Q 1.1

(1) $$\frac{\partial W(x;p)}{\partial p^T} = \frac{\partial (x+p)}{\partial p^T}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

(2) $$A = \frac{\partial I_{t+1}(x')}{\partial x'^T} \cdot \frac{\partial W(x;p)}{\partial p^T}$$

$$= \frac{\partial I_{t+1}(x')}{\partial x'^T}$$

$$= \frac{\partial I_{t+1}(x+p)}{\partial (x+p)^T}$$

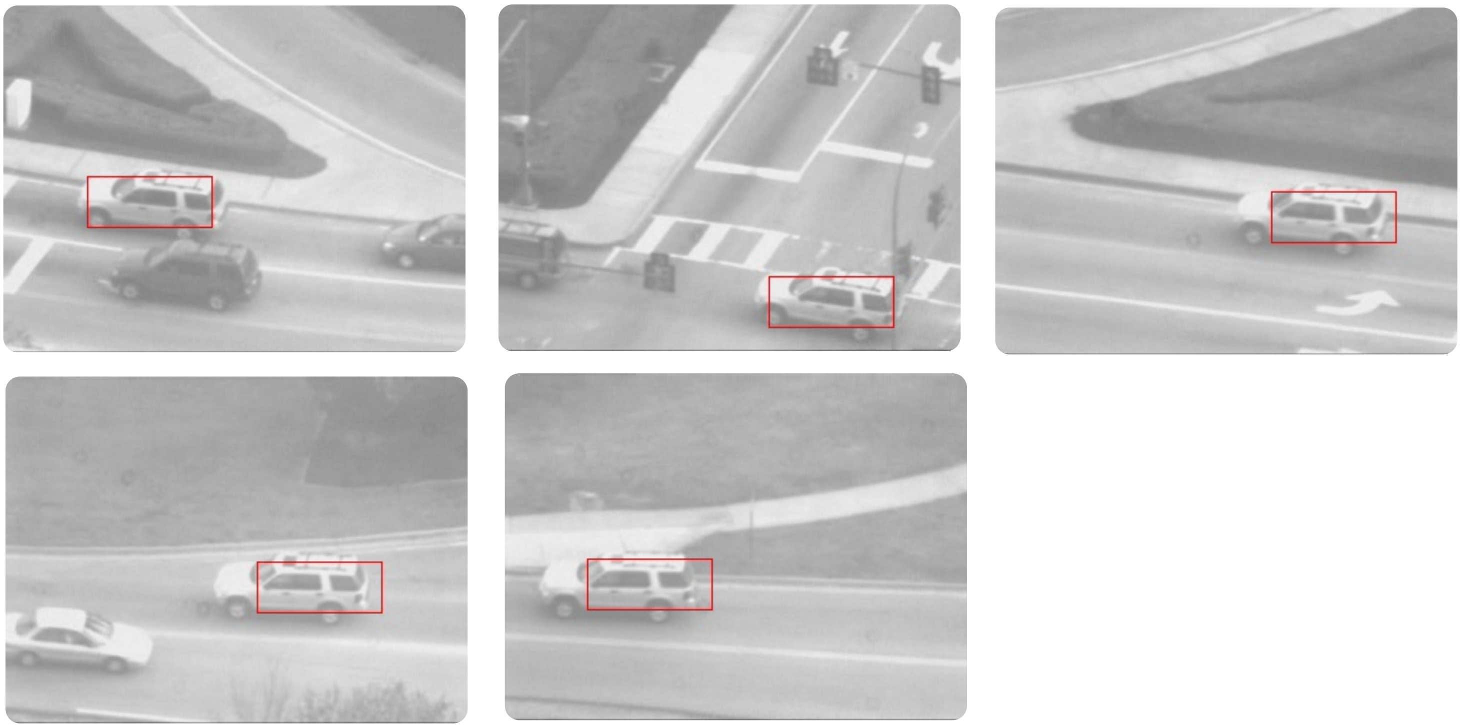
$$b = I_t(x) - I_{t+1}(x')$$

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

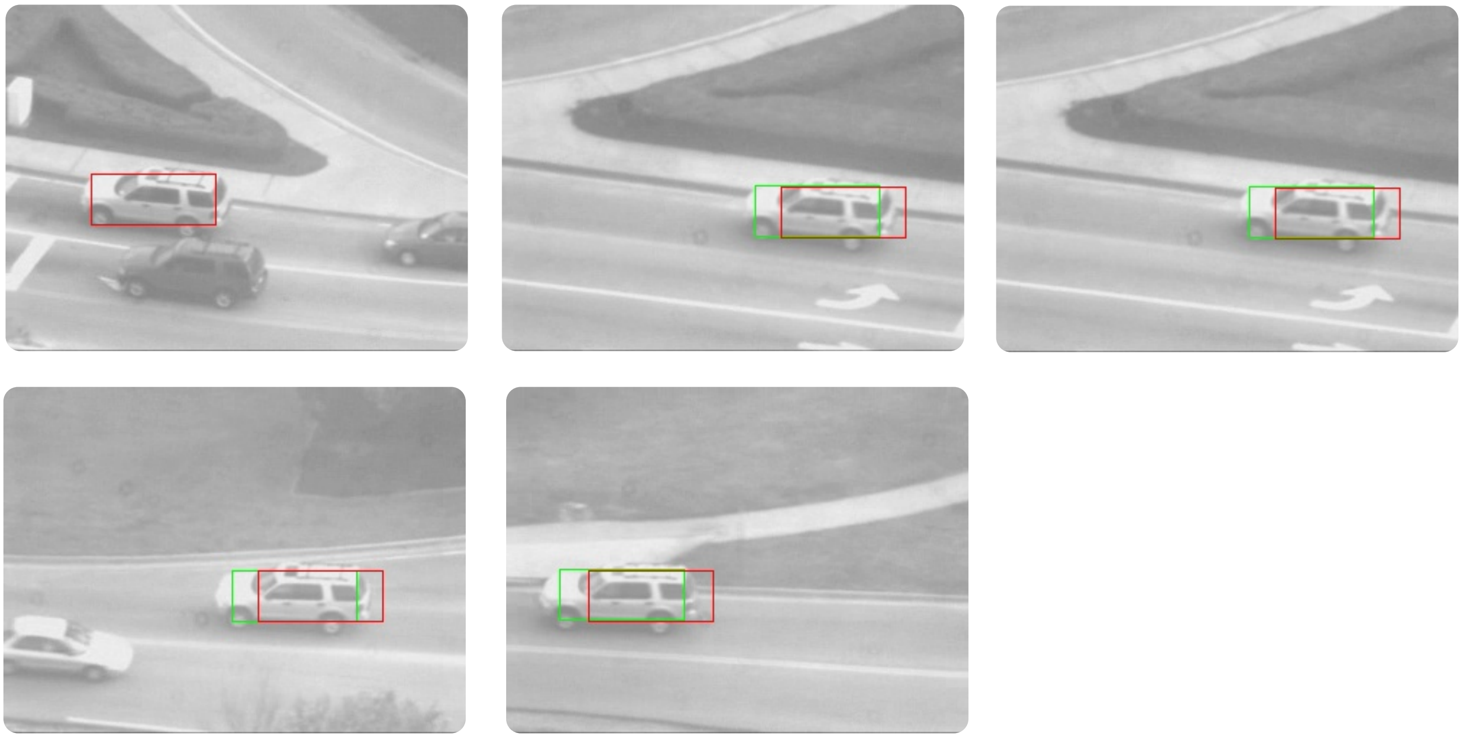
(3) If A^TA is invertible, then the solution to Δp is unique

$$\Delta p = (A^TA)^{-1}A^Tb$$

Q 1-3



Q1.4



Green : Track in Q1.4
Red : Tracker in Q1.3

Q 2-1

$$I_{t+1}(x) = I_t(x) + [B_1(x) \cdots B_K(x)] \begin{bmatrix} w_1 \\ \vdots \\ w_K \end{bmatrix}$$

$$[B_1(x) \cdots B_K(x)] \begin{bmatrix} w_1 \\ \vdots \\ w_K \end{bmatrix} = I_{t+1}(x) - I_t(x)$$

$$\begin{bmatrix} B_1(x)^T \\ \vdots \\ B_K(x)^T \end{bmatrix} [B_1(x) \cdots B_K(x)]\, w = \begin{bmatrix} B_1^T(x) \\ \vdots \\ B_K(x)^T \end{bmatrix} (I_{t+1}(x) - I_t(x))$$

$$\begin{bmatrix} B_1(x)^T B_1(x) & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & B_K(x)^T B_K(x) \end{bmatrix} W = \begin{bmatrix} B_1^T(x) \\ \vdots \\ B_K^T(x) \end{bmatrix} (I_{t+1}(x) - I_t(x))$$

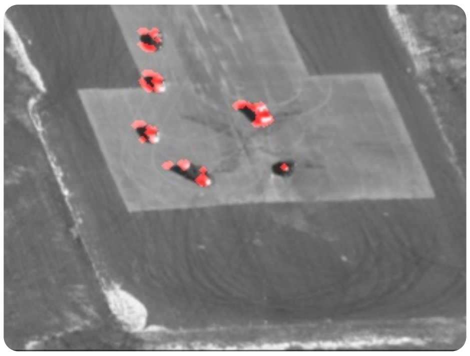
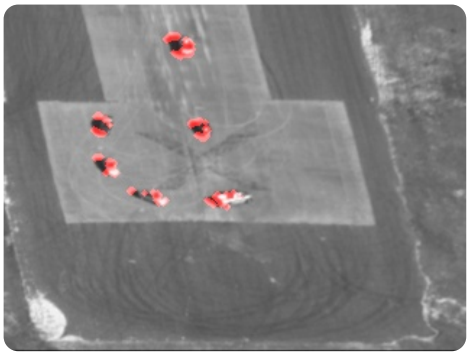
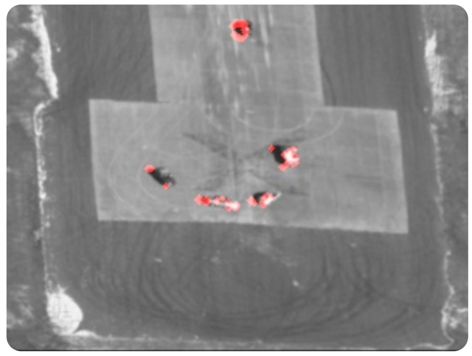
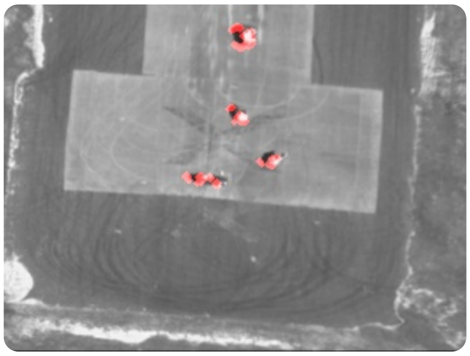
$$W = \begin{bmatrix} \frac{1}{\|B_1(x)\|_2^2} B_1^T(x) \\ \vdots \\ \frac{1}{\|B_K(x)\|_2^2} B_K^T(x) \end{bmatrix} [I_{t+1}(x) - I_t(x)]$$

Q 2-3





Q3-3

Q4-1

$\nabla p = (A^T A)^{-1} A^T b$

in classical approach

$A = \frac{\partial I_{t+1}(W(x;p))}{\partial W(x;p)^T}$, in each iteration, p changes

A has to be calculated again

But in inverse compositional approach

$A' = \frac{\partial I_t(x)}{\partial x^T}$

A' is a constant

So A' only needs to be calculted at the beginning of the loop