CS543/ECE549 Assignment 3

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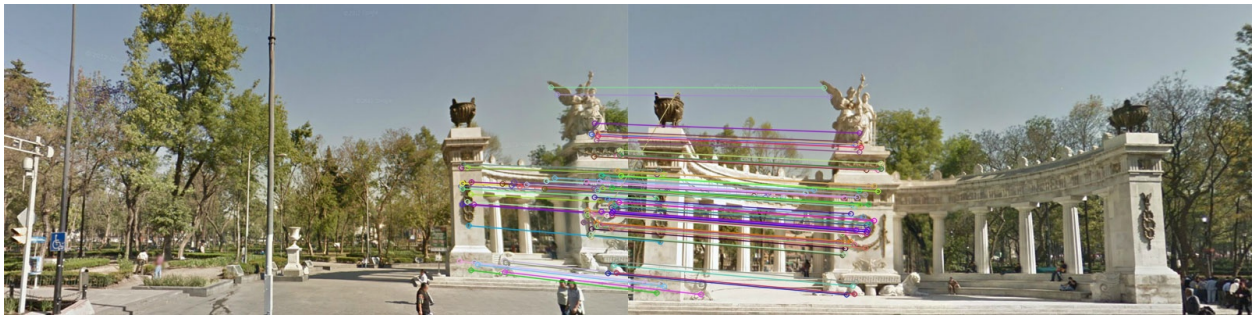
Part 1: Homography estimation

A: Describe your solution, including any interesting parameters or implementation choices for feature extraction, putative matching, RANSAC, etc.
My solution uses SIFT to find the key points and descriptors. Then I choose the KNN method to find the matches. When I'm doing some research on this topic. I think there is two way of matching. One is brute force and one is KNN. Based on my knowledge, KNN is a better option to go with and it works great. I set my threshold to be (0.5 * the distance). I uses RANSAC and set the parameter to 5.0. 5.0 is from the example of how to use the function so I try with it. I change the parameter up and down a little but it doesn't seem like there is a lot of changing on the result so I stay with 5.0. The example image from the assignment description had the left image warped. I have my right image warped since I have trouble correctly displaying the left image.

B: For the image pair provided, report the number of homography inliers and the average residual for the inliers. Also, display the locations of inlier matches in both images.
I did not use the plot function provided by the professor. I saved the image along the way because the variable setup was different from mine and to modify to fit the function will take more work than it should.

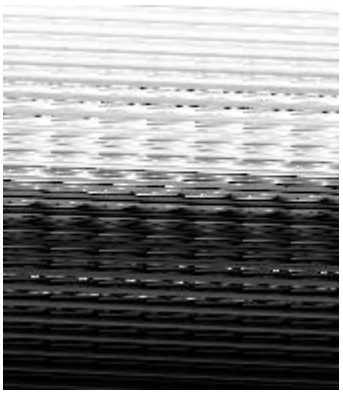
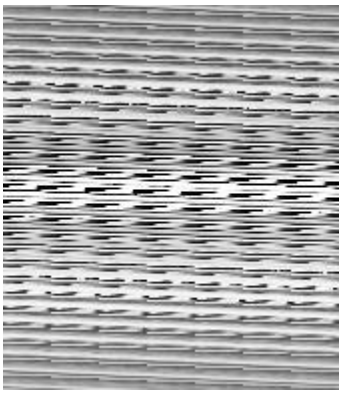
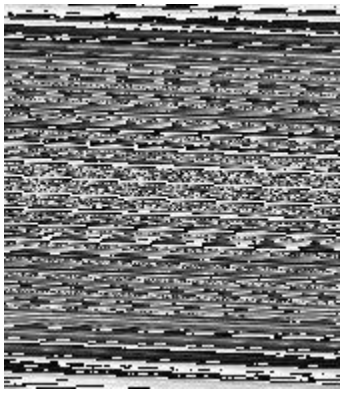


The number of inliers: 97
C: Display the final result of your stitching.

Part 2: Shape from shading

A: Estimate the albedo and surface normals

1) Insert the albedo image of your test image here:

2) What implementation choices did you make? How did it affect the quality and speed of your solution?
    a) The implementation I made is mostly following the steps of the homework description. Where I use numpy clip () method to make sure there is no negative value in the preprocess function and a lot of reshaping in the photometric stereo function. The implementation of get surface function is mostly to implement the 4 integration method. The result I get is not as expected. I kept getting output with horizontal lines and I have a hard time fixing it.
3) What are some artifacts and/or limitations of your implementation, and what are possible reasons for them?
    a) I think the limitation of my implementation is the speed of the processing time and probably the size of the image. With that said, a larger image size might lead to a longer processing time.
4) Display the surface normal estimation images below:

B: Compute Height Map

5) For every subject, display the surface height map by integration. Select one subject, list height map images computed using different integration method and from different views; for other subjects, only from different views, using the method that you think performs best. When inserting results images into your report, you should resize/compress them appropriately to keep the file size manageable -- but make sure that the correctness and quality of your output can be clearly and easily judged.
    a)
6) Which integration method produces the best result and why?
    a) Random method would produce the best result because rows and columns would only compute on one axis. The average method would have a better result since it is a combination of both rows and columns. The best result is the random method since it has two more integration paths than the average method.

7) Compare the average execution time (only on your selected subject, “average” here means you should repeat the execution for several times to reduce random error) with each integration method, and analyze the cause of what you’ve observed:

Integration method	Execution time
random	
average	
row	
column	

Row and column method is the fastest since it only has to go through each axis once. The average method would take a little longer since it has to perform both rows and columns and the output is close to double rows and columns. The random method would have the longest processing time since it traverses the pixel matrix four times.

C: Violation of the assumptions

8) Discuss how the Yale Face data violate the assumptions of the shape-from-shading method covered in the slides.
    a) As we learned Lambert's law in the lecture. We know that parts that are brighter like eyes, skin, and makeup does satisfy the diffuse reflection. The surface should only receive light from one point. However, we are not sure if that is true for this case.
9) Choose one subject and attempt to select a subset of all viewpoints that better match the assumptions of the method. Show your results for that subset.
    a)
10) Discuss whether you were able to get any improvement over a reconstruction computed from all the viewpoints.
    a)

Part 3: Extra Credit

Post any extra credit for parts 1 or 2 here.Don’t forget to include references, an explanation, and outputs to receive credit. Refer to the assignment for suggested outputs.