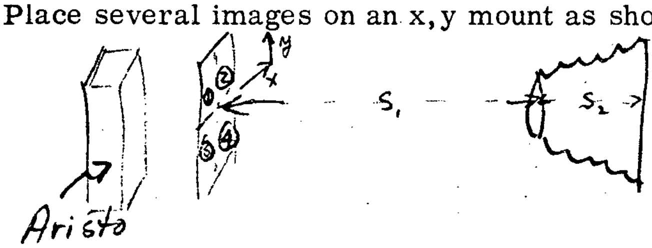
10/12/66
PSC 25X1

PROGRAM ORIENTATION NOTES

To perform a meaningful experiment it is necessary to obtain several types of images (e.g., resolution target, binary image, continuous tone images) containing the same aberration. Thus, for a given aberration, the related hologram filter and inverse squared amplitude filter can be used to compensate for the aberration, and the results from the different types of targets will allow a meaningful analysis. First, let us choose for the impulse response a simple asymmetric shape that is reproducible and yet easily analyzed. One possible response could be 'L' shaped or on arc of a circle. Several images can be aberrated in exactly similar ways by simultaneously photographing them as a group while the aberration is being introduced. An outline of one possible experiment follows:

1. Place several images on an x,y mount as shown

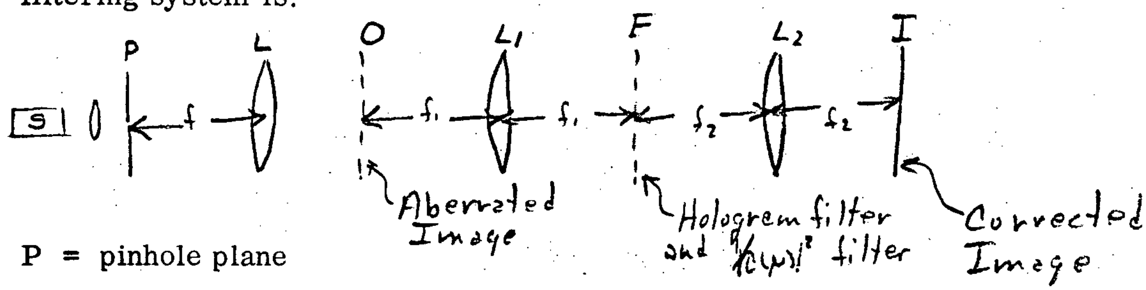


2. During an exposure, have the x,y mount moved in two orthogonal directions consecutively to effect an 'L' shaped smeared impulse response.

   (Note: If the magnification of the camera is small then the x,y mount can be moved by correspondingly larger distances and any undesired motion errors introduced will have a smaller effect in the final aberrated image.)

3. All (4) of the targets should have a reference point. Even though only one separated impulse response is necessary to construct the F. T. hologram filter and the inverse filter, it is advantageous to have the impulse response recorded to enable a measure of how well each image is corrected after filtering.

4. Because of the scale changes in diffraction caused by changes in the coherent radiation wavelength, it will be necessary to perform spatial filtering with a laser as a light source, or have the capability to alter the focal lengths of the first transform lens. The spatial filtering system is:



P = pinhole plane

L = collimating lens

L_1 and L_2 are the 1st and 2nd transform lenses respectively

O plane contains the aberrated image

$$I_{im}(y) = \int I_{ob}(x)\, S(y-x)\, dx \tag{1}$$

$$= I_{ob}(y) * S(y) \tag{2}$$

F plane contains the Fourier transform of the aberrated image

$$\tilde{I}_{im}(\mu) = \tilde{I}_{ob}(\mu) \circ \tau(\mu) \tag{3}$$

At the F plane we multiply (3) by

(a) the hologram filter $\left(1 + |\tau(\mu)|^2 + \tau^*(\mu)\, e^{ikx_o\mu} + \tau(\mu)\, e^{-ikx_o\mu}\right)$

(b) the inverse amplitude filter $1/|\tau(\mu)|^2$

to obtain:

$$\overset{\sim 1}{I}_{im}(\mu) = \frac{\tilde{I}_{ob}(\mu)\, \tau(\mu)}{|\tau(\mu)|^2}\left(1 + |\tau(\mu)|^2 + \tau^*(\mu)\, e^{ikx_o\mu} + \tau(\mu)\, e^{-ikx_o\mu}\right) \tag{4}$$

or from the 3rd term

$$\tilde{I}^{im}_{(3)}(\mu) = \tilde{I}_{ob}(\mu)\, e^{ikx_o\mu} \qquad (5)$$

The I plane contains:

$$I^{im}_{3}(z) = I_{ob}\left(\frac{z}{\lambda f} - \frac{x_o}{z}\right) \qquad (6)$$

which is the corrected image centered about the off-axis term determined by $e^{ikx_o\mu}$.

Note: In choosing imagery it is advantageous to have one military orientated scene such as one containing tanks or the like, or an aerial scene of an industrial complex.