# Assignment – 3

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GITHUB LINK

**Task – 1 –** Extrinsic matrix contains rotation and translation information of camera as follows

$$Ext = \begin{bmatrix} R_{3x3} & T_{3x1} \\ 0 & 1 \end{bmatrix}$$

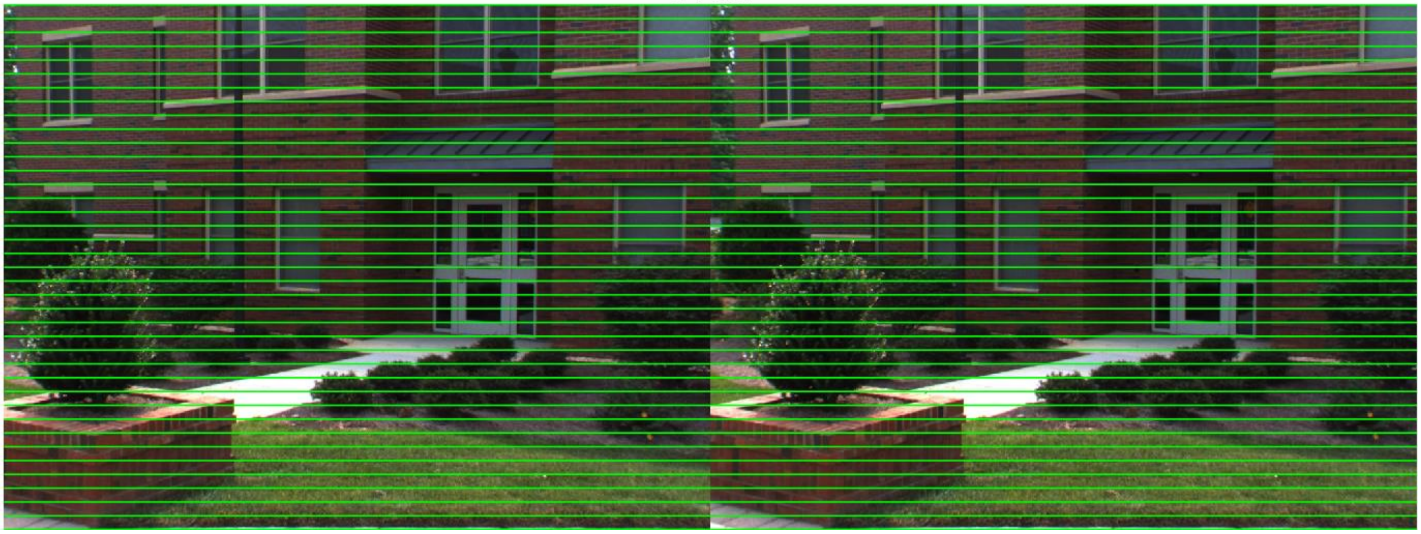
After finding this information, we can easily compute camera center with following formula

$$C = -R^T * T$$

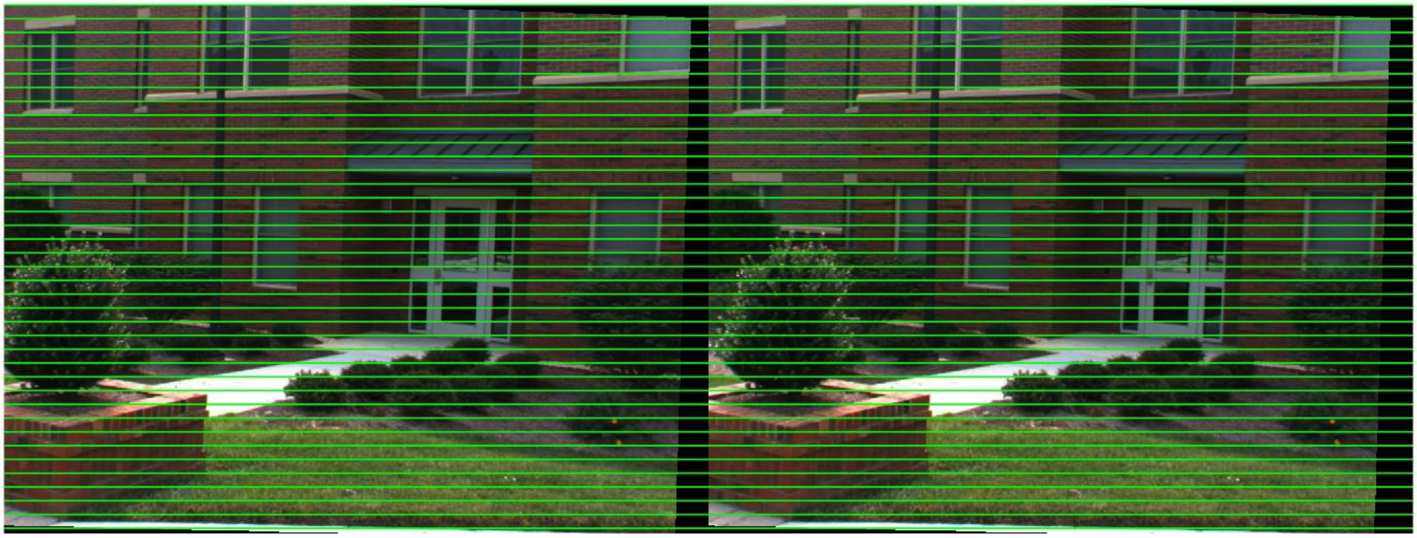
Where C is the camera center.

**Task – 2 –** For this task, I used the algorithm given in 34th slide of Lecture 13 and I got following results

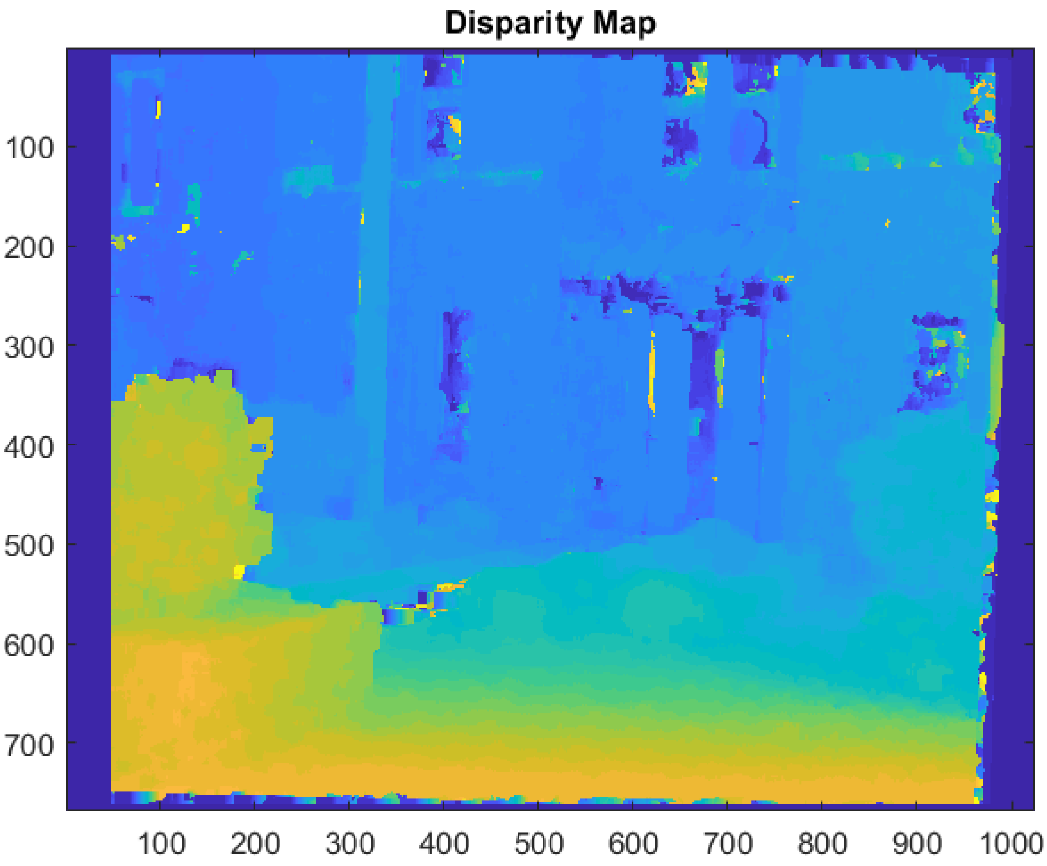
BEFORE



AFTER



**Task 3 –** For this task, I used window size of 8 with maximum distance of 40 and I got following disparity map.



As you noticed, we have disparity computation failures at boundaries of the objects in the image. This is because we chose small window size that is highly sensitive to noise. If we want to avoid this problem, we could increase the window size but then we will have reduced precision and less details about depth.

**Task 4 –** For this task, I have a disparity-to-depth mapping matrix as follows

$$Q = \begin{bmatrix} 1 & 0 & 0 & -c_x \\ 0 & 1 & 0 & -c_y \\ 0 & 0 & 0 & f \\ 0 & 0 & -\frac{1}{T_x} & \frac{(c_x - c'_x)}{T_x} \end{bmatrix}$$

Where c and c' are the left and right camera center information and T is the baseline length.

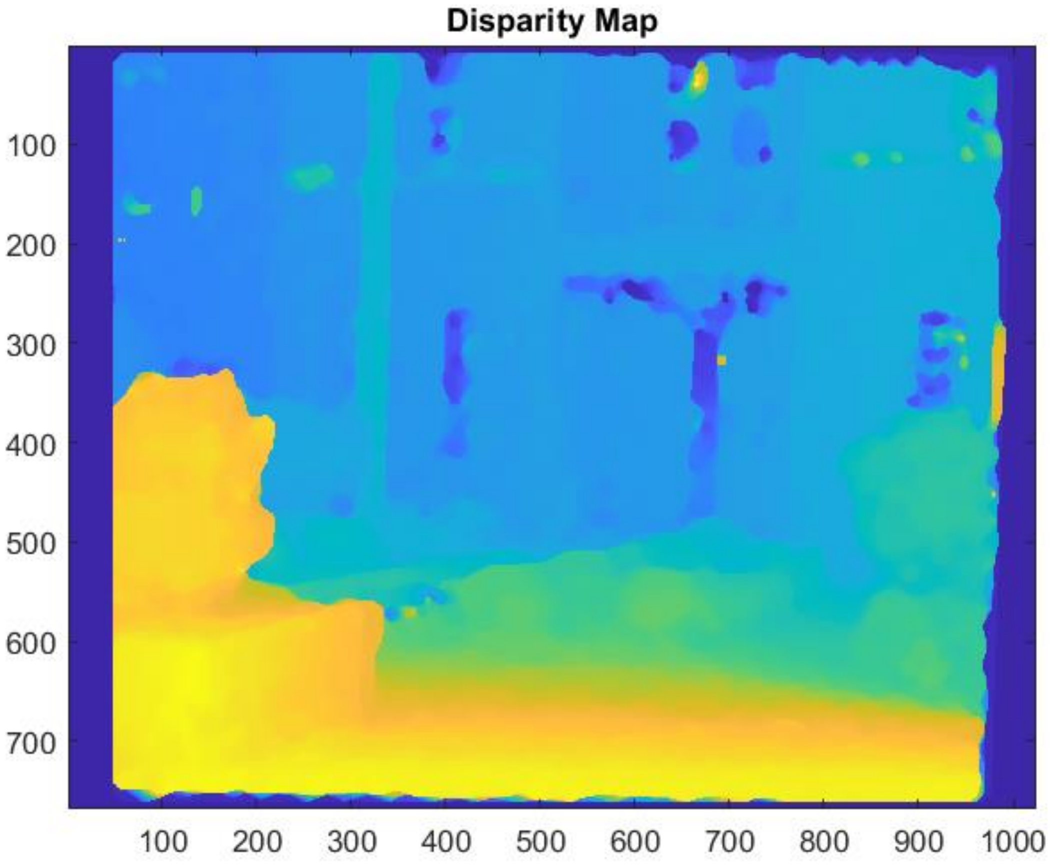
After this, I converted image coordinates with following formula.

$$\begin{bmatrix} X \\ Y \\ Z \\ W \end{bmatrix} = Q \begin{bmatrix} x \\ y \\ disparity(x, y) \\ 1 \end{bmatrix}$$

Where x and y are the image coordinates. To convert 4D points to 3D points I divided new coordinates by W.

**Task 5 –** After successful conversion, I used Matlab functions (pcwrite and pointCloud) to generate PLY format file.

**Bonus –** I used the formula given in guideline followed by median filtering of the same window size in Task 3 to have better disparity map and I got following smoother map. In corner cases, such as when i is in 1st index I took NCC scores for 2nd and 3rd and in the same way when i is in last index I took NCC score for i-1 and i-2.


Disparity Map