Q1.1

a)

$$\frac{\partial W(x;p)}{\partial p} = \begin{bmatrix} \frac{\partial Wx}{\partial p_1} & \cdots & \frac{\partial Wx}{\partial p_n} \\ \frac{\partial Wy}{\partial p_1} & \cdots & \frac{\partial Wy}{\partial p_n} \end{bmatrix}$$

where

$$W = \begin{bmatrix} Wx \\ Wy \end{bmatrix}$$

b)

for argmin(Ax-b), x = Δp,

we have

$$A = \nabla I \frac{\partial W}{\partial p}$$

and

$$b = T(x) - I(W(x;p))$$

where T is template image intensity, I is image intensity and W is warp function.

c)

$A^T A$ should be invertible and the determinant of $A^T A$ should equal to 0 if we want to find a unique solution.

Q1.3

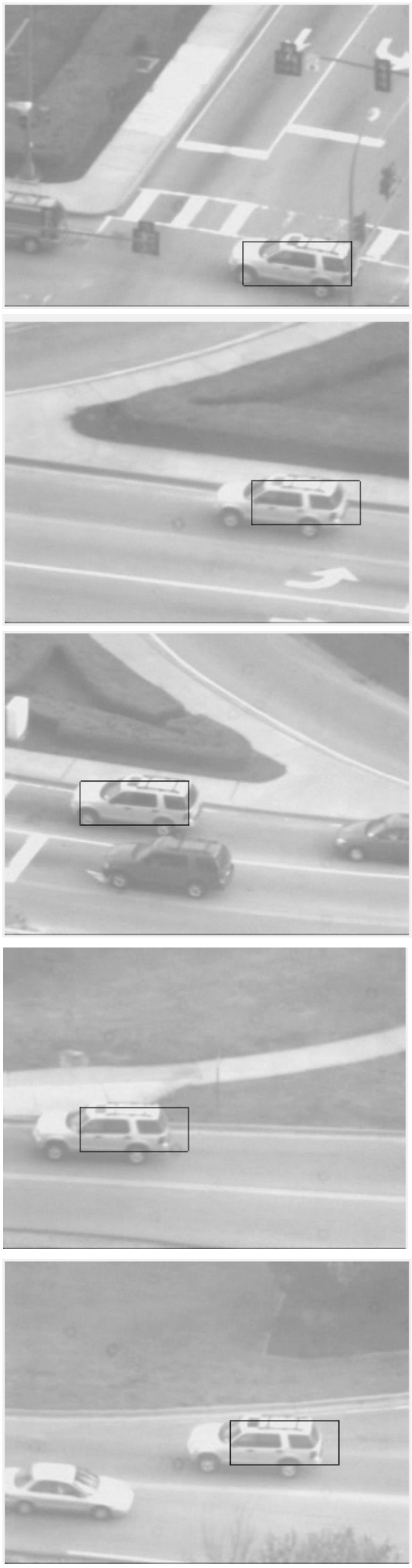

Figure 1. car at I = 1,100,200,300,400

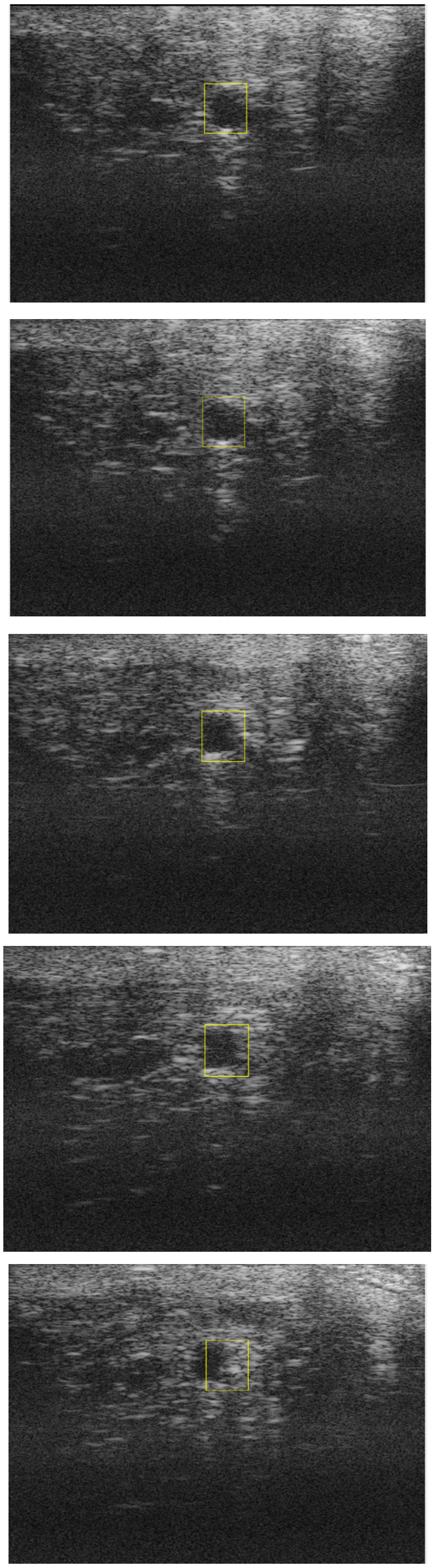

Figure 2. usseq at I = 1,25,50,75,100

Q2.1

$$I_{t+1}(x) - I_t(x) = \sum_{k=1}^{K} w_k B_k(x)$$

since each Bi is w by h, we can assume B is a w*h by K matrix and w is a K by 1 matrix

we can have

$$Bw = I_{t+1}(x) - I_t(x)$$

$$Bw - \left(I_{t+1}(x) - I_t(x) \right) = 0$$

if we want to solve for Ax – b =0, we have $x = (A'A)^{-1}A'b$
so that

$$w = (B'B)^{-1}B'(I_{t+1}(x) - I_t(x))$$

and since Bks are orthobases, we have

$$w = B'(I_{t+1}(x) - I_t(x))$$

Q2.3

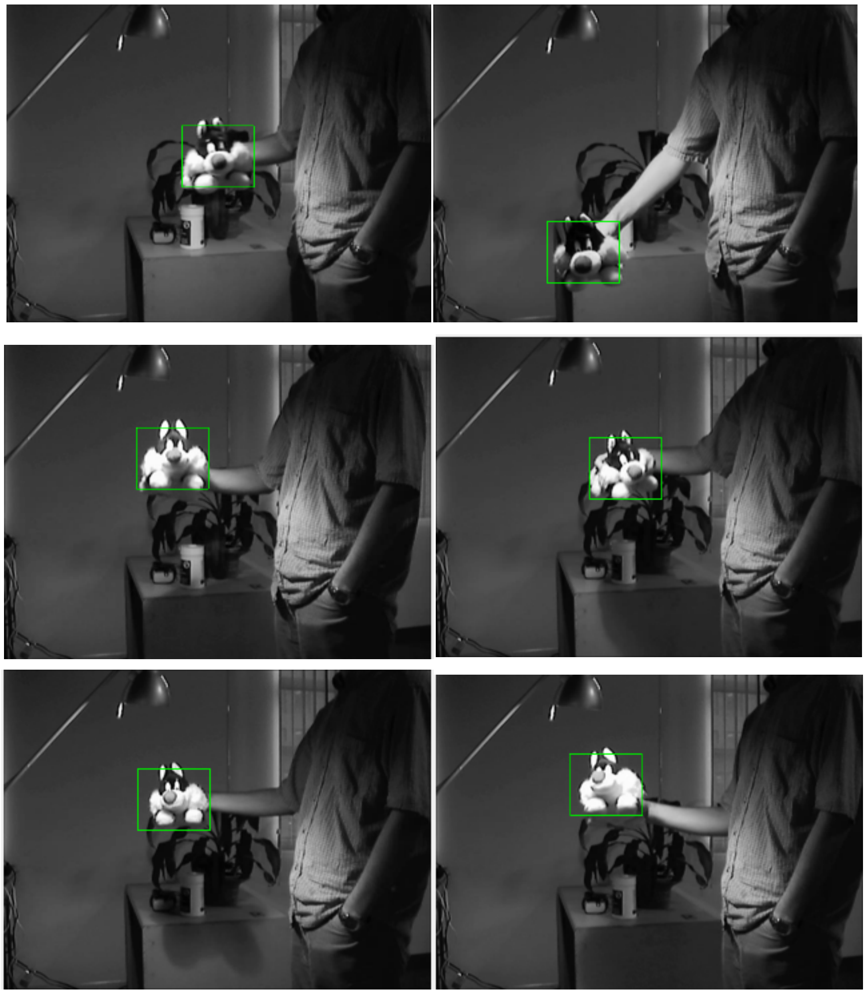

Figure 3. sylvseq at I = 1,100,200,350,400

Q3.3

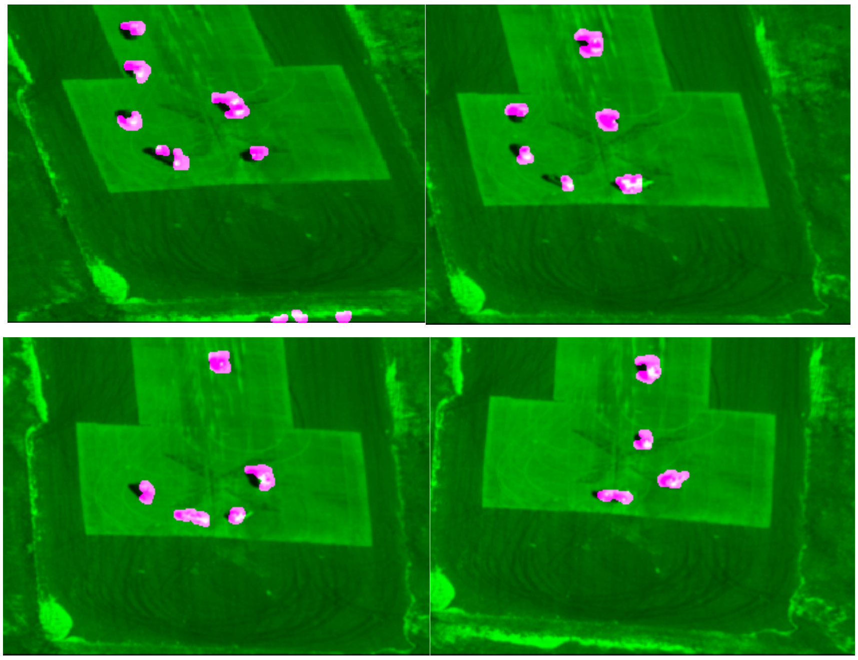

Figure 4. aerialseq at I = 30,60,90,120

Q3.4

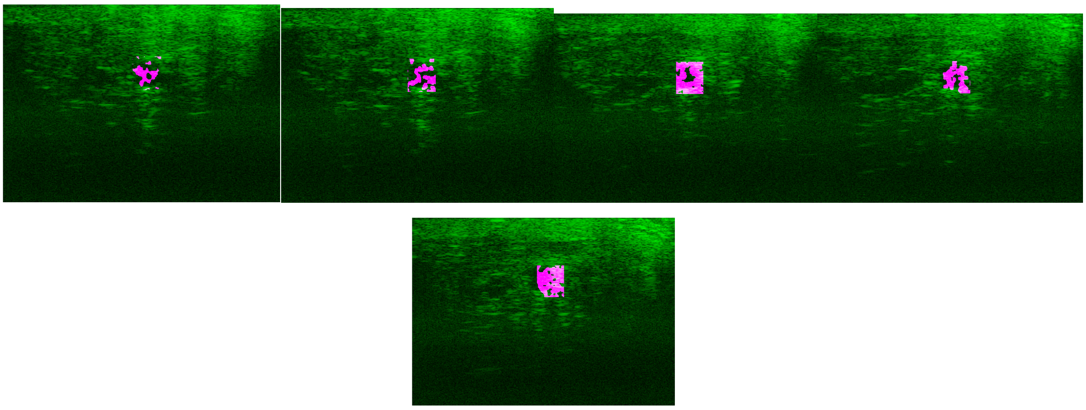

Figure 5: Lucas-Kanade Tracking of Affine Motion