Robotx Camera-Lidar Calibration Guide

Running the File:

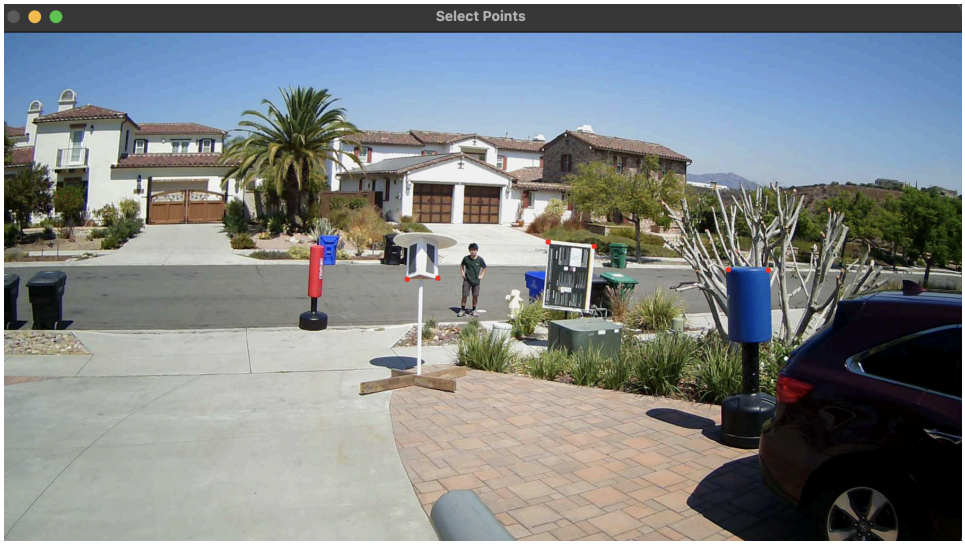
1. Navigate to the main function of the “camera_lidar_calibration.py” file

```python
def main():
    CAMERA_INTRINSIC_MATRIX_FILE = 'PLACEHOLDER_CAMERA_MATRIX'
    camera_matrix = np.loadtxt(CAMERA_INTRINSIC_MATRIX_FILE)

    # Input LiDAR data in numpy file
    lidar_data = np.load("PLACEHOLDER_NUMPY", allow_pickle=True)

    # Input corresponding image file
    image_path = 'PLACEHOLDER_IMAGE'
    image = cv2.imread(image_path)
```

Replace the PLACEHOLDER’s as seen above with the relative path for the user’s:
    a. Camera Matrix
    b. LiDAR data as a numpy array
    c. Corresponding Image file
2. Ensure that “utils.py” is within the same directory as the “camera_lidar_calibration.py”
3. Run “camera_lidar_calibration.py”

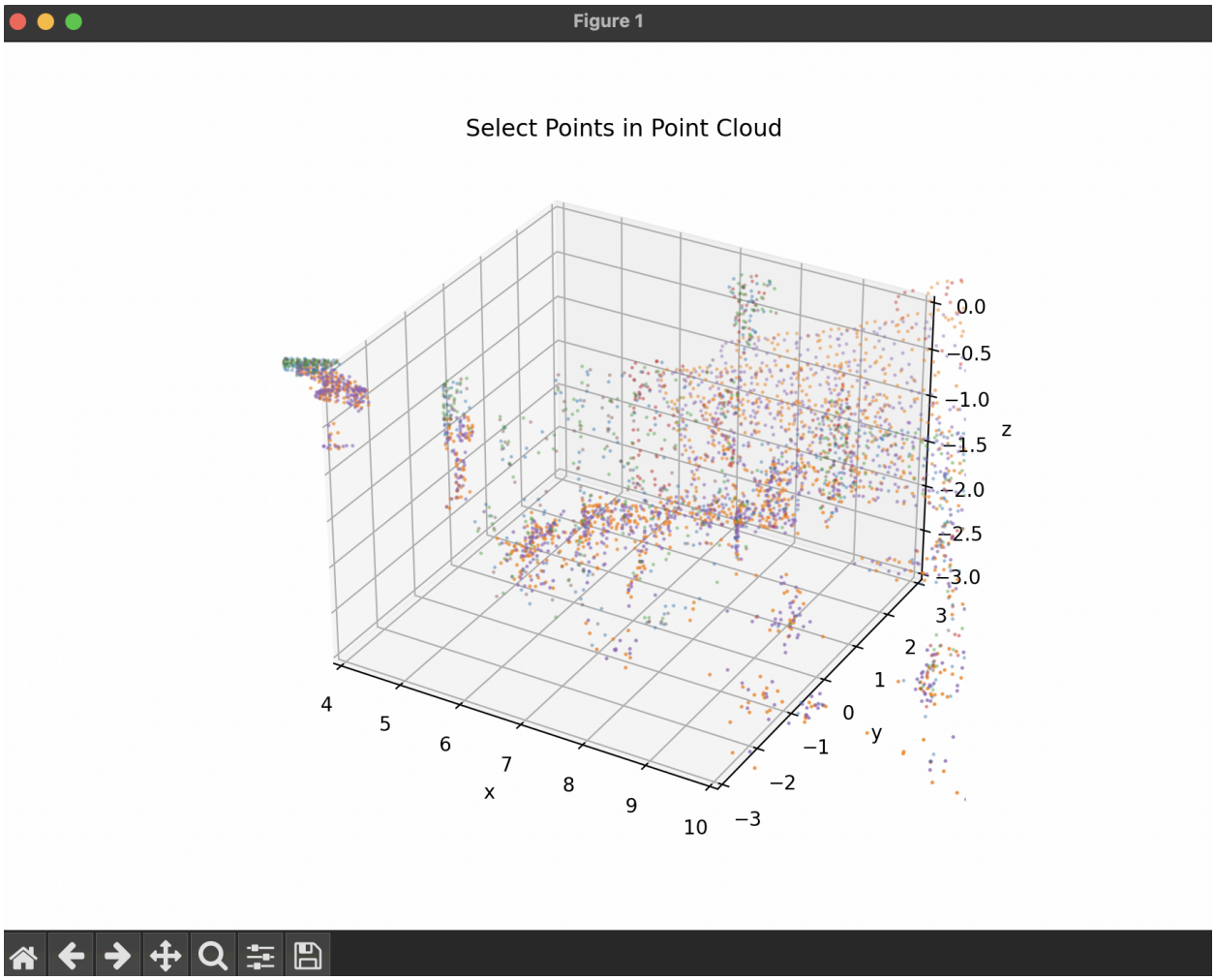
Using the File:

1. When the file is run, the user will be asked to select key points on the image that will allow for the calibration to occur. (NOTE: these points should be clearly distinguished by both the LiDAR data and the image data, the user should select an even number of points that is greater than or equal to four points, and ideally should represent multiple distances and depths)



a. The user will select these points using the mouse and clicking where they would like a point
b. It is important that the user remembers the order that these points are selected in as they will need to select the corresponding points in order on the LiDAR point cloud in the next step.
c. Once finished, the user will press ‘q’ to move onto the next step

2. Next, the user will be asked to select the corresponding LiDAR points that line up with the selected points on the image. To do this, the user will move a red dot throughout the LiDAR point cloud and select the location of the selected points in 3D space.



a. Use the arrow keys to move the current point:
Up Arrow: Increase Z-coordinate (move upward)
Down Arrow: Decrease Z-coordinate (move downward)
Left Arrow: Decrease Y-coordinate (move left)
Right Arrow: Increase Y-coordinate (move right)
',' Key: Decrease X-coordinate (move backward)
'.' Key: Increase X-coordinate (move forward)
b. Use the scroll wheel to zoom in and out.
c. Click and drag on the point cloud to spin it.

d. Press Enter to select the current point and save it.
e. Press 'q' to exit the point selection process.

3. Finally, the transformation matrix will be printed to the console for further use. The transformation matrix is represented in the following form:

$$T = \begin{bmatrix} r_{11} & r_{12} & r_{13} & t_{14} \\ r_{21} & r_{22} & r_{23} & t_{24} \\ r_{31} & r_{32} & r_{33} & t_{34} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

a. The elements labelled ‘r’ make up a 3x3 rotation vector.
b. The elements labelled ‘t’ make up a 3x1 translation vector.