Gradient Orientation and Color Based Particle Filter for Complex Visual Tracking

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Research Contents

Background

- Visual object tracking is a challenging computer vision task.
- Problem: Moving Camera
  Erratic object motion
  Cluttered Background
  Occlusion
- The key idea of particle filter is to approximate the required posterior density function by a set of N random samples with associated weights and to compute estimates based on these samples.
- Challenges of tracking with Particle filter:
  - Occlusion caused by similar colored object
  - Long-lived full occlusion

Proposed Particle Filter

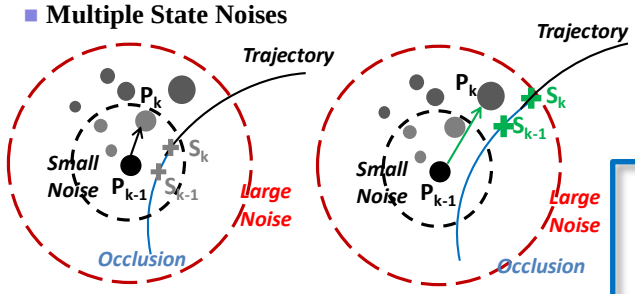
Gradient Orientation & Color Incorporated Observation Model

$$p_c^{(u)} = \frac{1}{\sum_{i=1}^{M} g(x_i, y_i)} \times \sum_{i=1}^{M} g(x_i, y_i)\delta\lfloor h(x^i) - u \rfloor$$

$$p_o^{(v)} = k\sum_{i=1}^{I} g(x_i, y_i)\left|G(x_i, y_i)\right|\delta\lfloor \theta(x_i, y_i) - v \rfloor$$

$$g(x, y) = \frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{1}{4\sigma^2}\left[\left(\frac{x-c}{w/2}\right)^2 + \left(\frac{y-r}{h/2}\right)^2\right]\right)$$

Multiple State Noises



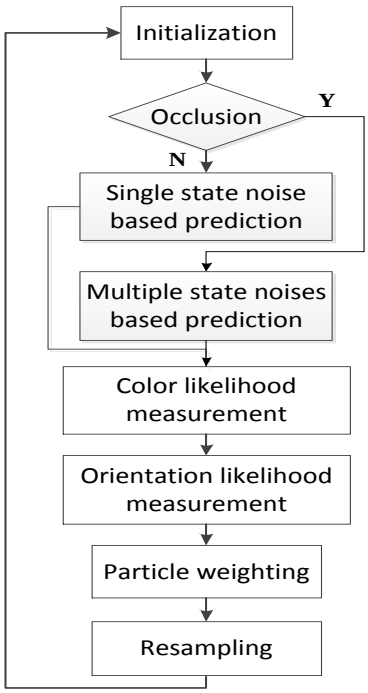
Adaptive State Noises

$$B_k^i = b * \frac{1}{2\pi\sigma_p^2} exp\left(\frac{\left\|X_{k-1}^i - \hat{X}_{k-1}^t\right\|^2}{2\pi\sigma_p^2}\right)$$

Centroid of the i_{th} particle at time k-1

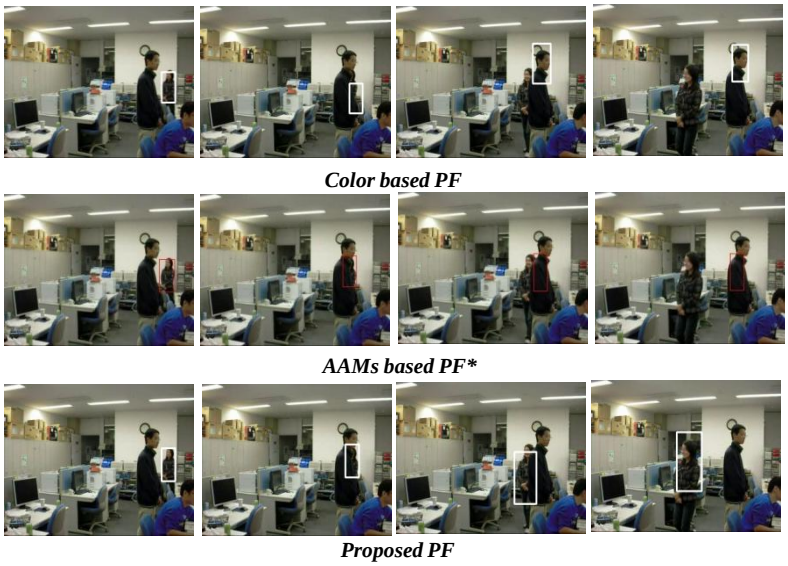
Centroid of the target at time k-1

Flow Chart

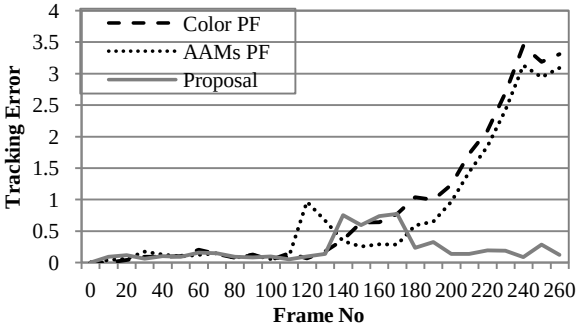


Experimental Results

Tracking Results



Error Comparison



* S.K. Zhou, R. Chellappa, B. Moghaddam, "Visual tracking and recognition using appearance-adaptive models in particle filters", IEEE Trans. on Image Processing (2004).

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