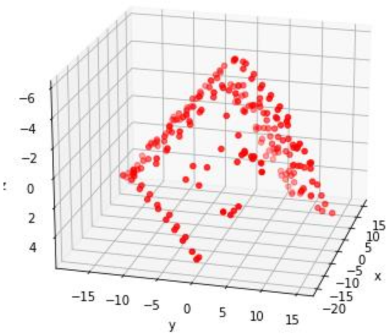
CS543/ECE549 Assignment 5

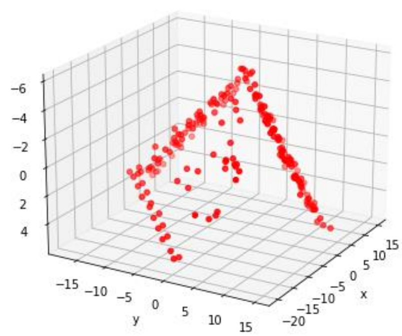
Name: Huey-Chii Liang

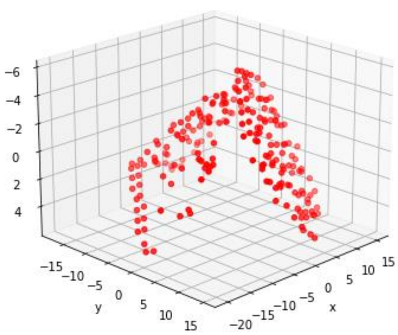
NetID: hcliang2

Part 1: Affine Factorization

A. Display the 3D structure (you may want to include snapshots from several viewpoints to show the structure clearly). Report the Q matrix you found to eliminate the affine ambiguity. Discuss whether or not the reconstruction has an ambiguity.

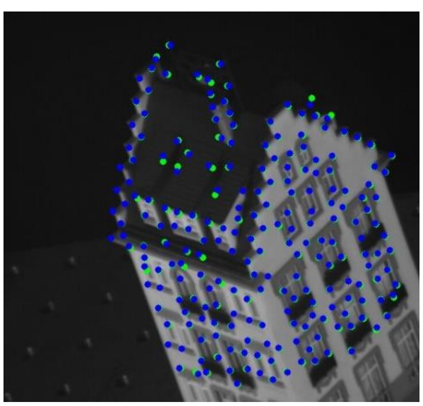
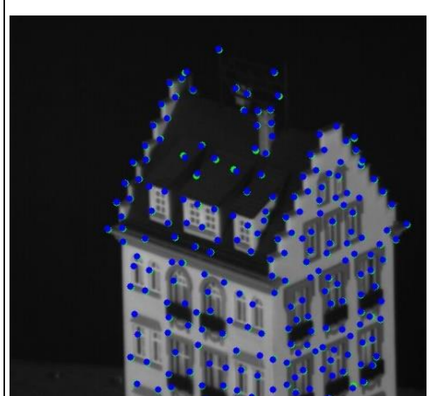
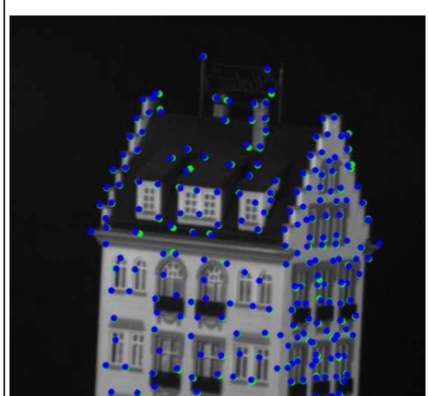






There is no ambiguity in the reconstruction result because the structure of the roof can be clearly seen when turning the 3D perspective.

B. Display three frames with both the observed feature points and the estimated projected 3D points overlayed.

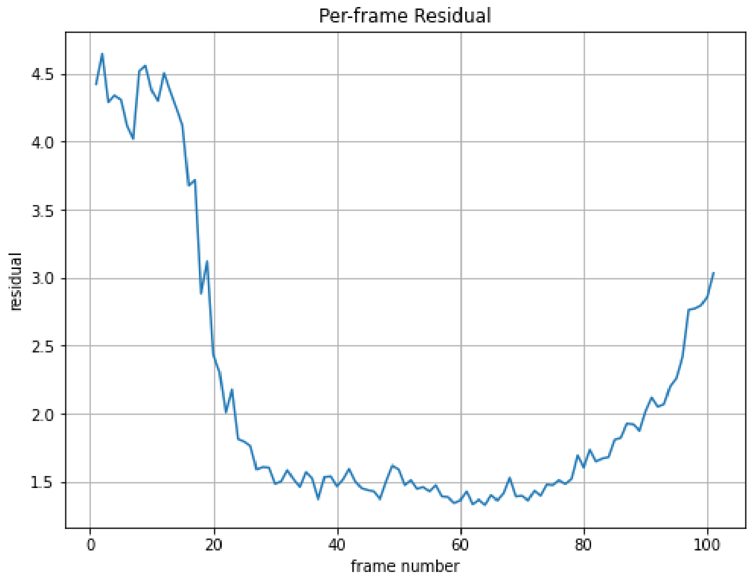
frame00000001	frame00000051	frame00000101
		

(Green points are the observed feature points. Blue points are the estimated projected 3D points.)

C. Report your total residual (sum of squared Euclidean distances, in pixels, between the observed and the reprojected features) over all the frames, and plot the per-frame residual as a function

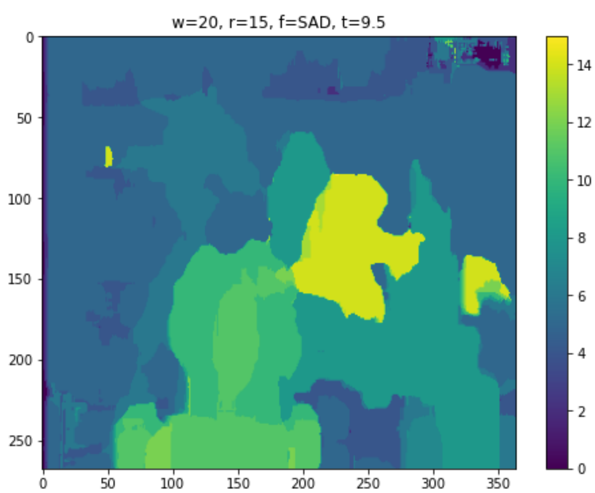
of the frame number.

Total residual: 217.8372



Part 2: Binocular Stereo

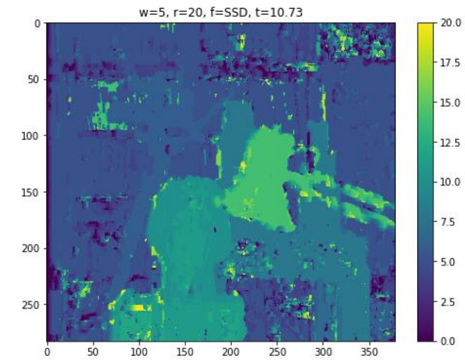
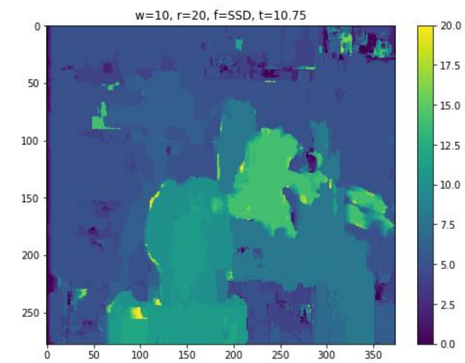
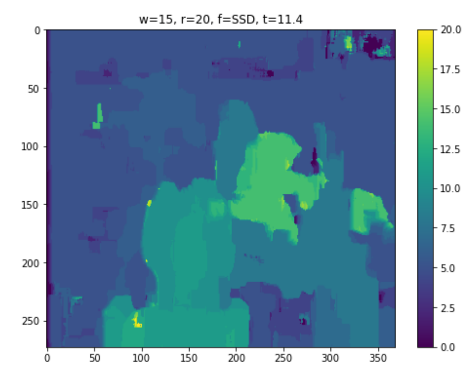
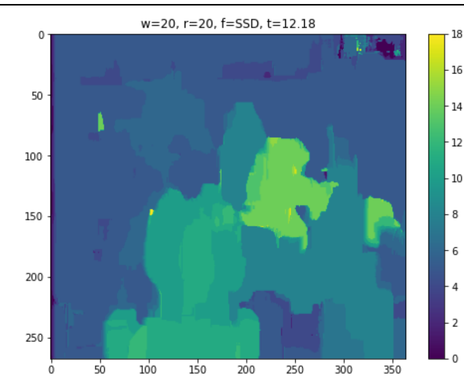
A. Display best output disparity maps for both pairs.

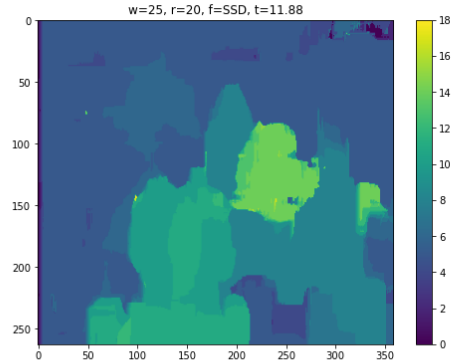
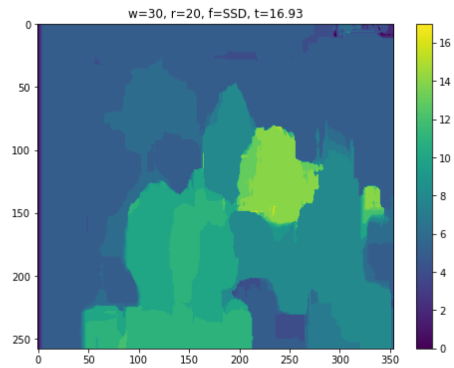


B. Study of implementation parameters:

1. **Search window size**: show disparity maps for several window sizes and discuss which window size works the best (or what are the tradeoffs between using different window sizes). How does the running time depend on window size?

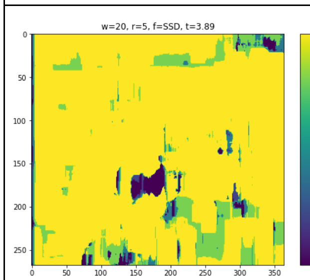
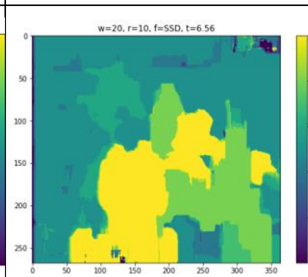
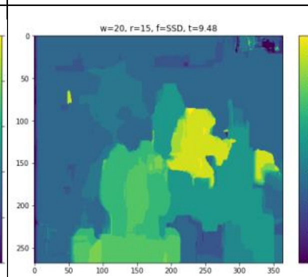
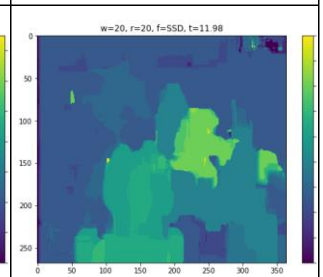
Window size	Running time	Disparity map

5	10.73 s	
10	10.75 s	
15	11.40 s	
20	12.18 s	

25	11.88 s	
30	16.93 s	

A window size equal to 20 gives the best disparity map because the result shows clearly the outline of each object while having minimal noise. However, it also requires the most computational time.

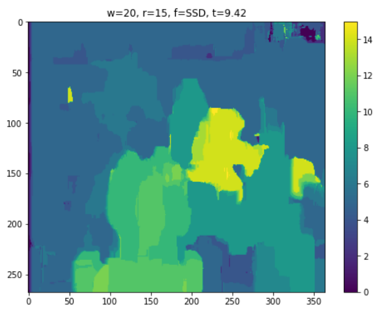
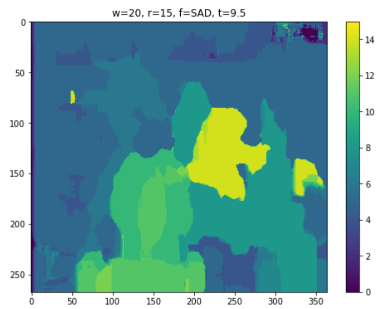
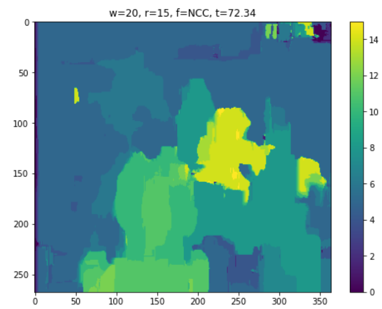
2. **Disparity range**: what is the range of the scanline in the second image that should be traversed in order to find a match for a given location in the first image? Examine the stereo pair to determine what is the maximum disparity value that makes sense, where to start the search on the scanline, and which direction to search in. Report which settings you ended up using.

5	10	15	20
			

The disparity map gives the best results when the range is equal to 15.

3. **Matching function**: try sum of squared differences (SSD), sum of absolute differences (SAD), and normalized correlation. Show the output disparity maps for each. Discuss whether there is any difference between using these functions, both in terms of quality of the results

and in terms of running time.

SSD	SAD	NCC
		

SAD can give the best results, SSD is also good, but NCC has the worst results. SAD and SSD require less time to reconstruct the disparity map. NCC, on the other hand, takes nearly 8 times longer to complete.

C. Discuss the shortcomings of your algorithm. Where do the estimated disparity maps look good, and where do they look bad? What would be required to produce better results? Also discuss the running time of your approach and what might be needed to make stereo run faster.

My algorithm has better results when estimating large-area objects. However, it does not perform well in smaller and more detailed areas. Additionally, my algorithm takes a long time to calculate on larger images.