CSC320H1, Winter 2019
Assignment 3

Name: JingXi, Hao
Student Number: 1000654188

Due Date: 12:00pm, Wednesday, March 20, 2019

Part 2. Report and Experimental evaluation

In this section, several test image pairs, including the supplied source/target image pairs, are displayed along with the outputs generated by the Patch Match algorithm. Also, we are going to discuss the strengths and the weakness of the Patch Match algorithm based on those outputs.

1. **Experiment 1 – Canyon**

   - Note that the Canyon test image pairs are resized before applying the Patch Match algorithm since the origin image pairs are too large and cause Memory Error.
   - Show the source and target images below.

Figure 1: Source

Figure 2: Target

   - Then, show the outputs generated by the Patch Match algorithm.

Figure 3: NNF-COL

Figure 4: Reconstructed Source

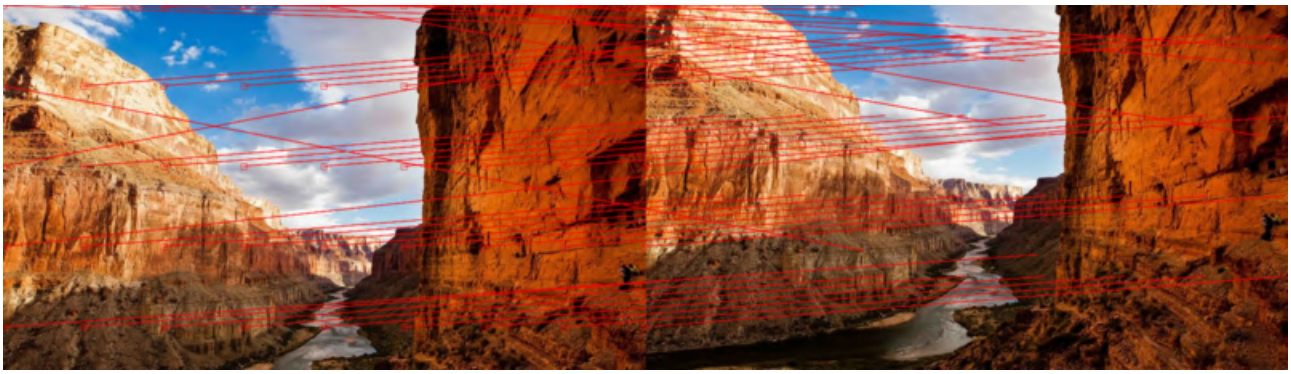

Figure 5: NNF-VEC

- According to the output images, we are able to conclude that this is a quite successful case. As we can see in *Figure 3*, *NNF-COL*, most of the area are clean and consistent in "grey", which implies that the patches in that area are perfectly matched from the source image to the target image. However, there are some noisy area at the top and the left. This is due to the shift between the source image and the target image. In *Figure 5*, we can see that the source image and the target image are taken from the same viewpoint, but the target image is shifted down a little bit. This also explains the pattern of the NNF vectors appeared in *Figure 5*, where some vectors are gathered and parallel to each other and point upwards. Moreover, the reconstructed source image is quite clear. Hence, this image pair shows a quite good case.

2. **Experiment 2 – Deer**

- Show the source and target images below.

Figure 6: Source

Figure 7: Target

- Then, show the outputs generated by the Patch Match algorithm.

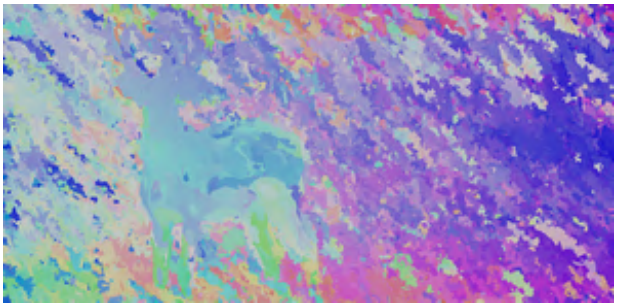

Figure 8: NNF-COL

Figure 9: Reconstructed Source

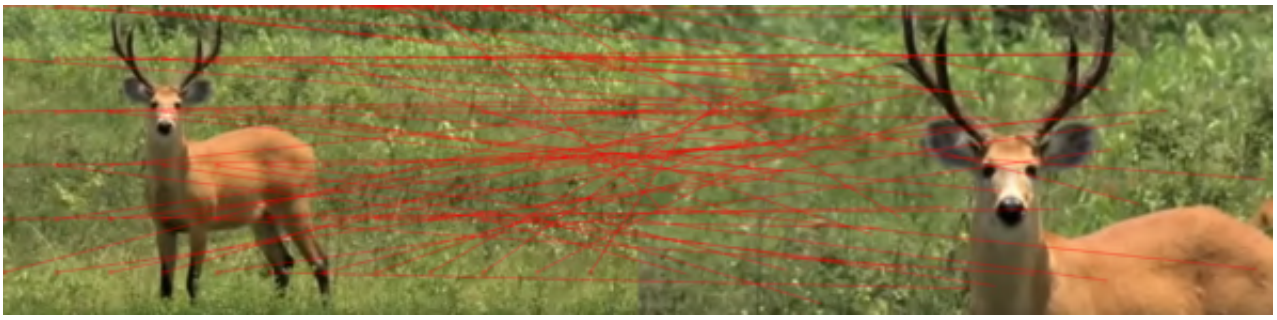

Figure 10: NNF-VEC

- As we can see in *Figure 8*, the NNF-COL image for this test image pair appears to be very noisy, which means that the patches are not matched perfectly but still matched with the most similar ones. The noisy part in "grass" area makes sense since there are too much details in the "grass" area and the target image is actually the zoom-in version of the source image. Also, the bottom part of the deer is not shown in the target image, which explains the unnatural area of the legs of the deer in the reconstructed source image. The Patch Match algorithm tend to find the patch in the target image that has the most similar color with the patch in the source image. Therefore, even though the bottom part of the deer and some part of the grass does not shown in the target

image, the reconstructed image is still in an accepted condition.

3. **Experiment 3 – Jaguar**

   - Show the source and target images below.

Figure 11: Source

Figure 12: Target

   - Then, show the outputs generated by the Patch Match algorithm.

Figure 13: NNF-COL

Figure 14: Reconstructed Source

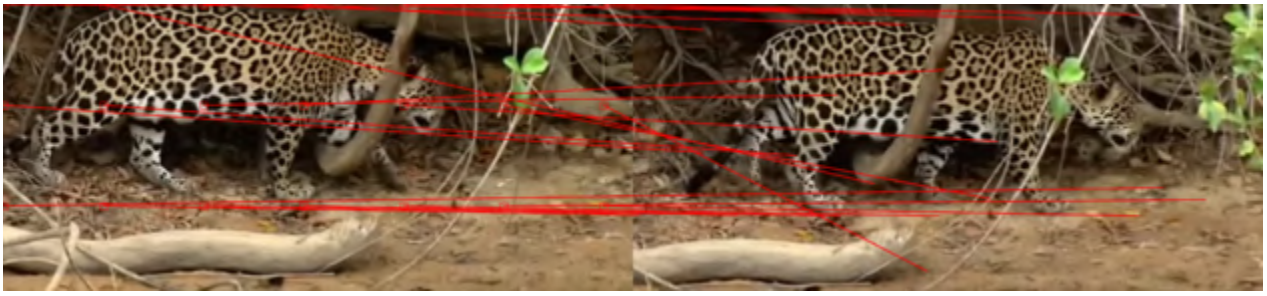

Figure 15: NNF-VEC

   - In *Figure 11*, it is obvious that the left area are quite noisy. This is due to the difference in the left area between the source image and the target image. In addition, the gesture of the jaguar (the shape of the jaguar) changes between the source image and the target image, which results

in the blurriness in the tail of the jaguar in the reconstructed source image. The blurriness of the head and foreleg of the jaguar in the reconstructed source image is due to the distraction of the surroundings. Hence, in this case, the jaguar is reconstructed but with blurriness in its body.

4. **Experiment 4 – Jaguar2**

   - Show the source and target images below.

Figure 16: Source

Figure 17: Target

   - Then, show the outputs generated by the Patch Match algorithm.

Figure 18: NNF-COL

Figure 19: Reconstructed Source

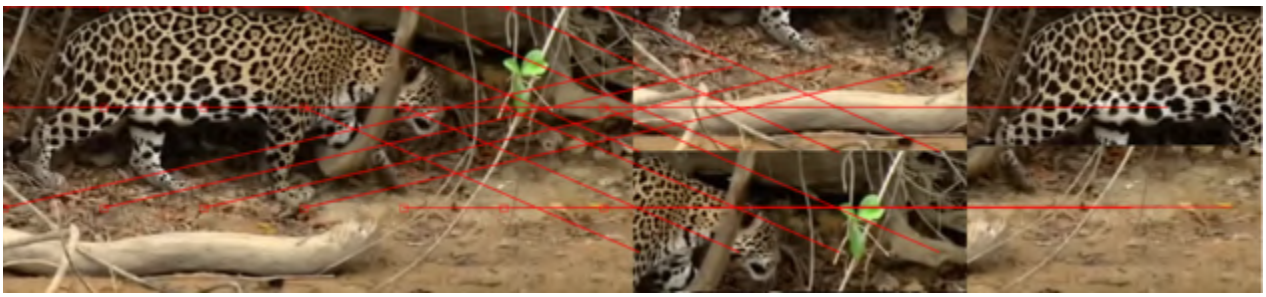

Figure 20: NNF-VEC

- In *Figure 18*, there are four clean and consistent areas in four different colors, which implies that in each color area the patches from the source image are matched very well. Also, it is quite noisy in the boundaries, which makes sense since the boundaries are the edges in the target image and it is hard to match at that area. However, this case produces better reconstructed source image in comparison with the last experiment, *Jaguar*, since the target images are the combinations of the different areas of the source image. Therefore, it is easier to find a good match in this case.

5. **Experiment 5 – Jaguar3**

- Show the source and target images below.

Figure 21: Source

Figure 22: Target

- Then, show the outputs generated by the Patch Match algorithm.

Figure 23: NNF-COL

Figure 24: Reconstructed Source

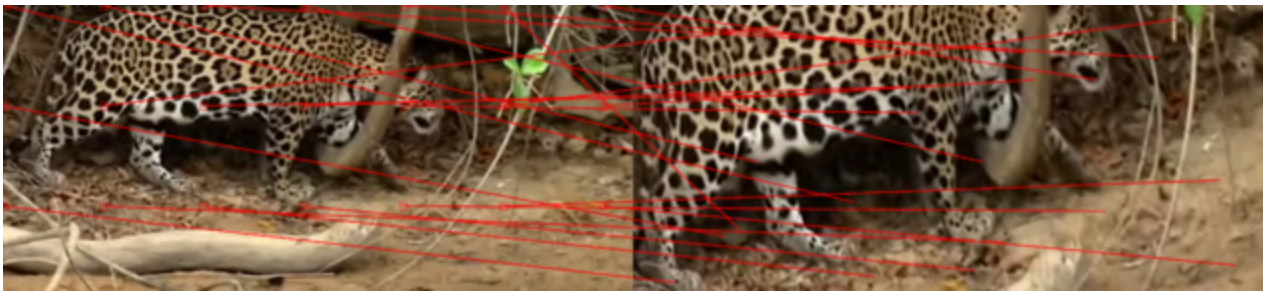

Figure 25: NNF-VEC

- In *Figure 21*, there is a "light" rectangular area and this indicates that the patches of the source image in this area are matched better than other area. The reconstructed source image agrees with that results. The body of the jaguar is more clear than the foreleg and head of the jaguar. This makes sense since parts of the foreleg and head of the jaguar are missing in the target image. Also, the leaves in the reconstructed image is very blur, which is because there is almost no leaves shown in target image and not much choice to match those "leaves" patches in the source image. Furthermore, this case produces a decent result, however the last experiment, *Jaguar 2*, produces better result than this one.

6. **Experiment 6 – Same Features In Different Patches**

- Show the source and target images below.

Figure 26: Source

Figure 27: Target

- Then, show the outputs generated by the Patch Match algorithm.

Figure 28: NNF-COL

Figure 29: Reconstructed Source

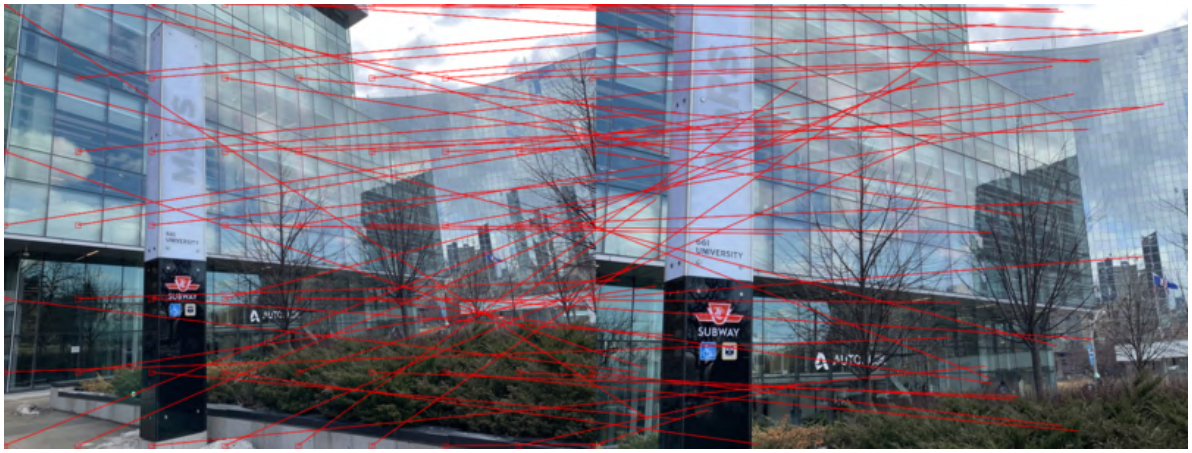

Figure 30: NNF-VEC

- In this case, we are able to see that the NNF vectors seem to pointed randomly from the source image to the target image. This is because there are many similar patches, containing quite similar color and features, in the target image, which results in the distraction for the matching process. Therefore, the reconstructed source image in this case is blur everywhere. Then, we can conclude that when the source image and the target image have many similar patches, then this would cause a "random" match issue for Patch Match algorithm and reduces its accuracy.

7. **Experiment 7 – Two Adjacent Frames Of Video**

- Show the source and target images below.

Figure 31: Source

Figure 32: Target

- Then, show the outputs generated by the Patch Match algorithm.

Figure 33: NNF-COL

Figure 34: Reconstructed Source

Figure 35: NNF-VEC

- In this experiment, the test images are the screenshots of the adjacent video frames. According to the *Figure 33* and *Figure 35*, this test image pair produces very good results. This experiment is expected to produce decent results since the source and the target images are quite the same for most of the pixels. Thus, the patches in the source image should be matched more accurately

with the patches in the target image. As we can see the reconstructed source image, it is very clear and very close to the original source image. Hence, this experiment is very successful.

8. **Experiment 8 – Angles Of The Camera**

- Note that there are two test cases in this experiment, one target image is taken by change the angle of the camera slightly and the other one is taken with a larger camera angle.
- Show the source and target images below.

Figure 36: Source

Figure 37: Target 1

Figure 38: Target 2

- Then, show the outputs generated by *Source* and *Target 1* using the Patch Match algorithm.

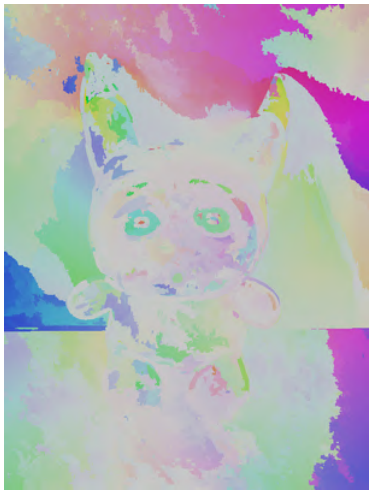

Figure 39: NNF-COL

Figure 40: Reconstructed Source

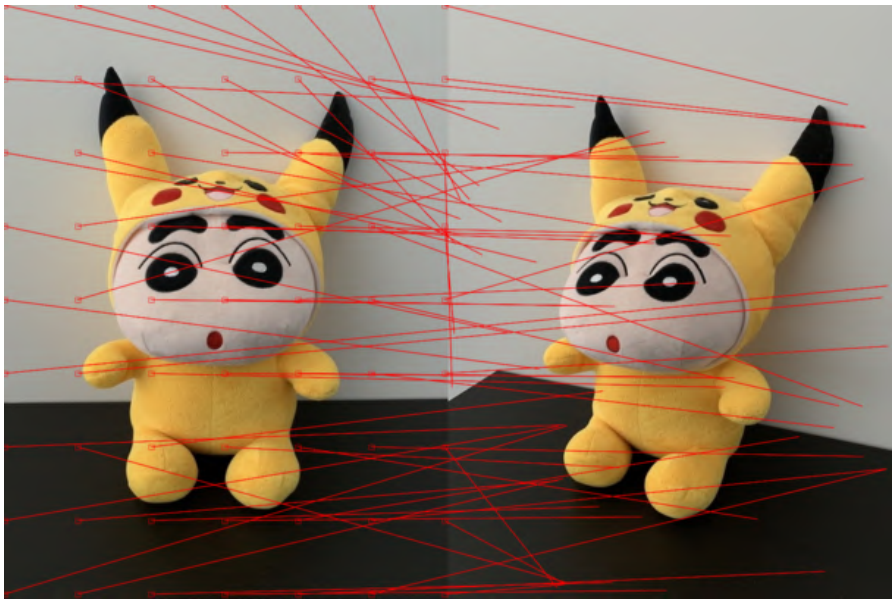

Figure 41: NNF-VEC

- Then, show the outputs generated by *Source* and *Target 2* using the Patch Match algorithm.

Figure 42: NNF-COL

Figure 43: Reconstructed Source

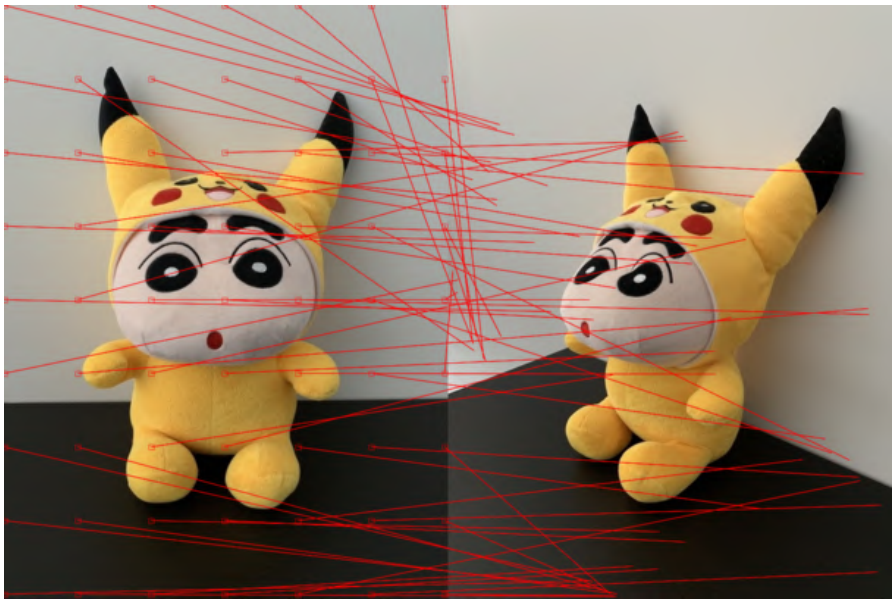

Figure 44: NNF-VEC

- Based on the results shown above, we are able to see that the target image with smaller camera angle produces better results. This makes sense since larger camera angle would cause more inaccurate matches for the same patch. When the camera angle becomes larger, the edges in the target image would become more skewed, which would cause the mistakes in patch match. Hence, the camera angle would affect the results of the Patch Match algorithm and the larger the camera angle the worse the results.

9. **Experiment 9 – Reconstruction Ability**

- Show the source and target images below.

Figure 45: Source

Figure 46: Target

- Then, show the outputs generated by the Patch Match algorithm.

Figure 47: NNF-COL

Figure 48: Reconstructed Source

Figure 49: NNF-VEC

- This experiment aims to test the reconstruction ability of the Patch Match algorithm. Therefore, every factors are kept the same except the existence of the tea tag. The target image do not have the tea tag however it is shown in the source image. Based on *Figure 47*, most of the patches are matched pretty well except the tea tag area (shown in green). However, the tea tag is reconstructed and shown in the reconstructed source image even though it is blur. This is because our Patch Match algorithm finds the most similar patch in color and match it. Therefore, our Patch Match algorithm has reconstruction ability.

10. **Experiment 10 – Stereo Image Pair**

- Show the source and target images below.

Figure 50: Source

Figure 51: Target

- Then, show the outputs generated by the Patch Match algorithm.

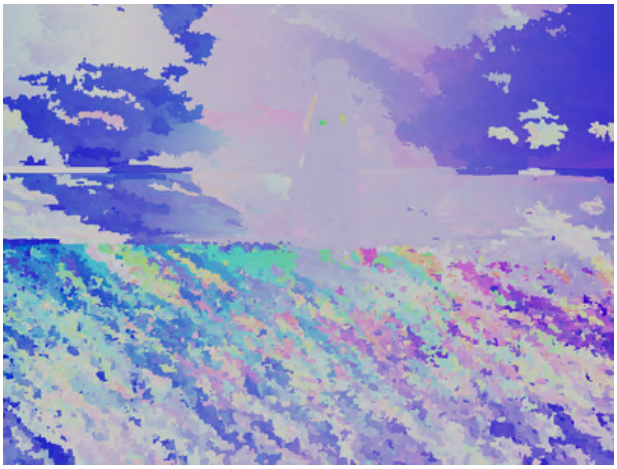

Figure 52: NNF-COL

Figure 53: Reconstructed Source

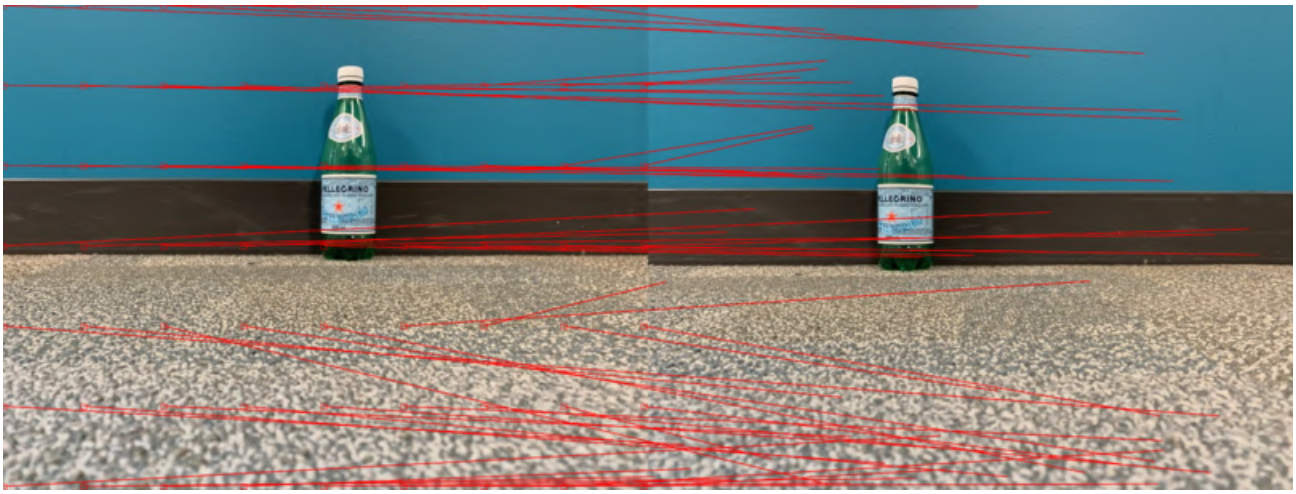

Figure 54: NNF-VEC

- This case does not work well since there are too much features in the background and the bottle. Thus, when the viewpoint changes slightly, the features have a huge change and hard to find a good match for the patches in the source image. Therefore, the NNF vectors points randomly and NNF color are quite noisy. Hence, the reconstructed source image is blur especially for the bottle.