Assignment 3

Id: vgramasw@andrew.cmu.edu

VIVEK GOPAL RAMASWAMY

Q1.1

a) It is called the Jacobian of the Warp

$$\frac{\partial \mathbf{W}}{\partial \mathbf{p}}^{\mathrm{T}} = \begin{pmatrix} \frac{\partial W_x}{\partial p_1} & \frac{\partial W_x}{\partial p_2} & \cdots & \frac{\partial W_x}{\partial p_n} \\ \frac{\partial W_y}{\partial p_1} & \frac{\partial W_y}{\partial p_2} & \cdots & \frac{\partial W_y}{\partial p_n} \end{pmatrix}.$$

b)

$\sum_{\mathbf{x}}[\nabla I(\mathbf{W})\frac{\partial \mathbf{W}}{\partial \mathbf{p}}]^{\mathrm{T}}[T(\mathbf{x}) - I(\mathbf{W}(\mathbf{x};\mathbf{p}))]$

Here **A** is called the Steepest Descent Images $\nabla I \frac{\partial \mathbf{W}}{\partial \mathbf{p}}$

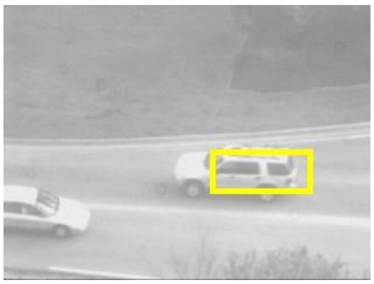
It is the product of the gradient of the image and the jacobian.

b is the difference between the template Image T(x) and the Image I warped with W(x;p) . It basically represents the error.

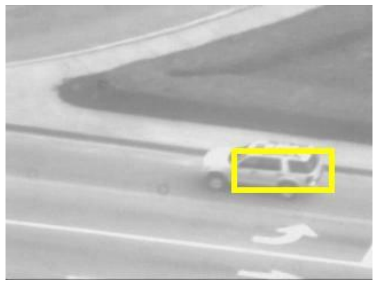
$[T(\mathbf{x}) - I(\mathbf{W}(\mathbf{x};\mathbf{p}))]$

c) The condition that A’A should meet so that a unique solution to $\Delta\mathbf{p}$ exists is that the matrix should be invertible or non-singular.

Q1.2 Lukas kanade



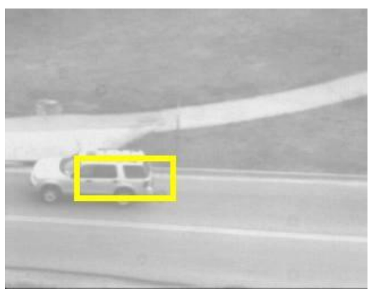
Frame : 1



Frame :100

Frame :200

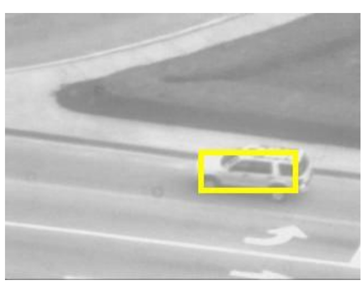
Frame : 300



Frame : 400

Q1.4 Lukas Kande with Template Correction

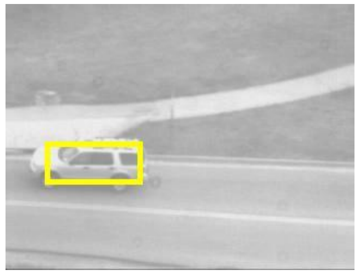
Frame : 1



Frame : 100

Frame : 200

Frame : 300



Frame: 400

Q2.1 Derivation

To find the weights of the Bases, we do the following:

$$\mathrm{I}_{t+1}(x) = I_t(x) + \sum_{k=1}^{K} w_k B_k(x)$$

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

$$\mathrm{w}_1 B_1 + w_2 B_2 + w_3 B_3 + w_4 B_4 + ... + w_k B_k = I_{t+1}(x) - I_t(x)$$

$$(Multiplying\ B_k andtakingtheirdotproductonbothsides)$$

$$B_k.(w_1 B_1 + w_2 B_2 + w_3 B_3 + w_4 B_4 + ... + w_k B_k) = B_k.(I_{t+1}(x) - I_t(x))$$

$$\textit{(The dot product of Orthogonal matricss(bases)=0)}$$

$$\mathit{0} + \mathit{0} + ...\ \mathit{0} + \|B_k\|^2 w_k = B_k.(I_{t+1}(x) - I_t(x))$$

$$w_k = \frac{B_k}{\|B_k\|^2}.(I_{t+1}(x) - I_t(x))$$

Q2.3 Lukas Kande with Appearance Basis

Frame : 1

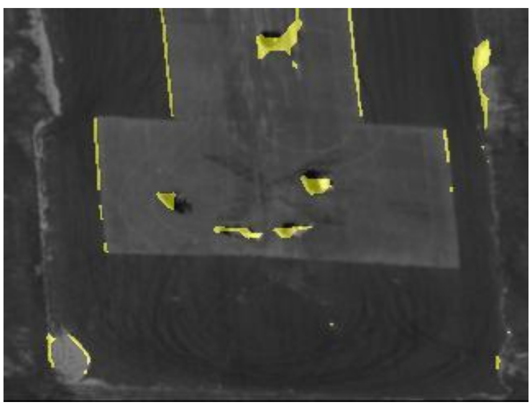
Frame : 200

Frame: 300

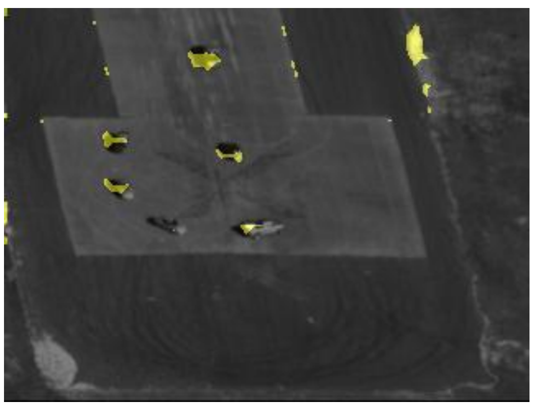
Frame : 350

Frame : 400

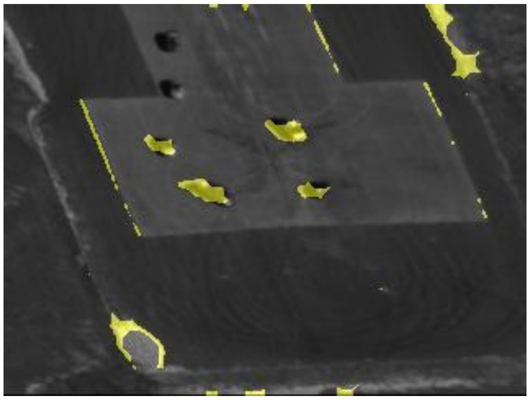
Q3.3 Moving Object Detection



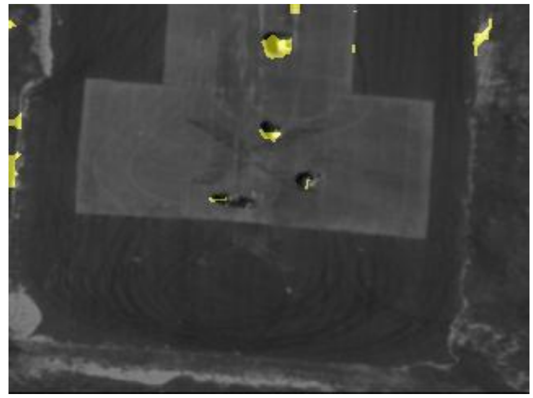
Frame : 30



Frame : 60



Frame : 90



Frame : 120