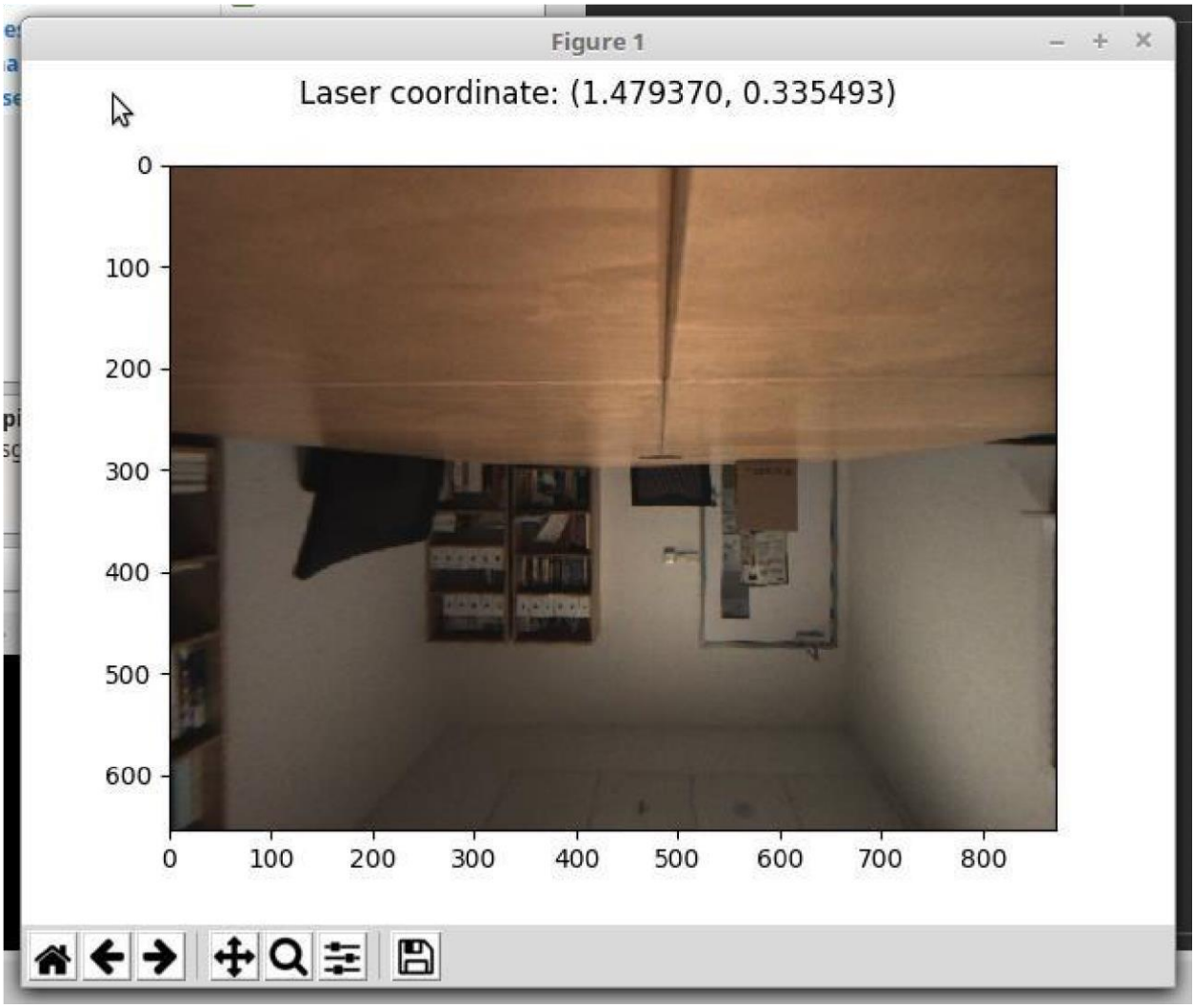
1. Delete all files in *data/* directory
2. Change the camera intrinsic parameter in *config/config.yaml* based on your camera
3. Change the *image_topic* parameter in *launch/collect_camera_lidar_data.launch* based on your camera image publish topic
4. Run *roslaunch camera_2d_lidar_calibration collect_camera_lidar_data.launch*
5. Camera intrinsic parameter will be shown in the terminal, and *rviz* will launch by itself

```
Camera parameters
Lens = fisheye
K =
[[393.442493   0.         479.083289]
 [  0.       394.007796 313.169892]
 [  0.         0.         1.      ]]
D =
[ 0.016366  0.008233  0.003436 -0.003117]
```

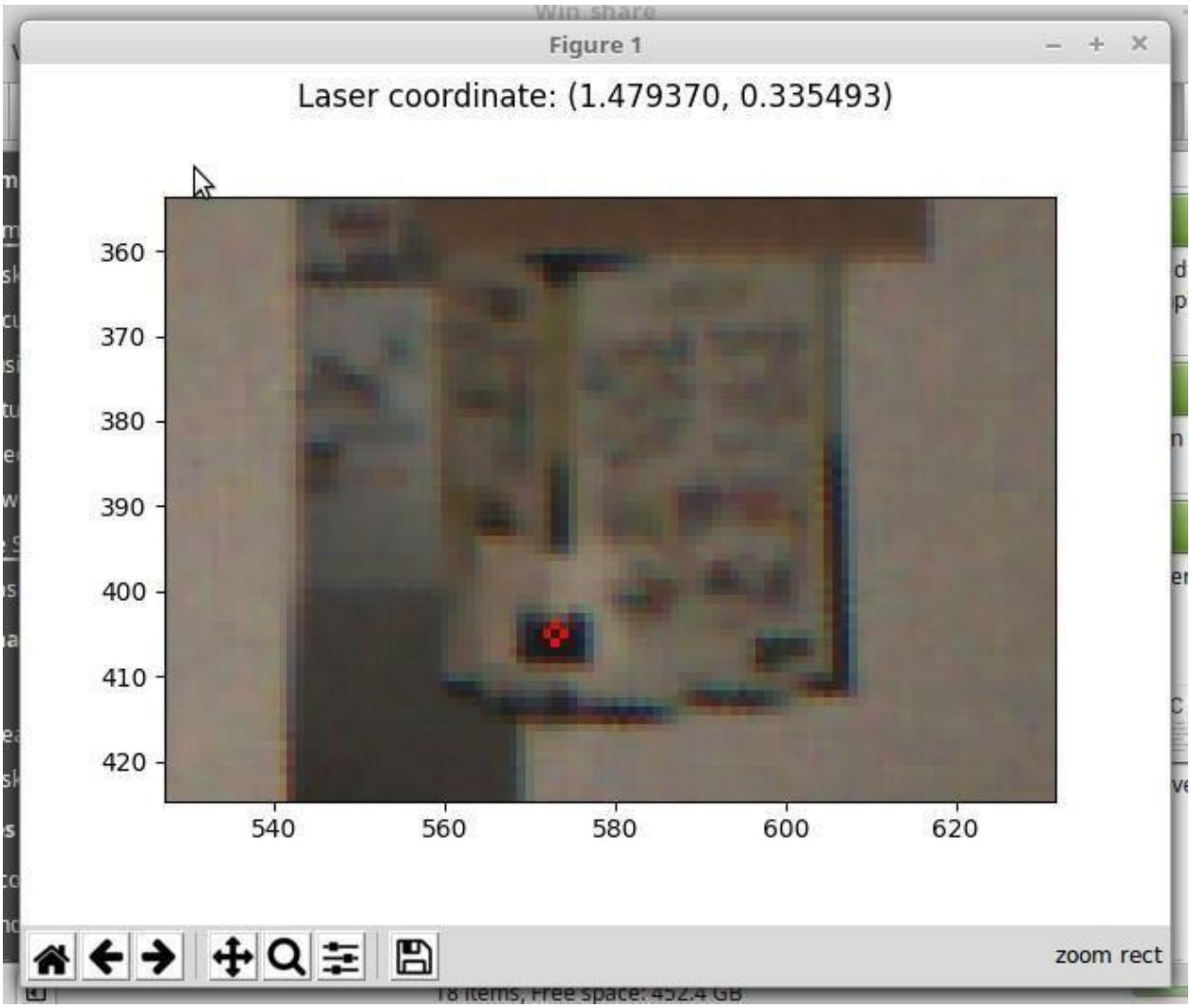
6. Use *2D Nav Goal* tool and click on the laser scan point of interest



7. A new window with undistorted image will appear. The title above the image shows the laser coordinate that you have just clicked on. You can repeat step 6 without closing this window to update the laser coordinate



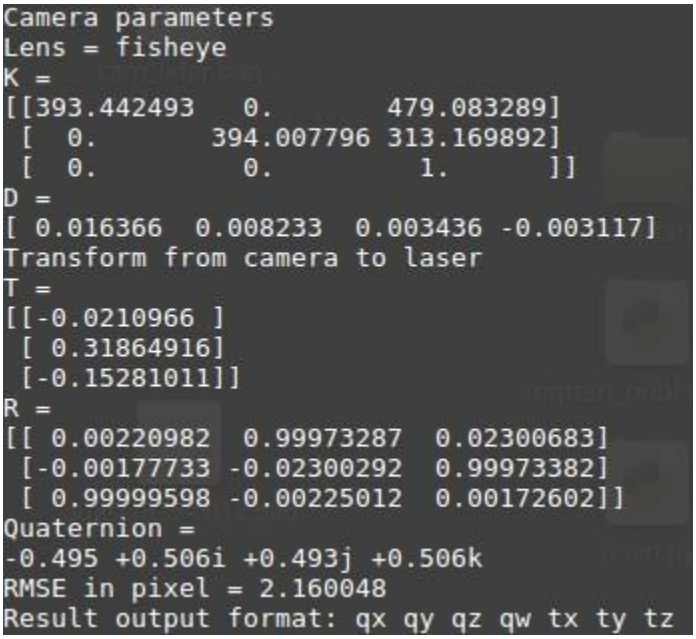
8. Press ‘Up’ or ‘Down’ arrow key to adjust contrast, press ‘Page Up’ or ‘Page Down’ to adjust brightness. You can use the pan, zoom button to look for the corresponding laser point on the image. In this case is the corner of the box on the table (I used camera with IR filter removed to look for the laser point location). Right click on the point on the image where the laser point falls on and a red circle will appear. You can repeat this step until you are satisfied. Press ‘Enter’ button on the keyboard to continue. The window will close by itself, laser coordinate and image coordinate will be shown on the terminal, and the data will be saved to *data/data.txt*. You can close the image window by clicking the ‘x’ button on the top right corner if you are not satisfied with it, the data will not be saved and printed on the terminal.




```
Image coordinate: (573, 405), Laser coordinate: (1.479370, 0.335493)
```

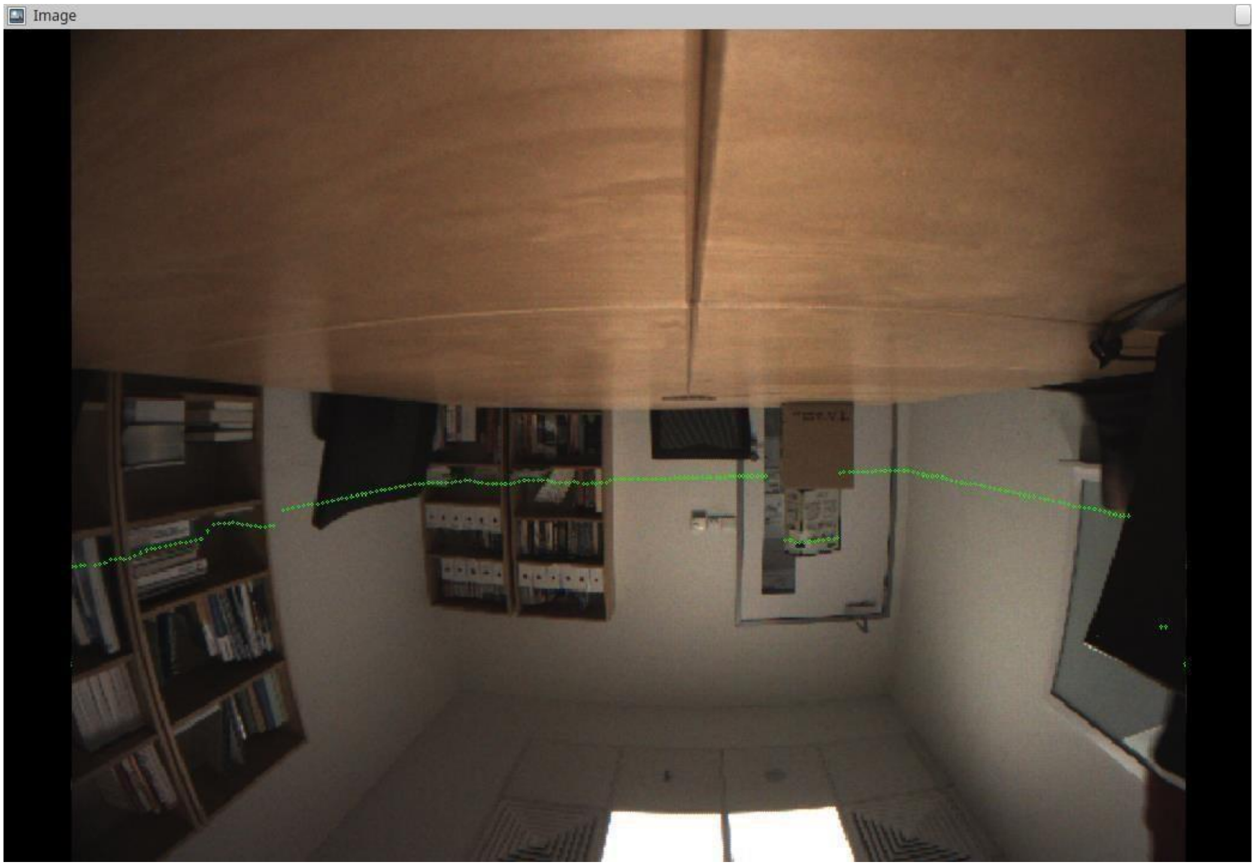
Calibration

1. Once you have collected enough data, run *roslaunch camera_2d_lidar_calibration calibration.launch*
2. The terminal will show camera intrinsic parameter, extrinsic parameter and RMSE once the process is done. The calibration result will be saved to *data/calibration_result.txt*



Laser Point Reprojection

1. After the calibration, you can run *roslaunch camera_2d_lidar_calibration reprojection.launch* to view the laser point reprojected onto the image, *rviz* will launch by itself
2. Change the *scan_topic* and *image_topic* parameter in the *launch/reprojection.launch* to your laser scan and camera image publish topic before running the launch file


Image