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README - kf.pdf

Guidance, Navigation and Controls Subsystem

Function Name (Kalman Filter)

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Description:
The code implements the Kalman Filter Algorithm to estimate the state of a bot. It models motion of a bot performing SHM. It assumes initial position as origin and angular frequency of oscillation as unity. Here we the know the ideal trajectory of the bot and hence it plots it and randomly generates measurements around this trajectory.Then it implements the Kalman Filter Algorithm and estimates the state of the bot i.e its position and velocity.
The algorithm has two steps, prediction and update. The predict step uses the estimates from the previous time step and produces an estimate for the current time step. This is called *priori* estimate.
In update step we define innovation as difference between *priori* estimate and current observation. Then it is multiplied by the Kalman gain and added to previous estimate which improves the accuracy.
Formulae & References:
Variables in predict function:
m_F : state transition matrix.
m_G : GG^T is the covariance of state noise.
Variables in update function:
z : measurement.
m_H : observation matrix.
e : innovation.
S : innovation covariance.
L : Kalman gain.
Theory of Kalman Filter Algorithm
Algorithm Derivation
Input parameters:
The input arguments to the code are as follows:

1. **velocity** : (Float) - initial velocity of the bot. *m/s*
2. **covariance** : (Float) - initial covariance of state.(If initial state is accurately known, type 0) m^2

3. **amplitude** : (Float) - amplitude of the oscillations. m

Output:
The code plots the state estimates of the trajectory, one curve showing the position and the other velocity as the state evolves.It also plots the covariance.