Computer Vision HW4 Report

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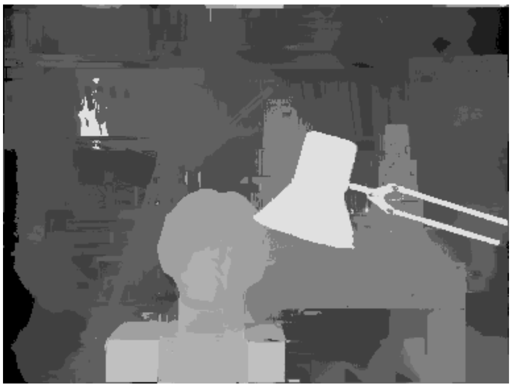
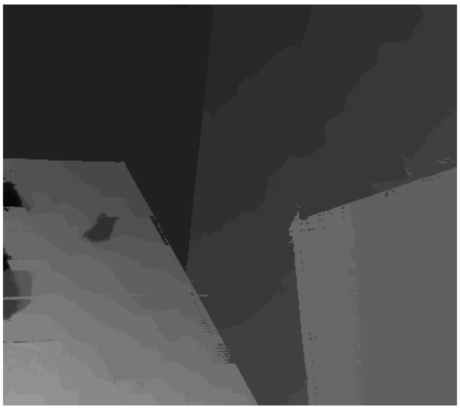
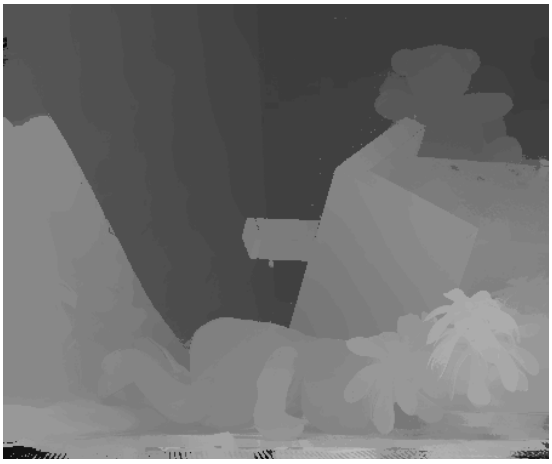
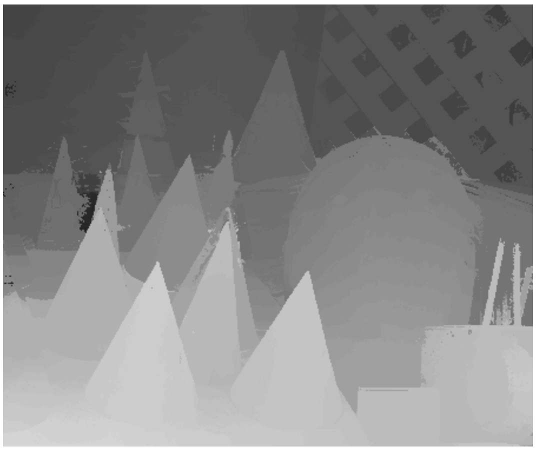
Visualize the disparity map of 4 testing images.

Tsukuba	Venus
	
Teddy	**Cones**
	

Report the bad pixel ratio of 2 testing images with given ground truth (Tsukuba/Teddy).

	bad pixel ratio
Tsukuba	4.04%
Teddy	9.61%

Describe your algorithm in terms of 4-step pipeline.

1. **Cost computation**

   First, I used the brute force method to implement the census cost estimation. However, the implementation time was over time (around 17 mins). So, I tried to improve this algorithm. I first computed the local binary matrix from both the left and right images. By doing so, I could use the matrix operation to accelerate the implementation time (around 25 s).

2. **Cost aggregation**

   I used the bilateral filters to filter out the disparity maps. The parameters of the jointBilateralFilter is important. I have tried several parameters, as shown below:

Tsukuba image	Bad pixel ratio
jointBilateralFilter(30, 5, 5)	4.52%
jointBilateralFilter(9, 5, 5)	4.36%

jointBilateralFilter(30, 10, 10)	4.81%
jointBilateralFilter(20, 5, 5)	4.27%
jointBilateralFilter(20, 10, 10)	**4.04%**

3. Disparity optimization

I used the winner_take_all algorithm, which can be implemented by argmin.

```
    winner_L = np.argmin(cost_list_L, axis=2)
    winner_R = np.argmin(cost_list_R, axis=2)
```

4. Disparity refinement

First, I used the left-right consistency check method to enhance the quality of disparity map, as shown below.

```
for i in range(h):
        for j in range(w):
            if winner_L[i, j] == winner_R[i, j - winner_L[i, j]]:
                continue
            else:
                winner_L[i, j]=-1
```

Second, I used hole filling to fill out the invalid disparity map generated from the left-right consistency check method, as shown below.

```
for i in range(h):
        for j in range(w):

            if winner_L[i, j] == -1:
                l_idx = j - 1
                r_idx = j + 1
                while l_idx >= 0 and winner_L[i, l_idx] == -1:
                    l_idx -= 1

                if l_idx < 0:
                    FL = 100000000
                else:
                    FL = winner_L[i, l_idx]

                while r_idx < w and winner_L[i, r_idx] == -1:
                    r_idx += 1

                if r_idx > w - 1:
                    FR = 100000000
                else:
                    FR = winner_L[i, r_idx]
                winner_L[i, j] = min(FL, FR)
```

Finally, the weightedMedianFilter is used to enhance the disparity map.

```
labels = xip.weightedMedianFilter(Il.astype(np.uint8), winner_L.astype(np.uint8), 18, 1)
```