Triangulation Practical Exercise

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The triangulation is the image taken by two cameras of a common 3D world coordinate that from a triangle with both optical axis and the point itself form the triangulation.now we have the images and we want to extract the 3D points from the image points.so let us consider m be the homogeneous coordinates of the image points and M be the Corresponding points in the World coordinates then,$m_i \cong PM_i$ is in equality up to a scale for all the index of the image,where P is the Projective matrix.

$$\begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = P_{3,4} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix} \tag{1}$$

where $P = KR[I|-T]$,K is the intrinsic parameter,R is the rotation matrix and T is the position of the camera in the 3D world.As P is the unknown that we to find,let is be filled with variable names.

And P be $P = \begin{bmatrix} P11 & P12 & P13 & P14 \\ P21 & P22 & P23 & P24 \\ P31 & P23 & P33 & P34 \end{bmatrix}$ so,

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \begin{bmatrix} P11 & P12 & P13 & P14 \\ P21 & P22 & P23 & P24 \\ P31 & P23 & P33 & P34 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix} \tag{2}$$

$$u = \frac{p_{11}X + p_{12}Y + p_{13}Z + p_{14}}{w * (p_{31}X + p_{32}Y + p_{33} + p_{34})} \tag{3}$$

$$w = \frac{p_{21}X + p_{22}Y + p_{23}Z + p_{24}}{w * (p_{31}X + p_{32}Y + p_{33} + p_{34})} \tag{4}$$

we have 2 equations for a point and 4 unknowns,so we can use the second image's equation to solve for the the 3D points. I have implemented it on the matlab in the form of AX = 0 to solve with SVD to obtain the 3D points. then I add the Gaussian error to the images coordinates, then solved to get the error.
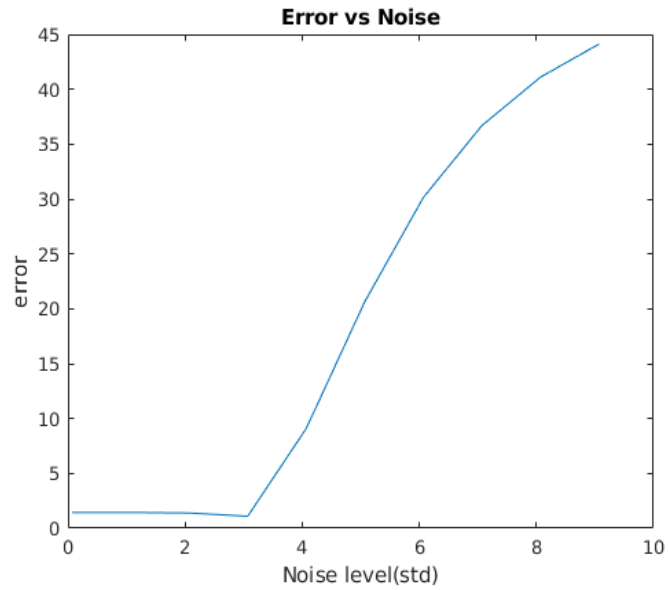

Figure 1: Triangulation

we see that noise increases as the noise level(std) increases, the error calculated is the absolute error. Now, that i have results for one 3D points.I made a function make_3world to create the 3d world points to test for more point.then same SVD technique can used to get the 3D world points.
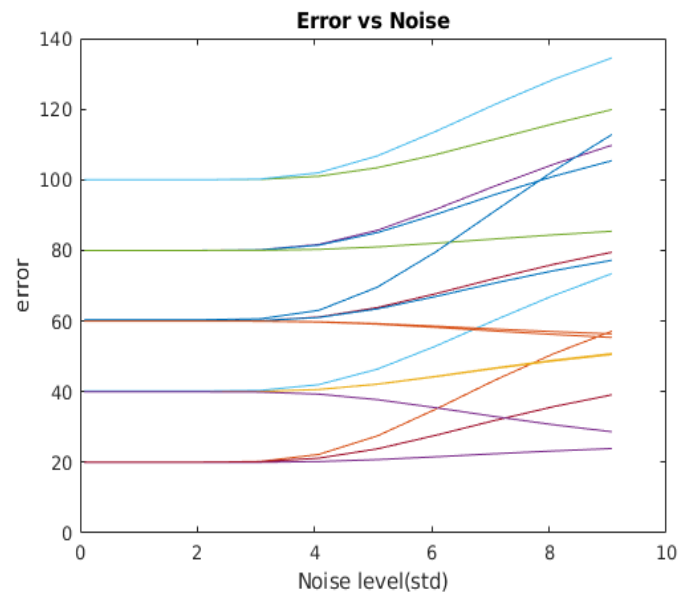
Figure 2: Triangulation

The here also is calculated by the absolute difference between the real and the noised images.The error here also is raising as the Noise level is raising.