Intrusion Detection

Change Detection

I_{ref}

I_t

Change Detection

cI_t

Change Detection

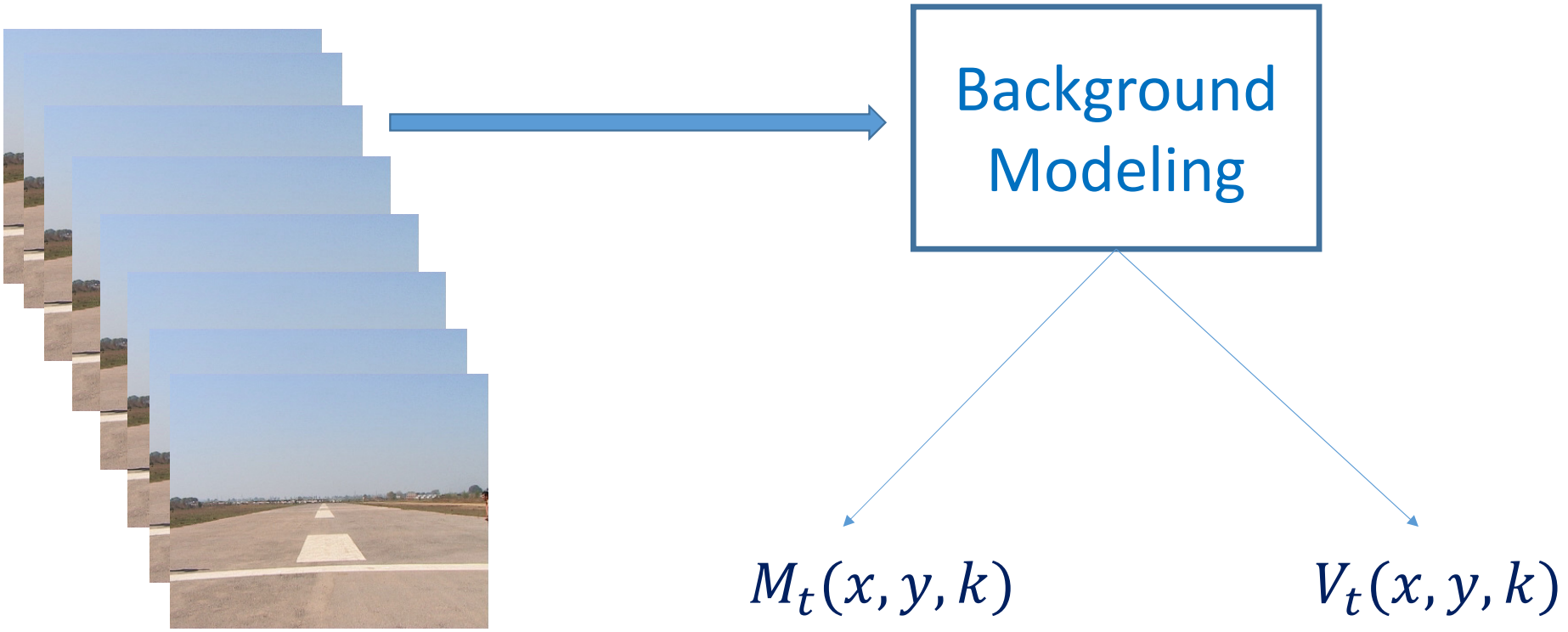
I_{ref}

I_t

$$\neg C(x,y,t) \Rightarrow \wedge_{k=0}^{2} \left[\left| I_t(x,y,k) - I_{ref}(x,y,k) \right| \leq \eta_c \right]$$

$$cI_t(x,y) = \begin{cases} 0, & \neg C(x,y) \\ 255, & Otherwise \end{cases}$$

Unimodal Background Model



Foreground Detection

$\{M, V\}$

Foreground Detection

I_t

cI_t

Foreground Detection

$\{M_{t-1}, V_{t-1}\}$

I_t

$$d_t(x,y,k) = I_t(x,y,k) - M_{t-1}(x,y,k)$$

$$\neg C(x,y,t) \Rightarrow \wedge_{k=0}^{2} [d_t^2(x,y,k) \leq \lambda^2 V_{t-1}(x,y,k)]$$

$$cI_t(x,y) = \begin{cases} 0, & \neg C(x,y,t) \\ 255, & Otherwise \end{cases}$$

Background Model Update

cI_t

$\{M_t, V_t\}$

$$d_t(x,y,k) = I_t(x,y,k) - M_{t-1}(x,y,k)$$

IF $cI(x,y,t) = 0$

$$M_t(x,y,k) = (1-\alpha)M_{t-1}(x,y,k) + \alpha I_t(x,y,k)$$

$$M_t(x,y,k) = M_{t-1}(x,y,k) + \alpha d_t(x,y,k)$$

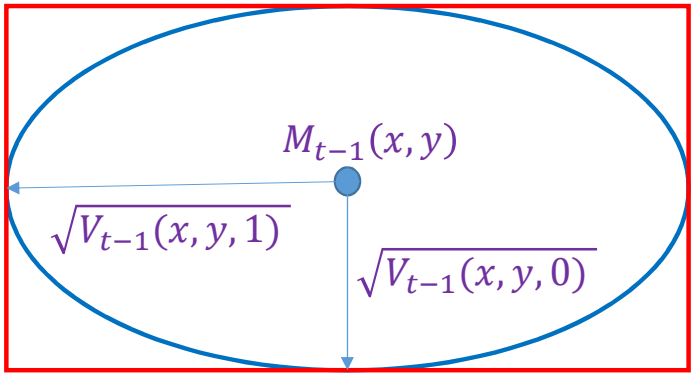
$$V_t(x,y,k) = (1-\alpha)[V_{t-1}(x,y,k) + \alpha d_t^2(x,y,k)]$$

$k = 0(R), 1(G), 2(B)$

An Implementation Issue

$$d_t(x, y, k) = I_t(x, y, k) - M_{t-1}(x, y, k)$$

$$\sum_{k=0}^{2} \frac{\{I_t(x, y, k) - M_{t-1}(x, y, k)\}^2}{V_{t-1}(x, y, k)} \leq \lambda^2$$



$$\wedge_{k=0}^{2} \left[d_t^2(x, y, k) \leq \lambda^2 V_{t-1}(x, y, k)\right]$$