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Homework #5

Prof. SUH

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| %%%%%%%%%%%%%%%%%%%% (1) Do simulation to generate xk and zk with initial position 0.  N = 500;  tt = 0:T:T\*(N-1);  w = sqrtm(Q) \* randn(n, N);  v = sqrtm(R) \* randn(m, N);  x = zeros(n, N);  z = zeros(m, N);  % Given that the initial position is 0  x(:, 1) = [0 0 0]';  z(1) = 0;  for k = 2:N  x(:, k) = F\*x(:, k-1) + w(:, k-1); % True values  z(:, k) = H\*x(:, k) + v(:, k); % Measurement samples  end |

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| %%%%%%%%%%%%%%%%%%% (2) With a Kalman filter, find xˆk from zk.  %%%%%%%%%%%%%%%%%%% Assume that you know the exact initial position 0.  xh0 = x(:, 1);  P0 = zeros(n, n);  xh\_result = zeros(n, N);  P\_result = zeros(n, n, N); % array of N matrices, each matrix is n x n  e\_result = zeros(n, N);  % Run Kalman filter  xh = xh0;  P = P0;  for k = 2:N  % Time update stage  xh\_minus = F\*xh; % Prediction of state  P\_minus = F\*P\*F' + Q; % Prediction of error covariance    % Measurement update stage  K = P\_minus\*H'\*inv(H\*P\_minus\*H' + R); % Computation of Kalman gain  xh = xh\_minus + K\*(z(k) - H\*xh\_minus);% Computation of estimate  P = (I - K\*H)\*P\_minus; % Computation of error covariance    % Save results after each round  xh\_result(:, k) = xh;  P\_result(:, :, k) = P;  e\_result(:, k) = x(:, k) - xh;  end |

1. Draw plot of e(k), Pk(1, 1), Pk(2, 2), Pk(3, 3)

A graph with orange lines and blue line

Description automatically generated

A graph with a line

Description automatically generated

A graph of a line

Description automatically generated

A graph of a function

Description automatically generated