Theory- HW 3

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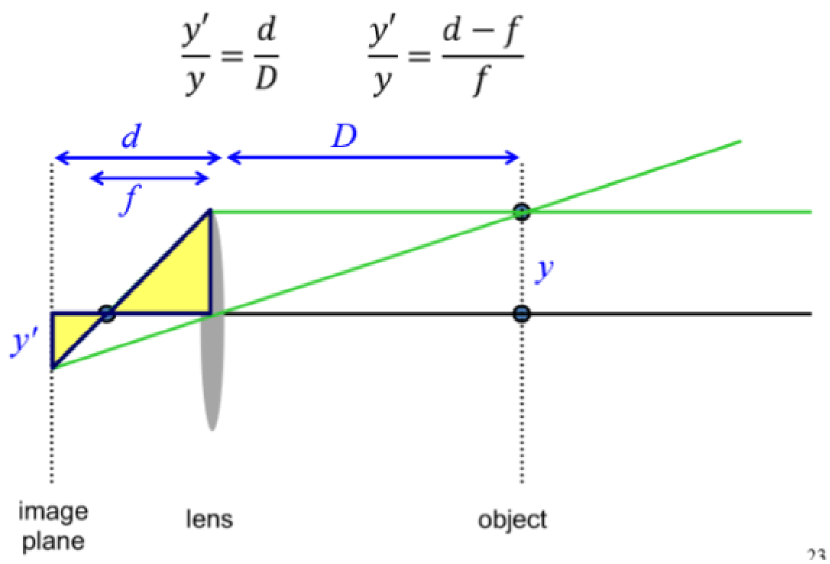
마리암

#1



As we have d= (1+m)f and we need to calculate the distance of image plan to the object that is equal to D+d so as we see in the above image from the lecture $\frac{d-f}{f} = \frac{d}{D}$

$$D = \frac{fd}{d-f}$$

$$D = \frac{(1+m)f^2}{(1+m)f - f} = \frac{(1+m)f^2}{fm} = f\left(\frac{1}{m} + 1\right)$$

$$D + d = f\left(\frac{1}{m} + 1\right) + (1+m)f = \left(\frac{1}{m} + 2 + m\right)f$$

Proved the distance is equal to the $\left(\frac{1}{m} + 2 + m\right)f$

#2

a- If points p and q are points in real world so we do projection to obtain 2d image plane to make homogeneous coordinates as following:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

So to apply homography we will need a 3×3 matrix

b- The rank of point vectors are 2 as we are working in 2D with homogeneous coordinates so the rank of S should be 3 equal to the number of rows. If the rank be smaller so the output point's 3rd row will be parallel to another row that will change the output image.

c- The minimum number of points needed would be S's(row*col -1)/2 as we have 2 equation for each pixel . in this example we need at least 4 points

d-

$$\begin{bmatrix} x_1 & y_1 & 1 & 0 & 0 & 0 & -x'_1 x_1 & -x'_1 y_1 & -x'_1 \\ 0 & 0 & 0 & x_1 & y_1 & 1 & -y'_1 x_1 & -y'_1 y_1 & -y'_1 \\ & & & & \vdots & & & & \\ x_n & y_n & 1 & 0 & 0 & 0 & -x'_n x_n & -x'_n y_n & -x'_n \\ 0 & 0 & 0 & x_n & y_n & 1 & -y'_n x_n & -y'_n y_n & -y'_n \end{bmatrix} \begin{bmatrix} h_{00} \\ h_{01} \\ h_{02} \\ h_{10} \\ h_{11} \\ h_{12} \\ h_{20} \\ h_{21} \\ h_{22} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \vdots \\ 0 \\ 0 \end{bmatrix}$$

We will have 2N equations which make a 2N×9 matrix for A and a 9×1 for b that all b's elements equal to zero.