Exercise Session 6 – Condensation Tracker

COMPUTER VISION

Assignment Tasks

1. Condensation tracker with color histogram observations

2. Experiment with the condensation tracker

General Tracking Framework

1. **Prediction**, based on **system model**

$$x_t = f_{t-1}(x_{t-1}, w_{t-1})$$

f = system transition function

2. **Update**, based on **measurement model**

$$z_t = h_t(x_t, v_t)$$

h = measurement function

$Z_t = (z_1, \ldots, z_t)$ is the history of observations

Condensation Tracker

- The probability distribution is represented by a sample set S

$$S = \left\{ (s^{(n)}, \pi^{(n)}) \,|\, n = 1 \ldots N \right\}$$

- π - weights giving the sampling probability

Condensation Tracker

1. Prediction

Start with S_{t-1} , the sample set of the previous step, and apply the system model to each sample, yielding predicted samples $s_t^{'(n)}$

$$s_t^{'(n)} = A \cdot s_{t-1}^{(n)} + B \cdot w_{t-1}^{(n)}$$

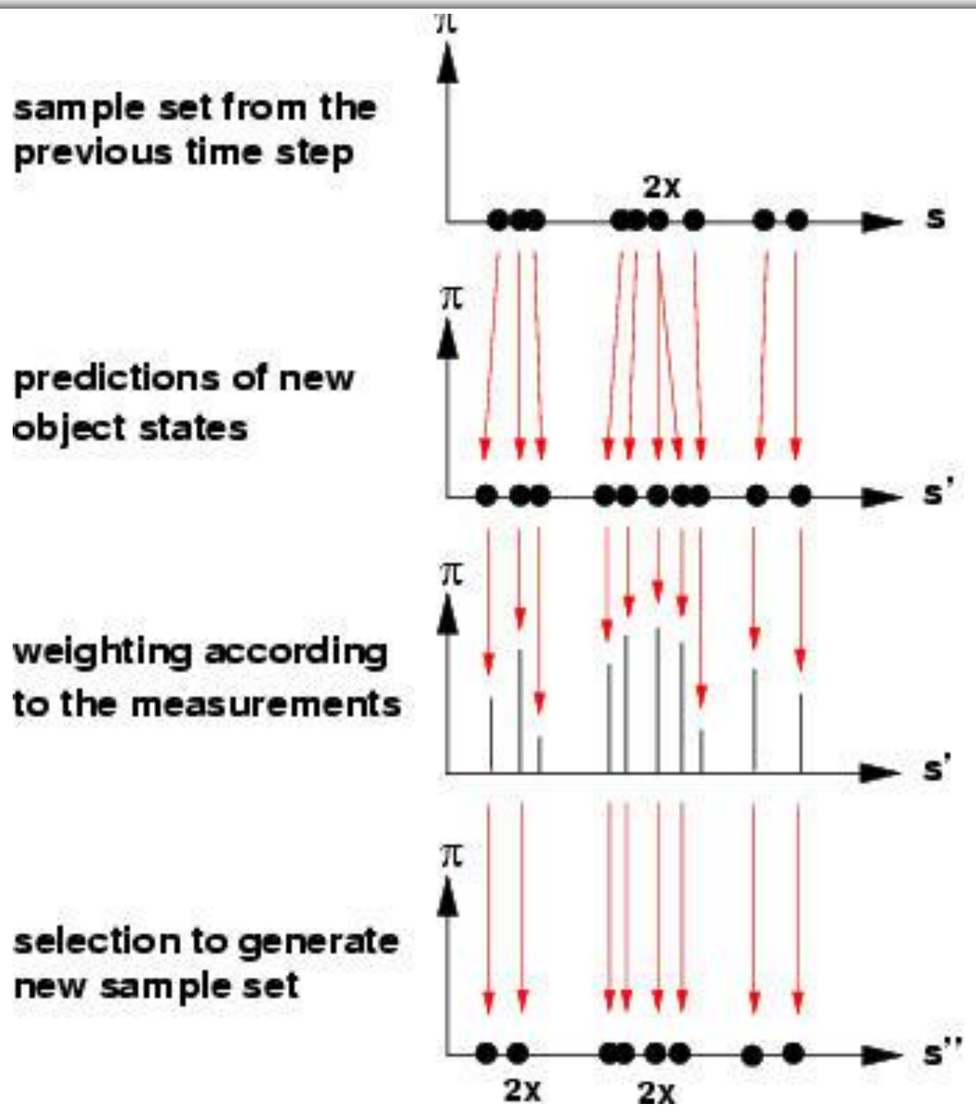
2. Update

Sample from the predicted set, where samples are drawn with replacement with probability (using measurement model)

$$\pi^{(n)} = p(z_t \mid s_t^{'(n)})$$

Condensation Tracker

Samples may be drawn multiple times, but noise will yield different predictions



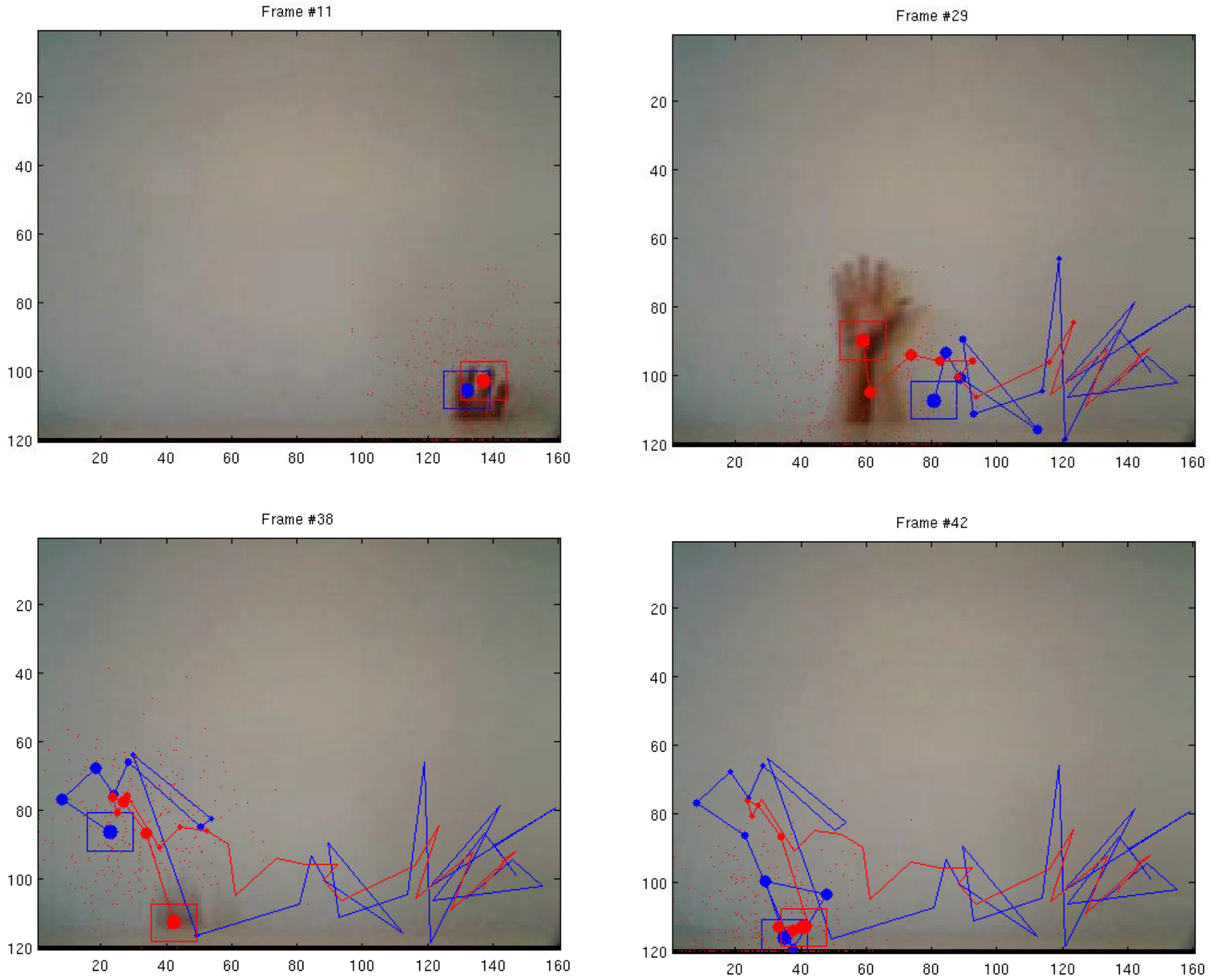
Task :
Experiment with the Condensation Tracker

- Moving hand
- Uniform background

- Moving hand
- Clutter
- Occlusions

- Ball bouncing
- Motion model

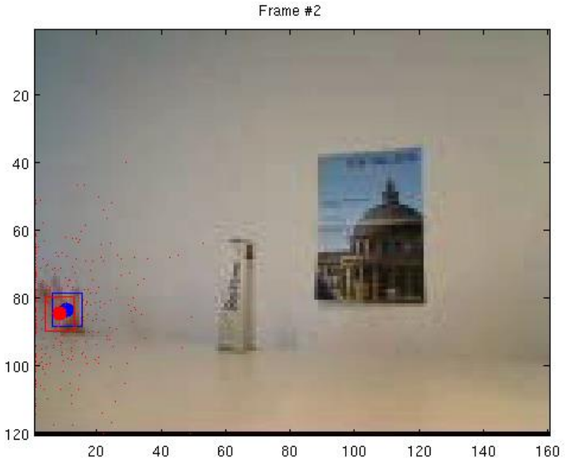
Video 1: Hand, uniform background

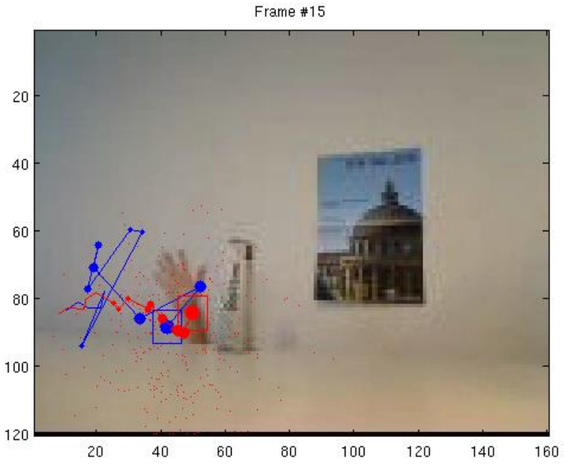


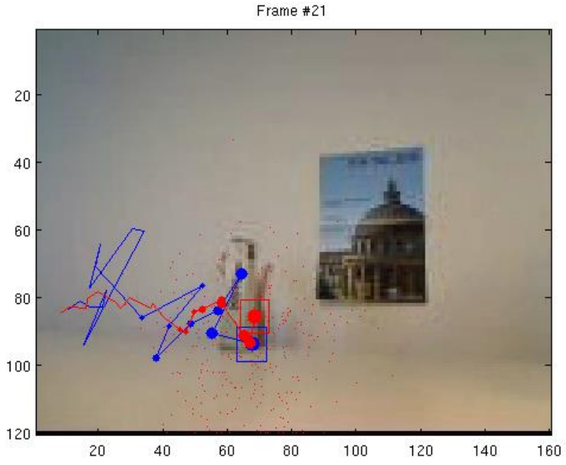
a priori mean state

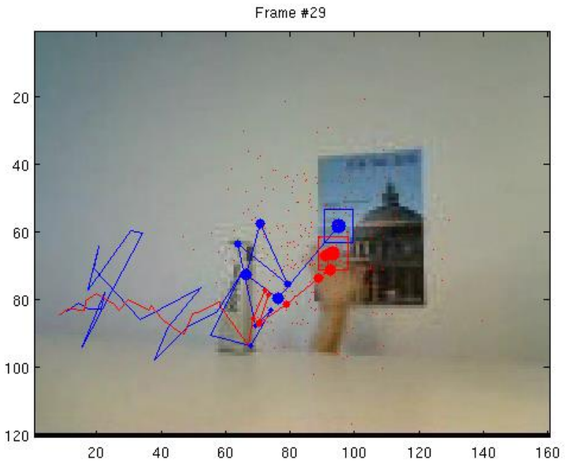
a posteriori mean state

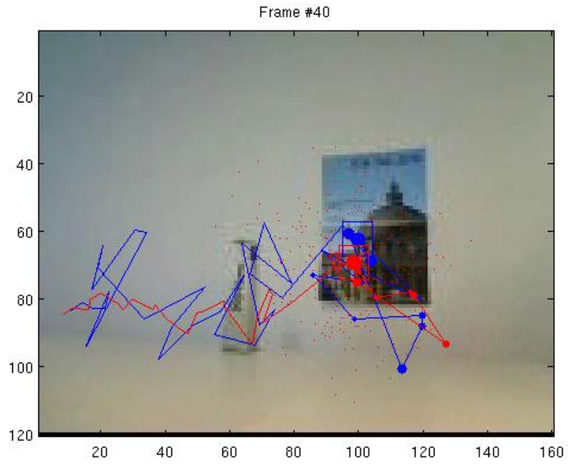
Video 2: Hand, clutter, occlusions







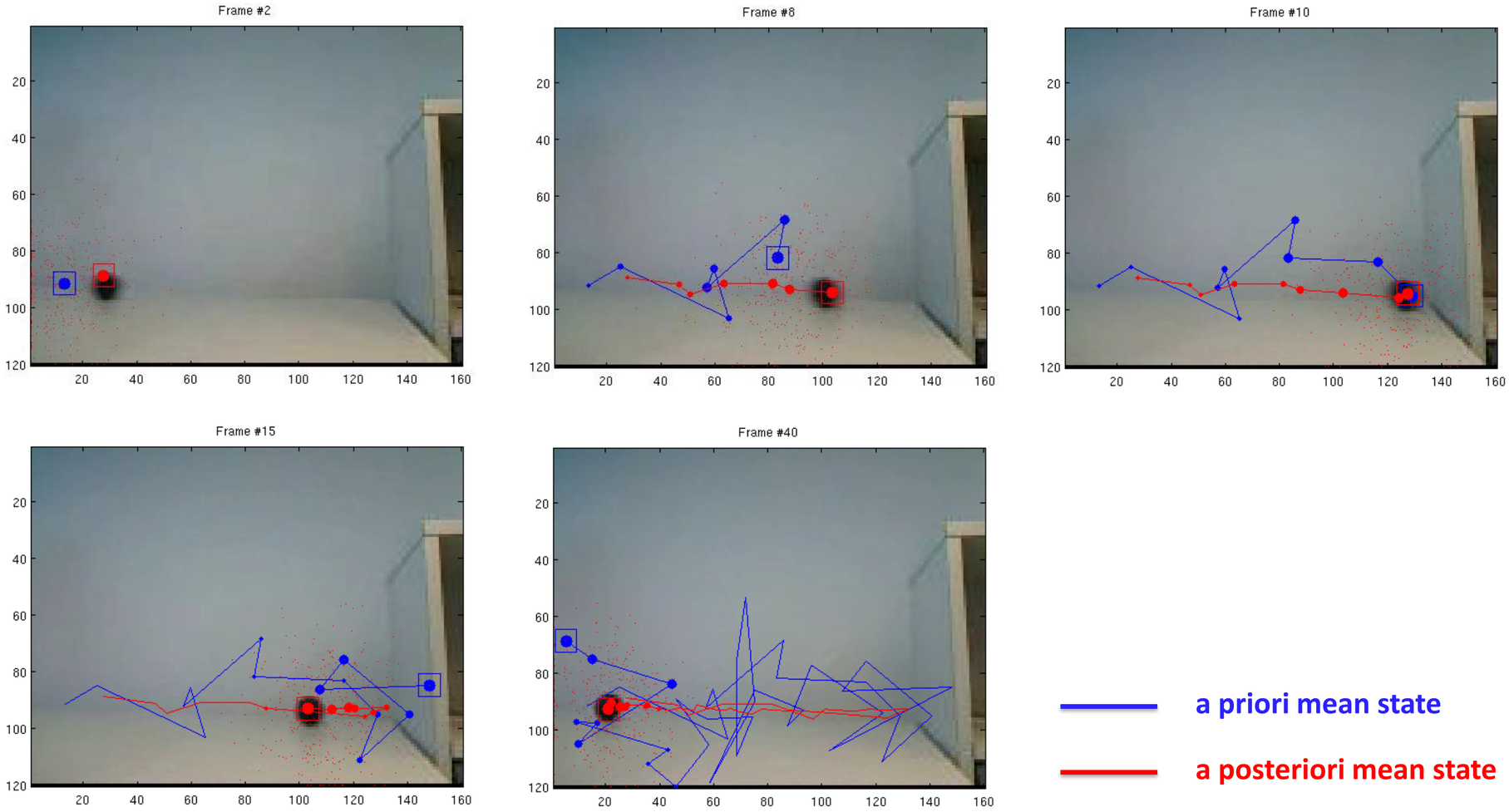




a priori mean state

a posteriori mean state

Video 3: Ball bouncing



Report

- Python code
  - We provide the overall structure
  - Write the code to perform each step of the CONDENSATION tracker
- Plot the trajectories of the mean state
- Experiment different settings
    - number of particles
    - number of bins for quantization
    - updating appearance model
    - motion model