Lab 5: Camera Mosaic

Intoduction:

The following lab report aims to analyze the results after performing the process of Harris Corner Detection to do an image mosaic with the images clicked using a mobile phone camera, the output should be a panoramic view of the stitched images. All the pictures were clicked using an iPhone 14 Pro Max.
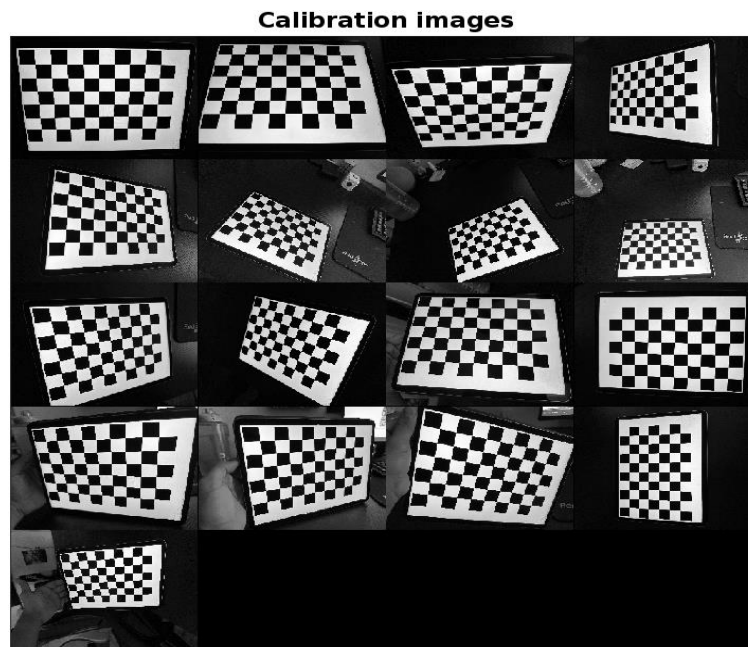
Camera Calibration:

It can be seen from figure 2 the calibration results are as follows:

17 Images were used for camera calibration.

An iPhone 14 Pro Max was used with ProRes mode turned on. The images used are in 4K.

The Reprojection error came to be Reprojection error = [0.82018   0.64082] which is under acceptable value, since the images used for calibration were in 4K. It is also worth noting that modern camera phones have Lens Correction inbuilt. (The phone used has a setting to be toggled for auto lens correction)

Calibration-Figure 1 shows the 17 images in different scales, orientation and rotation used for camera calibration using the Caltech Camera Calibration toolbox in MATLAB.
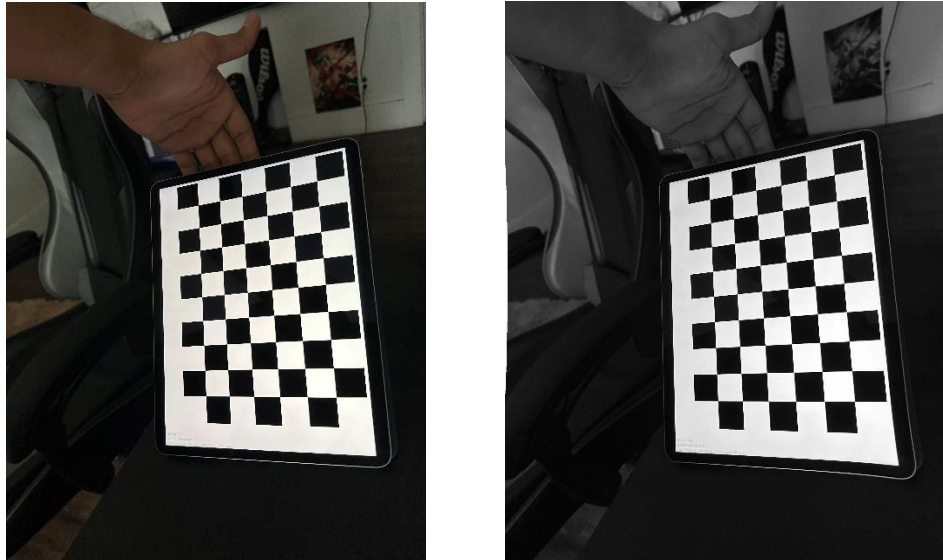

Calibration-Figure 2 shows the parameters after calibration.

Lab 5: Camera Mosaic

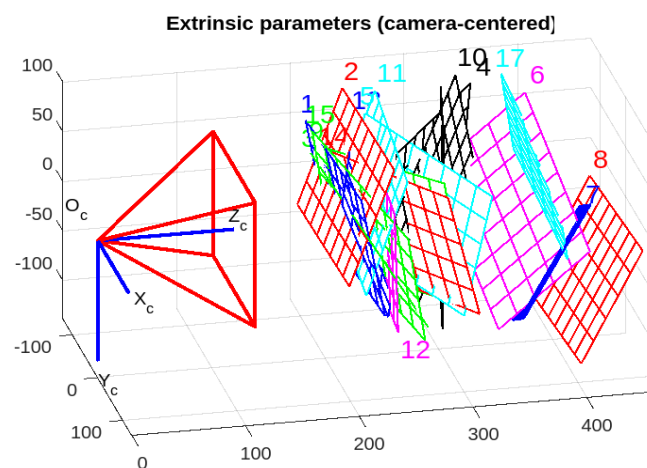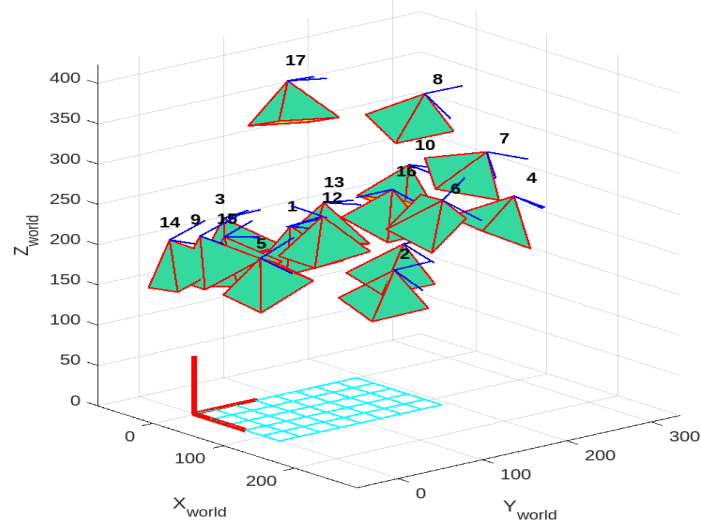Calibration-Figures 3 and 4 show the image before and after calibration.
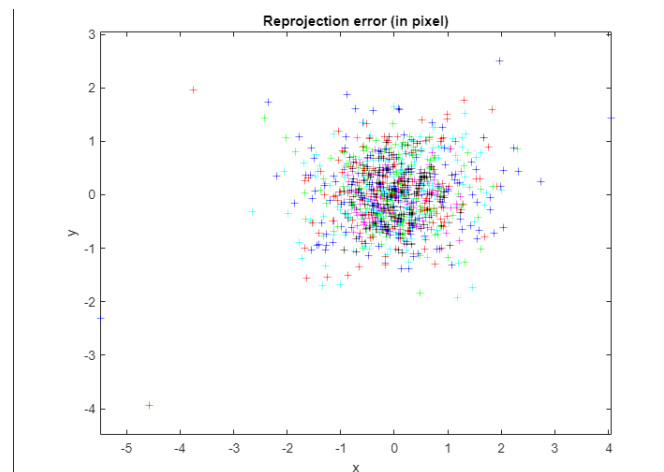
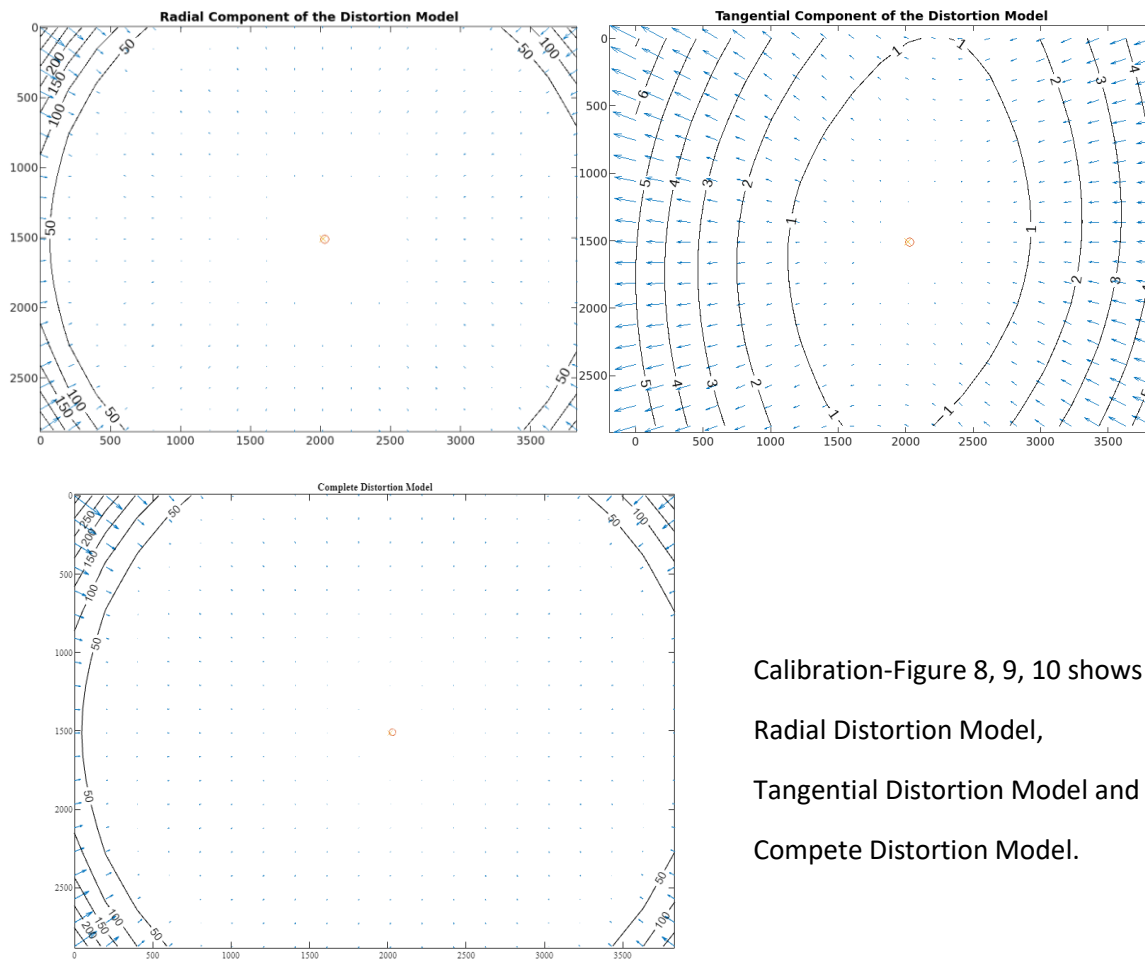Calibration-Figure 5 shows the Reprojection Error (in pixel).

Calibration-Figure 6 shows the Extrinsic Parameters in a Camera-Centered view.

Lab 5: Camera Mosaic

Extrinsic parameters (world-centered)

Calibration-Figure 7 shows the Extrinsic Parameters in a World-Centered view.

Calibration-Figure 8, 9, 10 shows Radial Distortion Model, Tangential Distortion Model and Compete Distortion Model.

Pixel error	= [0.8202, 0.6408]	
Focal Length	= (2903.85, 2904.16)	+/- [5.891, 5.866]
Principal Point	= (2028.36, 1508.49)	+/- [4.201, 3.792]
Skew	= 0	+/- 0
Radial coefficients	= (0.1743, -0.4953, 0)	+/- [0.005452, 0.01875, 0]
Tangential coefficients	= (-0.0001897, -0.001186)	+/- [0.0005024, 0.0005659]

Lab 5: Camera Mosaic
Latino Images Mosaic:

The camera mode used to click all the pictures of LSU were using the Pro Mode in the camera. This has kept the colors consistent throughout the image set. To obtain good results, I had to tweak the code and play around with the detector and its values. Without much change in the rest of the code, the panoramic stitched image was made. I tried adding the camera intrinsic parameters to undistort the image, but I didn't see much difference with the results. So, I decided to use the normal way without the camera parameters involved.

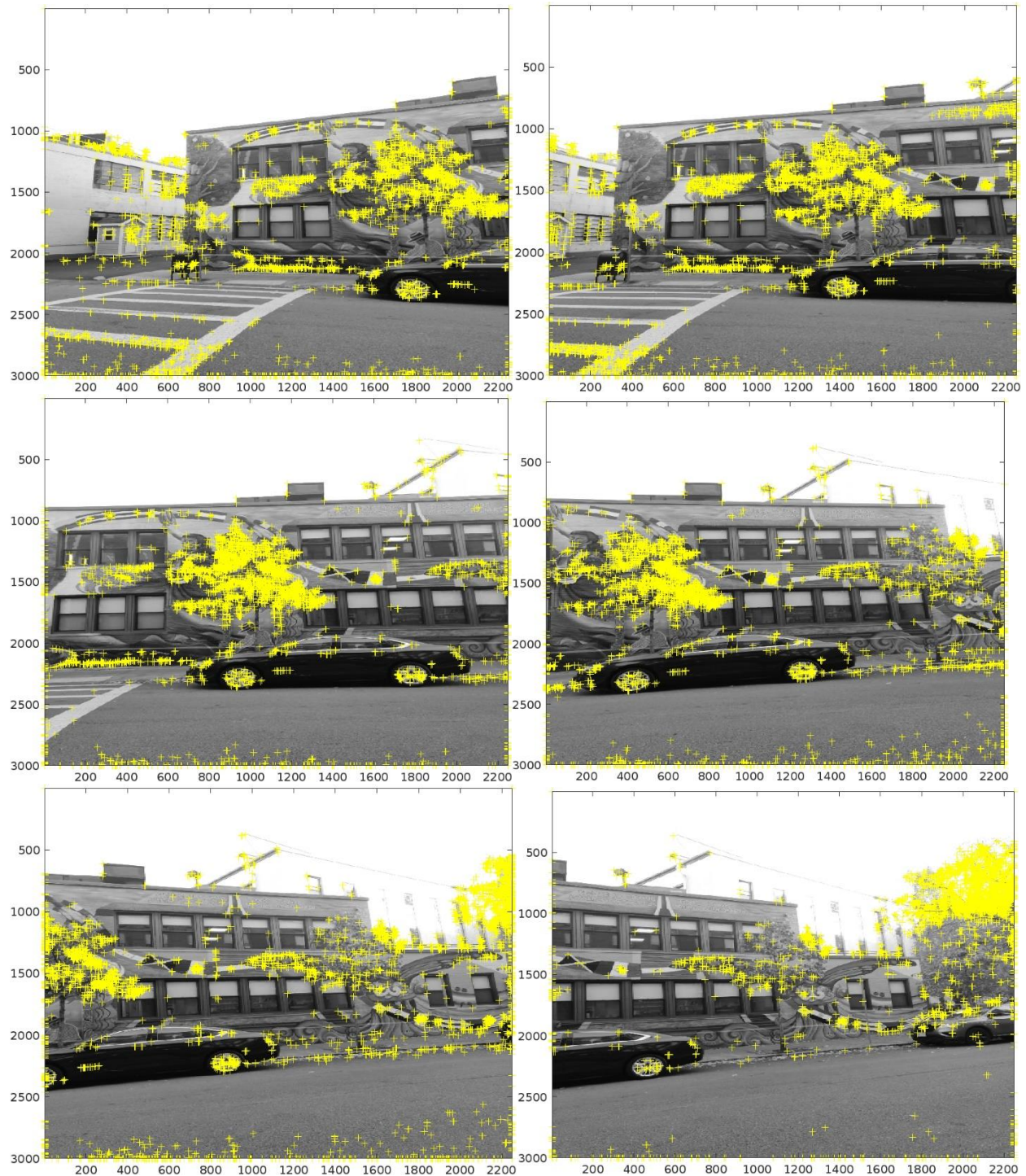LSU-Figure 1 shows the 6 pictures used for stitching.
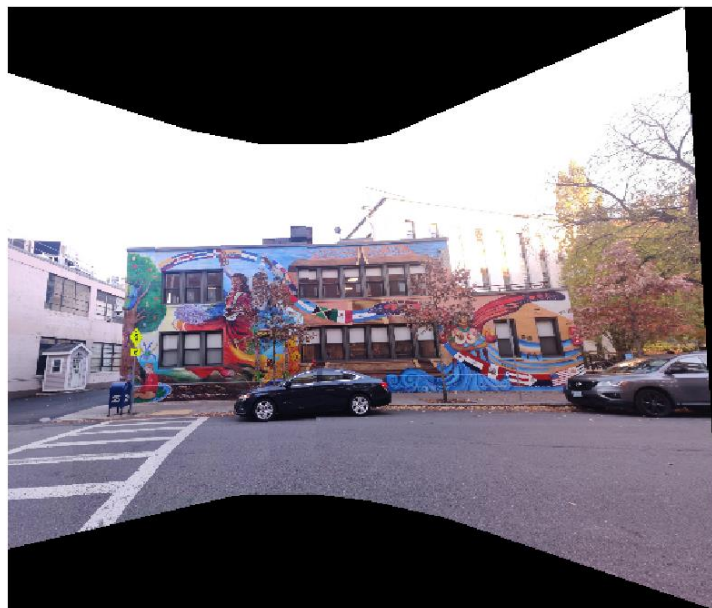

LSU-Figure 2 Shows the picture after stitching.

LSU-Figure 3 -8 under this subheading shows the distribution of Harris Corners across LSU image set.
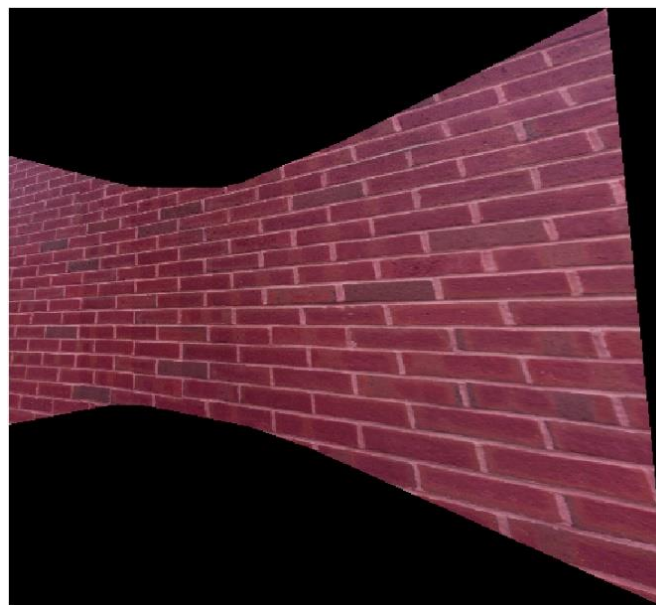
Lab 5: Camera Mosaic

Cinder Brick Wall Images Mosaic:

The cinder brick wall mosaic was comparatively tough as there are multiple repetitive patterns that are spaced very close together. Due to this I had to tweak the number of points to a higher value. After several trial and errors, giving a points value of 10000 with a [4,4] window size, the following images were stitched to a mosaic. Also, since the photos were taken from a very close distance, the panoramic view might have become more stretched. Due to memory allocation error, I had to add code to close all previous figures and clear all previous workspace variables, this helped clear space.
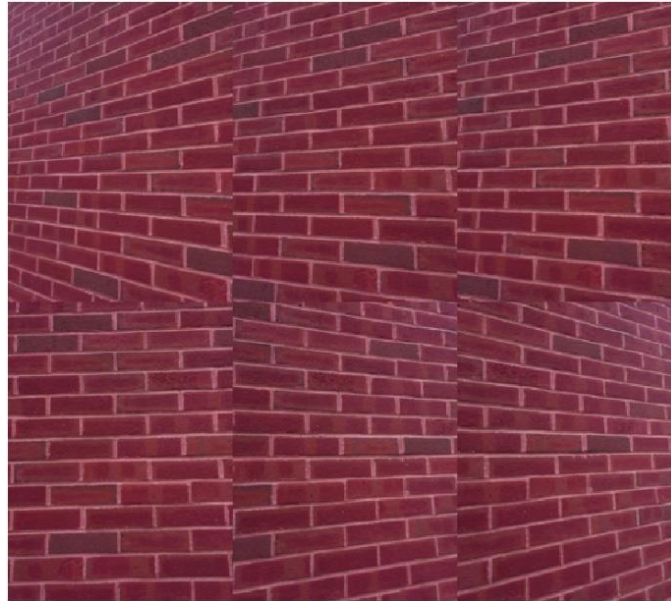
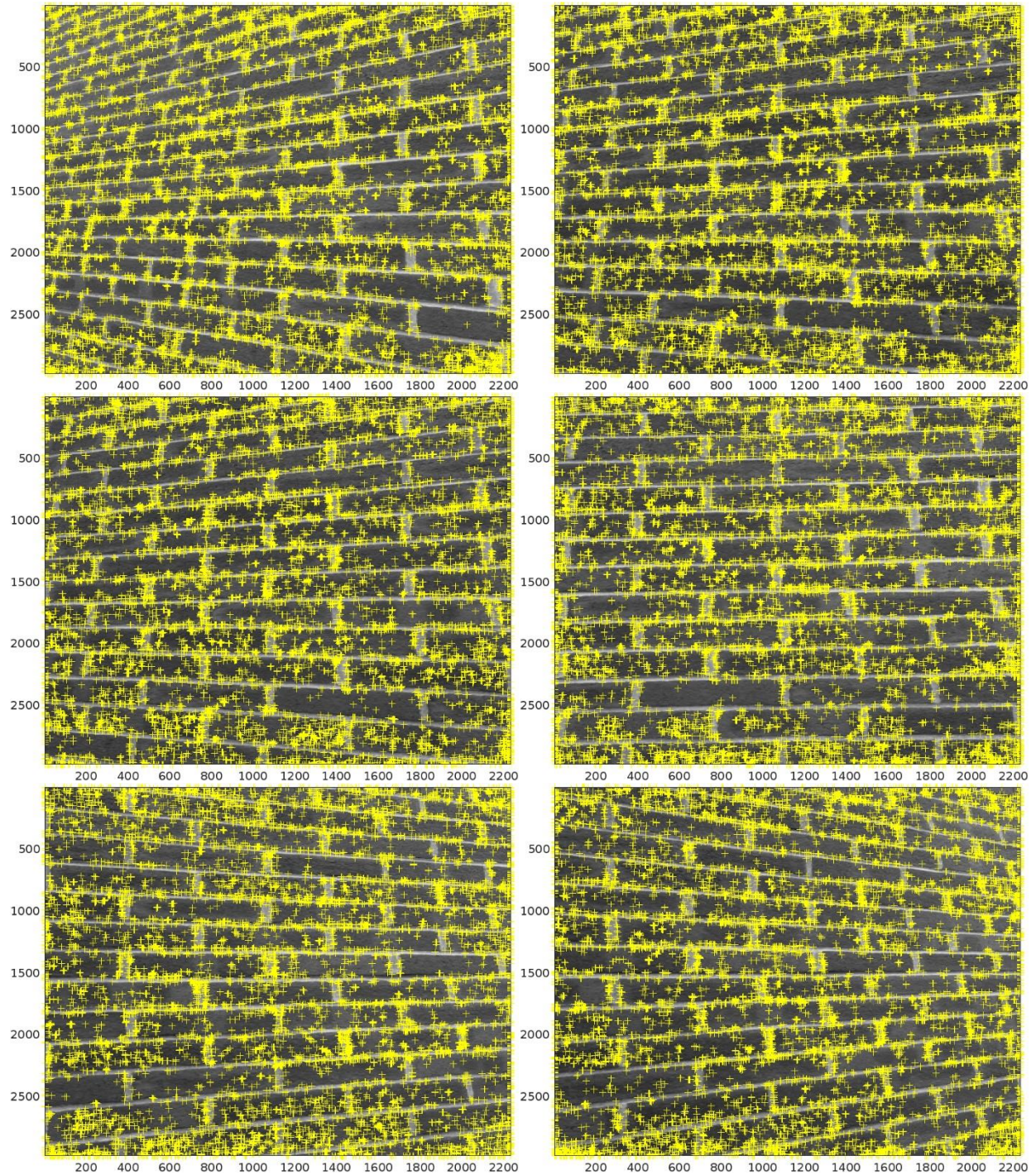Brick-Figure 1 shows the 6 images used for mosaic.

Brick-Figure 2 shows the stitched images as a mosaic.

Lab 5: Camera Mosaic
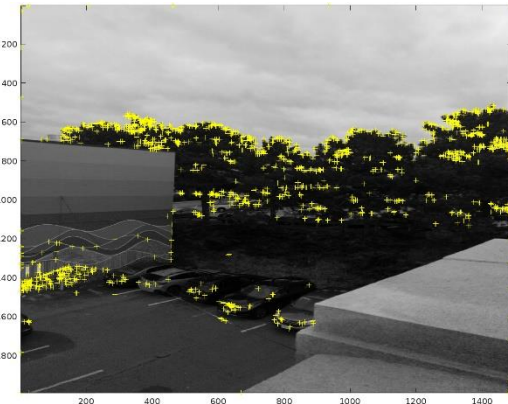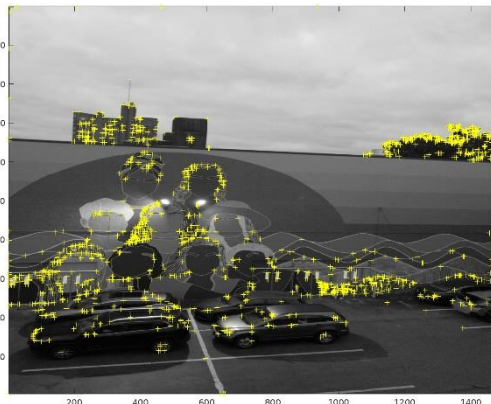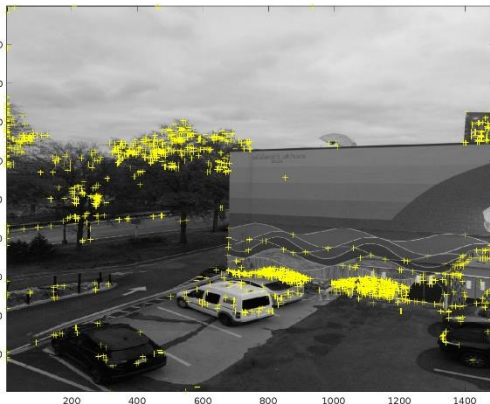
Brick-Figures 3 – 6 show the distribution of Harris Corners among the cinder brick walls images.
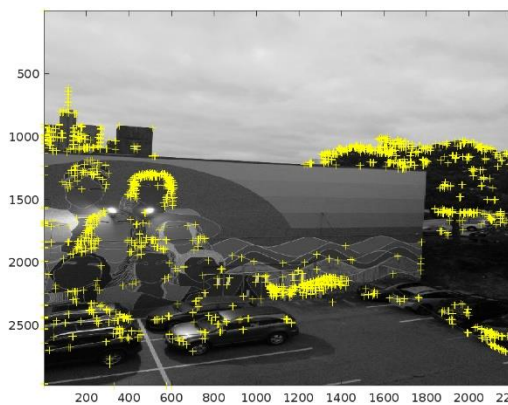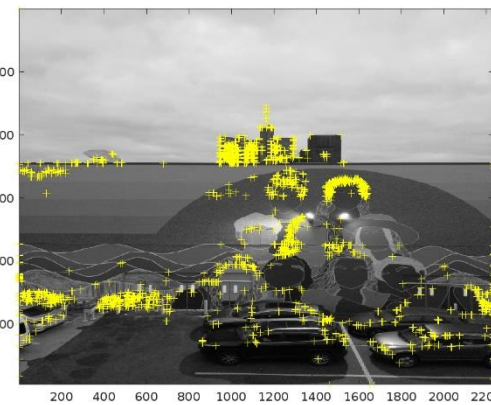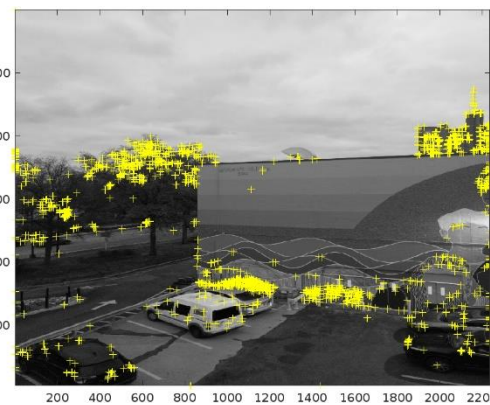
Lab 5: Camera Mosaic

Mural Images Mosaic (15% and 50% with overlap):

Mural-Figures 1-3 show the distribution of Harris corners among the Mural images with 15% overlap.


Mural-Figures 4-6 show the distribution of Harris corners among the Mural images with 50% overlap.

In this task I faced multiple errors, starting with memory error, I found two ways to deal with it. By resizing the image to a scale factor of 0.5 and by setting the window size to [1,1]. There was an error of the matrix being not singular, thus I defined a code to set transformation matrix to singular before calculation. Further in all the code I had added close all and clear all after encountering the memory size error in this code. In this code I had added clearvars – expect tag to clear out all the other variables other than the ones needed for forming the panorama.

Lab 5: Camera Mosaic
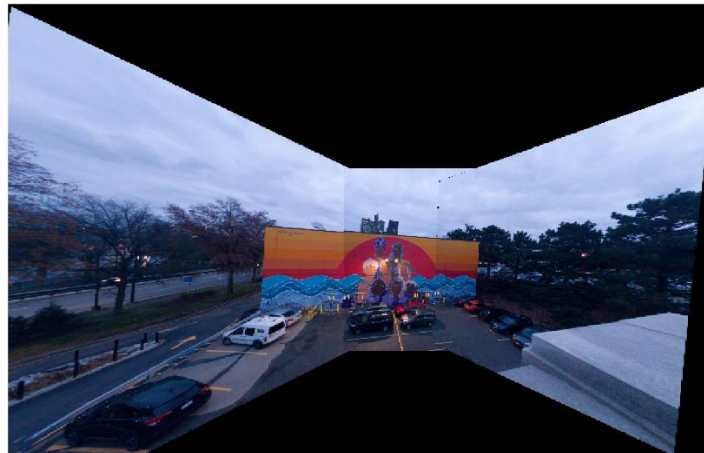
Mural-Figure 7 shows the Mural images stitched using the images taken with 15% overlap.

It can be seen from figure 7 that the main center of the mural when taken with 15% overlap was stitched properly, but the edge of the image is stretched. This stretch is due to the lack of points that overlap after using the edge detector in those stretched areas. For stitching this image, the number of points were increased. The number of points used was 1000 with a windows size of [1,1] which gave a well stitched but stretched mosaic.

Mural-Figure 8 shows the Mural images stitched using the images taken with 50% overlap.

It can be seen from figure 8 that the images with a 50% overlap are more uniformly stitched along the whole mosaic. This is because there are a greater number of overlapping points, which in turn has increased the performance of the stitching drastically. In this mosaic a greater number of points were used to stitch the mosaic, because the overlap provided a lot of features that matched in consecutive images taken. Further increasing the points gave a better stitched image. In the 15% overlap, I found that increasing the points after a level started stitching the images in the wrong orientations.