

Bearing-only tracking: From EKF to particle filter

11. September 2020

## Example application: Bearings-only tracking

A challenge that has defeated solution attempts since the late 70s.

## Problem statement

- Own-ship state:  $\mathbf{x}^o = [x^o, y^o, \dot{x}^o, \dot{y}^o]^T$ . Both state vector and orientation known.
- Target state:  $\mathbf{x}^{\tau} = [x^{\tau}, y^{\tau}, \dot{x}^{\tau}, \dot{y}^{\tau}]^{\mathsf{T}}$ .
- Kinematics model (to be discretized using standard linear techniques):

$$\dot{\mathbf{x}}^{\tau} = \left[ egin{array}{ccc} \mathbf{0}_{2 imes 2} & \mathbf{I}_2 \\ \mathbf{0}_{2 imes 2} & \mathbf{0}_{2 imes 2} \end{array} 
ight] \mathbf{x}^{ au} + \mathbf{v}(t)$$

Measurement model:

$$\mathbf{z}_k = \operatorname{atan2}(y_k^{\tau} - y_k^{o}, x_k^{\tau} - x_k^{o}) + \mathbf{w}_k$$

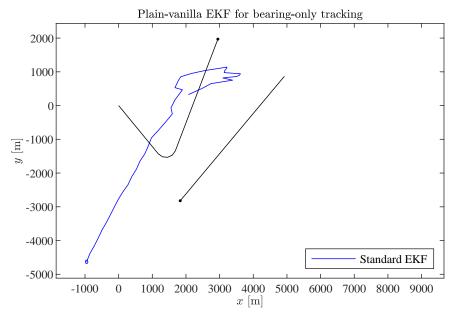
Noise processes assumed zero-mean white mutually independent Gaussian.

## Challenges

- The measurement model is nonlinear.
- The problem is not observable unless own-ship executes manoeuvres.

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## Let's attempt a standard EKF



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