Bayesian Filtering and Smoothing: Exercise Set 10

1. Use a fixed-point smoother to estimate the initial state for `car_demo.m`. Compare to the answer obtained using the fixed-interval smoother.

2. Use a fixed-point EKF-based smoother to estimate the initial state for set 6 question 3.

3. Use a backward-simulation particle smoother to estimate the track from set 6 question 3.

4. Use a backward-simulation particle smoother to estimate the track from set 8 question 6.

5. The script `rbpf_demo.m` uses the model from textbook exercise 7.5. Modify the script to use the model

$$\mathbf{x}_k | \mathbf{x}_{k-1}, u_k \sim \mathrm{N}(\begin{bmatrix} 1 & 0.05 \\ 0 & 1 \end{bmatrix} \mathbf{x}_{k-1}, \begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix}),$$

$$\mathbf{y}_k | \mathbf{x}_k, u_k \sim \begin{cases} \mathrm{N}(\begin{bmatrix} 1,0 \end{bmatrix} \mathbf{x}_{k-1}, 1) & \text{if } u_k = 0 \\ \mathrm{N}(\begin{bmatrix} 0,0 \end{bmatrix} \mathbf{x}_{k-1}, 100) & \text{if } u_k = 1 \end{cases}$$

6. Show that

$$p(y_k \mid x_k) = 0.9N(y_k \mid x_k, 1) + 0.1N(y_k \mid 0, 10^2)$$

for the measurement model of textbook exercise 7.5 and that $\mathrm{E}(y_k \mid x_k) = 0.9 x_k$.

Answers

1. $[0.6466, 0.1286, 1.0342, -1.3172]^\top$ 2. $[1.8276, 0.1360]^\top$