Panorama Image Stitching

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Special Thanks to TA's

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Preface

Purpose:

The purpose of the project component of this course is to demonstrate our ability to apply the knowledge and technique learned during this course. The task here is to learn and code the pipeline to perform Panorama image stitching and understand the concepts associated with Feature detection and Image warping.

Assumption:

- Each image should have few repeated local features (~30−50% or more, empirically chosen). In this project, you need to capture multiple such images.
- Camera motion should be limited to purely translational or rotational around the camera center.

Panorama Image Stitching

The various steps involved in Panorama Stitching are listed below:

Step – 1: Adaptive Non-Maximal Suppression (or ANMS):

- Detect Corner points that are equally distributed throughout the image which eases our Image Warping.
- *'cornermetric'* function of MATLAB was used to find the Corners which we referred to as *'cornerScore'*.
- Found the corresponding Local maxima for the points using *'imregionalmax'* and also the location of these corner points was used.
- Finally, a list of strong points was found, and the number of strong points was a user-specific input.

[*Results for various Image datasets are shown below....*]

Step – 2: Feature Descriptor:

- The *'N-best corners'* and the neighbouring pixels are used to define a *'Feature'* and this is captured using a *'Image Patch'*.
- We then convert this Feature descriptor *'Matrix'* to a **Column Vector**.
- Later we Standardize the vector with Zero Mean and Unit Variance so that the algorithm is robust to small noise and varying lighting conditions.

[*Results for various Image datasets are shown below....*]

Step – 3: Feature Matching:

- The column vector which we got from the Feature Descriptor is used for Matching.
- The Sum of Squared Difference is calculated between these feature points and the top 2 results with a specific ratio is chosen.

[*Results for various Image datasets are shown below....*]

Step – 4: RANSAC and Homography:

- The RANSAC algorithm which was developed in previous homework was used to reject the Inliers which was obtained from Feature Matching step.
- It was noted if we tweak the threshold that we used to calculate the SSD, we get better results in terms of matching, but this is a painful task and cannot be done on a case-by-case basis.
- Homography matrix *'H'* was calculated using the given starter code function.

[*Results for various Image datasets are shown below....*]

Step – 5: Warping and Blending:

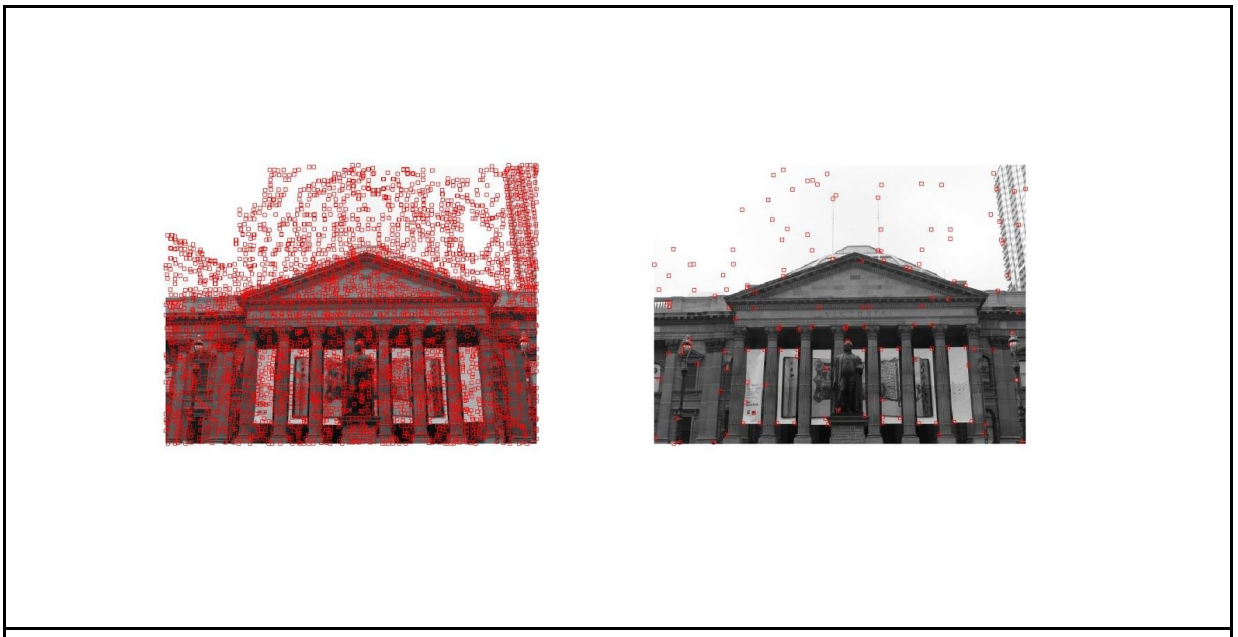
- We used '*imwarp'* for warping and Alpha Blending to blend the images.

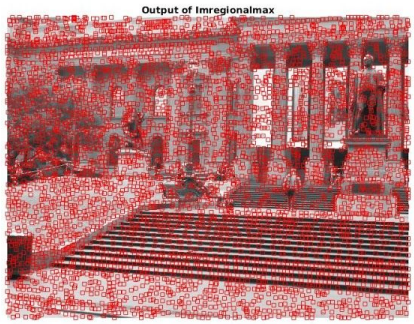
Challenges faced and rectifications:

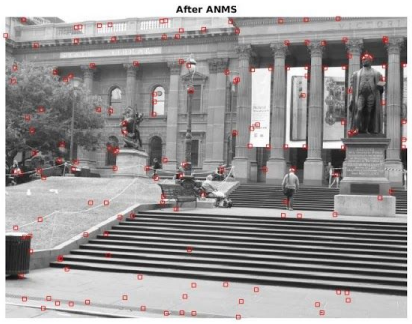
- For the DataSet-3, we downsized the images by 75% to since the files were large file and Matlab kept running out of memory.
- Initially, some of the feature matches were coming out to be wrong, but we decreased the feature descriptor SSD ratio threshold to weed out wrong matches.

DataSet – 1:

Step-1) Corner Metric and ANMS:







Step-2) Feature Matching:

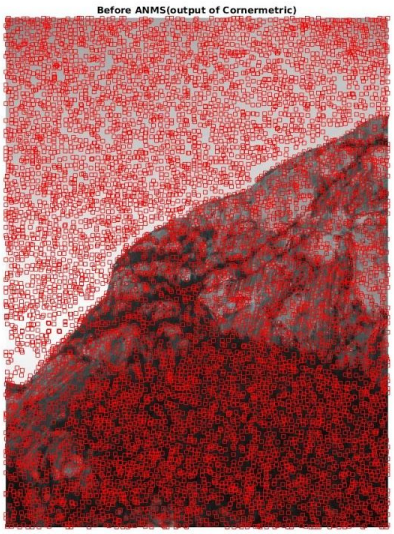
Step-3) RANSAC:

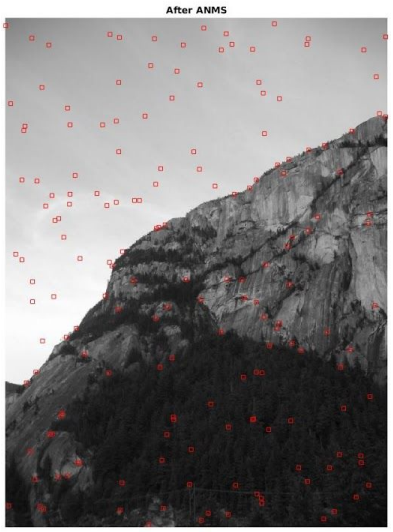
Step-4) Warping:

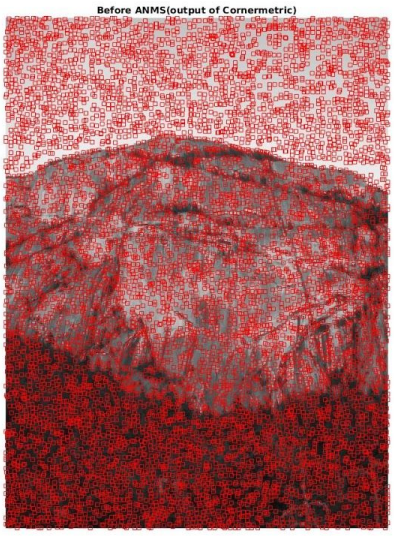
Step-5) Blending:

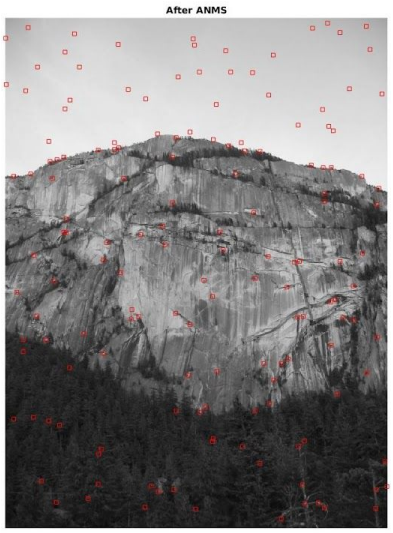
DataSet – 2:

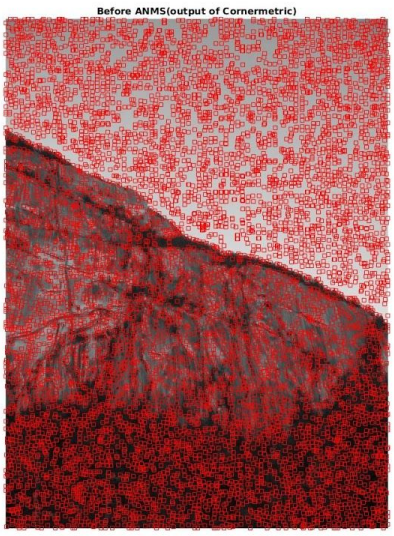
Step-1) Corner Metric and ANMS:

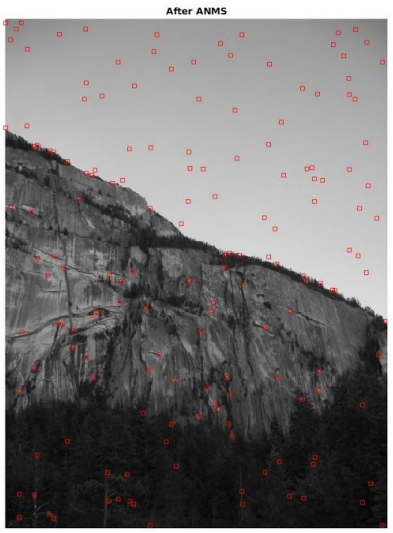




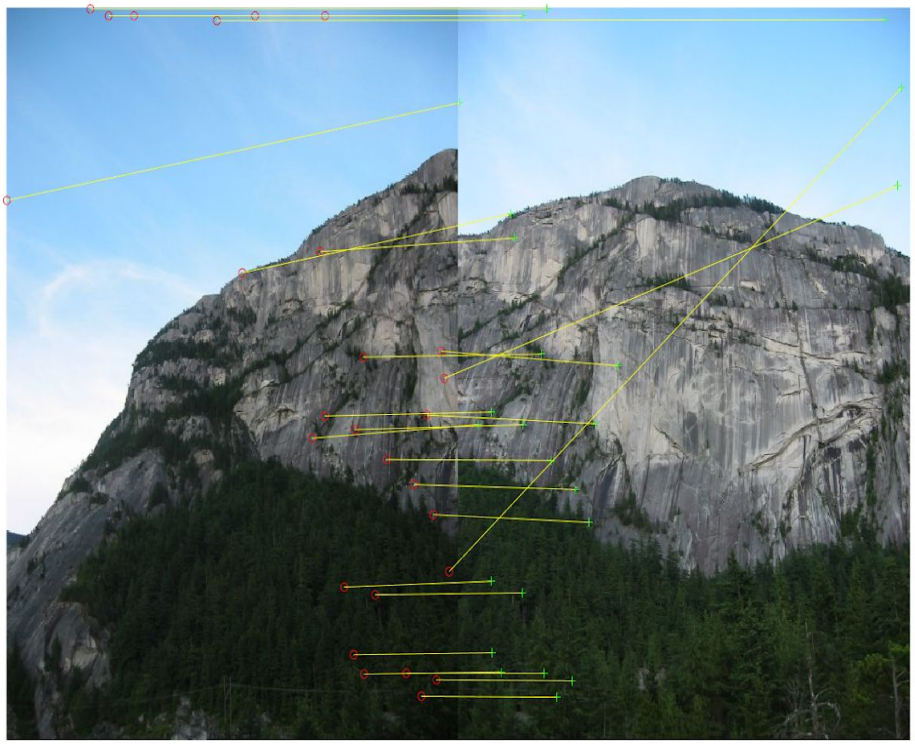




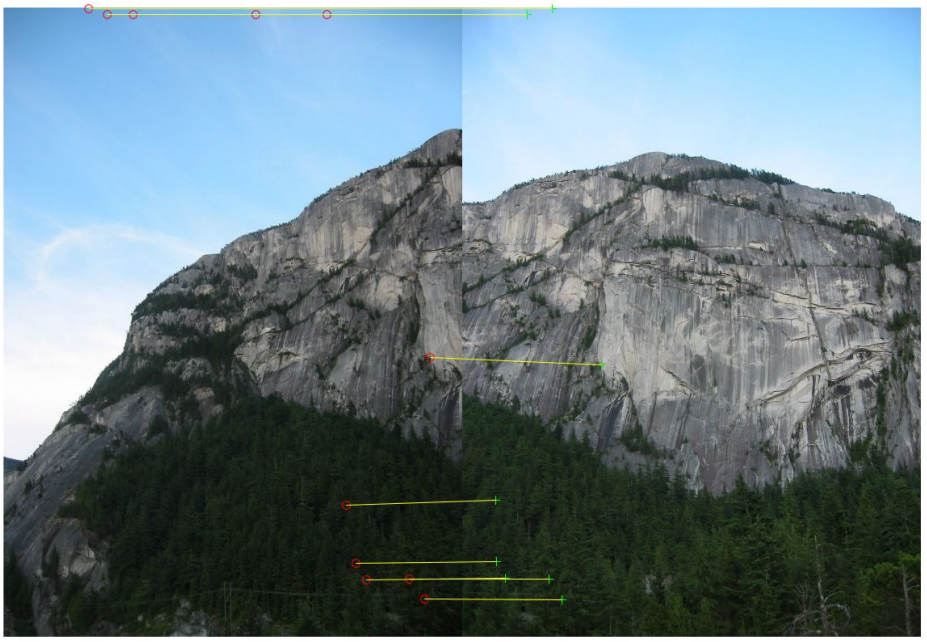




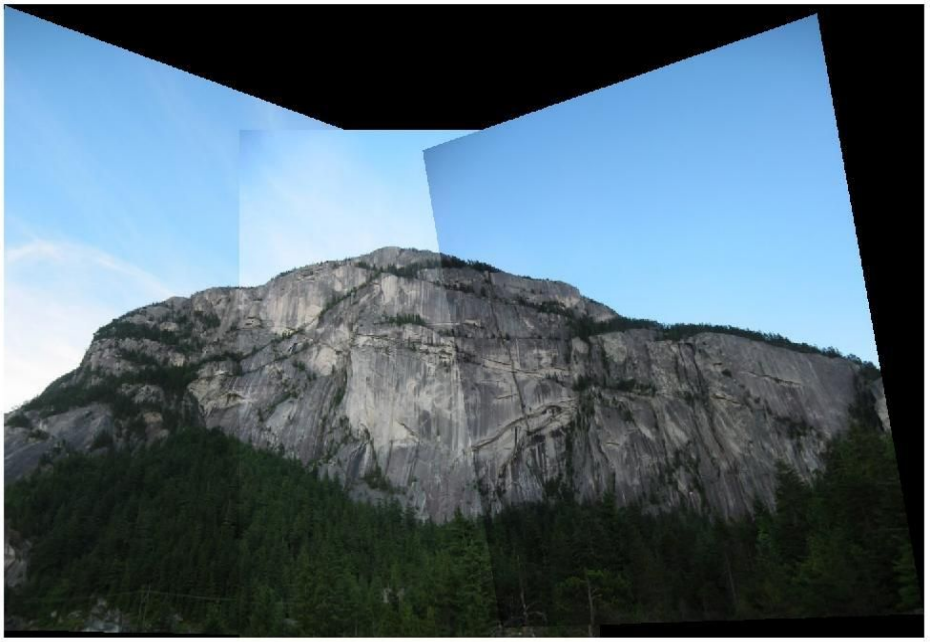
Step-2) Feature Matching:



Step-3) RANSAC:

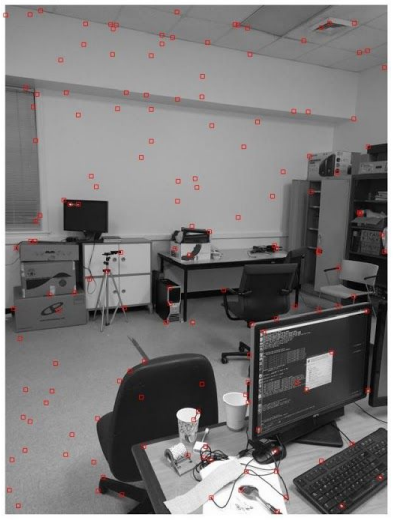


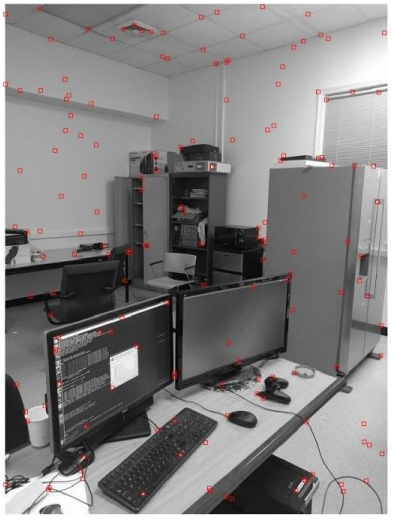
Step-4) Warping and Stitching:

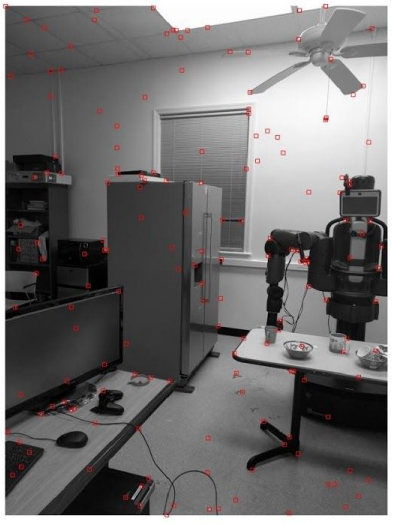


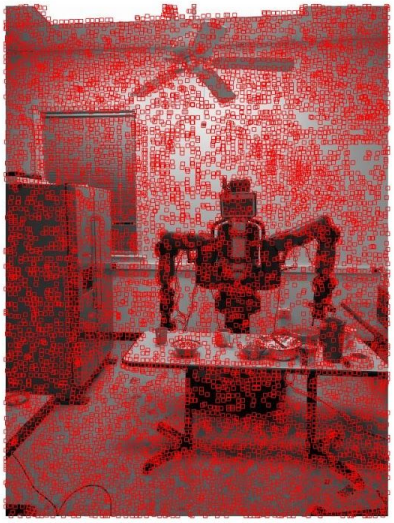
DataSet – 3:

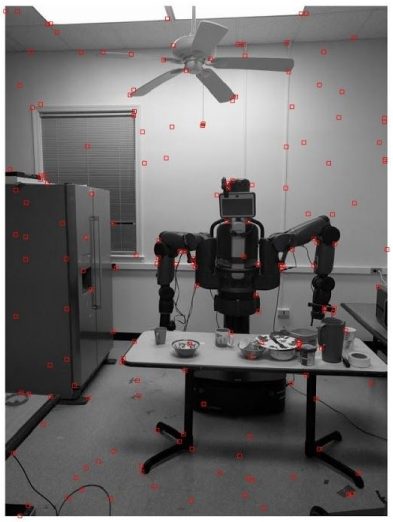
Step-1) Corner Metric and ANMS:

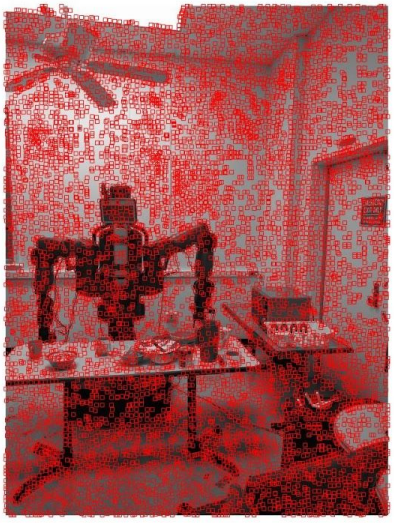


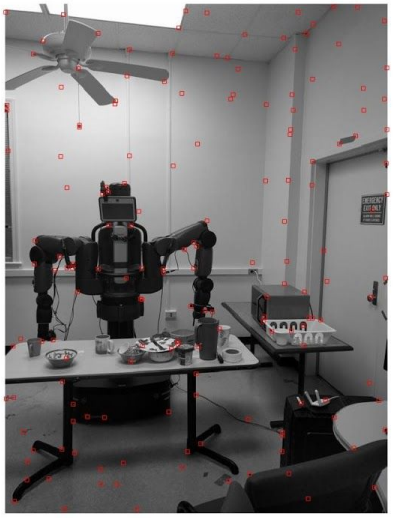


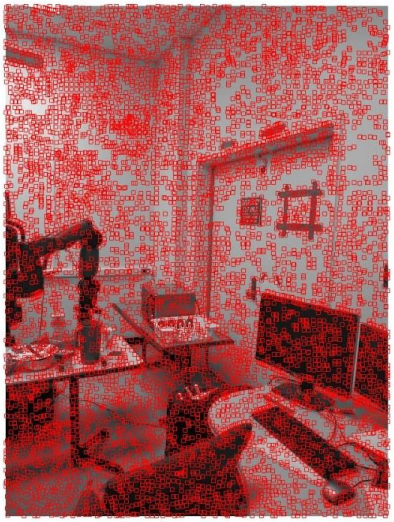


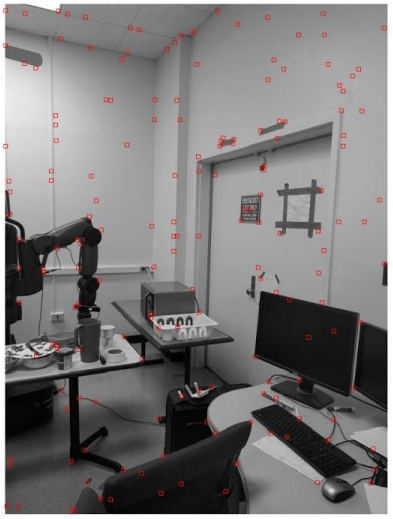


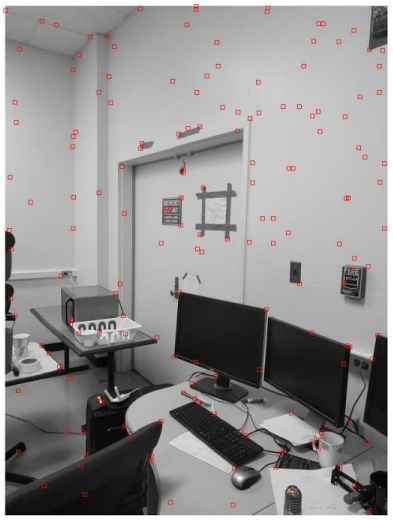


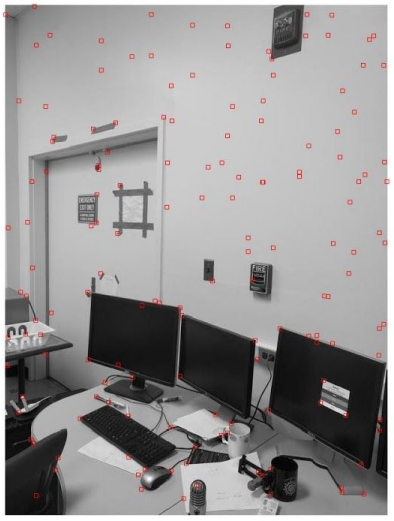




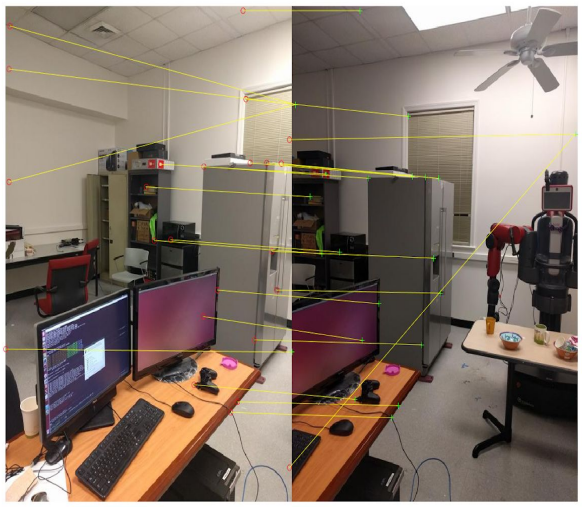


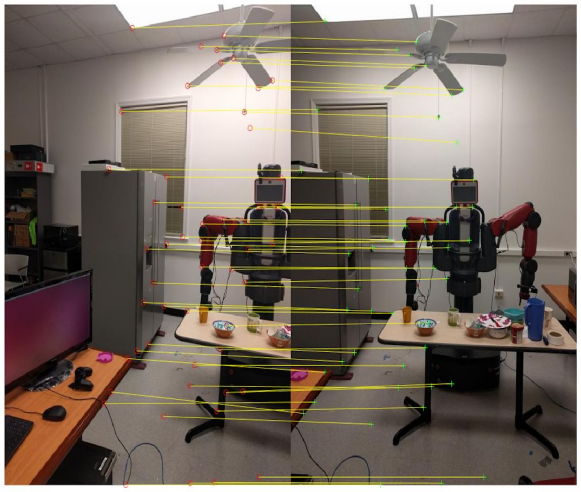




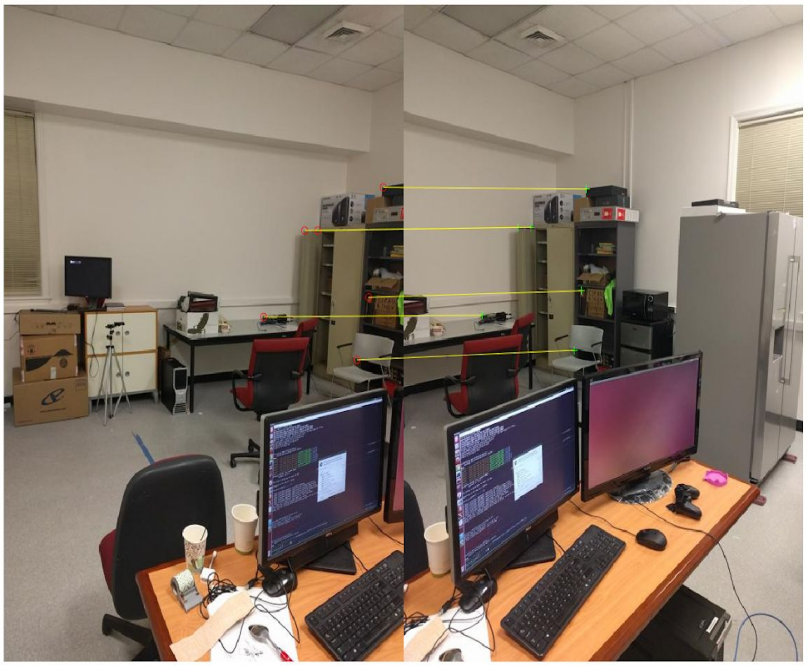


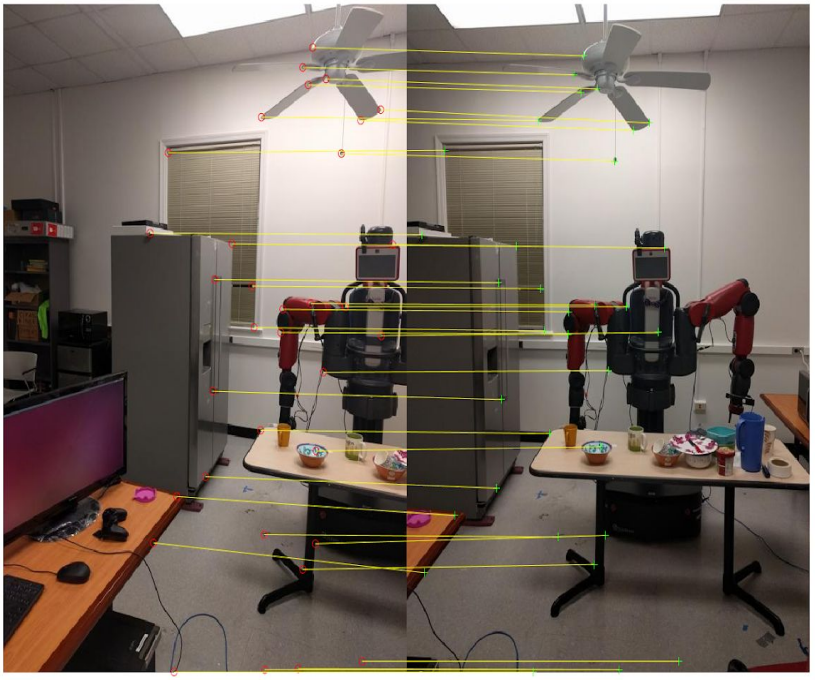
Step-2) Feature Matching:



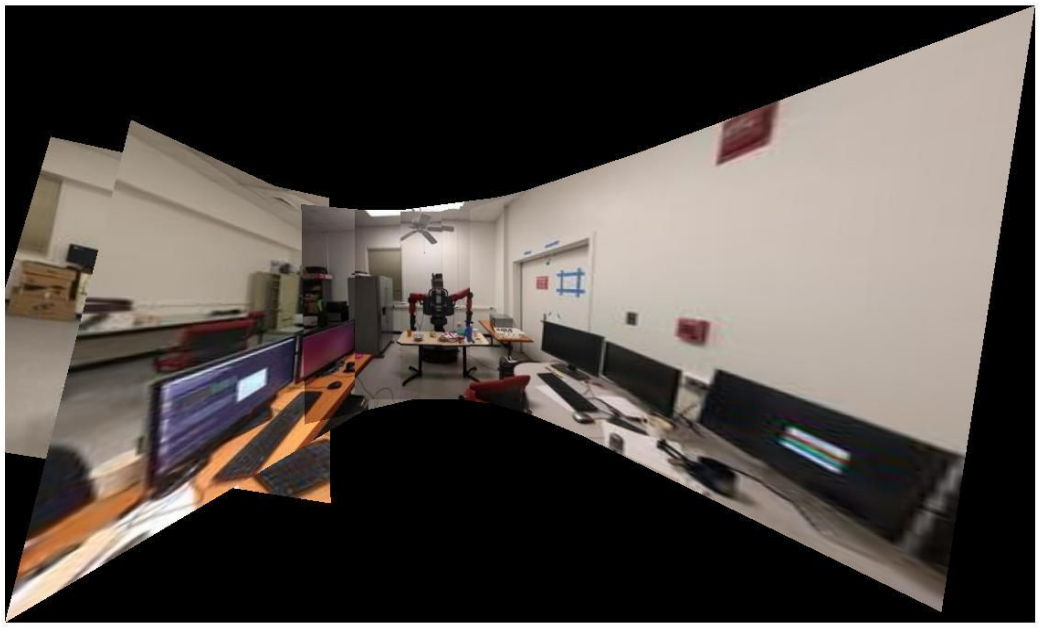


Step-3) RANSAC:



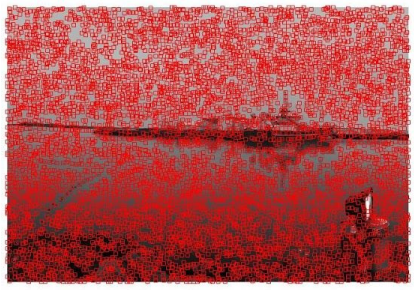


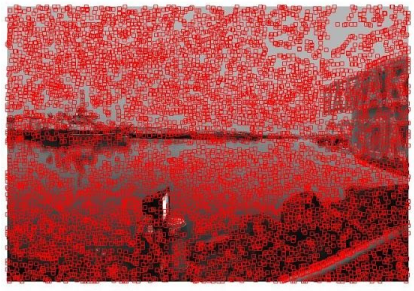
Step-4) Panorama Stitching:

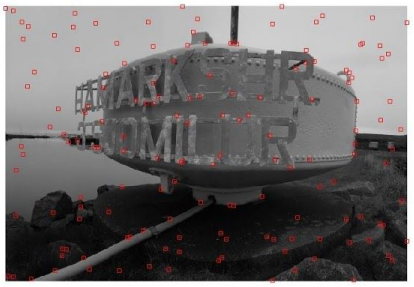


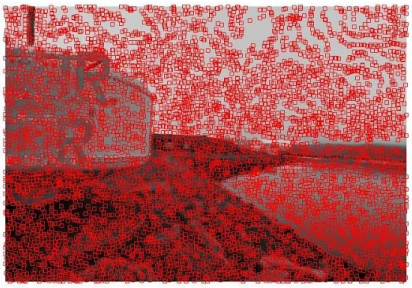
Test – 1:

Step-1) Corner Metric and ANMS:



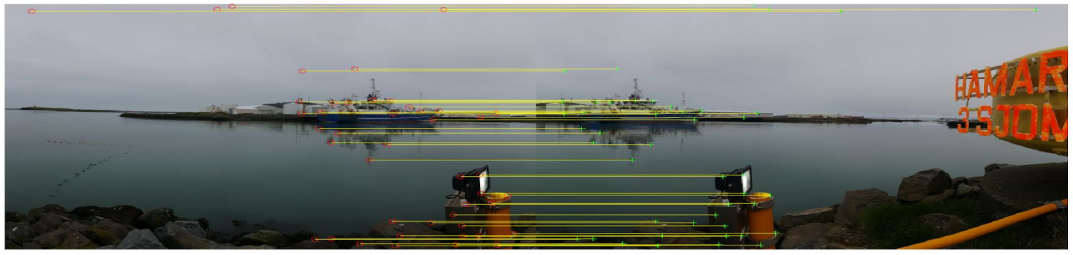






Step-2) Feature Matching:

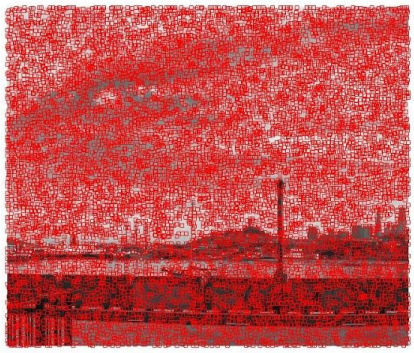
Step-3) RANSAC:

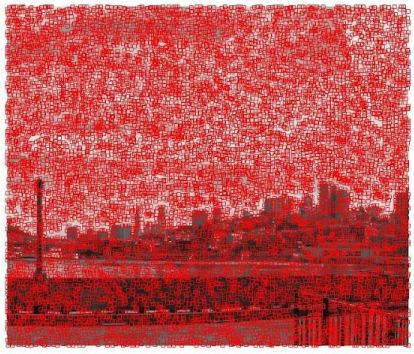


Step-4) Panorama Stitching:

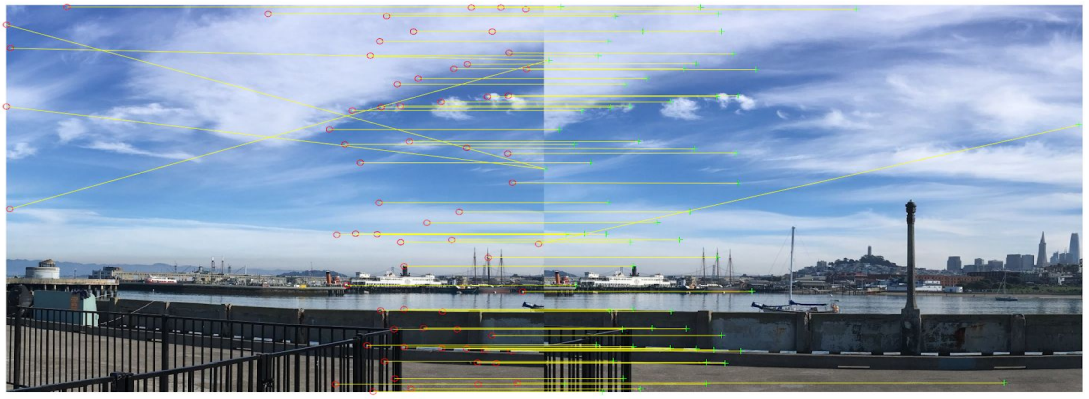
Test – 2:

Step-1) Corner Metric and ANMS:

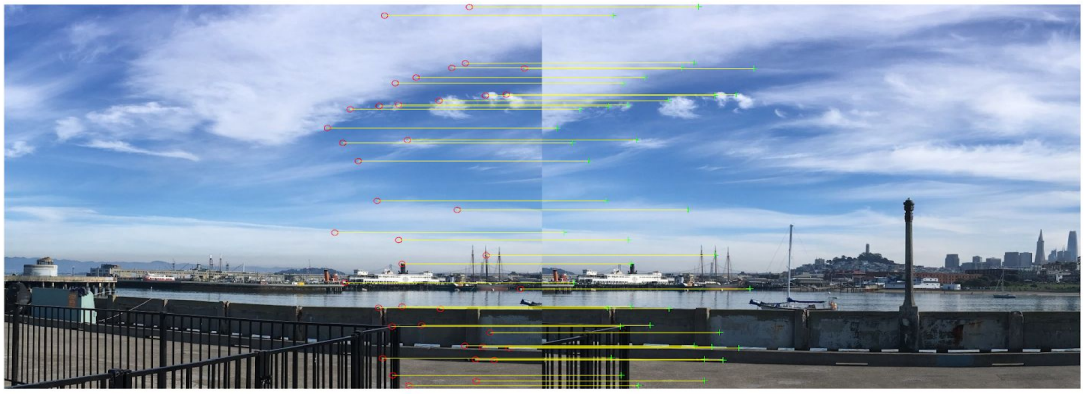




Step-2) Feature Matching:



Step-3) RANSAC:



Step-4) Panorama Stitching: