ME 425_525
HW # 5
Localization of a Mobile Robot Using Kalman Filters
Due: 05/01/2026, 23:55

- Consider a holonomic point robot moving on the plane with a state vector given by the robot's pose $q = [x, y]$. Observations of the robot are made at discrete points in time and consist of the robot's distance from the origin d and the bearing angle α measured from the origin. Assume that the noise associated with these two measurements is independent and additive Gaussian. Develop and implement a *Kalman Filter (KF)* that maintains an ongoing estimate of the robot's state. To this end, generate simulation data in Matlab/Simulink by applying any appropriate control inputs to the robot along x and y axes. Assume that the uncertainty in the motion of the robot can also be modeled by additive Gaussian noise.

  Provide all relevant graphs (predicted states (x and y) vs time, elements of the 'a priori error covariance matrix' vs time, optimal states (x and y) vs time, elements of the 'a posteriori error covariance matrix' vs time, etc.) and comment on your results.

- Consider a nonholonomic point robot moving on the plane with a state vector given by the robot's pose $q = [x, y, \theta]$. Observations of the robot are made at discrete points in time and consist of the robot's distance from the origin d and the bearing α measured from the origin. Assume that the noise associated with these two measurements is independent and additive Gaussian. Develop and implement an *Extended Kalman Filter (EKF)* that maintains an ongoing estimate of the robot's state. To this end, generate simulation data in Matlab/Simulink by applying any appropriate control inputs to the robot along the x and y axes. Assume that the uncertainty in the motion of the robot can also be modeled by additive Gaussian noise.

  Provide all relevant graphs (predicted states (x, y, and θ) vs time, elements of the 'a priori error covariance matrix' vs time, estimated states (x, y, and θ) vs time, elements of the 'a posterior error covariance matrix' vs time etc.) and comment on your results.