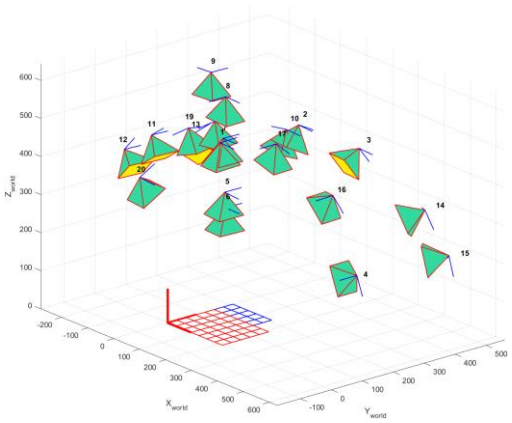
Lab 5

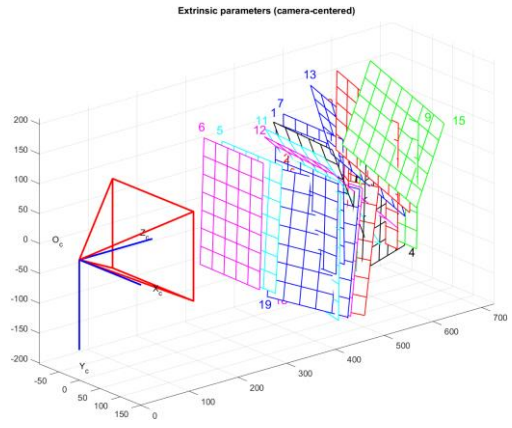
Panorama

Part 2: Camera Calibration

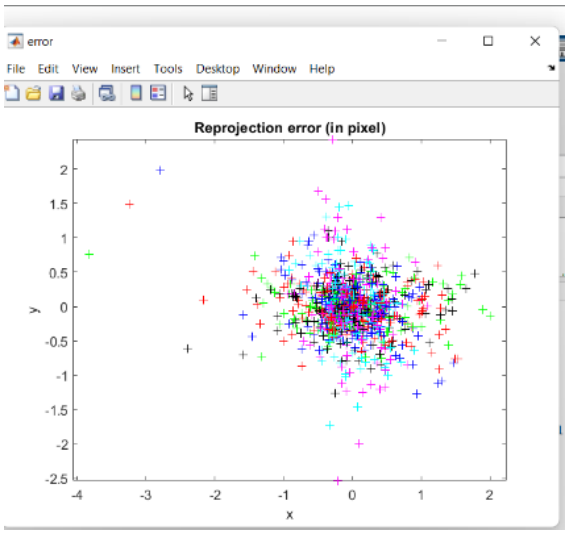
The images taken for calibration are present in the Calibration Images folder. The images were taken at the same focal length changing the skewness of the checkerboard image, and a few images were taken with a different focal length to calculate the error at various points. The reprojection error has been plot below and the Pixel error: err = [0.54606   0.43567] (all active images). The Extrinsic view of how the images were taken is shown below



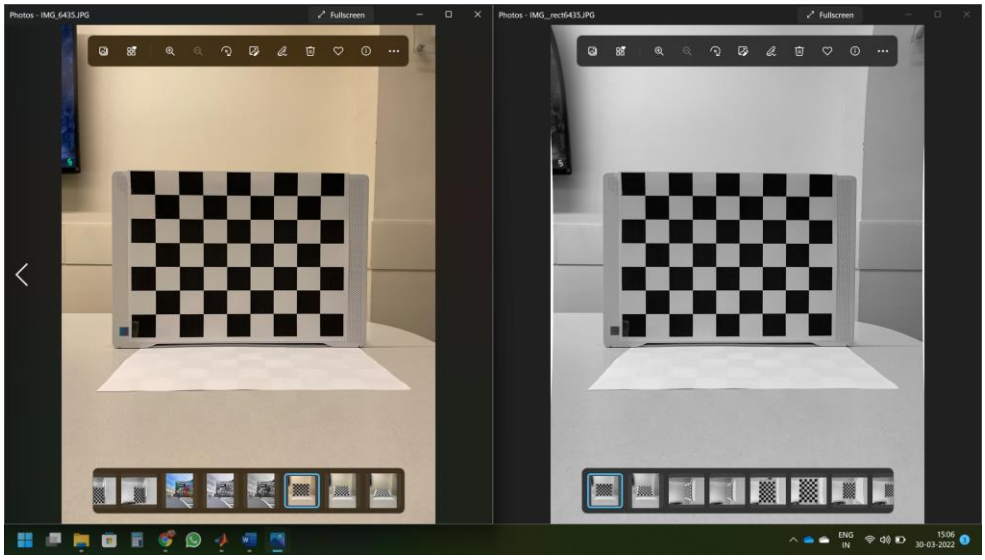
World Centric Frame



Camera Centric Frame



Pixel Reprojection Error



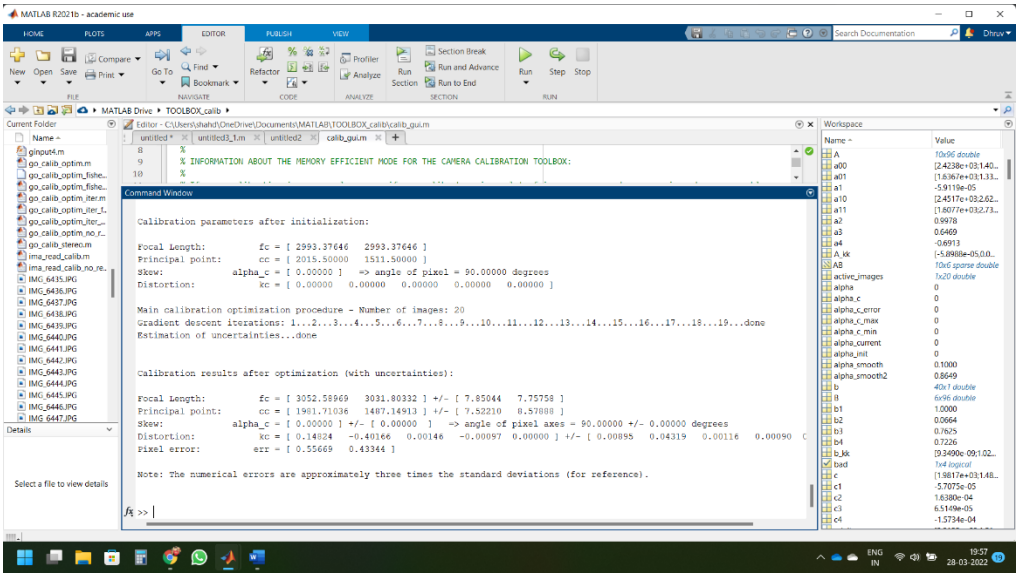
Calibration image

The above image shows the error being corrected. We can see that there are a few white bars around the images showing how the distorted image has been undistorted. The pixel error has been applied to this after image.

Calibration before and after image

The same effect can be observed on the image of the Forsyth Street Panorama showing that a similar type of correction is applied on an image not used for calibration giving a similar result.

The Calibration parameters are shown below

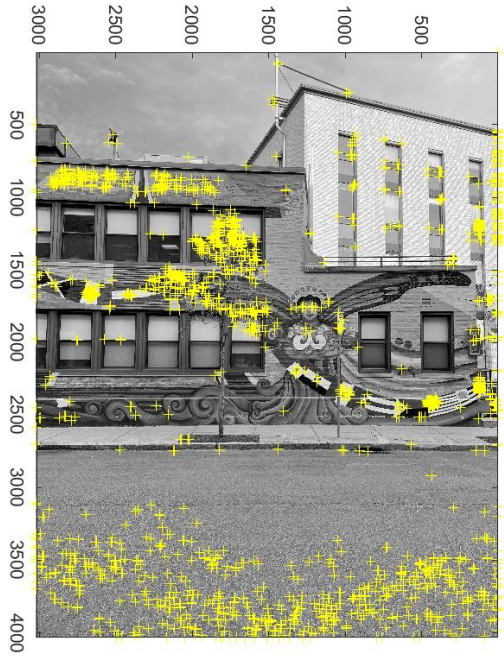


Calibration Parameter

Part 3

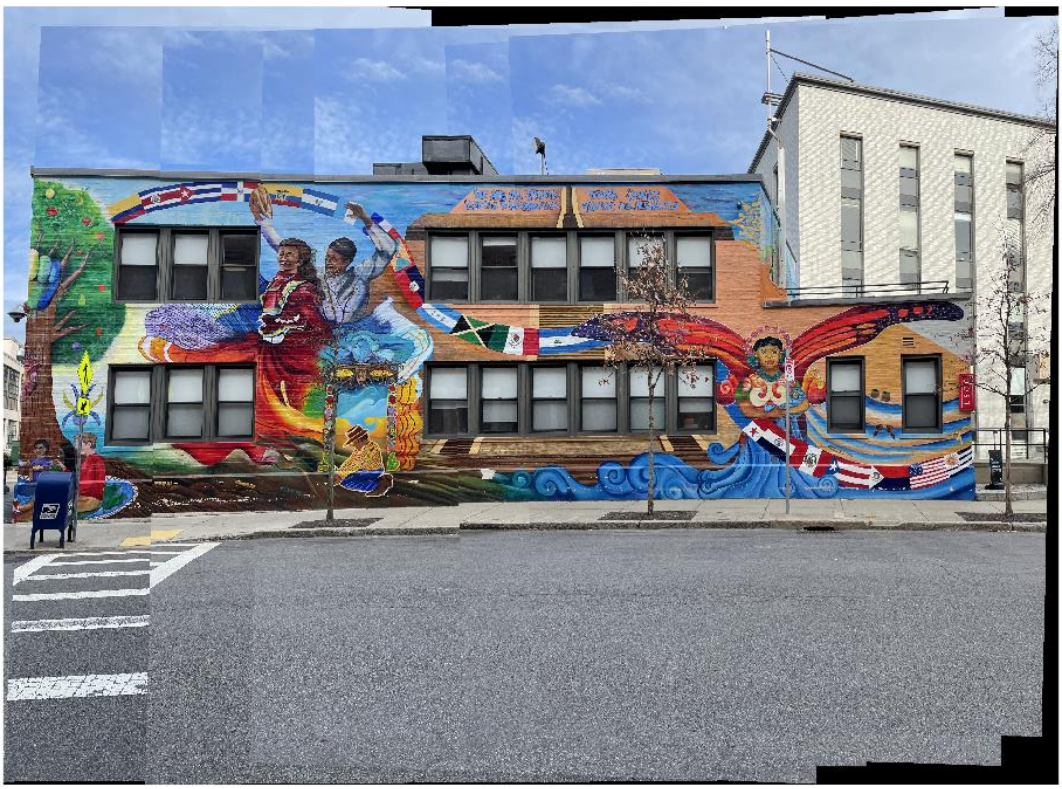
Picture Set for Forsyth Street Mosaic

Part 5



The above image is the representation of the Harris Corner Detection showing the feature points being displayed layered on the image. These images are used and the feature points are used to extract image features and then these points and features are used to match with a previous image and then the images are stitched together giving a following result

Part 6



The above panorama has been generated with 200 feature points showing how good the harris features work for such a small number of features. Approximately the image overlap was about 60%.

Part 7

The same code fails to produce an output for the cinder block images which are very similar to each other and hence feature detection and matching fails. The number of features was bumped up to 12000 and the confidence of uniqueness of the matching was got down to 80%. The laptop failed due to memory error and also due to not having a matrix matching of minimum 4 points. After iterating various values and using a GPU for MATLAB a result was generated which is not up to the mark and hence we can validate that the cinder block imagery does not work for the panorama code

```
% Detect and extract SURF features for I(n).
  [y,x,m] = harris(grayImage, 12000, 'tile', [2 2],"disp");
points = [x,y];
[features, points] = extractFeatures(grayImage, points);

% Find correspondences between I(n) and I(n-1).
indexPairs = matchFeatures(features, featuresPrevious, 'Unique', true);

matchedPoints = points(indexPairs(:,1), :);
matchedPointsPrev = pointsPrevious(indexPairs(:,2), :);

% Estimate the transformation between I(n) and I(n-1).
tforms(n) = estimateGeometricTransform2D(matchedPoints, matchedPointsPrev,...
    'projective', 'Confidence', 85, 'MaxNumTrials', 2000);
```

```
Error using repmat
Requested 64313x36724 (17.6GB) array exceeds maximum array size preference (15.9GB). This might cause MATLAB to become
unresponsive.

Error in meshgrid (line 61)
        xx = repmat(xrow,size(ycol));

Error in images.geotrans.internal.getSourceMappingInvertible2d (line 9)
[dstXIntrinsic,dstYIntrinsic] = meshgrid(1:Rout.ImageSize(2),1:Rout.ImageSize(1));

Error in imwarp>remapAndResampleInvertible2d (line 544)
[srcXIntrinsic,srcYIntrinsic] = images.geotrans.internal.getSourceMappingInvertible2d(Rin,tform,Rout);

Error in imwarp>remapPointsAndResample (line 256)
        outputImage = remapAndResampleInvertible2d(inputImage,R_A,tform,outputRef,method,fillValues, SmoothEdges);

Error in imwarp (line 238)
outputImage = remapPointsAndResample(parsedInputs.InputImage,R_A,tform,outputRef,method,fillValues, SmoothEdges);

Error in ImgPanarama (line 122)
    warpedImage = imwarp(I, tforms(i), 'OutputView', panoramaView);

Related documentation

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```
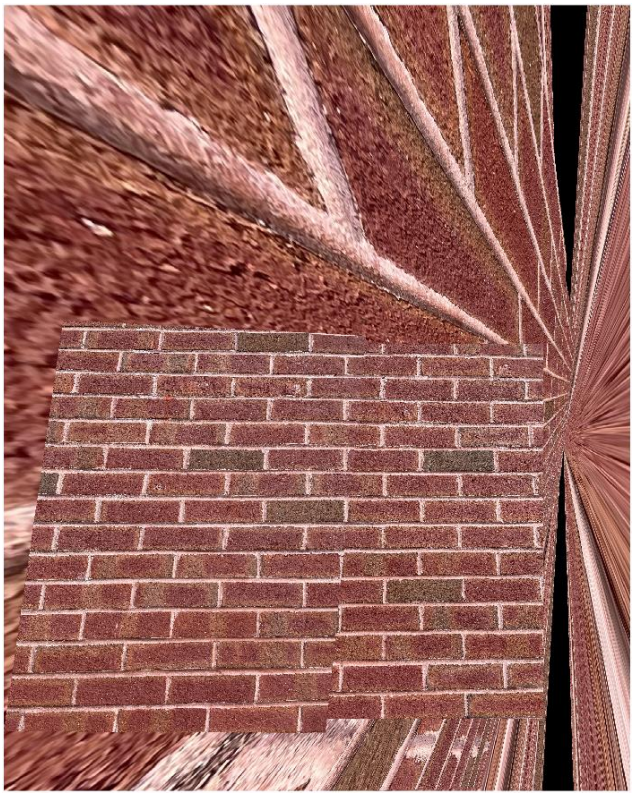
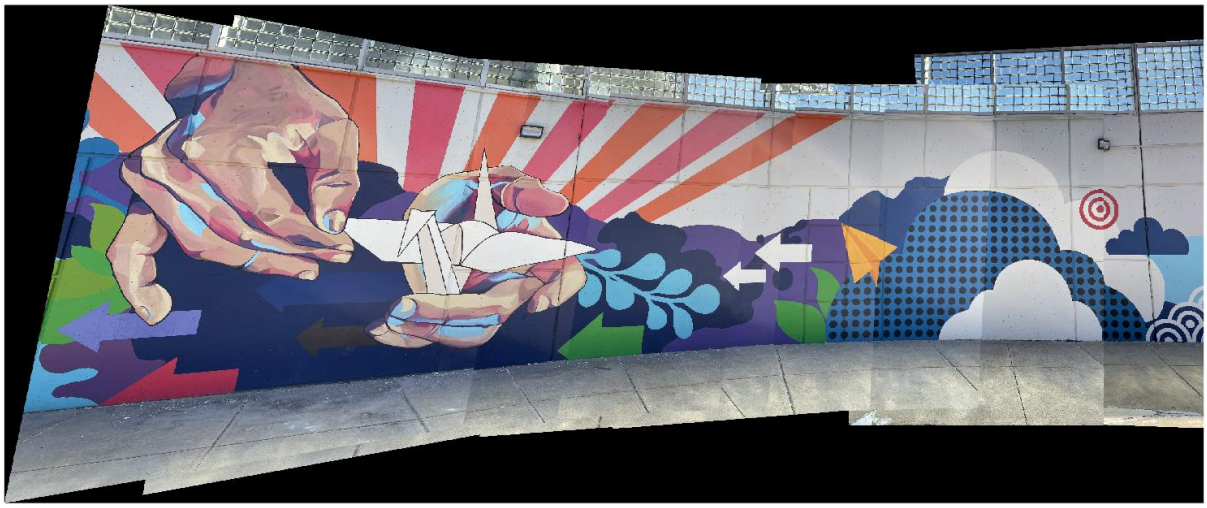

The number of features and confidence and the error.



The image obtained after the various iterations and GPU use.

Part 8

The above image has been generated by using images with a 15% overlap and the image feature points are 1000.



The above image has been generated by using images with 15% overlap and image features points about 1500 as few images don't have enough features and leads to warping.