1)

1. Focal length x = 909.70605
   Focal length y = 735.50371651
   Principal point = [407.5829205,158.88243811]

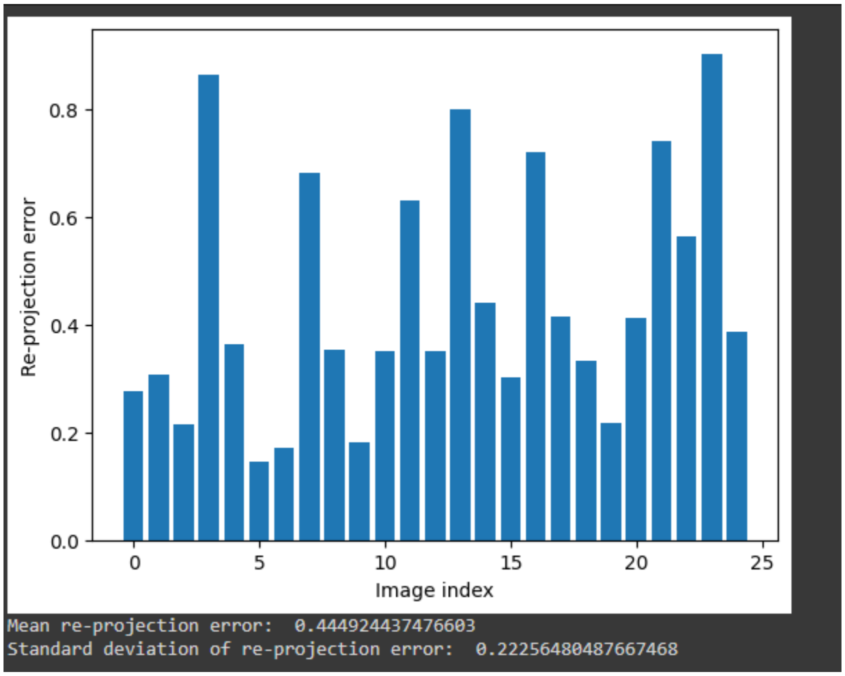
2. All rotation matrices on this link - roation matrices.npy
   Translation vectors on this link - translation_vectors.npy

3. Distortion coefficients - [3.47273085e-01, -6.17862308e+00, 1.76777237e-02, 4.49527183e-03, 1.11077456e+01]

We can see that the boundaries of the checkerboard becomes more straighter and undistorted in these images than the original ones.

4. Reprojection errors for all images - [reprojection-errors.npy]()

   Error bar plots for all 25 images -



5. All 25 plots in the colab file.

   Reprojection error is computed by findin the euclidean distance between the corner points detected by cv2 and the corner points obtained by reprojecting the corner points in 3d world coordinates to 2d image plane
6. Plane normals - [camer_plane_normals.npy]()

2)

2.

We find the translation that minimizes the difference in distance from the camera origin to each plane, represented in the camera coordinate system and the laser coordinate system.

$$t1 = (\theta^{T}{}_{c}\theta_{c})^{-1}\,\theta^{T}{}_{c}(\alpha_{c} - \alpha_{l})$$

We thenfind the rotation between the reference frames that minimizes the difference between the normal from the origin to the corresponding planes in the two frames.

$$R = VU^{T}\ ,$$

Where θ_c = list of all camera normals

θ_L = list of all plane normals of LIDAR points

α_c = offset of camera plane normals

α_L = offset of lidar plane normals
And $\theta_L \theta_c^T$= USV^T using SVD\

4. Yes all the points lie inside the camera boundaries