Exercise 4
3D Computer Vision

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1 Theory

1. the epipolar line of each point in a pair of rectified images is just along the horizontal scanlines. Thus in rectified images, with knowing a point, the correspondence can be searched along the scanline.

2. The triangulation can be simplified based on rectified images, the Z-coordinate is depend on the disparity. Based on Z-coordinate, focal length, and image point, we can calculate X and Y coordinates.

3. Image rectification is not a good approach in multi-view dense reconstruction, since the correspondences might not exist in any two images at the same time, which could lead to solving a similar triangle problem with infinity scale.

2 Practical

1. (a) see code

   (b) the pixel based disparity map is shown in Figure 3.

Figure 1: Left.

Figure 2: Right.

Figure 3: pixel-based matching.

   (c) pixel based disparity map is not a good representation of the original scene. Because there are too many possible matches on the other images, many points look similar.

2. (a) see code.

   (b) The disparity maps with 7x7 window computed by ncc and ssd are shown in Figure 4 and 5.

   (c) See figure 6-11

   (d) the quality of the disparity map improved a little bit in window-based results. Since the similar points are reduced based on a bigger matching window.

   (e) see code

   (f) See Figure 12.

3. (a) The result is shown in the figure 13-14.

   (b) The result is shown in the figure 15-16.
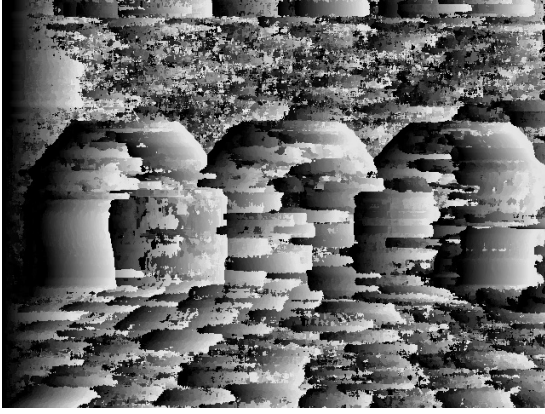
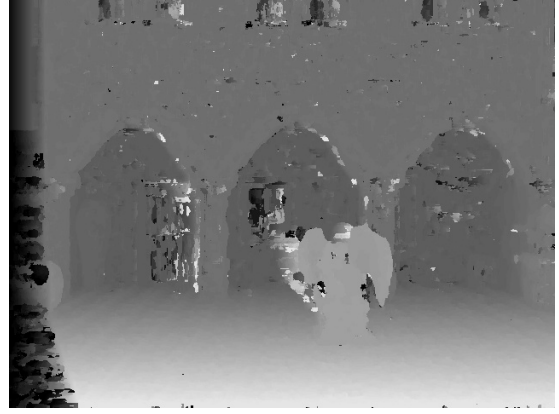Figure 4: nccDisparity7x7.jpg

Figure 5: ssdDisparity7x7.jpg

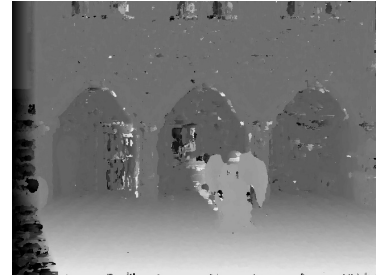Figure 6: ssd disparity 3x3.

Figure 7: ssd disparity 5x5.

Figure 8: ssd disparity 7x7.

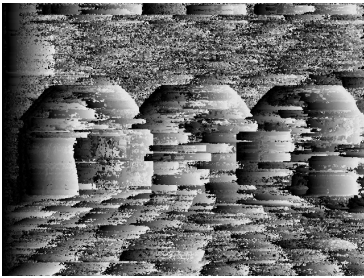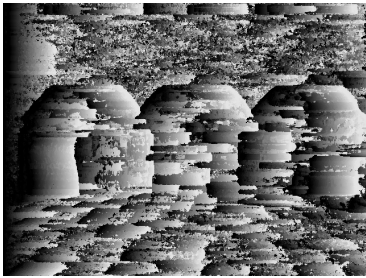
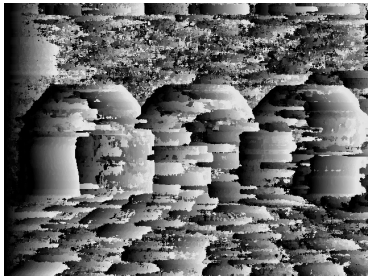Figure 9: ncc disparity 3x3.

Figure 10: ncc disparity 5x5.

Figure 11: ncc disparity 7x7.

(c) with bigger window size, the reconstruction quality goes better with fewer isolated areas, with smaller window size, the quality goes worse but with more details. With the size of window increasing, the the processing time increases as well.
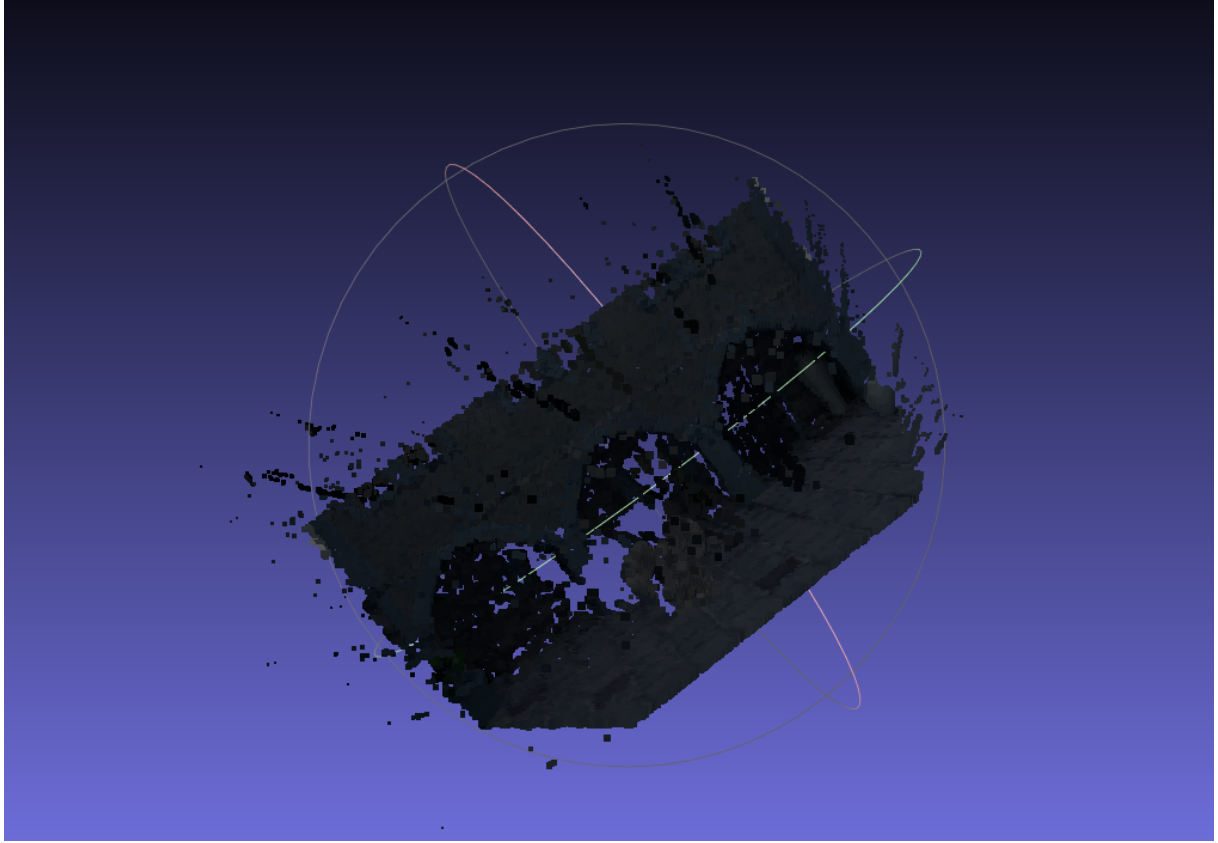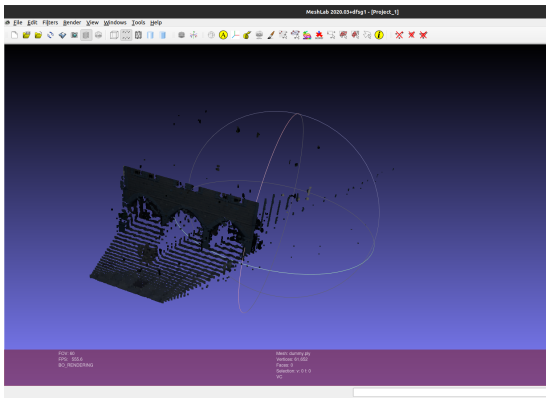
Figure 12: Meshlab Screenshot ncc 7x7.
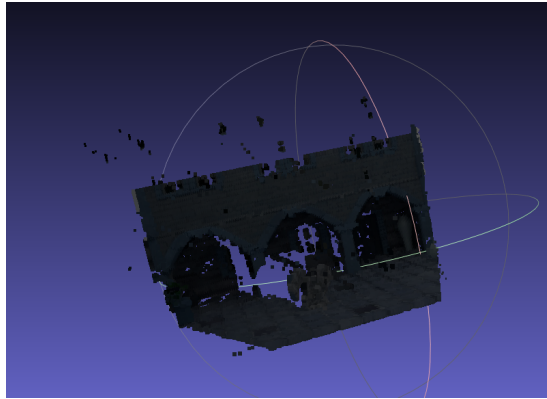

Figure 13: ssd Filtering N=3.
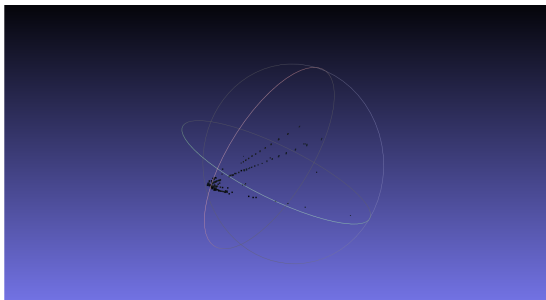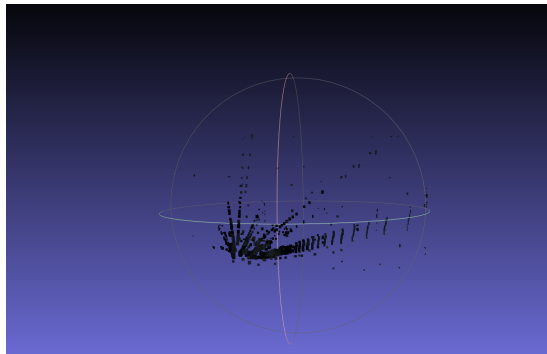

Figure 14: ssd Filtering N=4.

Figure 15: ncc Filtering N=2.

Figure 16: ncc Filtering N=4.