AERO: 626 : ESTIMATION OF DYNAMICAL SYSTEMS
RESULTS OF THE FINAL PROJECT

Subodh Mishra

1 Tracking a falling object

1.1 Results with Linear Measurement: z = Hx + v

To view and run the code of this section, please navigate to `Q1/question1_1ac2.m` and `Q1/question1_1bc1d.m`.

a Plots of state and the uncertainties after 5 s.

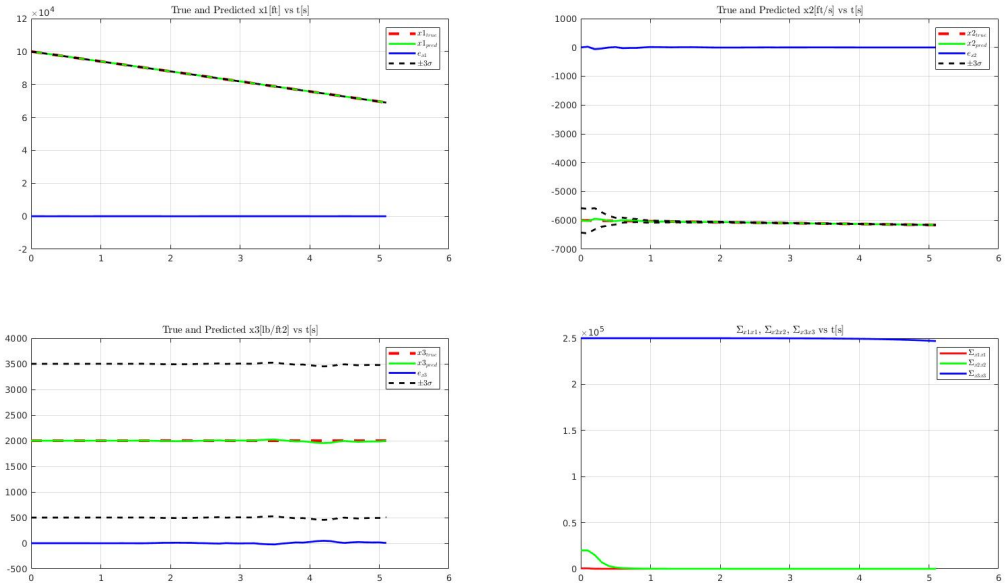

Figure 1.1: Plots of state and the uncertainties after 5 s for EKF

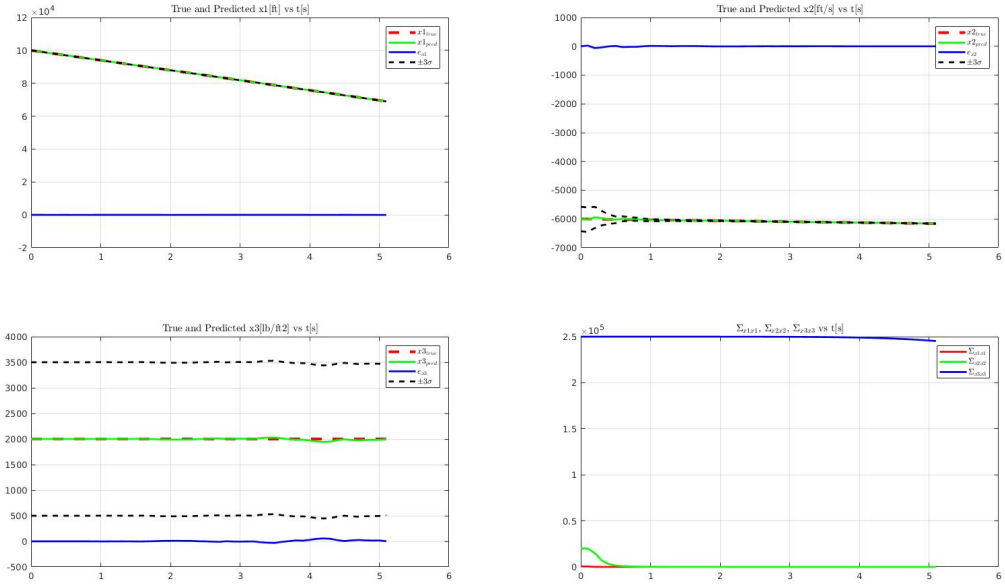

Figure 1.2: Plots of state and the uncertainties after 5 s for UKF

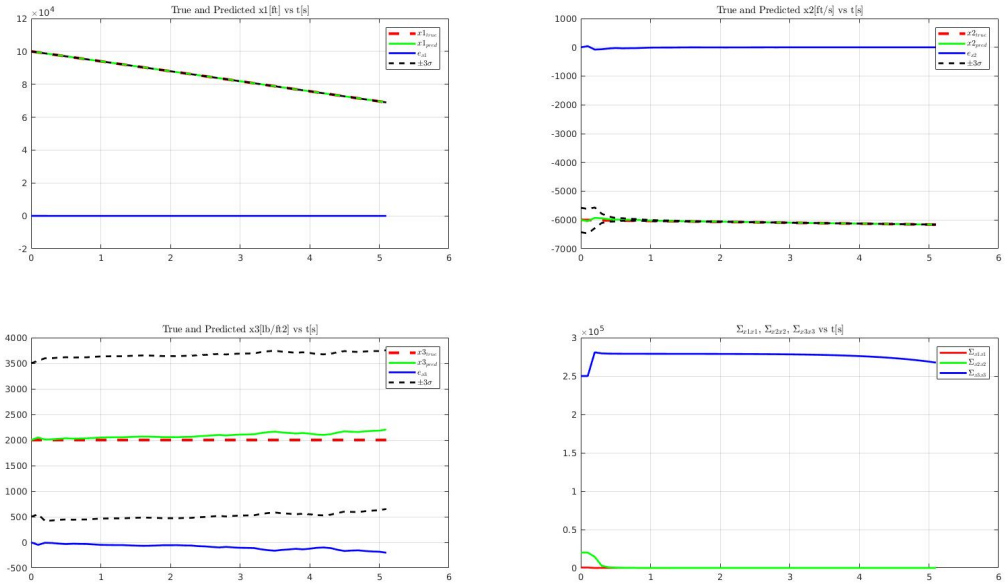

Figure 1.3: Plots of state and the uncertainties after 5 s for EnKF

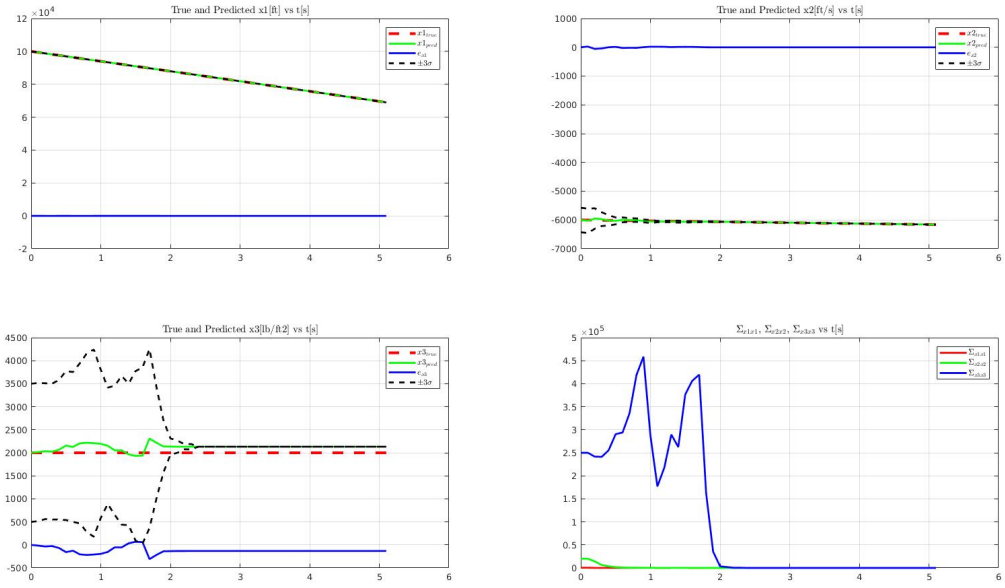

Figure 1.4: Plots of state and the uncertainties after 5 s for PF

b Averaged Estimation Errors over 50 Monte Carlo runs

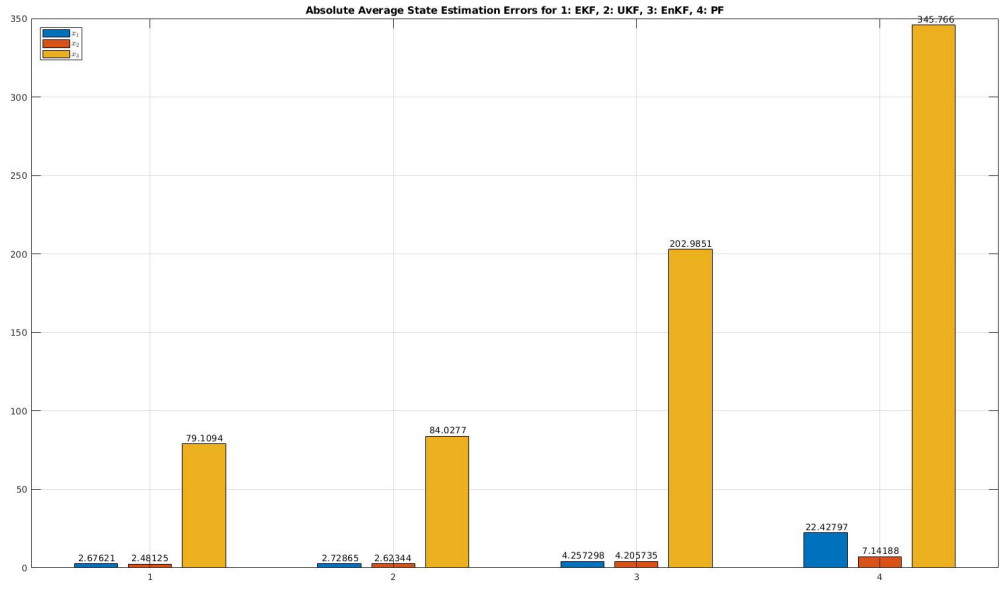

Figure 1.5: Averaged Estimation Error for 1 EKF, 2 UKF, 3 EnKF and 4 PF

c NEES Test and 3σ plots

i NEES Test

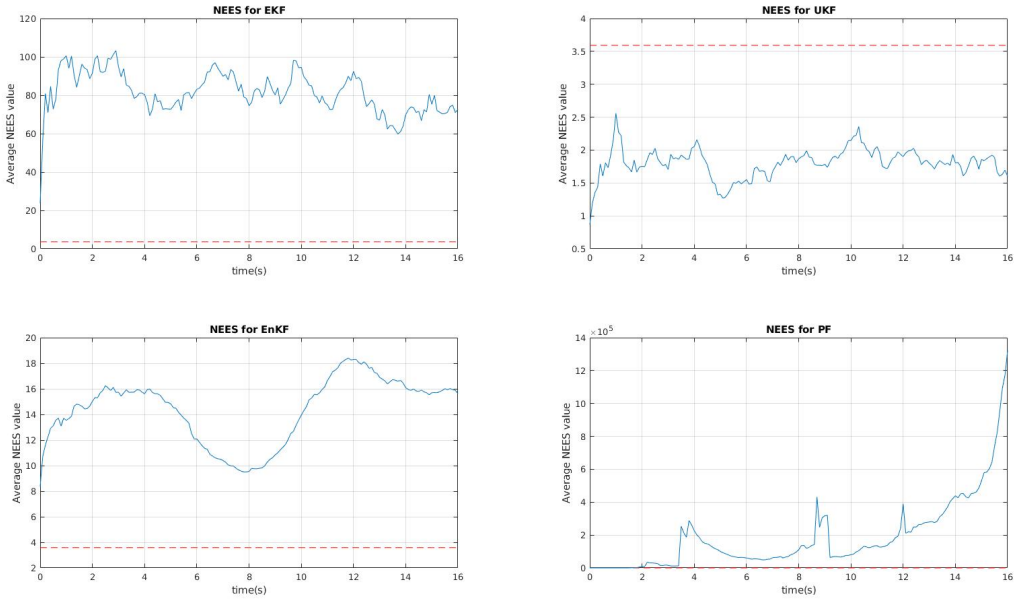

Figure 1.6: NEES for 1 EKF, 2 UKF, 3 EnKF and 4 PF

ii 3σ plots

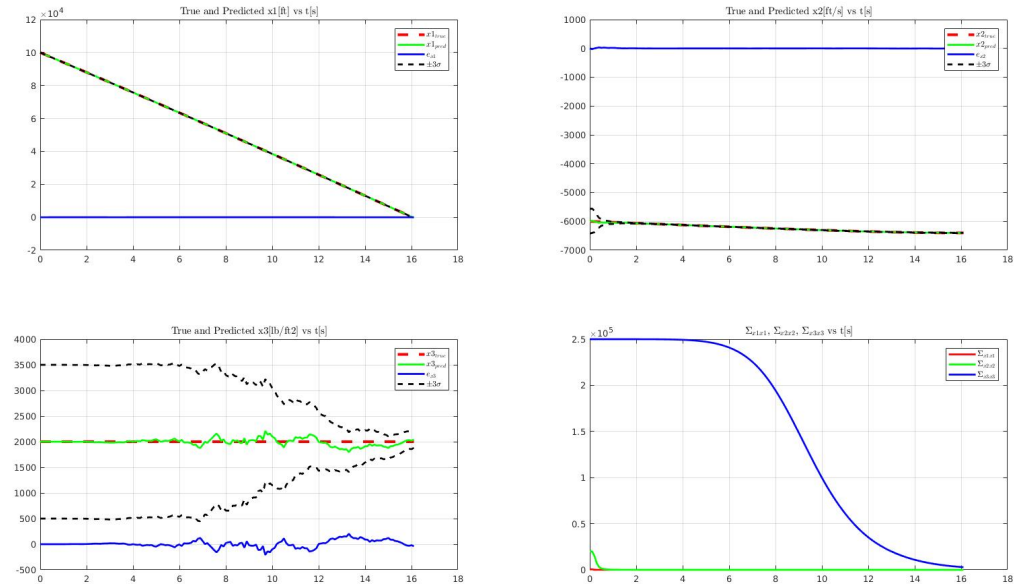

Figure 1.7: Plots of state and the uncertainties after 16 s for EKF

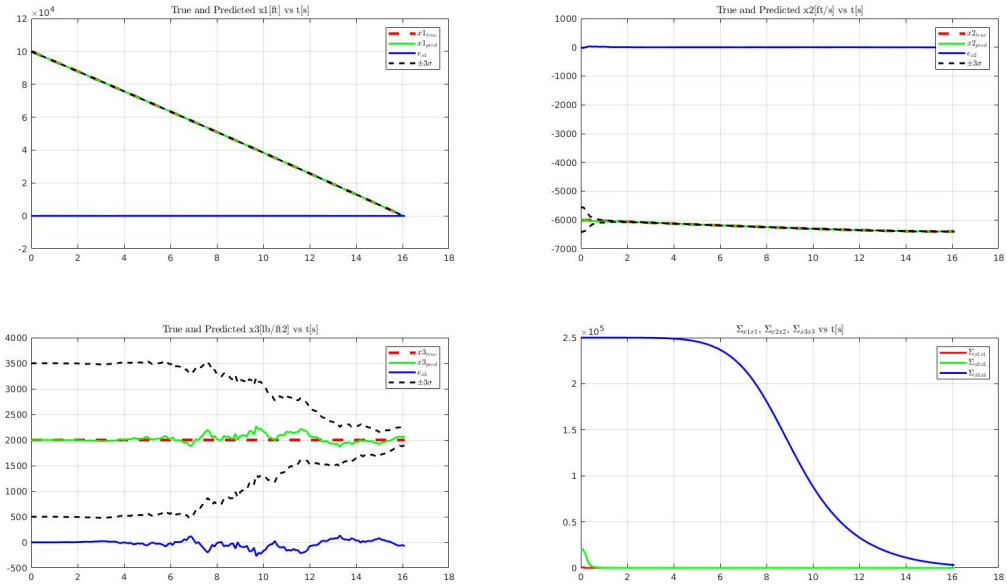

Figure 1.8: Plots of state and the uncertainties after 16 s for UKF

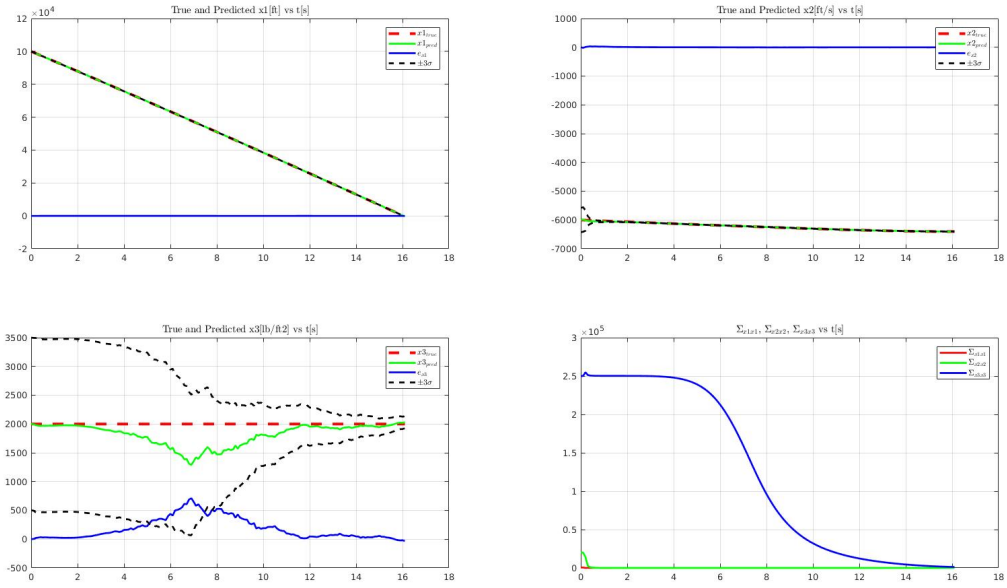

Figure 1.9: Plots of state and the uncertainties after 16 s for EnKF

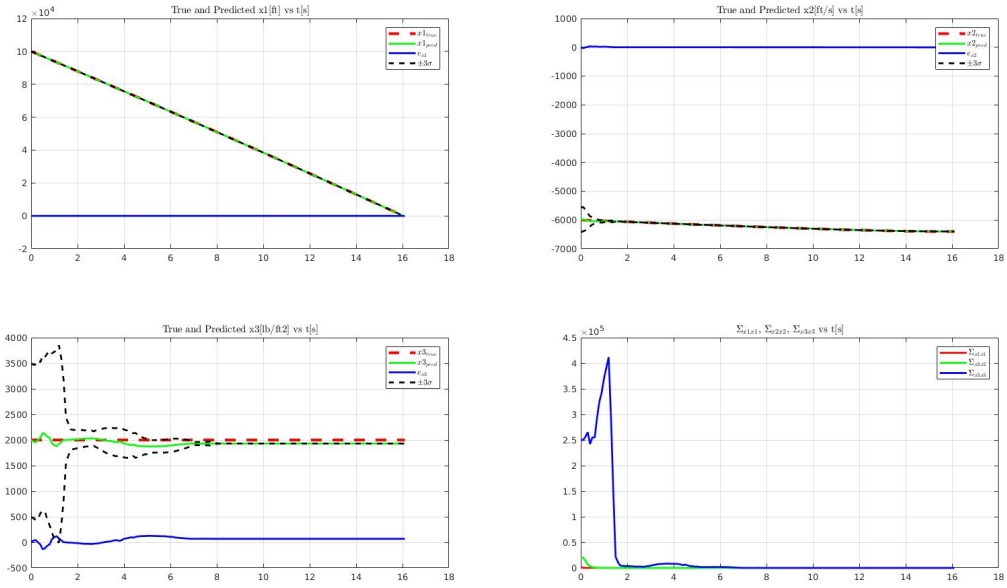

Figure 1.10: Plots of state and the uncertainties after 16 s for PF

d Average Execution Time per iteration

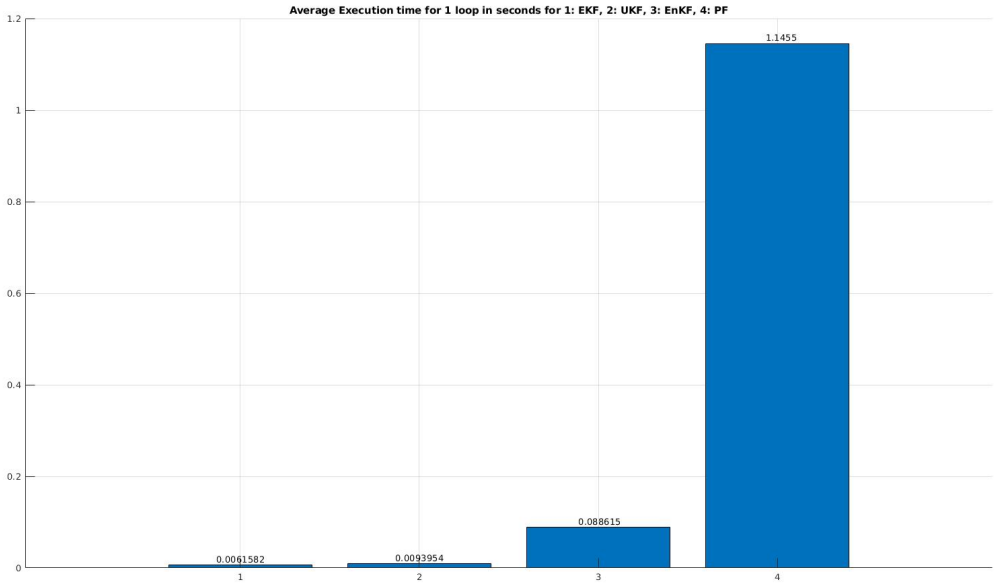

Figure 1.11: Average Execution Time per iteration in 1. EKF, 2. UKF, 3. EnKF, 4. PF

1.2 Results with Non Linear Measurement: $\mathbf{z = H(x) + v}$

To view and run the code of this section, please navigate to `Q1/question1_2ac2.m` and `Q1/question1_2bc1d.m`.

a Plots of state and the uncertainties after 5 s.

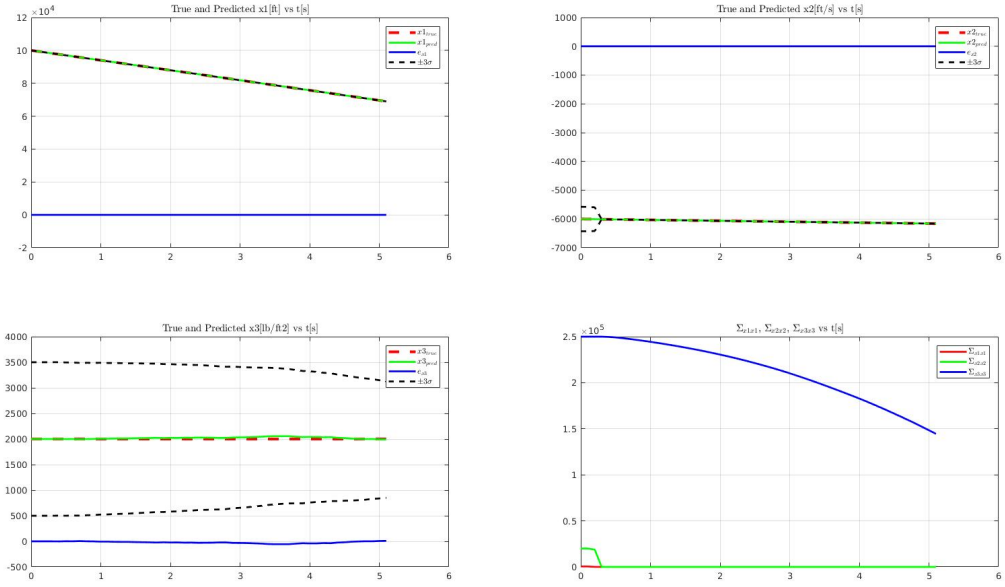

Figure 1.12: Plots of state and the uncertainties after 5 s for EKF

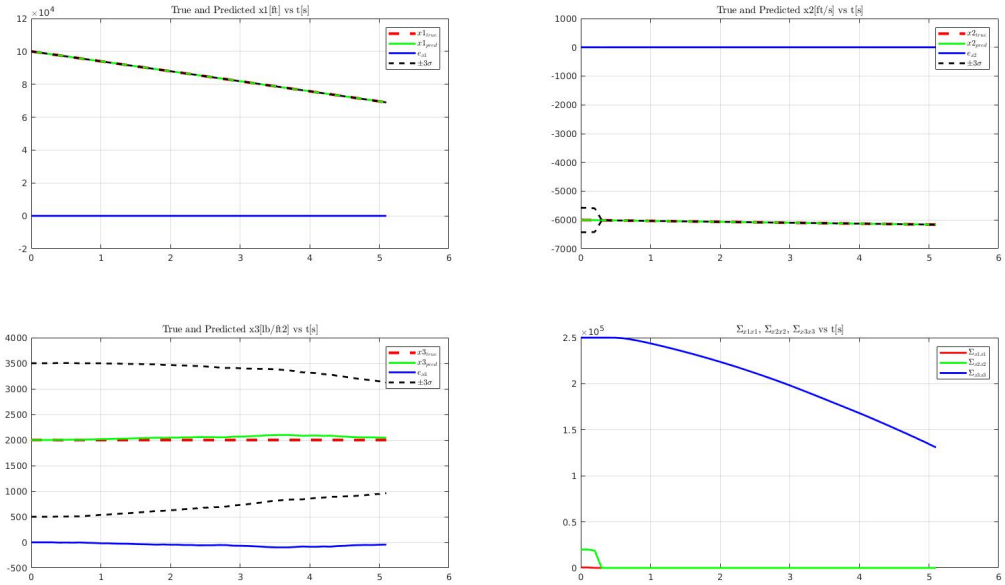

Figure 1.13: Plots of state and the uncertainties after 5 s for UKF

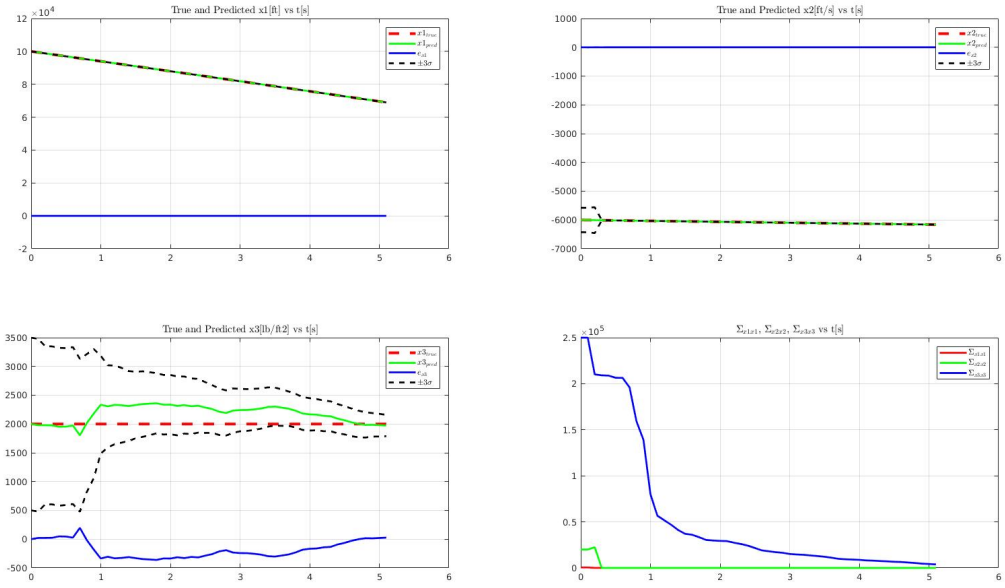

Figure 1.14: Plots of state and the uncertainties after 5 s for EnKF

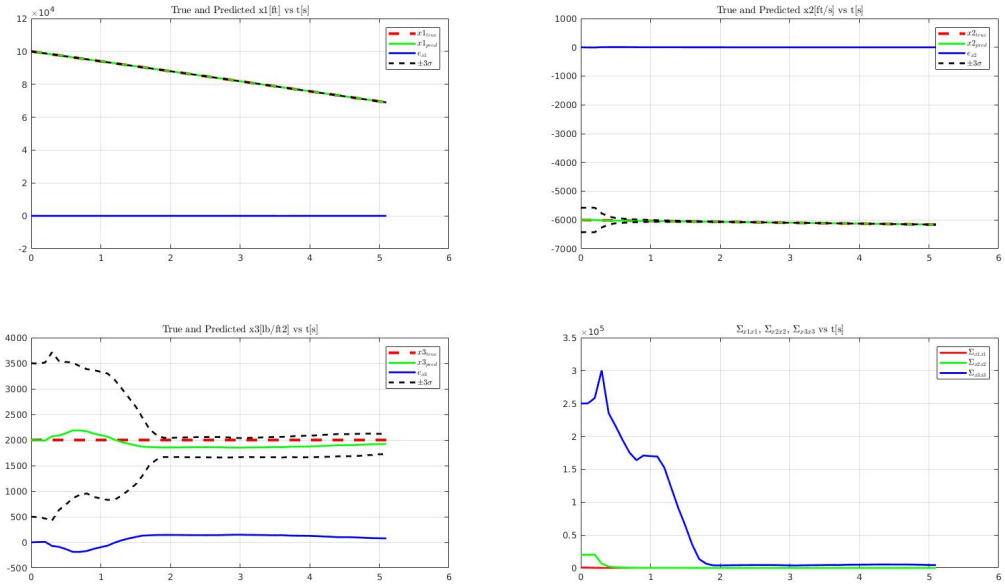

Figure 1.15: Plots of state and the uncertainties after 5 s for PF

b Averaged Estimation Errors over 50 Monte Carlo runs

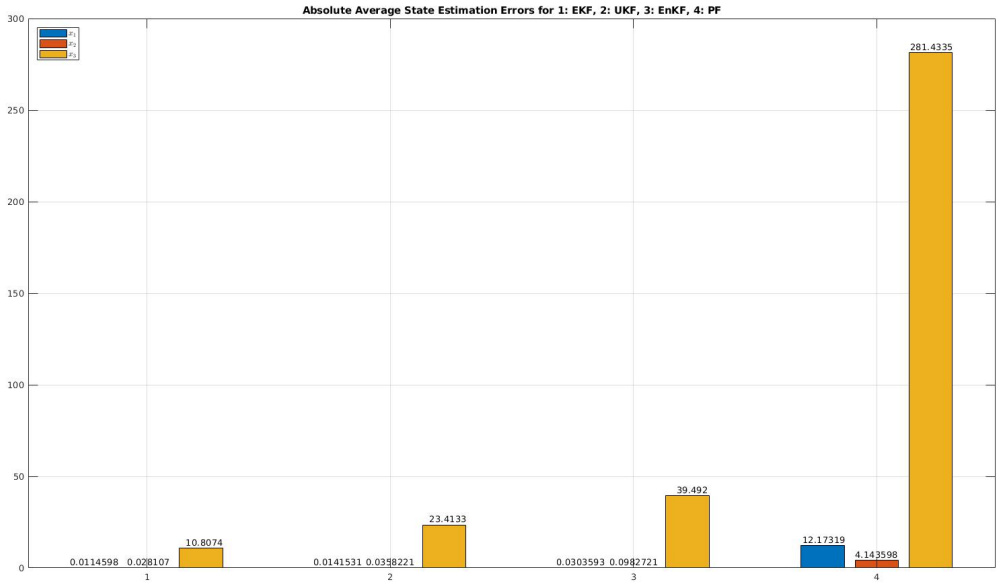

Figure 1.16: Averaged Estimation Error for 1 EKF, 2 UKF, 3 EnKF and 4 PF

c NEES Test and 3σ plots

i NEES Test

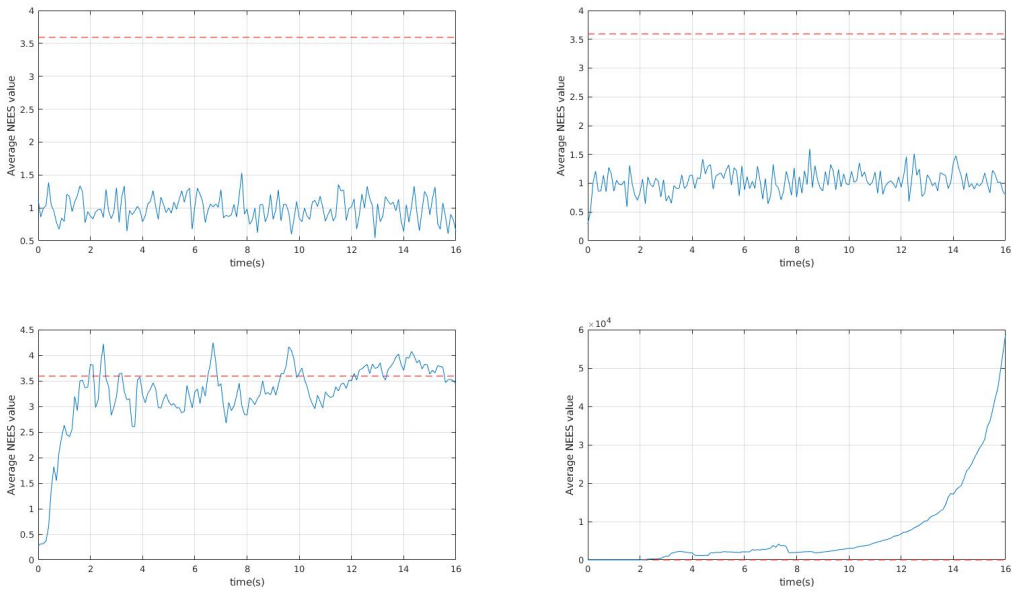

Figure 1.17: NEES for 1 EKF, 2 UKF, 3 EnKF and 4 PF

ii 3σ plots

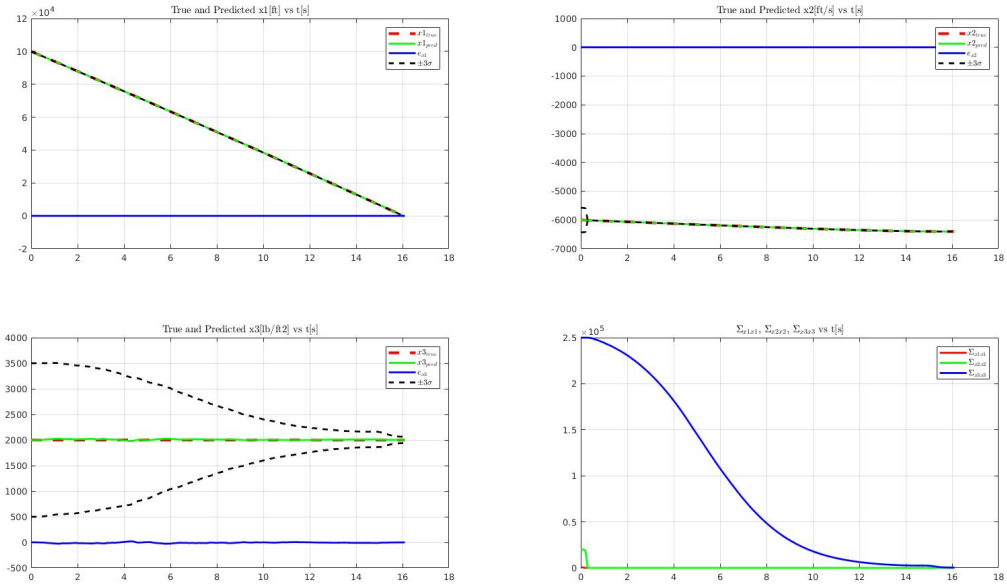

Figure 1.18: Plots of state and the uncertainties after 16 s for EKF

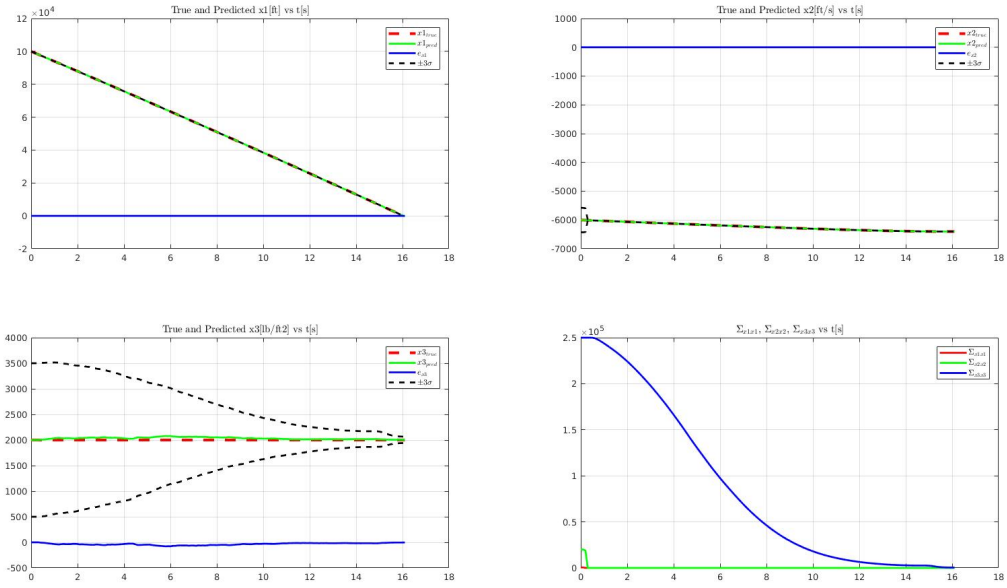

Figure 1.19: Plots of state and the uncertainties after 16 s for UKF

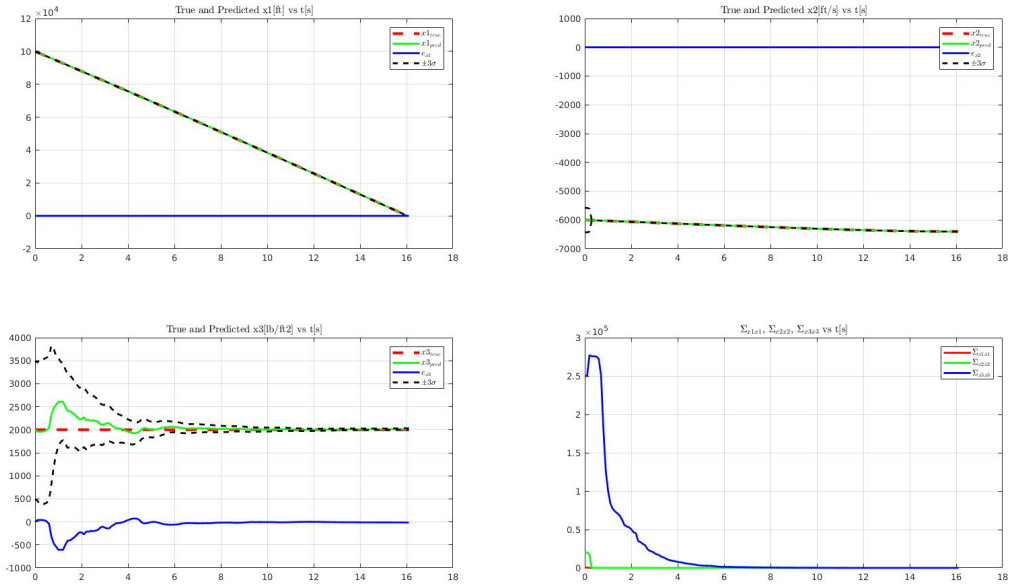

Figure 1.20: Plots of state and the uncertainties after 16 s for EnKF

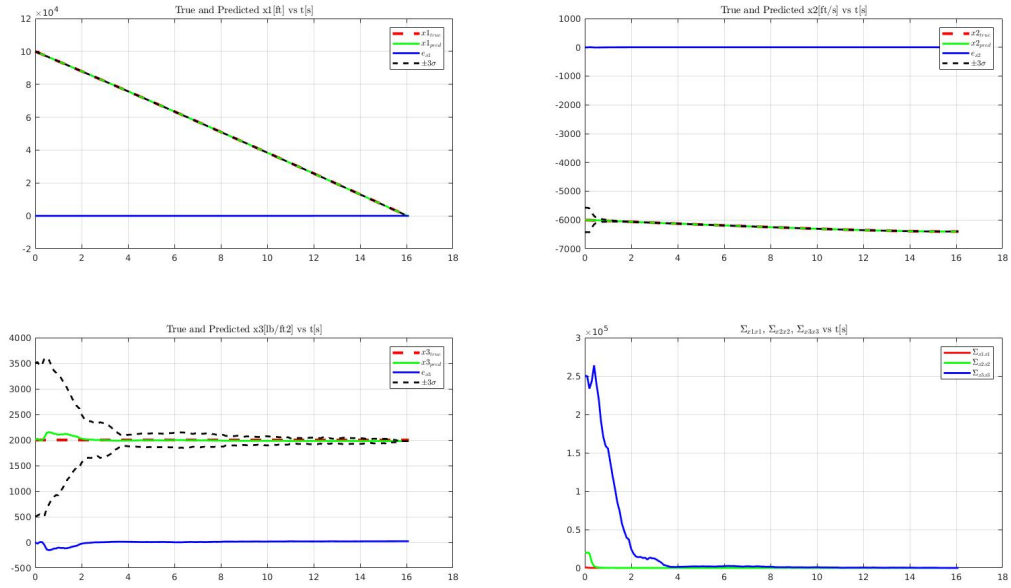

Figure 1.21: Plots of state and the uncertainties after 16 s for PF

d Average Execution Time per iteration

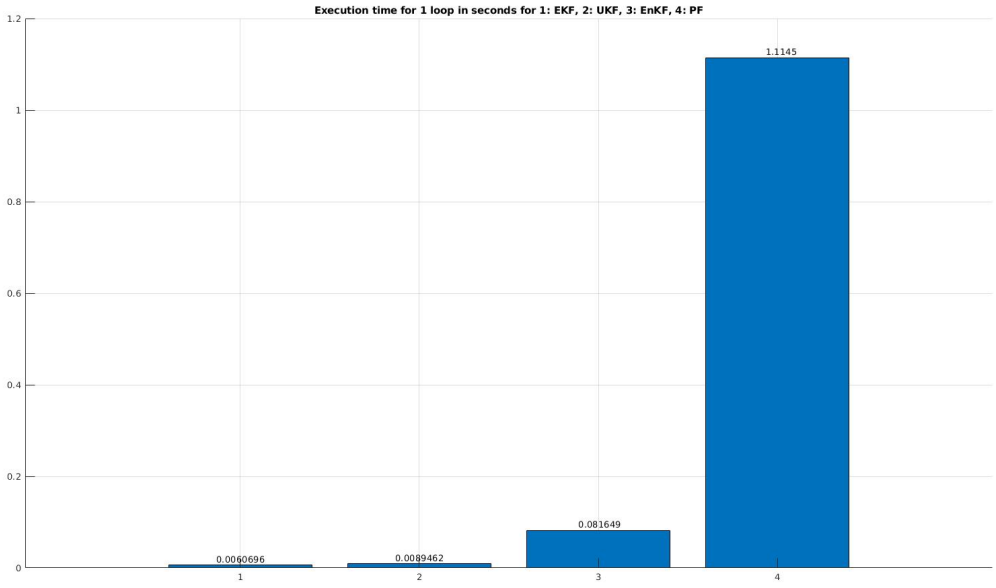

Figure 1.22: Average Execution Time per iteration in 1. EKF, 2. UKF, 3. EnKF, 4. PF

2 State Estimation of a Robot in a Plane

a Estimated and Truth Trajectory for 1 run for EKF, UKF, EnKF and PF. The corresponding code is located at `Q2/q2_a.m`.

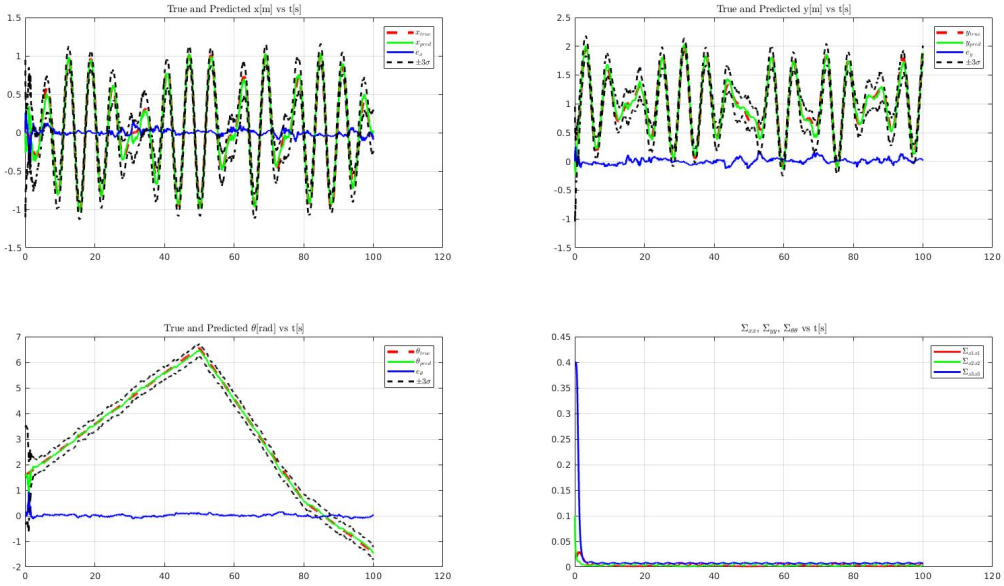

Figure 2.1: State Estimation with EKF

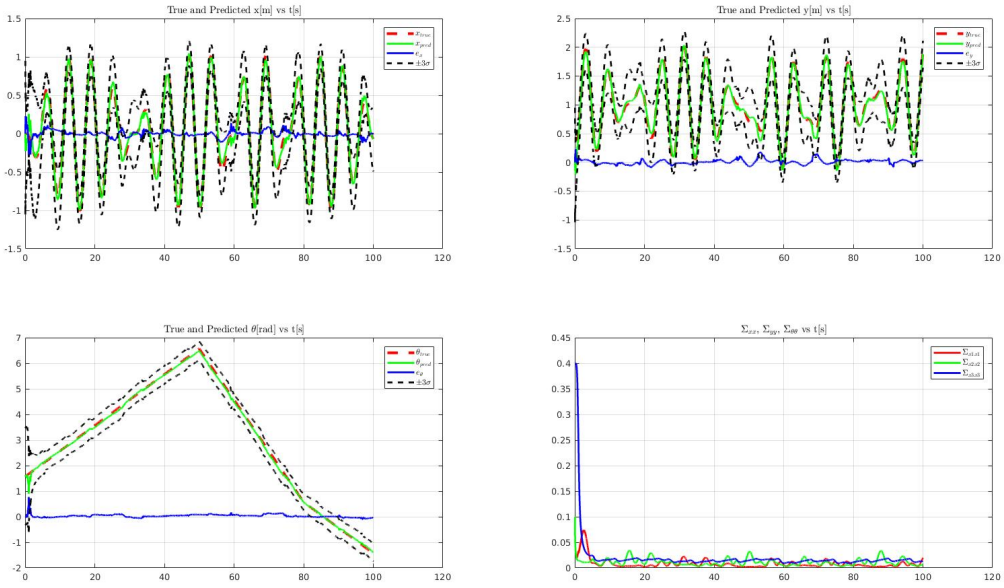

Figure 2.2: State Estimation with UKF

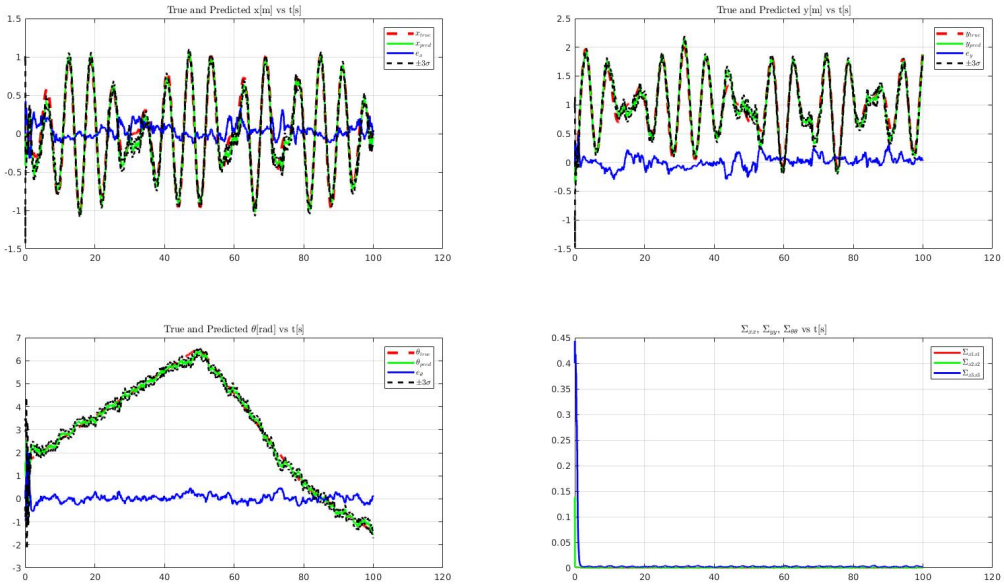

Figure 2.3: State Estimation with EnKF

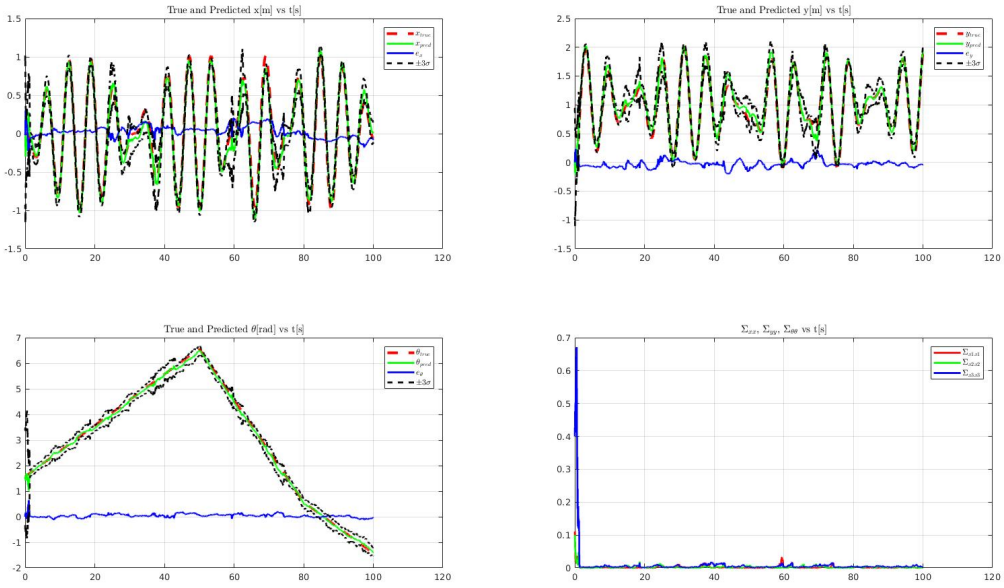

Figure 2.4: State Estimation with PF

The corresponding code for `b`, `c` and `d` is located at `Q2/q2_bcd.m`.

b Average Root Mean Squared Errors for 1. EKF, 2. UKF, 3. EnKF and 4. PF.

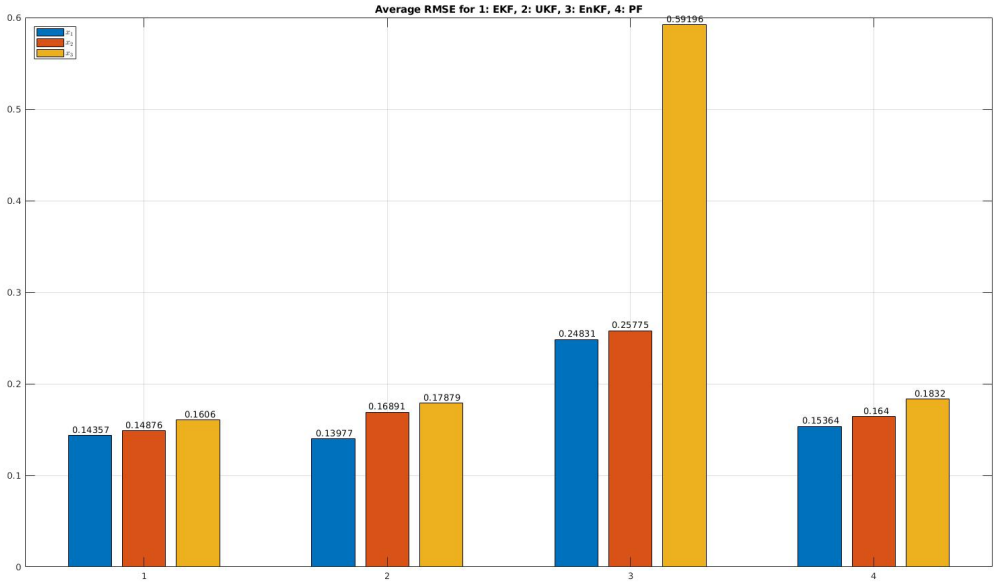

Figure 2.5: Average Root Mean Squared Error

c NEES Test for the estimators.

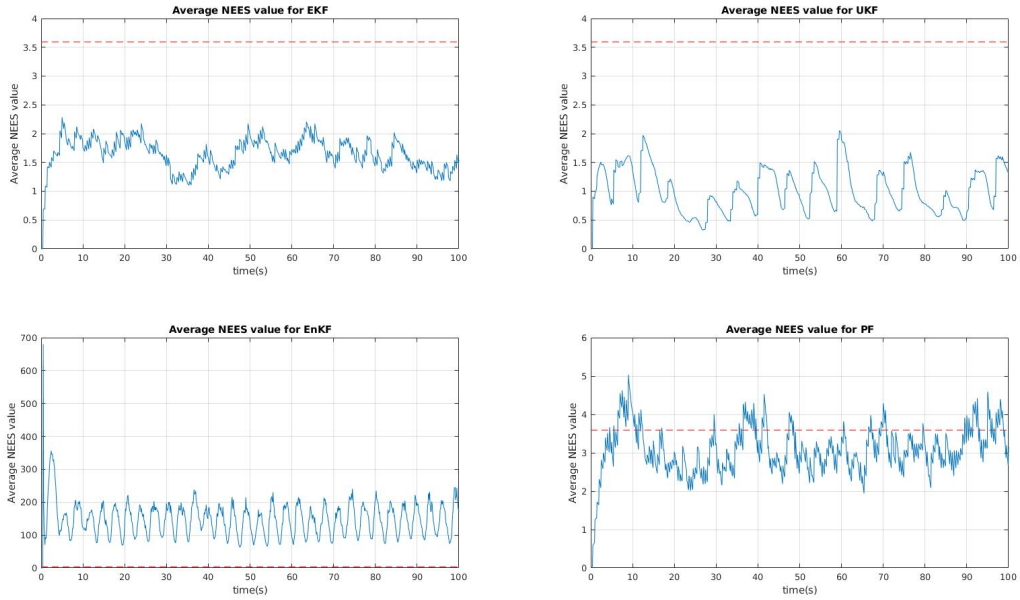

Figure 2.6: NEES Tests for 1. EKF, 2. UKF, 3. EnKF and 4. PF

d Average time taken per for 1 monte carlo iteration.

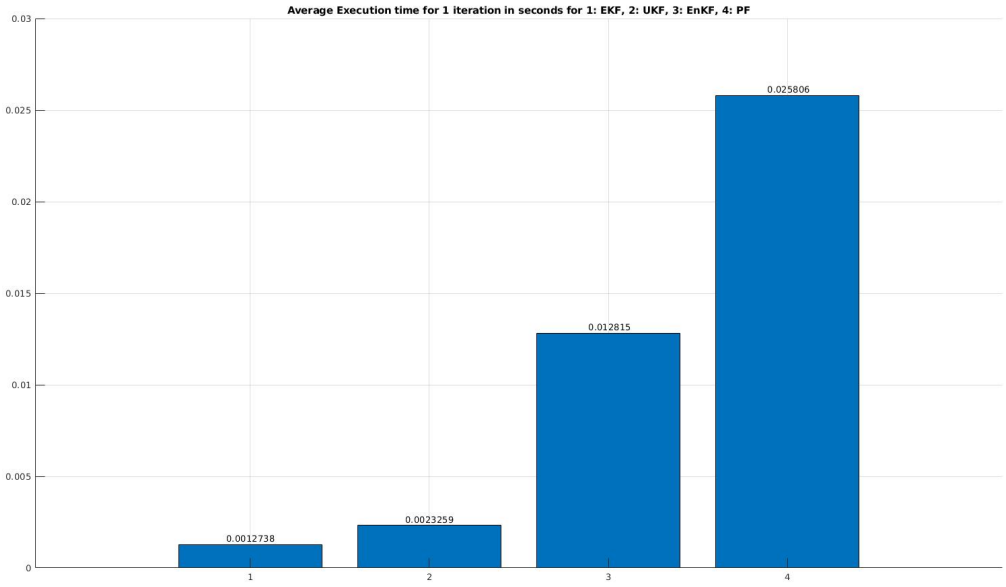

Figure 2.7: Average time taken per for 1 monte carlo iteration

The corresponding code for `e` and `f` is located at `Q2/q2_ef.m`.

e Marginal distribution before 1st measurement.

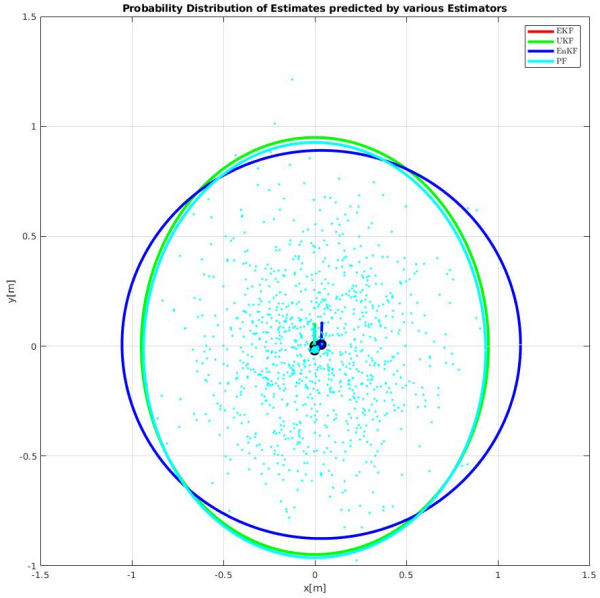

Figure 2.8: Marginal distribution before 1st measurement

f Marginal distribution after 1st measurement.

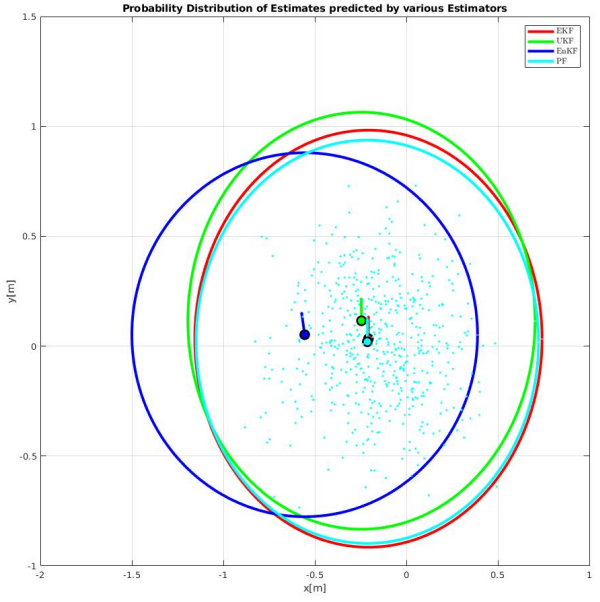

Figure 2.9: Marginal distribution after 1st measurement