Lab 5

Aim:

In this lab the process of calibration of monocular cameras and stitching images into a mosaic is explored. By the end of the experiment, a mosaic of a couple of stitched images is produced and the calibration matrix of the camera is obtained.

Set up:

Calibration of the camera:

A checkerboard pattern of 7 x 9 squares is printed in 11 in x 8.5 in sheet. The checkerboard pattern is then stuck on a flat surface. Multiple pictures are taken of the checkerboard pattern from a variety of different angles.

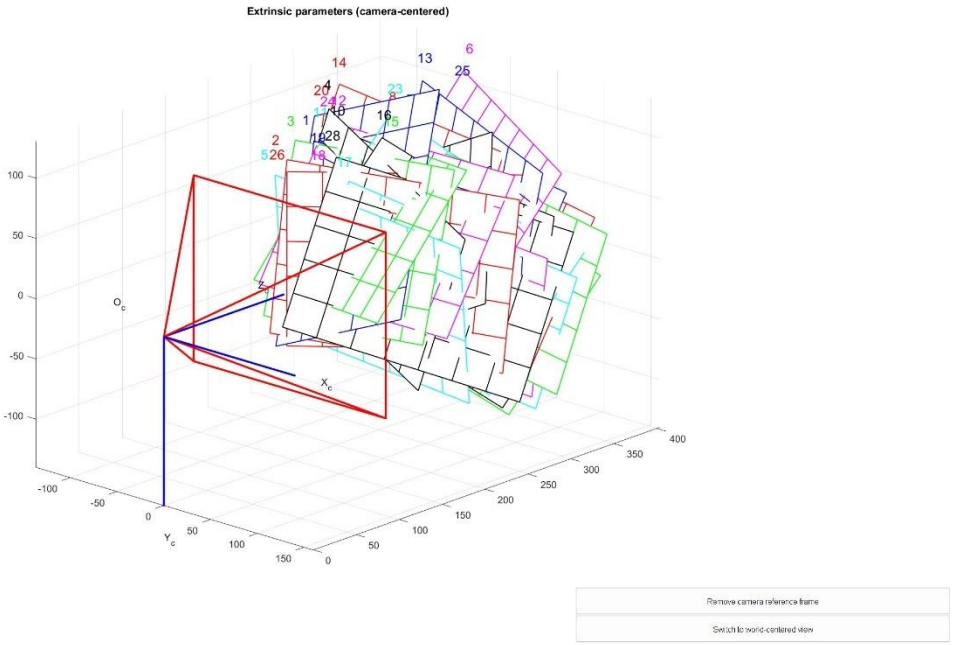
Stitching images

A set of pictures are taken while moving slightly to the right. One set of pictures is taken in a way that there is around 15% overlap of the contents between the previous image and the current image and one set of pictures with 50%

The points of interest in the images, the corner in this case is extracted using Harris corner detection. The particular feature is then extracted from the corresponding points and correlation is made between the points in one image and the points in the other image. This correlation is used to then derive the transforms between the images and then stitched together to give a single panoramic image.

Results:

Calibration results:



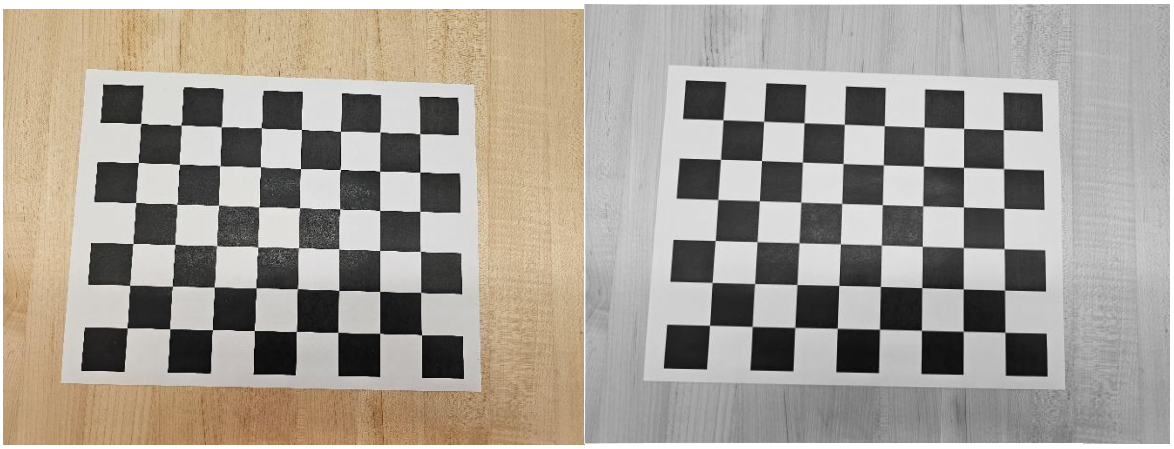


Image before calibration *Image after calibration*

Extrinsic parameters:

Focal Length(fc) = [2727.76703, 2720.09028] ± [8.85413, 8.65028]

Principal point(cc) = [1885.92655, 1485.26859] ± [8.94672, 7.61075]

Skew(alpha_c) = [0.00000] ± [0.00000] => angle of pixel axes = 90.00000 ± 0.00000 degrees

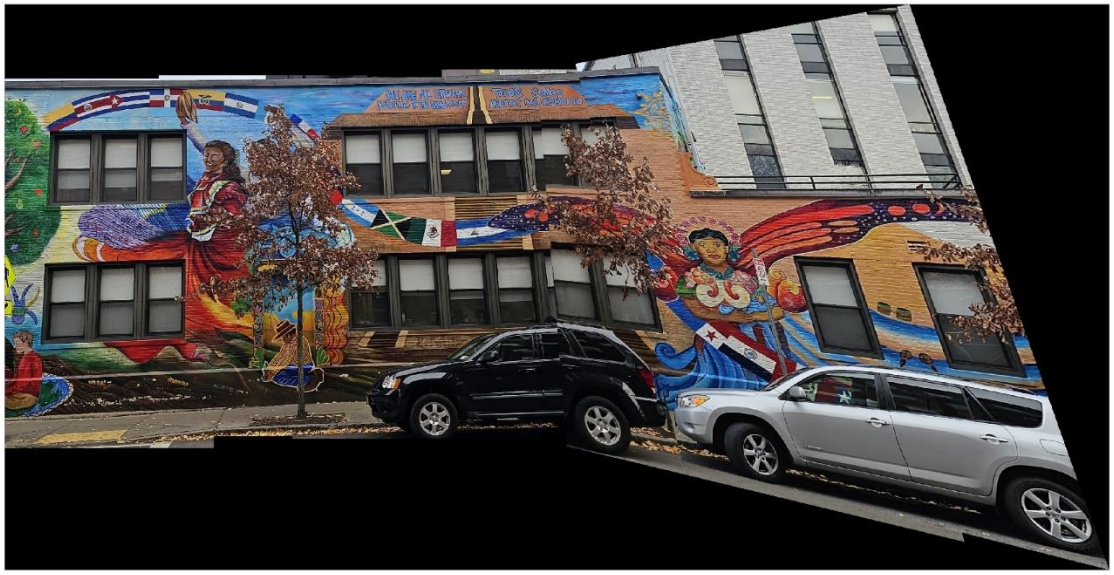
Distortion(kc) = [0.01591, -0.02131, 0.00051, -0.00096, 0.00000] ± [0.01020, 0.03557, 0.00102, 0.00126, 0.00000]

Pixel error: [1.65052, 1.42521]

Mosaic:

Distribution of points:

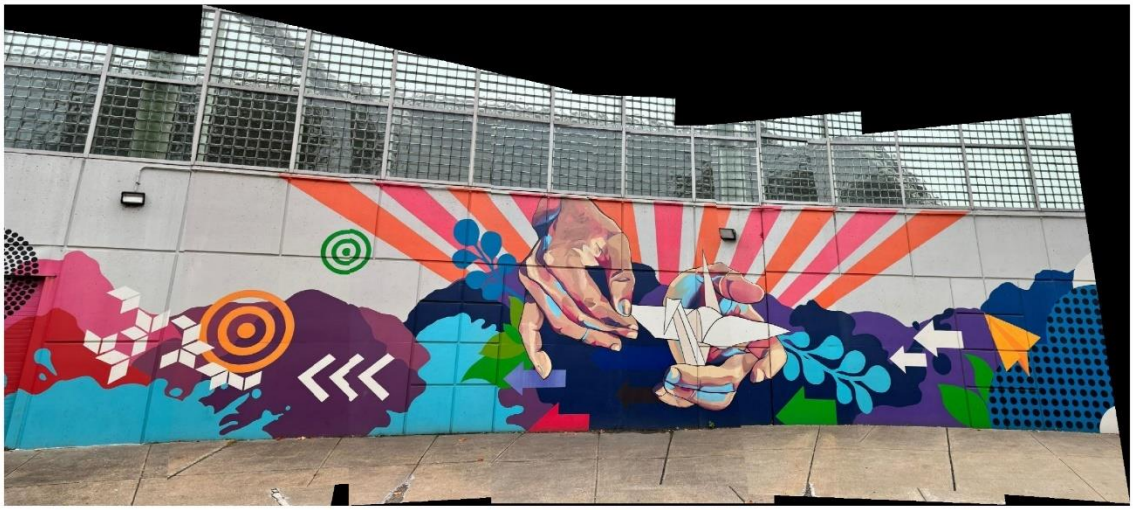
The LSC building(15% overlap):



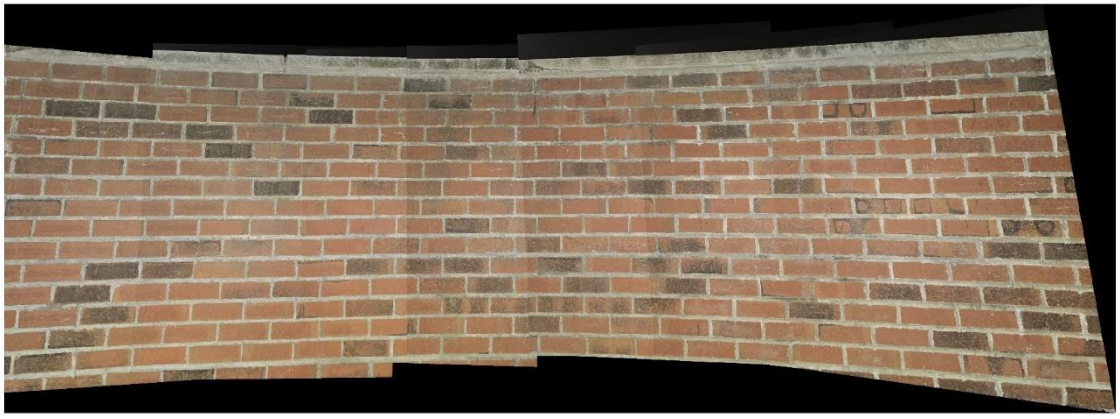
The LSC building(50% overlap):

The Ruggles station(15% overlap):

The Ruggles station(50% over):



Brick wall:



Conclusions:

- *15% overlap image set:*
  To produce a mosaic, the points of interests parameter of the Harris corner detection function was set a relatively high value. This was done to get as many correlations as possible to derive transformations to rotate the images.
- *50% overlap image set:*
  To successfully produce a mosaic, the points of interest parameter of the Harris corner detection function was set to default values sometimes to lower values to limit the number of constraints placed to derive the transformation matrices.
- There were a bit more complications when it came to producing the mosaic of the brick wall. Most of the complications rose from the lack of unique features to avoid correlating to repetitive elements in the image. This is evidently seen when the stitched image is compared with the raw images.