

Bayesian Modeling of Dynamic Scenes for Object Detection

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 Yaser Sheikh, and Mubarak Shah
 by lbg@dongseo.ac.kr 2009.02.25

Background $\varphi_b = \{y_1, y_2, \dots, y_n\}, y = (r, g, b, x, y) \in \mathbb{R}^5$

Foreground $\varphi_f = \{z_1, z_2, \dots, z_m\}$

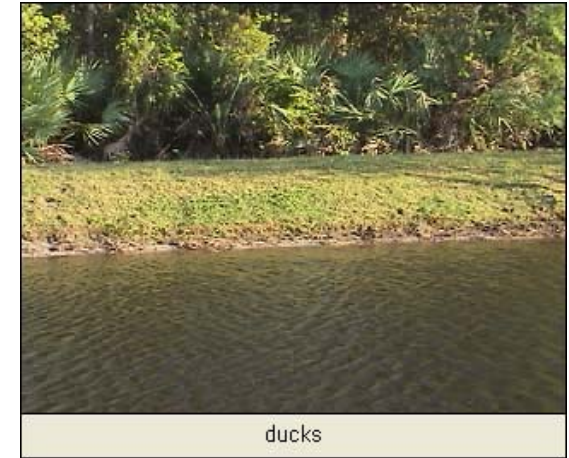
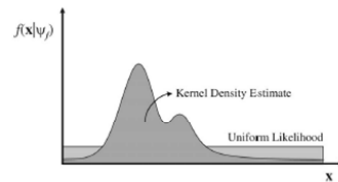
$$P(x | \psi_b) = \frac{1}{n} \sum_{i=1}^n \varphi_H(x - y_i)$$

$$P(x | \psi_f) = \alpha \gamma + (1 - \alpha) m^{-1} \sum_{i=1}^m \varphi_H(x - z_i)$$

d-variate Gaussian density

$$\varphi_H^{(N)}(x) = |H|^{-1/2} (2\pi)^{-d/2} \exp\left(-\frac{1}{2} x^T H^{-1} x\right)$$

Likelihood ratio classifier $\tau = -\ln \frac{P(x | \psi_b)}{P(x | \psi_f)}$



Algorithm

Initialize ψ_b using 1st frame, $\psi_f = \emptyset$. At frame t , for each pixel,

Detection Step

- 1) Find $P(x_i | \psi_f)$ (Eq. 7) and $P(x_i | \psi_b)$ (Eq. 1) and compute the Likelihood Ratio τ (Eq. 8).
- 2) Construct the graph to minimize Equation 13.

Model Update Step

- 1) Append all pixels detected as foreground to the foreground model ψ_f .
- 2) Remove all pixels in ψ_f from ρ_f frames ago.
- 3) Append all pixels of the image to the background model ψ_b .
- 4) Remove all pixels in ψ_b from ρ_b frames ago.

