Q 1.1

x = $\begin{bmatrix} \mathrm{x} \\ y \end{bmatrix}$

W = $\begin{bmatrix} \mathrm{W_x(x, y)} \\ \mathrm{W_y(x, y)} \end{bmatrix}$

∂W/∂p = $\begin{bmatrix} \partial \mathrm{W_x}/\partial \mathrm{p_1} & \partial \mathrm{W_x}/\partial \mathrm{p_2} & \dots & \partial \mathrm{W_x}/\partial \mathrm{p_N} \\ \partial \mathrm{W_y}/\partial \mathrm{p_1} & \partial \mathrm{W_y}/\partial \mathrm{p_2} & \dots & \partial \mathrm{W_y}/\partial \mathrm{p_N} \end{bmatrix}$

A = ∇I ∂W/∂p
b = T(x) – I(W(x;p))

For a unique solution to Δp,

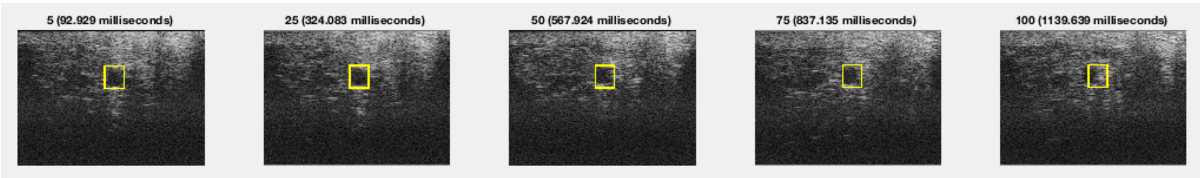
$A^T A$ must be invertible.
Determinant of $A^T A$ should not be equal to 0.

Q 1.2

Please see code

Q 1.3

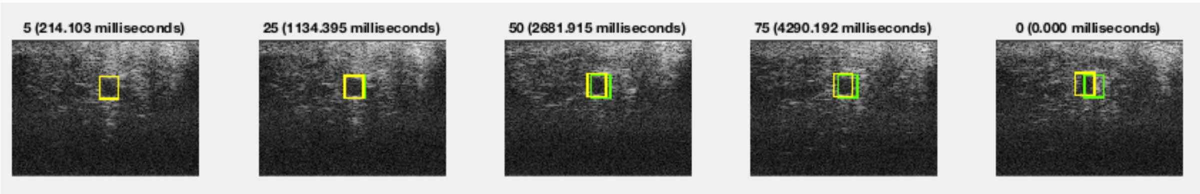
Please see code



Q 1.4

See code.
Implemented the template correction strategy 3 in the given paper. Used a new LucasKanade function with pinitial as the extra input to initialize p. (File: LucasKanadeInverseCompositionalWithCorrection.m)

Following are the results:



Yellow: With correction   Green: Without correction

Q 2.1

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

For a certain w_i and corresponding $B_i(x)$, where $i \in [1,K]$,

Multiplying both sides with $B_i(x)$,

$B_i(x)\ (I_{t+1}(x) - I_t(x)) = w_i\ ||B_i(x)||^2$ since orthogonal, $B_j.B_i = 0$ when $j \neq i$

Hence,

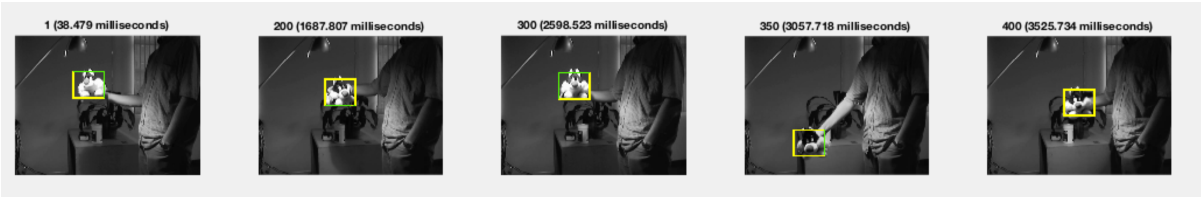
$w_i = \frac{B_i(x)\ (I_{t+1}(x) - I_t(x))}{||B_i(x)||2}$ for $i \in [1,K]$

Q 2.2

See code

Q 2.3

See code



Yellow: With basis   Green: Without basis
Similar accuracy seen for the Lucas Kanade tracker with appearance basis and without it for the inversion compositional Lucas Kanade.

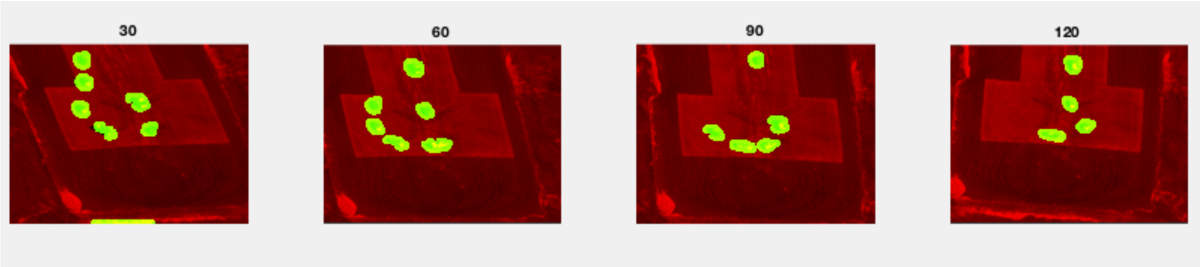
Q 3.1

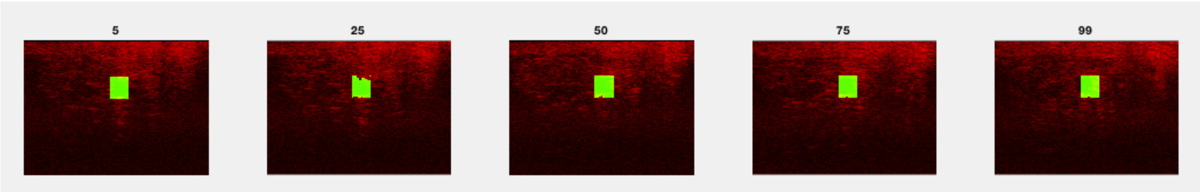
See code

Q 3.2

Please code

Q 3.3





Green represents dominant motion, able to track accurately.