



State rather $\rightarrow x_- = \begin{bmatrix} p_x \\ p_y \\ v_x \\ v_y \end{bmatrix}$ we get this from measurement assume zero for now.

$$F = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

previous_timestamp = timestamp

uncertainty, covariance matrix \rightarrow

$$P = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1000 & 0 \\ 0 & 0 & 0 & 1000 \end{bmatrix}$$

These values are high because we don't know the speed from the first measurement. The uncertainty is therefore very high.

Predict

$dt = \text{timestamp} - \text{previous_timestamp}$

$$F = \begin{bmatrix} 1 & 0 & dt & 0 \\ 0 & 1 & 0 & dt \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$x' = Fx$$

$$Q = \begin{bmatrix} \frac{\Delta t^4}{4} \sigma_{ax}^2 & 0 & \frac{\Delta t^3}{2} \sigma_{ax}^2 & 0 \\ 0 & \frac{\Delta t^4}{4} \sigma_{ay}^2 & 0 & \frac{\Delta t^3}{2} \sigma_{ay}^2 \\ \frac{\Delta t^3}{2} \sigma_{ax}^2 & 0 & \Delta t^2 \sigma_{ax}^2 & 0 \\ 0 & \frac{\Delta t^3}{2} \sigma_{ay}^2 & 0 & \Delta t^2 \sigma_{ay}^2 \end{bmatrix}$$

$$P' = F \cdot P \cdot F^T + Q$$

