Methods for Background Subtraction in Video

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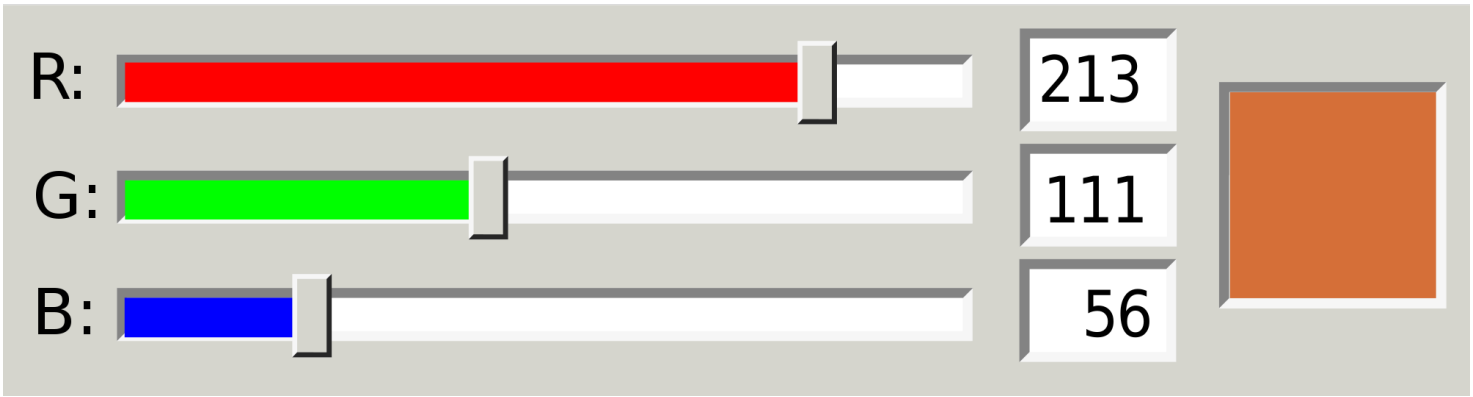
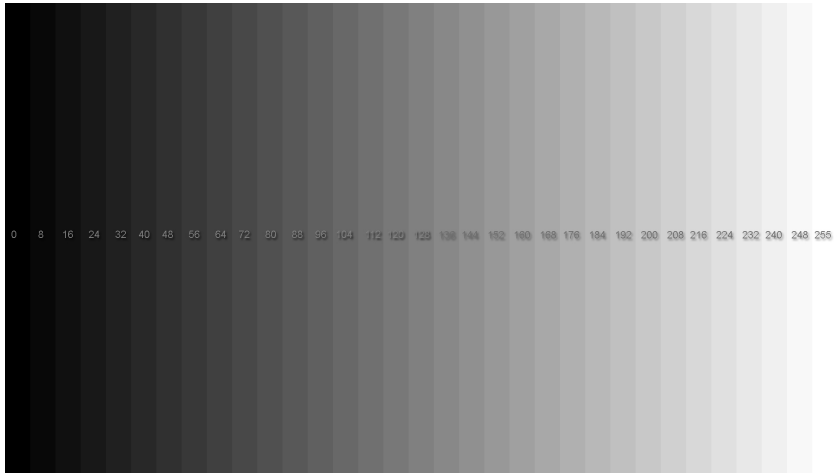
July 24, 2012

Analysing video in Matlab



Analysing video in Matlab



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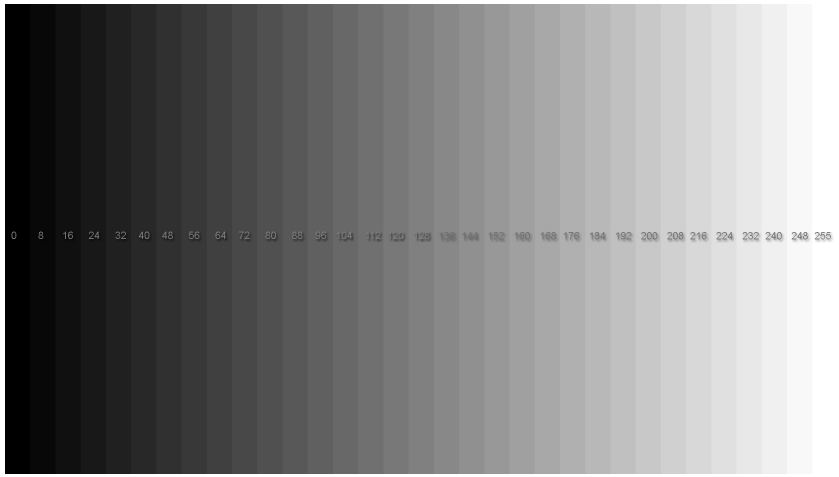

$$X_t = \begin{pmatrix} 54 & 106 & 69 \\ 220 & 7 & 3 \\ 6 & 45 & 101 \end{pmatrix}$$

$$X_t = [54, 106, 69, 220, 7, 3, 6, 45, 101] \quad t = 1 : T$$

Frame Difference

- Assume that the first frame is the background.
- Accept pixel i as forground if

$$|X_t[i] - X_{t-1}[i]| > \tau.$$

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- Advantage: Computationally light, adaptive.
- Disadvantage: Stationary objects can vanish
- Disadvantage: Interior pixels for uniformly distributed
- Choice of τ

Approximate Median

$$\begin{aligned} \text{If} \quad & X_t[i] > B[i] \quad \text{then} \quad B[i] = B[i] + 1 \\ \text{If} \quad & X_t[i] < B[i] \quad \text{then} \quad B[i] = B[i] - 1 \end{aligned}$$

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- Advantage: Seperates as a whole
- Advantage: Still fairly efficient
- Disadvantage: Background adapts more slowly.
- Disadvantage: Lots of ghost trails (τ dependent)

Challenging real world problems require something more adaptive.

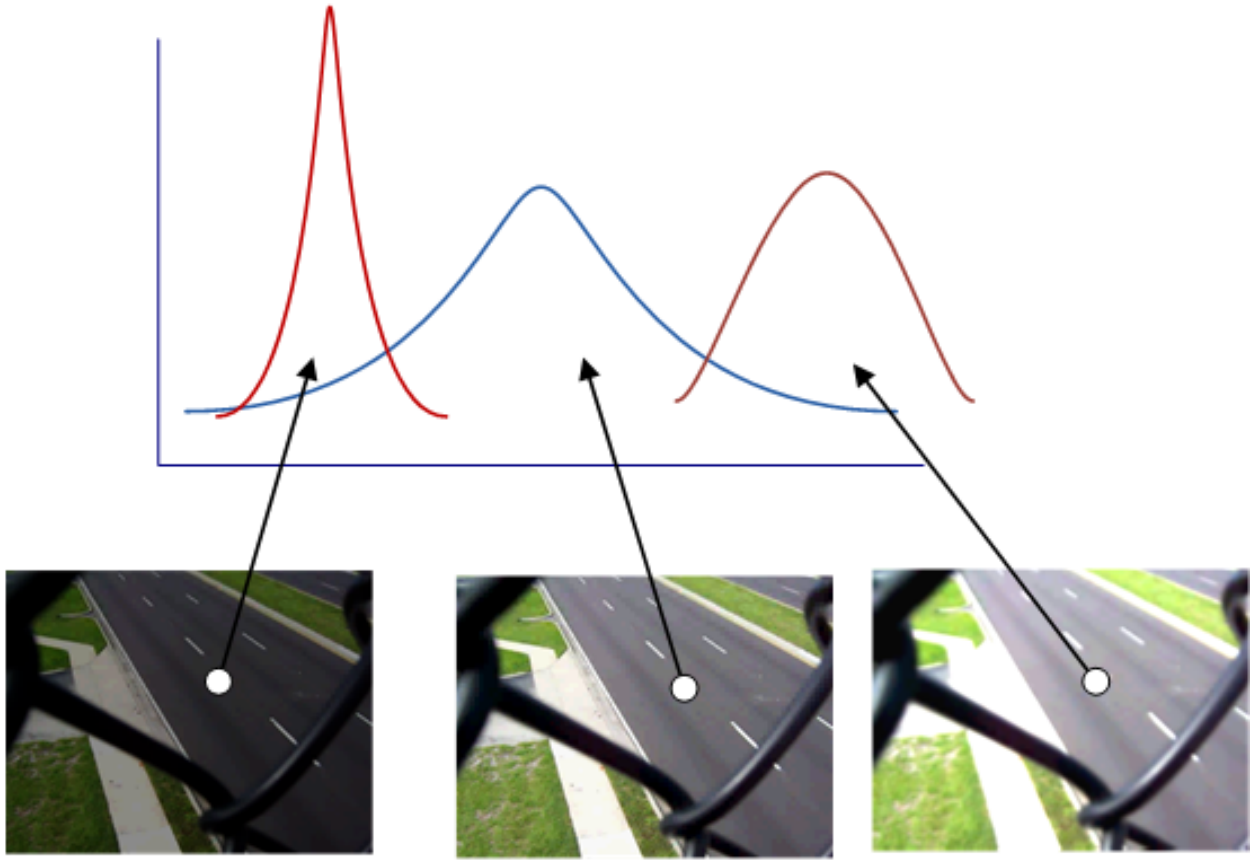
Ghosts

Ghost: A set of connected points detected as motion but not corresponding to any real moving object.

Mixture of Gaussian

- Parametric background model based on visual history.
- Each pixel represented by a mixture of Gaussian functions.
- μ: educated guess of the $X_{t+1}[i]$
- σ: Our confidence
- 3-5 Gaussian components and weight them

$$\omega_1 * N(\mu_1, \sigma_1) + \omega_2 * N(\mu_2, \sigma_2) + \omega_3 * N(\mu_3, \sigma_3)$$



- Advantage: Slow illumination changes
- Self corrective (parked cars)
- Disadvantage: Shadows
- Disadvantage: Physical background changes are slow.
- Disadvantage: Computationally heavy.

Review

- Frame difference
- Approximate Median
- Mixture of Gaussian