

## Assignment 2 – Written Answers

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1.

$$1. \text{ ssdd}(1,2,2) =$$

$$\begin{array}{|c c c|} \hline 2 & 3 & 4 \\ \hline 7 & 8 & 9 \\ \hline 12 & 13 & 14 \\ \hline \end{array} \quad \begin{array}{|c c c|} \hline 1 & 1 & 1 \\ \hline 2 & 2 & 2 \\ \hline 3 & 3 & 3 \\ \hline \end{array} \Rightarrow (2-1)^2 + (3-1)^2 + (4-1)^2 + (7-2)^2 + (8-2)^2 + (9-2)^2 + (12-3)^2 + (13-3)^2 + (14-3)^2 = 426$$

$$\text{ssdd}(1,2,3) = 426 \quad (\text{same as before})$$

$$\begin{array}{|c c c|} \hline 2 & 3 & 4 \\ \hline 7 & 8 & 9 \\ \hline 12 & 13 & 14 \\ \hline \end{array} \quad \begin{array}{|c c c|} \hline 1 & 1 & 1 \\ \hline 2 & 2 & 2 \\ \hline 3 & 3 & 3 \\ \hline \end{array}$$

$$\text{ssdd}(2,3,0) = (8-2)^2 + (9-2)^2 + (10-2)^2 + (15-3)^2 + (16-3)^2 + (17-3)^2 + (18-4)^2 + (19-4)^2 + (20-4)^2 = 1191$$

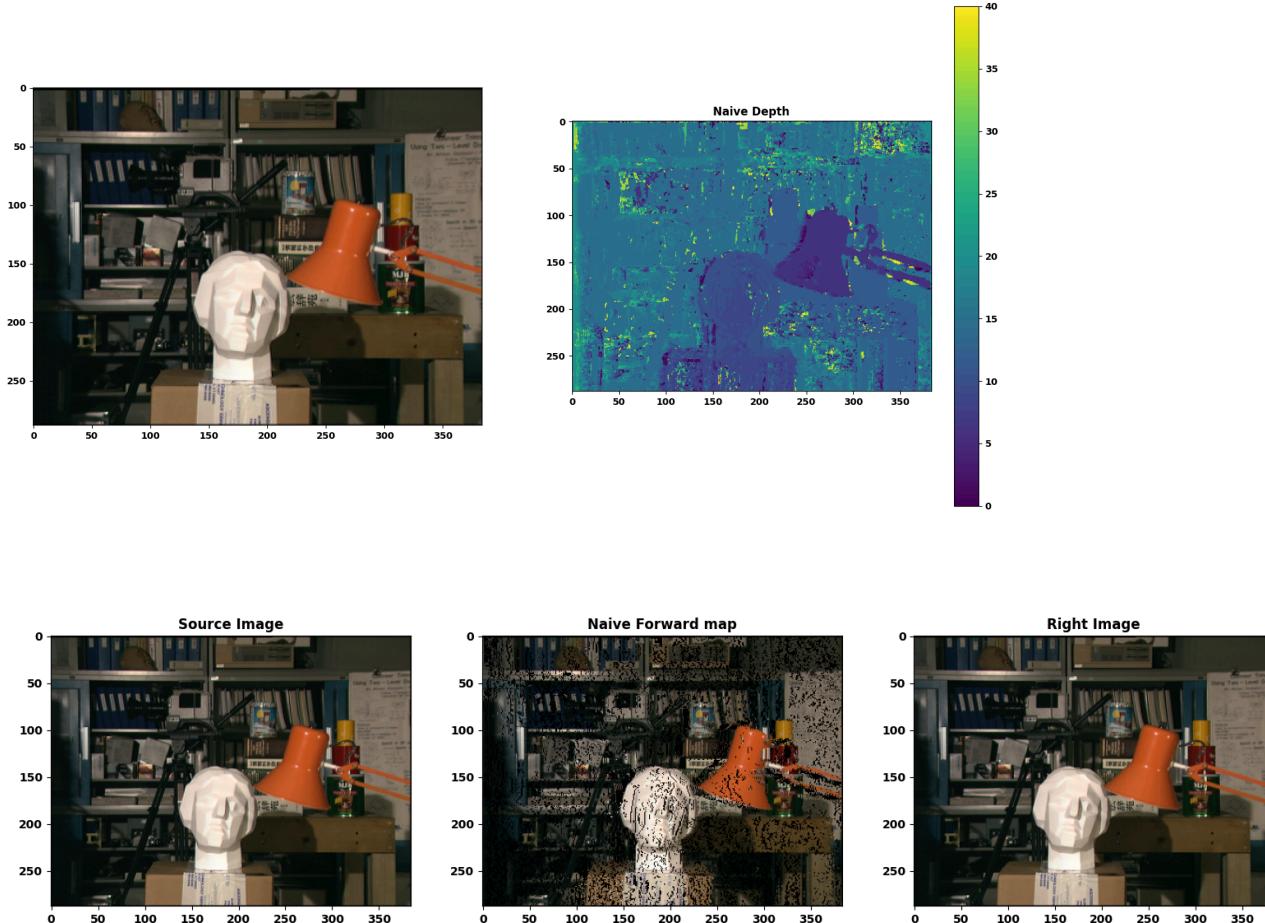
$$\text{ssdd}(2,3,1) = 1191 \quad (\text{same as before})$$

$$\begin{array}{|c c c|} \hline 8 & 9 & 10 \\ \hline 13 & 14 & 15 \\ \hline 18 & 19 & 20 \\ \hline \end{array} \quad \begin{array}{|c c c|} \hline 2 & 2 & 2 \\ \hline 3 & 3 & 3 \\ \hline 4 & 4 & 4 \\ \hline \end{array}$$

2. In code.

3. In code.

4. The images below are the result of the naive approach. The problem with using the naive approach is that we might choose a local minima in many cases. In addition, places in the images which have areas with very similar disparities can cause a labeling mistake.

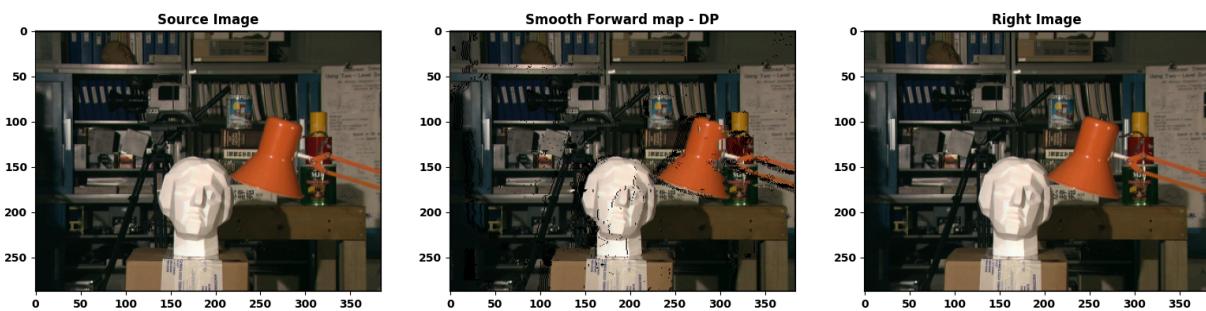
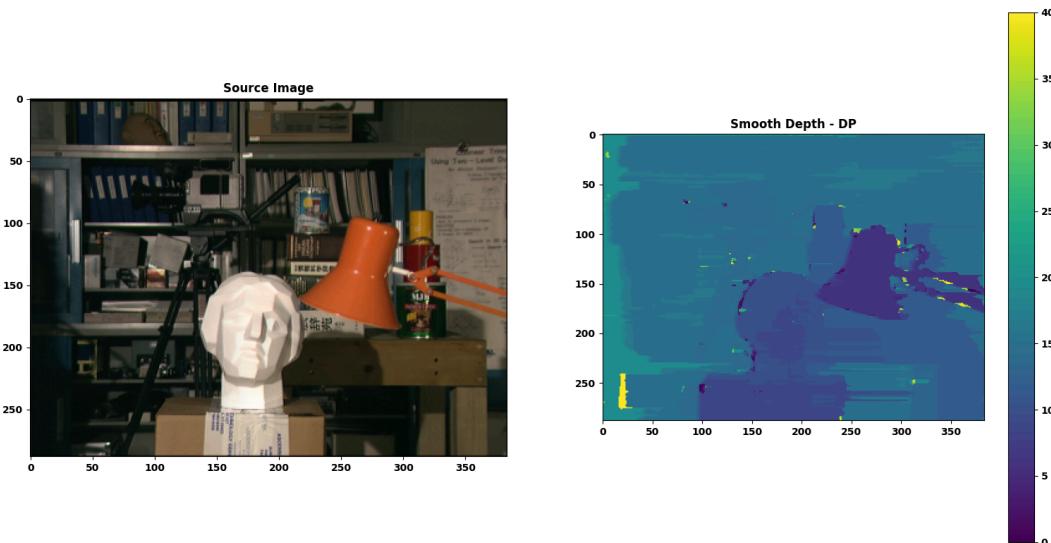


5. In code.

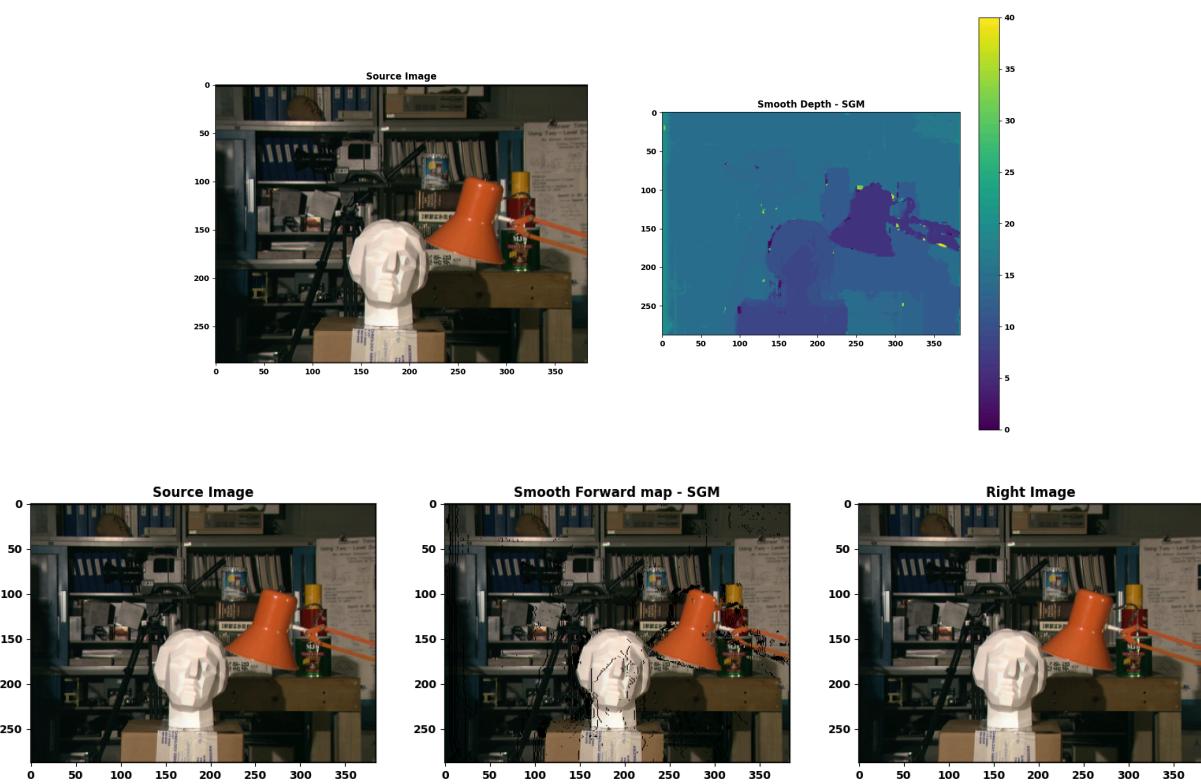
6. In code.

7. The Depth map using Dynamic Programming to smooth disparity on the horizontal axis can be seen in the images below.

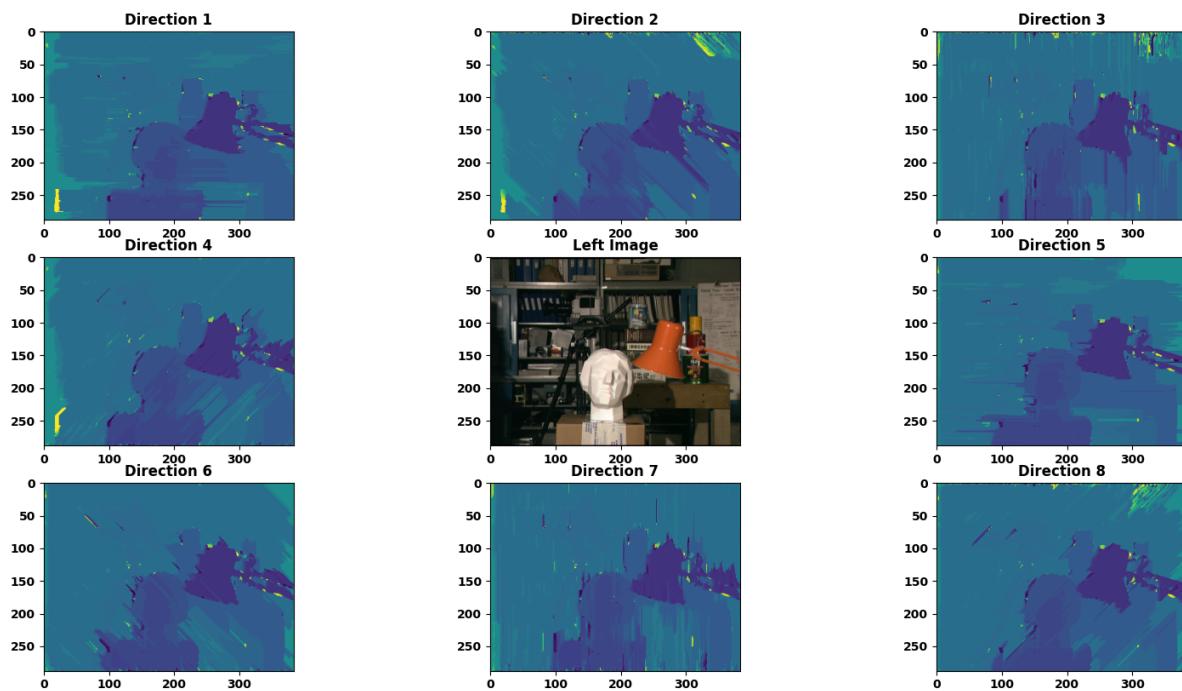
As expected, the smoothing approach resulted with a much smoother depth map (compared to the naive approach) and with much less noise (as can be seen in the forward map). Yet, the image still contains a bit of black areas.



8. In code.
9. In code.
10. In code.
11. Below are the depth map and the image after using the Semi Global Matching (SGM) approach. The difference between the obtained depth map in SGM to the naive approach is that now we get a much smoother depth map (in all directions). Regarding the image obtained in this approach, we can see that there is much less noise compared to the naive approach but we still have a bit of noise (similar to the smoothing approach we have implemented before).



## 12. Depth map per direction:



13.

We chose a tough image with some high frequencies and a variety of disparities. Therefore we have penalized serious similarities with a high shift (cost2) and we used a pretty big disparity range: cost1=2, cost2=16, win\_size=3, disparity\_range=48. More parameter tuning shall be further done to obtain better results.

These are the outputs of our chosen pair of images (we still have a lot of artifacts):

