CS 482 - HW1
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1. Histogram Equalization

2. Contrast Stretching

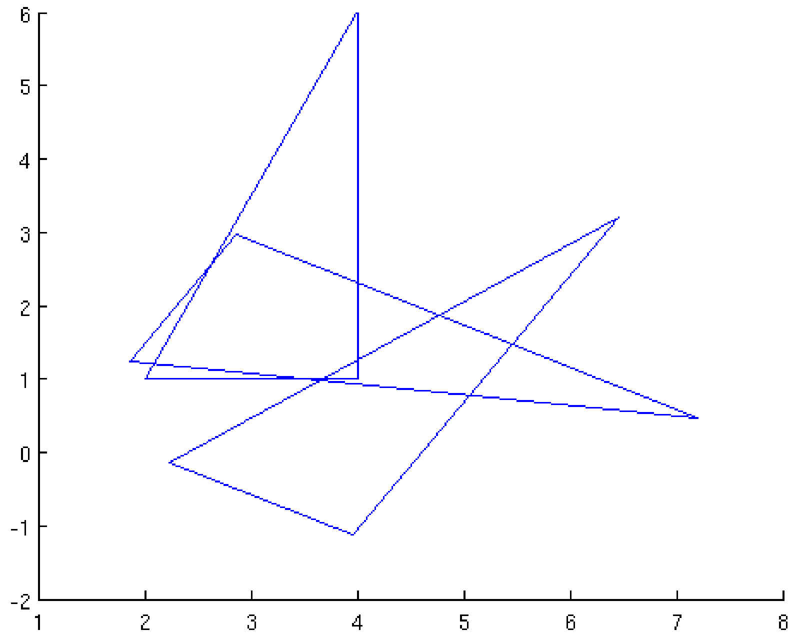
3. Convolution

   Convolution involves averaging all of the pixels in the target window. The number of additions required is about $I_w \times I_h \times W_w \times W_h$, where I is the number of pixels in the image, and W is the number of pixels in the window.

4. Perspective Projection

   My results seem incorrect, and seem extremely large in the XY direction.

5. Rigid Body Transformations



(a) A rotation matrix of $\begin{bmatrix} cos(\theta) & -sin(\theta) \\ sin(\theta) & cos(\theta) \end{bmatrix}$ will have a determinant of $cos(\theta)^2 + sin(\theta)^2$

(b) However, the rotation matrix $\begin{bmatrix} sin(\theta) & cos(\theta) \\ cos(\theta) & -sin(\theta) \end{bmatrix}$ will have a determinant of $-1 \times (sin(\theta)^2 + cos(\theta)^2)$

(c) T_2 is not a rigid body transformation, the figure T_2 is reflected across the diagonal before the rotation, while T_1 is only rotated.

6. Rigid Body Transformmation Composition

(a) The relative displacement $g_{31} = g_{21} \times g_{23}^{-1}$.

(b)

$$R(2,1) = \begin{bmatrix} R1_{11} & R1_{12} & T1_1 \\ R1_{21} & R1_{22} & T1_2 \\ 0 & 0 & 1 \end{bmatrix}$$

$$R(2,3) = \begin{bmatrix} R2_{11} & R2_{12} & T2_1 \\ R2_{21} & R2_{22} & T2_2 \\ 0 & 0 & 1 \end{bmatrix}$$

$$R(3,1) = \begin{bmatrix} R1_{11} \times R2_{11}^{-1} + R1_{12} \times R2_{21}^{-1} & R1_{11} \times R2_{12}^{-1} + R1_{12} \times R2_{22}^{-1} & R1_{11} \times T2_1^{-1} + R1_{12} \times T2_2^{-1} + T1_1 \\ R1_{21} \times R2_{11}^{-1} + R1_{22} \times R2_{21}^{-1} & R1_{21} \times R2_{12}^{-1} + R1_{22} \times R2_{22}^{-1} & R1_{21} \times T2_1^{-1} + R1_{22} \times T2_2^{-1} + T1_2 \\ 0 & 0 & 1 \end{bmatrix}$$

7. Vanishing Point

(a) For the lines $X = X_0 + at$
$Y = Y_0 + bt$
$Z = Z_0 + ct$

we get $Z \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = K \begin{bmatrix} R & T \\ 0 & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$ So as Z approaches infinity, we can use l'Hopital rule to show that the equation for$x$ converges to $\frac{X_0+at}{Z_0+ct} \Rightarrow \frac{a}{c}$ regardless of $X_0 and Z_0$.

(b)

$$A = \begin{bmatrix} 5+3t \\ 1+2t \\ t \end{bmatrix}$$

$$B = \begin{bmatrix} 2+3t \\ 1+2t \\ t \end{bmatrix}$$

as t approaches infinity, both equations converge at $(3, 2)$

(c) the system of equations never converge if Z doesnt take t as a parameter, in other words when the lines don't vary over the Z-axis