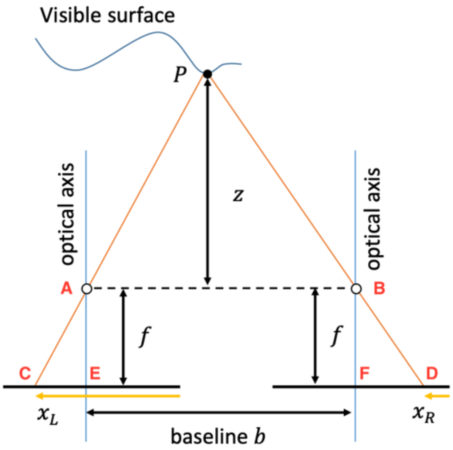
Computer Vision Assignment 4

機械五 b04605067 黃沛沅



1. Assume the optical axis is right on the middle of the screen perspectively and the length of each screen is l,

   so we can say that $\overline{CE} = x_L - \frac{l}{2}$, and $\overline{DF} = \frac{l}{2} - x_R$.

   Apply the similarity of triangle, $\Delta PAB \sim \Delta PCD$.

   We can write down the equation:

$$\frac{z}{\overline{AB}} = \frac{z+f}{\overline{CD}} = \frac{z+f}{\overline{CE} + \overline{EF} + \overline{FD}}$$

$$\Rightarrow \frac{z}{b} = \frac{z+f}{x_L - \frac{l}{2} + b + \frac{l}{2} - x_R} = \frac{(z+f)}{b + x_L - x_R}$$

$$\Rightarrow \frac{z}{b} = \frac{z+f}{b+d}$$

$$\Rightarrow z * b + z * d = b * z + b * f$$

$$\Rightarrow z * d = b * f$$

$$\Rightarrow d = \frac{f * b}{z}$$

2. Algorithm:

   (1) Cost Computation:

   For cost computation, I implemented sum-of-squared-differences algorithm. I stored cost in a h*w*ch matrix and computed cost with respect to the disparity. Moreover, I also did padding for both left and right image cost.

   (2) Cost Aggregation:

   For cost aggregation, I used box blur in cv2 package. I also tried other filter, but it cannot have best of all images, so I chose the best performance in average bad pixel ratio.

   (3) Disparity Optimization:

   For disparity optimization, I implemented winner-take-all algorithm. It's simple to implement. Just take the minimum of the cost in all disparity of every single pixel.

   (4) Disparity Refinement:

   For disparity refinement, I did consistency check, hole filling and passed it through weighted median filter.

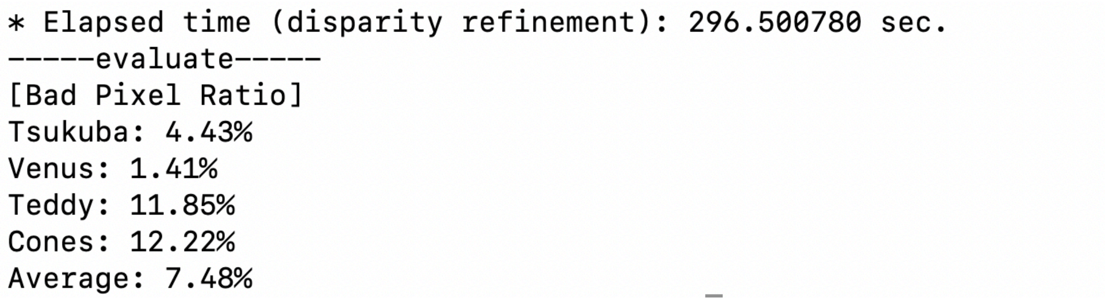
For consistency check, I checked if each of the pixel of disparity of the left image can match the one of the right image. If not, set the disparity of that pixel to be 0, and record the position in lists.

In consistency check, we made a lot of hole (by setting a lot of zeros in disparity map). Therefore, we had to do hole filling.

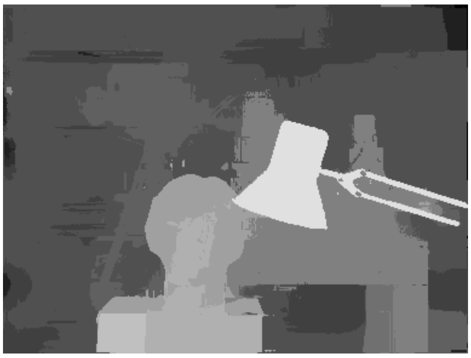
For hole filling, we took the minimum of the non-zero pixel of value aside of the hole.

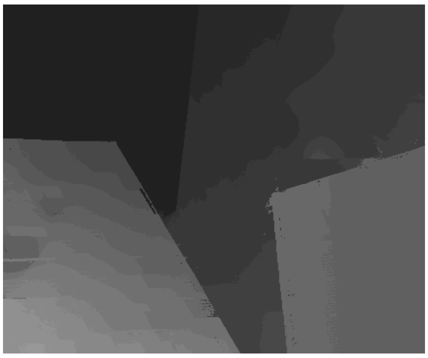
Finally, I let the disparity map go through weighted median filter to get the final result.

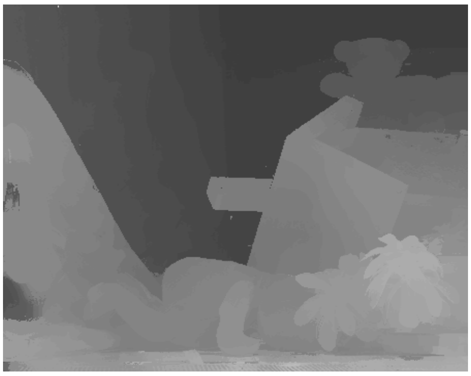
Evaluation:

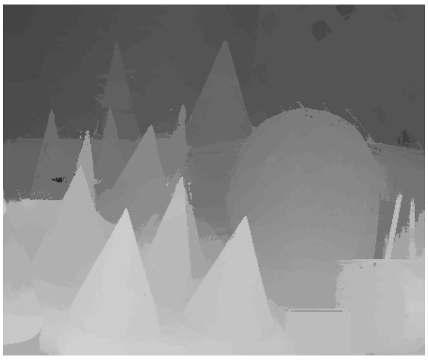


```
* Elapsed time (disparity refinement): 296.500780 sec.
-----evaluate-----
[Bad Pixel Ratio]
Tsukuba: 4.43%
Venus: 1.41%
Teddy: 11.85%
Cones: 12.22%
Average: 7.48%
```









Reference: The lesson lectures.