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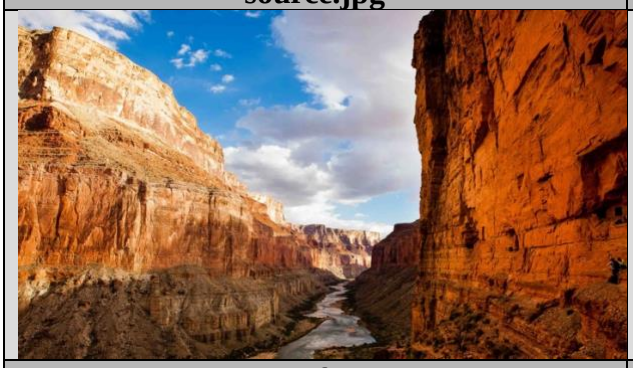
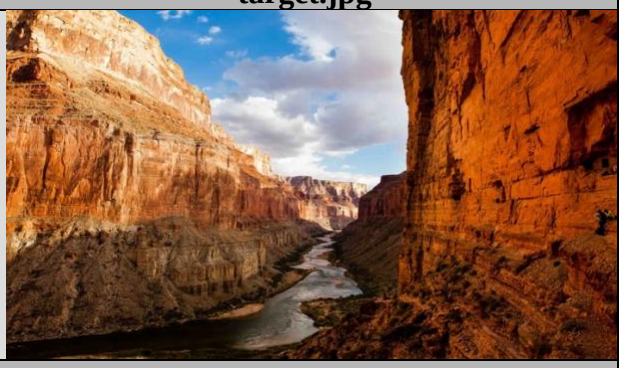
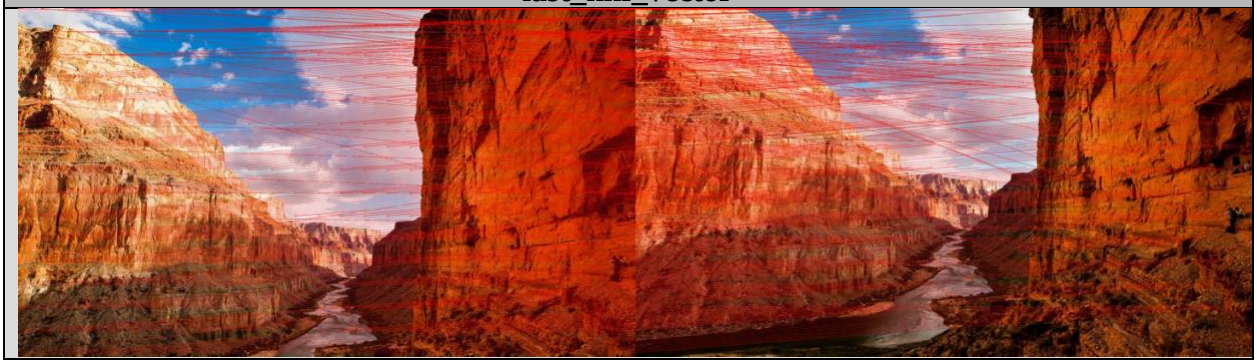
CSC320 Assignment 3

NOTE:

- **Algorithm: NNF (nearest neighbor field),** use the idea of applying propagation and random search interleaved at the patch level in each iteration to **reconstruct the source image using the pixels in the target image.**
- All the image sets were generated using **3 iterations** with **both propagation true and random true**. In my report, I only show the image of the last iteration and give the analysis based on the final result.
- **For each image sets (there are total 8 sets), provide 5 images:**

source.jpg: the image which need to be constructed
target.jpg: the image which provides the pixels used to reconstruct the source image
last_nnf_color: the nnf colorization image which measure the direction and the magnitude of the difference vector for each pixel.
last_nnf_vector: the nnf vector image, the left part is the source image and the right part is the target image, the vector indicates the most similar pixel finding by the algorithm in target image for the pixel in the source image.
last_reconstruct_source: the final reconstructed source image by the algorithm.

1. Canyon

source.jpg	target.jpg
	
last_nnf_color	**last_reconstruct_source**
	
last_nnf_vector	
	

Explanation:

- Analysis of source and target images:

The target image is obtained by "down" the point of view of the source image. Also, the source and target images in this pair are much larger than the other sets. Therefore, need more time to run to reconstruct the source image.

- Analysis of last_nnf_color image:

In the colorization image, we can see that except the 'upper' part pixels of image have the colors, the other region's pixels are all gray. This makes sense since when we want to reconstruct the source image from the target image, the pixels in the 'bottom' part of the image remain the same, therefore the color remains the constant. However, since the source and the target images differ by changing the point of view up or down, the upper part of the target image need to be

reconstructed in order to the reconstruct the source image, this correspond to the color in the upper part of colorization image.

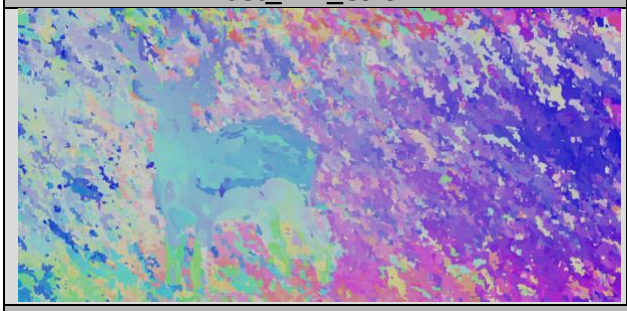
- **Analysis of last_nnf_vector image:**

In the nearest neighbor vector image, we can see groups of horizontal parallel match lines with a little up/down angles. This makes sense, since the source and target images only differ by changing the point of view up/down, and there is almost no changes in the left or right point of view, therefore, most of the pixels in the source image match to the pixels in the same position of the target image.

- **Analysis of reconstruct image:**

On my computer, I opened the source image and the target image together in order to compare them, and I found that because of the high quality of the source and target images and the little changes in bottom part of these two images, it's hard to visualize the differences between them. However, the up left part of blue sky in the reconstructed source image is brighter than the source image, this probably because the cloud difference in the sky between the source and target images.

2. Deer

source.jpg	target.jpg
	
last_nnf_color	**last_reconstruct_source**
	
last_nnf_vector	
	

Explanation:

- Analysis of source.jpg and target.jpg:

The target image is obtained from the target image by zooming in the source image. Also notice that in the target image, the deer is in focus, and the background grasses are out of focus, therefore, the grasses in the target image is blurrier than the source image.

- Analysis of last_nnf_color image:

In the colorization image, we can see that the ‘upper’ body of the deer has the similar color, which means that most of the nearest neighbor vectors in that region of the image have the similar directions and magnitudes. This is because the target image is the zoom in version of the source image, and most of the pixels in the target image respond to the ‘upper’ deer body. Therefore, the pixels correspond to the deer body in the target image need to do the left shift to reconstruct the deer in the source image. To reconstruct the pixels other than deer, the algorithm just searches for the random similar pixel ground in the target image, which correspond to the random color other than the deer body in the colorization image.

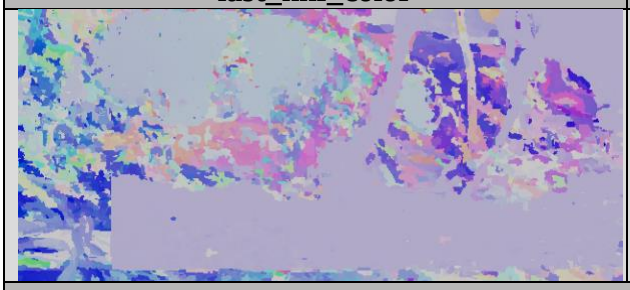
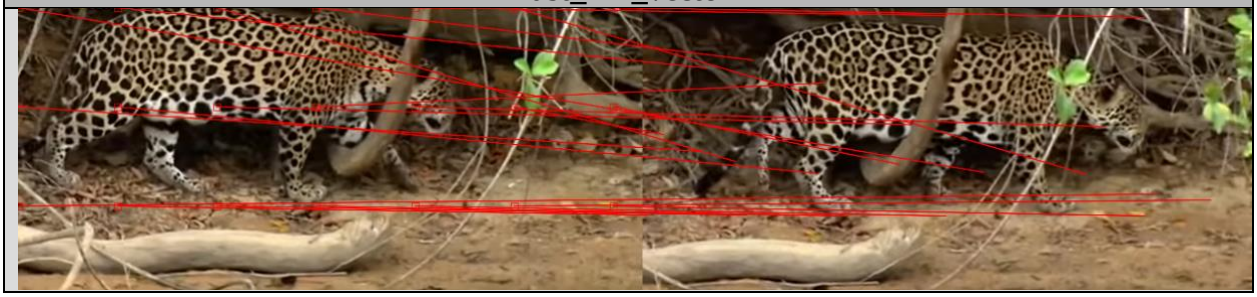
- Analysis of last_nnf_vector image:

In the nearest neighbor vector image, we can observe that the pixels in the ‘light brown’ part of the deer body matches well, while some ‘dark’ pixels on the deer’s leg in the source image find the ‘dark’ pixels on the deer’s horn in the target image. Also, notice that the grasses pixels are random matched.

- Analysis of reconstruct image:

The reconstruct image is good at the first glance, but the grasses are blurrier than the original source image due to the random search. Also, the ‘bottom’ part of the deer’s body has weird circle shadow and also the black legs are blurrier, this probably because of the miss-matches that pointed out in the nnf_vector image’s analysis. Therefore, these ‘fake’ information in the reconstruct source image cause some artifacts.

3. Jaguar

source.jpg	target.jpg
	
last_nnf_color	**last_reconstruct_source**
	
last_nnf_vector	
	

Explanation:

- **Analysis of source.jpg and target.jpg:**

The source and target images are like two adjacent frames of video with the jaguar walks one step. The target image is obtained by the jaguar in the source image with one step to the right. Also notes the differences of the branches on the bottom left between the two images.

- **Analysis of nnf_color image:**

In the colorization image, we can see that the belly and back parts and the bottom right part of the ground are with the same color. This makes sense since these parts almost remain the same in the source and target images. The other parts are with relatively random color because of the differences between the source and the target images.

- **Analysis of nnf_vector image:**

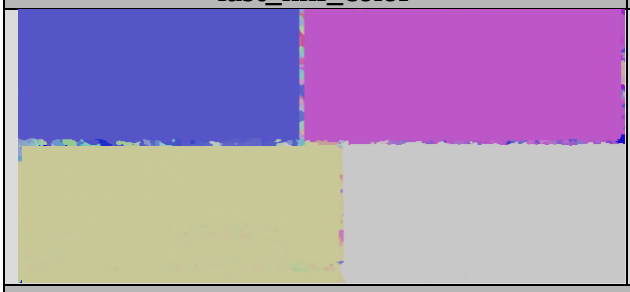
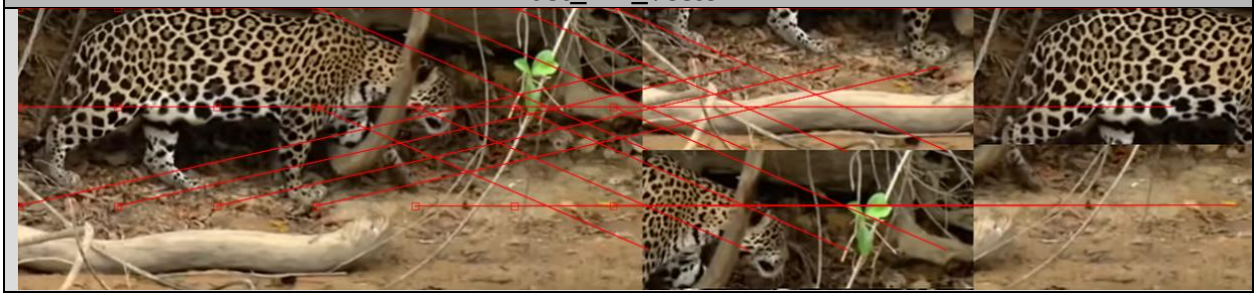
In the nearest neighbor vector image, we can see that the pixels for the ground and the branches are matched randomly. Also, we noticed that the dark points on the jaguar's body in the source image are randomly matches to the different dark points of the jaguar in the target image.

- **Analysis of reconstruct image:**

By observing the reconstruct source image, we can find that it is not only blurrier that the source image, but also have some little artifacts on the jaguar's legs and the branches. Also, the dark

spots on the jaguar's body look so fake, this probably because the mis-matches that we discussed in the nnf_vector image part. It worth points out that the neck part of the jaguar is constructed so bad with lots of visible artifacts.

4. jaguar2

source.jpg	target.jpg
	
last_nnf_color	**last_reconstruct_source**
	
last_nnf_vector	
	

Explanation:

- Analysis of source.jpg and target.jpg:

Target image is obtained by zooming in the source image and then cutting out the four critical parts of the source image.

- Analysis of nnf_color image:

By observing the color image, we can find four color (blue, pink, yellow and gray) rectangles correspond to the four rectangles in the target image. This makes sense since the four rectangles in the target image is the relatively 'subtle' parts in the source image and each rectangle does not have a huge color differences locally (the evidence to analyze the constant color: colorization image is measured by both the direction and the magnitude of the vector). For example, the top left blue rectangle may represent that to reconstruct the source image, the pixels in the top left rectangle of the target image need to point down. Similarly, pink represents pointing left, yellow

means points up right, and the gray means stay. The boundaries between each rectangle in the colorization image just matched randomly.

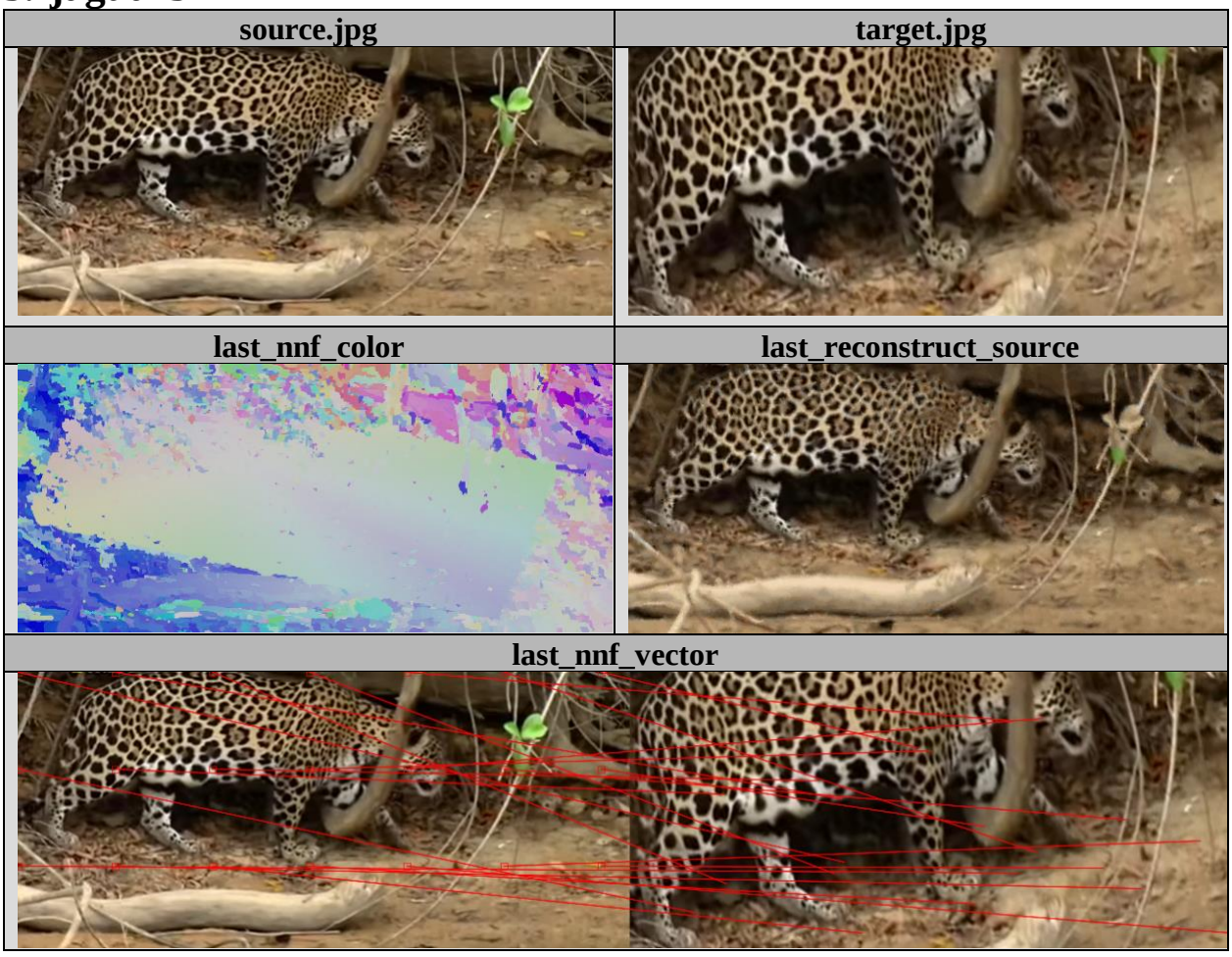
- **Analysis of nnf_vector image:**

The red vectors in the nnf_vector image support the direction claim in the analysis of nnf_color image part.

- **Analysis of reconstruct image:**

In the reconstruct image, we observed that even though there are subtle artifacts on the legs and the hindneck of the jaguar, it is much better than the previous adjacent frames set. And then observing more, we can find that these artifacts are correspond to the 'boundaries' of the four rectangles in the target image. Therefore, collaborate with observing the colorization image, the artifacts may come from the random match on the boundaries among the four rectangles in the target image.

5. jaguar3



Explanation:

- Analysis of source.jpg and target.jpg:

Target image is obtained by first anti-clockwise rotating the source image a little bit and then zoom in.

- Analysis of nnf_color image:

There is a large slant rectangle (right part of the rectangle a little bit downwards), this makes sense since in order to reconstruct the source image using the pixels in the target image, we need to turn the pixels for the jaguar in the target image clockwise a little bit, which correspond to the rectangle direction (rotated clockwise) in the colorization image. The other pixels out of the rectangle just matched randomly.

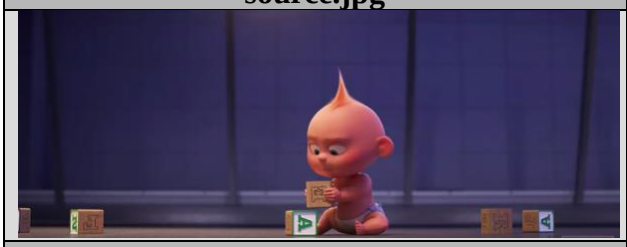
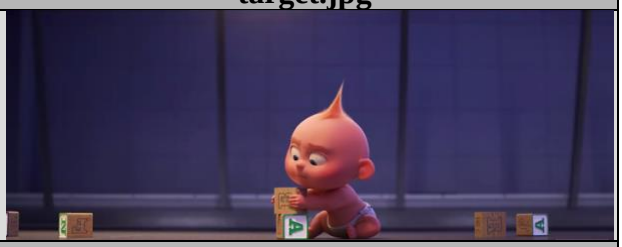
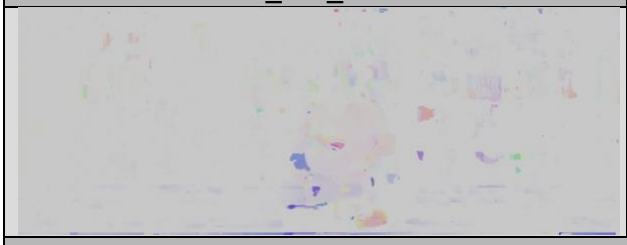
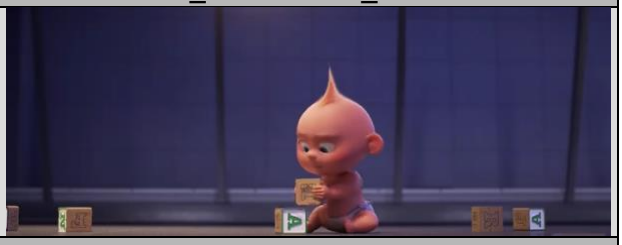
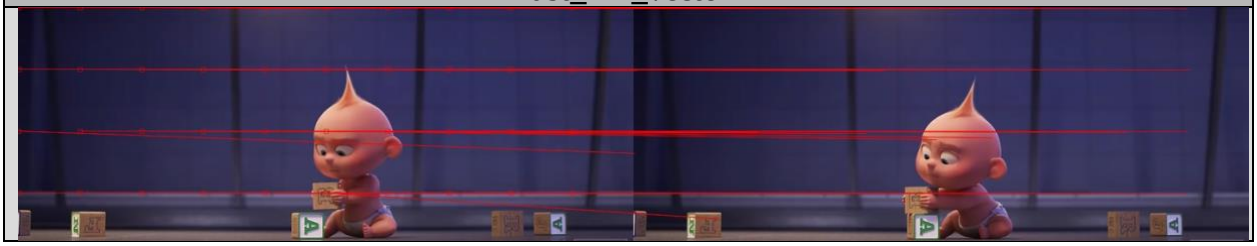
- Analysis of nnf_vector image:

The red lines correspond to the pixel inside the slant rectangle seemed point to the correct pixel locations while the pixel outside of the slant rectangle seemed point randomly. This matches the analysis in the nnf_color image.

- Analysis of reconstruct image:

The blurs and the artifacts on the legs and spots of the jaguar in the reconstruct image is similar to the previous set. However, we can observe that part of the leaves on the top right of the reconstruct source image is ‘fake’ with brown color rather than the expected green color. This probably because the algorithm decides the nearest neighbor vectors randomly, and we may not be able to match the green leaves in the source image with the small path of green in the target. And once we cannot create the expected ‘green’ matchings, it is more likely that we will create a reconstruction without desired green in it.

6. Two adjacent frames of video

source.jpg	target.jpg
	
last_nnf_color	**last_reconstruct_source**
	
last_nnf_vector	
	

Explanation:

- **Analysis of source.jpg and target.jpg:**

The source and target images are two adjacent frames of video.

- **Analysis of nnf_color image:**

We can see in the colorization image that most of the image is gray, this is because in the adjacent two frames of the video, the source and the target images are almost the same, except a little changes the baby made, therefore, there are only some colors for the pixels around the baby.

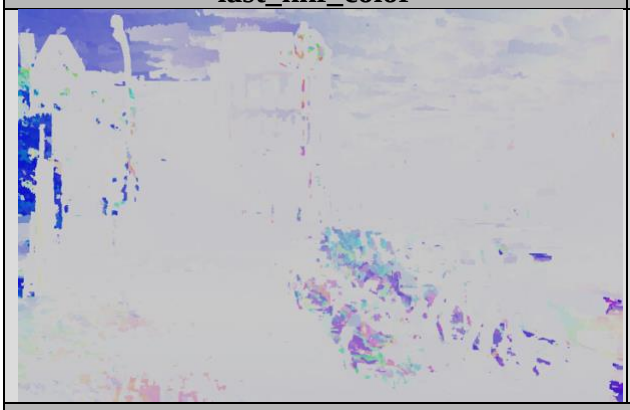
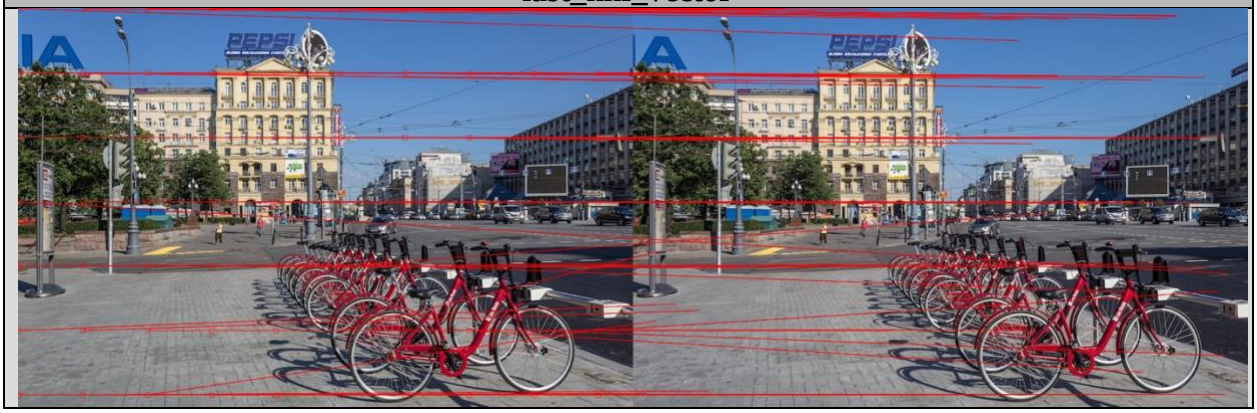
- **Analysis of nnf_vector image:**

Since the source and target images are almost the same, the pixels are matches pretty well.

- **Analysis of reconstruct image:**

Except a little blur, the algorithm works pretty good on this set.

7. “stereo” image pairs

source.jpg	target.jpg
	
last_nnf_color	**last_reconstruct_source**
	
last_nnf_vector	
	

Explanation:

- **Analysis of source.jpg and target.jpg:**

The source and the target images are the ‘stereo’ pairs of the same scene.

- **Analysis of nnf_color image:**

From the colorization image, we find that most of the regions are gray, this is because this pair of stereo images are just change the point of view horizontally a little bit. Therefore, most part are remained the same. Change the point of view makes the bicycles and advertise letters move the location, therefore, in order to reconstruct the source image using the pixels in the target image, we need to shift those pixels a little bit.

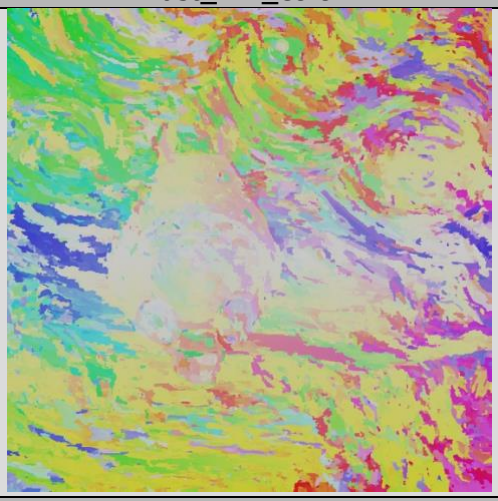
- **Analysis of nnf_vector image:**

The horizontal red line indicates what we said in the analysis of nnf_color image part that most of the pixels just remain the same.

- **Analysis of reconstruct image:**

Except the blur, the reconstruct source image has some artifacts on the tires of the bicycle, this probably because, originally, the bicycle tires part is complex, then when we horizontally change the point of view, this causes more likelihood of mis-matching.

8. Upside down pairs

source.jpg	target.jpg
	
last_nnf_color	**last_reconstruct_source**
	
last_nnf_vector	
	

Explanation:

- **Analysis of source.jpg and target.jpg:**

The target image is obtained by upside down the source image.

- **Analysis of nnf_color image:**

The colorization image is much difference then all the previous set, this is because we flip the source image to get the target image, to reconstruct the source image, we need to match the pixels with large magnitude of the distance vector.

- **Analysis of nnf_vector image:**

In the vector image, we can see that the pixels on the top match to the pixels on the bottom, vice versa.

- **Analysis of reconstruct image:**

Since this is an oil painting, we can see that there is more blurrier for the horizontal lines thane the vertical lines by observing the oil paint, and the overall blur level is higher than the previous sets.

9. Overall Conclusion

- **Conditions algorithm works well:**

- Slightly change the point of view (Canyon & Stereo image pairs)
- Zoom in (Deer)
- Two adjacent frames of video (Jaguar & set6)
- Zoom in and get the significant part to construct the target image (Jaguar2)

- **Conditions algorithm works bad:**

- Rotate and zoom in the image, or equivalently rotate the image dramatically such that lose some information (Jaguar2 & set8)
- Dramatically light change, for example, day and night of the same scene, have test with the algorithm, but cannot reconstruct, this probably because cannot find the similar pixel.