UKF with 2D State Vector

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1 Design

1.1 State Vector

$$\mathbf{x}_t = \begin{bmatrix} z \\ \dot{z} \end{bmatrix} \tag{1}$$

1.2 Prediction Step

1.2.1 Control Input

$$\mathbf{u}_t = \begin{bmatrix} \ddot{z} \end{bmatrix} \tag{2}$$

1.2.2 State Transition Function

$$g(\mathbf{x}_{t-\Delta t}, \mathbf{u}_t, \Delta t) = \begin{bmatrix} ? & ? \\ ? & ? \end{bmatrix} \mathbf{x}_{t-\Delta t} + \begin{bmatrix} ? \\ ? \end{bmatrix} \mathbf{u}_t \tag{3}$$

1.3 Measurement Update Step

1.3.1 Measurement Vector

$$\mathbf{z}_t = \begin{bmatrix} r \end{bmatrix} \tag{4}$$

1.3.2 Measurement Function

$$h(\bar{\mathbf{x}}_t) = \begin{bmatrix} ? & ? \end{bmatrix} \bar{\mathbf{x}}_t \tag{5}$$

1.3.3 Measurement Covariance Matrix

Populate the measurement covariance matrix $\mathbf{R}_t$ with a reasonable value for the variance σ_r^2 of the range reading r.

$$\mathbf{R}_t = \begin{bmatrix} ? \end{bmatrix} \tag{6}$$

Your histogram image here

2 Implementation

2.1 Initializing $\dot{z}$

Your answer here

2.2 Consecutive Predictions vs. Updates

Your answer here

2.3 Comparison of UKF to EMA Filter

Your answer and Height Readings chart image here