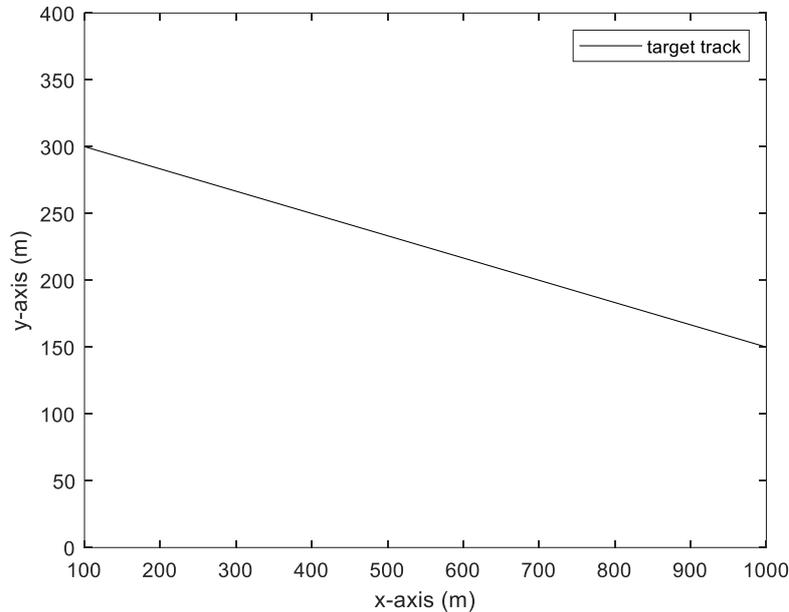


Broadband Transmission Technology
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Lab3: Target Tracking with Range-theta Measurement Using the Extended Kalman Filter

Problem Scenario:



Suppose the target moves with a constant velocity and its motion trajectory is shown in the above figure, where the trajectory is recorded 30 seconds and the sampling period is $T = 0.1$ sec. Assume that the observer is located at position (0,0) and the measurements are simulated with $R = \sqrt{x_N^2 + y_N^2}$ and $\theta = \tan^{-1}(y_N / x_N)$, where $x_N = x + N_x$ and $y_N = y + N_y$, and besides, N_x and N_y are modeled by mutually independent zero-mean white Gaussian noises of standard deviation 20 meters.

Denote $\mathbf{x} = [x \dot{x} y \dot{y}]^T$ the state vector and $\mathbf{z} = [R \theta]^T$ the measurement vector. Let n be the sample index. We have the state equations as expressed in the following:

$$\mathbf{x}_{n+1} = \phi \mathbf{x}_n + \mathbf{w}_n$$

$$\mathbf{z}_n = h(\mathbf{x}_n) + \mathbf{v}_n$$

where

$$\phi = \begin{bmatrix} 1 & T & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & T \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad h(\mathbf{x}_n) = \begin{bmatrix} \sqrt{x_n^2 + y_n^2} \\ \tan^{-1}(y_n / x_n) \end{bmatrix}$$

and \mathbf{w}_n and \mathbf{v}_n are mutually independent process noise vector and measurement noise vector, respectively.

Please employ the extended Kalman filter (EKF) to estimate the target track and velocity

on x-axis and y-axis, assuming the initial estimate is $\mathbf{x}_0 = [1 \ 10 \ 25 \ 250 \ -10]^T$.

Results:

