

Homework Assignment 3: Geometry

I. Calibration

a. Matrix M, projection, and residual

- i. The matrix M you recovered from the normalized points (3x4)
 $\begin{bmatrix} -0.45827554 & 0.29474237 & 0.01395746 & -0.0040258 \\ 0.05085589 & 0.0545847 & 0.54105993 & 0.05237592 \\ -0.10900958 & -0.17834548 & 0.04426782 & -0.5968205 \end{bmatrix}$
- ii. The $\langle u, v \rangle$ projection of the last point given your M matrix
 $[0.1419060767490895, -0.4518430095960978]$
- iii. The residual between that projected location and the actual one given
0.00156213604622

b. Calibration

- i. Average residual for each trial of each k arranged in (3 x 10) matrix (first row for k = 8, second row for k = 12, third row for k = 16)
 $\begin{bmatrix} 2.3248861832944527, 1.4867745504280934, 3.1312041528962973, 7.833929692711857, 1.9007750887950876, 1.7726152147011218, 4.616783725283263, 2.7048094213990606, 0.9613511171196245, 1.1046423703300197, 1.2688916046780148, 1.167052637574858, 1.818536080537236, 1.5630336980027313, 1.0940584564149745, 1.141851067617253, 3.5343150800356975, 0.721704141572998, 1.03629139951458, 1.4654185483605133, 1.2494424784162192, 0.8503244772244554, 1.4952959368049283, 0.9306438971944166, 1.1314515072594533, 0.7701421839576832, 1.5608609193262533, 1.7764204531315846, 1.2762748963307256, 1.7279907288918281 \end{bmatrix}$
- ii. Explain any difference you see between the results for the different k's
By varying number for k and using different random point we can calculate various M matrixes. If we were using all the points (like in 1B-i) and some of them were outliers, we would've gotten a larger error. But by trying so many different combinations and choosing the one with the smallest error we lower our chances of having used an outlier in our calculations. Number of points doesn't matter as whether they are outliers or not.
- iii. The best M matrix (3 x 4)
 $\begin{bmatrix} -6.99622131e-03 & 4.08704168e-03 & 1.28601012e-03 & 8.25800158e-01 \\ -1.56400122e-03 & -1.01840503e-03 & 7.33016833e-03 & 5.63842122e-01 \\ -7.69925683e-06 & -3.69874758e-06 & 1.90469148e-06 & 3.41185842e-03 \end{bmatrix}$

c. Camera center

- i. The location of the camera in real 3D world coordinates
 $[303.08847721245854, 307.200922059899, 30.42816787897266]$

II. Fundamental Matrix Estimation

a. F – full rank

- i. The matrix F generated using least squares function
 $\begin{bmatrix} -6.60698417e-07 & 7.91031621e-06 & -1.88600198e-03 \\ 8.82396296e-06 & 1.21382933e-06 & 1.72332901e-02 \end{bmatrix}$

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$[-9.07382302e-04 \ -2.64234650e-02 \ 9.99500092e-01]$

b. F – 2 rank

i. Fundamental matrix F

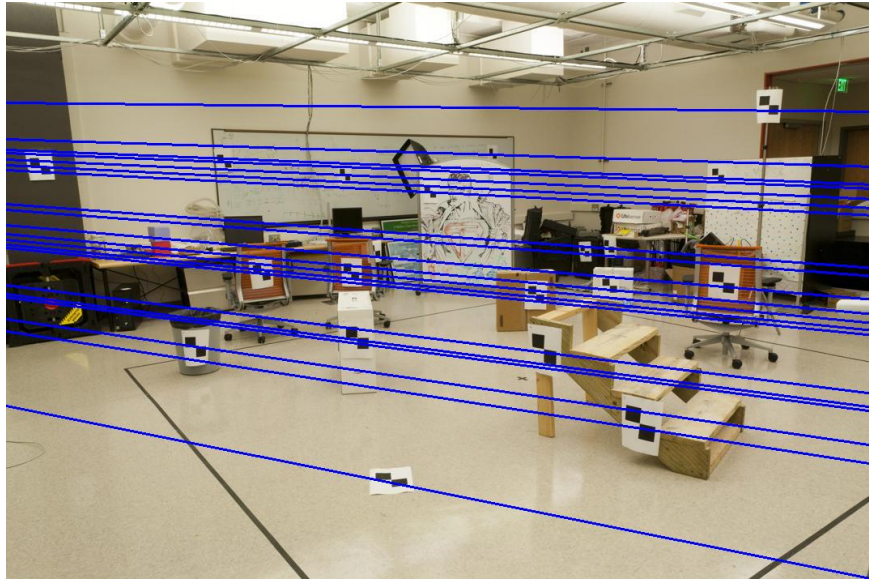
$[[-5.36264199e-07 \ 7.90364771e-06 \ -1.88600204e-03]$

$[\ 8.83539184e-06 \ 1.21321685e-06 \ 1.72332901e-02]$

$[-9.07382264e-04 \ -2.64234650e-02 \ 9.99500092e-01]$

c. Lines

i. ps3-2-c-1



ii. ps3-2-c-2

