Ex1 Let $x_{t+1} = x_t + \delta t[\dot{x}_t \cos\psi_t - \dot{y}_t \sin\psi_t] + w_t^x$

$y_{t+1} = y_t + \delta t[\dot{x}_t \sin\psi_t + \dot{y}_t \cos\psi_t] + w_t^y$

$\psi_{t+1} = \psi_t + \delta t[\dot{\psi}_t] + w_t^\psi$

range measure

$$y_{t,dist}^j = |m^j - p_t| + v_{t,dist}^j$$

$$y_{t,bearing}^j = \tan^{-1}\left(\frac{m_y^j - y_t}{m_x^j - x_t}\right) - \psi_t + v_{t,bearing}^j$$

for $j = 1, 2 \cdots n$

$$x_t = \begin{bmatrix} x_t \\ y_t \\ \psi_t \\ m_x^1 \\ m_y^1 \\ \vdots \\ m_x^n \\ m_y^n \end{bmatrix} \qquad y_t = \begin{bmatrix} |m^1 - p_t| \\ \vdots \\ |m^n - p_t| \\ \tan^{-1}\left(\frac{m_y^1 - y_t}{m_x^1 - x_t}\right) - \psi \\ \vdots \\ \tan^{-1}\left(\frac{m_y^n - y_t}{m_x^n - x_t}\right) - \psi \end{bmatrix} + \begin{bmatrix} v_{t,dis}^1 \\ \vdots \\ v_{t,dis}^n \\ v_{t,be}^1 \\ \vdots \\ v_{t,be}^n \end{bmatrix}$$

$$X_k = f(x_{k-1}, u_k) + w_k$$

$$\begin{bmatrix} x_k \\ y_k \\ \psi_k \\ m_x^1 \\ m_y^1 \\ \vdots \\ m_x^n \\ m_y^n \end{bmatrix} = \underbrace{\begin{bmatrix} x_{k-1} + \delta_t\left[\dot{x}_{k-1}\cos\psi_{k-1} - \dot{y}_{k-1}\sin\psi_{k-1}\right] \\ y_{k-1} + \delta_t\left[\dot{x}_{k-1}\sin\psi_{k-1} + \dot{y}_{k-1}\cos\psi_{k-1}\right] \\ \psi_{k-1} + \delta_t\dot{\psi}_{k-1} \\ m_x^1 \\ m_y^1 \\ \vdots \\ m_x^n \\ m_y^n \end{bmatrix}}_{f_k} + \begin{bmatrix} \psi^x_{k-1} \\ \psi^y_{k-1} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ \vdots \end{bmatrix}$$

$$y_k = \underbrace{\begin{bmatrix} \|m^1 - p_k\| \\ \vdots \\ \|m^n - p_k\| \\ \operatorname{atan2}(m_y^1 - y_k, m_x^1 - x_k) - \psi_k \\ \vdots \\ \operatorname{atan2}(m_y^n - y_t, m_x^n - x_k) - \psi_k \end{bmatrix}}_{h_k} + \begin{bmatrix} v_{k,d}^1 \\ \vdots \\ v_{k,d}^n \\ v_{k,b}^1 \\ \vdots \\ v_{k,b}^n \end{bmatrix}$$

$$F_k = \frac{\partial f}{\partial x}\bigg|_{\hat{x}_{k-1|k-1},\, u_k}$$

$$F_K = \begin{bmatrix} 1 & 0 & -\delta t\left[\dot{x}_{k-1}\sin\psi_{k-1|k-1} + \dot{y}_{k-1|k-1}\cos\psi_{k-1}\right] & 0 & \cdots & 0 \\ 0 & 1 & \delta t\left[\dot{x}_{k-1}\cos\psi_{k-1|k-1} - \dot{y}_{k-1}\sin\psi_{k-1}\right] & 0 & \cdots & 0 \\ 0 & 0 & 1 & 0 & \cdots & 0 \\ 0 & 0 & 0 & 1 & \cdots & 0 \\ 0 & 0 & \vdots & 0 & 1 & \vdots \\ \vdots & \vdots & \vdots & \vdots & & \ddots \\ 0 & \vdots & 0 & 0 & \cdots & 1 \end{bmatrix}$$

$$H = \frac{\partial h}{\partial x}\Big|_{x=x_{k|k-1}}$$

$$H_K = \begin{bmatrix} \frac{(x_K - m_x^1)}{\|m^1 - p_K\|} & \frac{y_K - m_y^1}{\|m^1 - p_K\|} & 0 & \frac{m_x^1 - x_K}{\|m^1 - p_K\|} & \frac{m_y^1 - y_K}{\|m^1 - p_K\|} & \cdots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & & & \vdots & \vdots \\ \frac{(x_K - m_x^n)}{\|m^n - p_K\|} & \frac{y_K - m_y^n}{\|m^n - p_K\|} & 0 & \cdots & & \cdots & \frac{m_x^n - x_K}{\|m^n - p_K\|} & \frac{m_y^n - y_K}{\|m^n - p_K\|} \\ \frac{m_y^1 - y_K}{\|m^1 - p_K\|^2} & \frac{x_t - m_x^1}{\|m^1 - p_K\|^2} & -1 & \frac{y_K - m_y^1}{\|m^1 - p_K\|^2} & \frac{m_x^1 - x_K}{\|m^1 - p_K\|^2} & 0 & \cdots & 0 \quad 0 \\ \vdots & \vdots & & \vdots & \vdots & & \vdots & \vdots \\ \frac{m_y^n - y_K}{\|m^n - p_K\|^2} & \frac{x_t - m_x^n}{\|m^n - p_K\|^2} & -1 & 0 & 0 & \cdots & \frac{y_t - m_y^n}{\|m^n - p_K\|^2} & \frac{x_t - m_x^n}{\|m^n - p_K\|^2} \end{bmatrix}$$

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Figure 2 (on 1125836cf4b5)

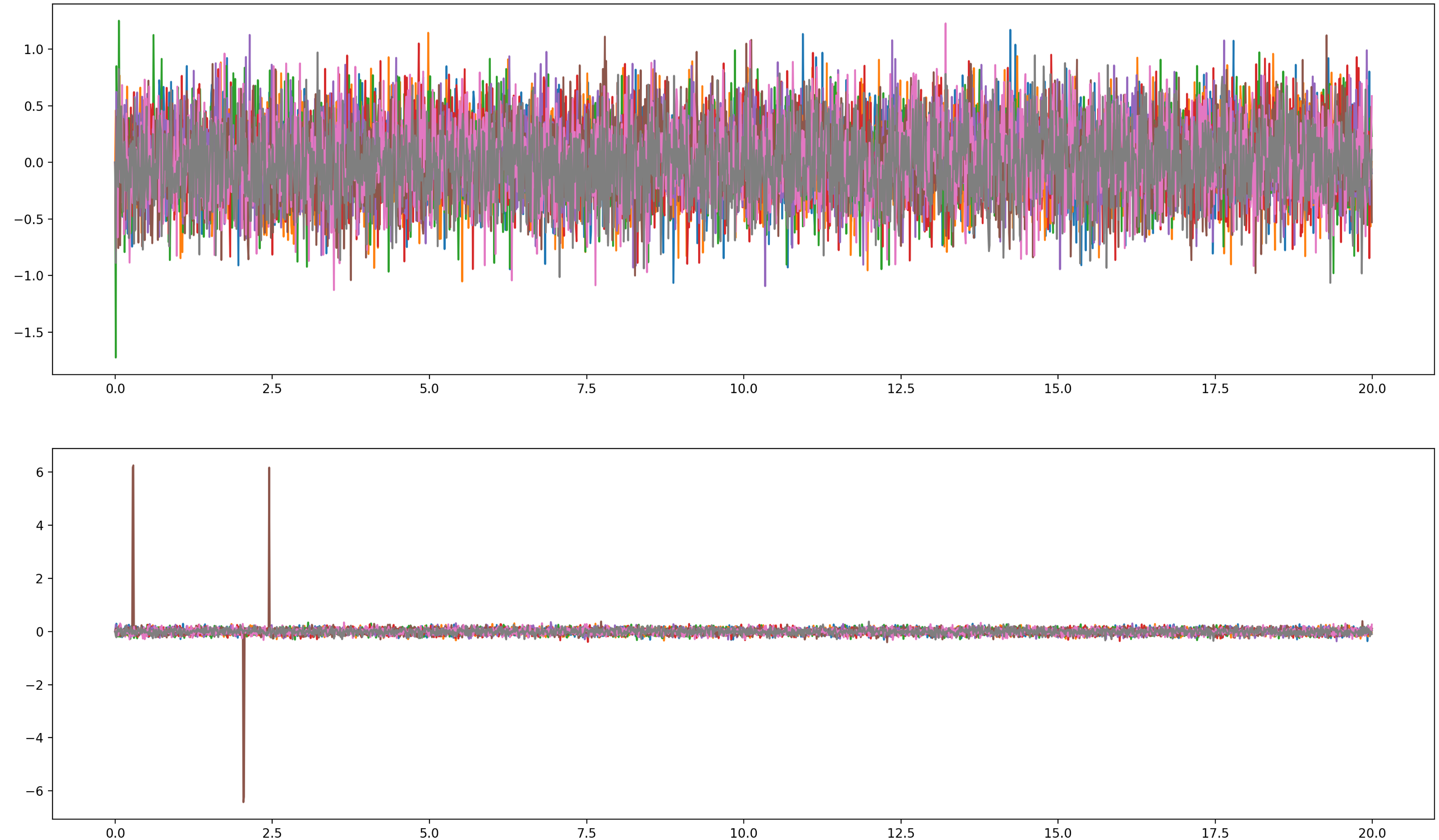

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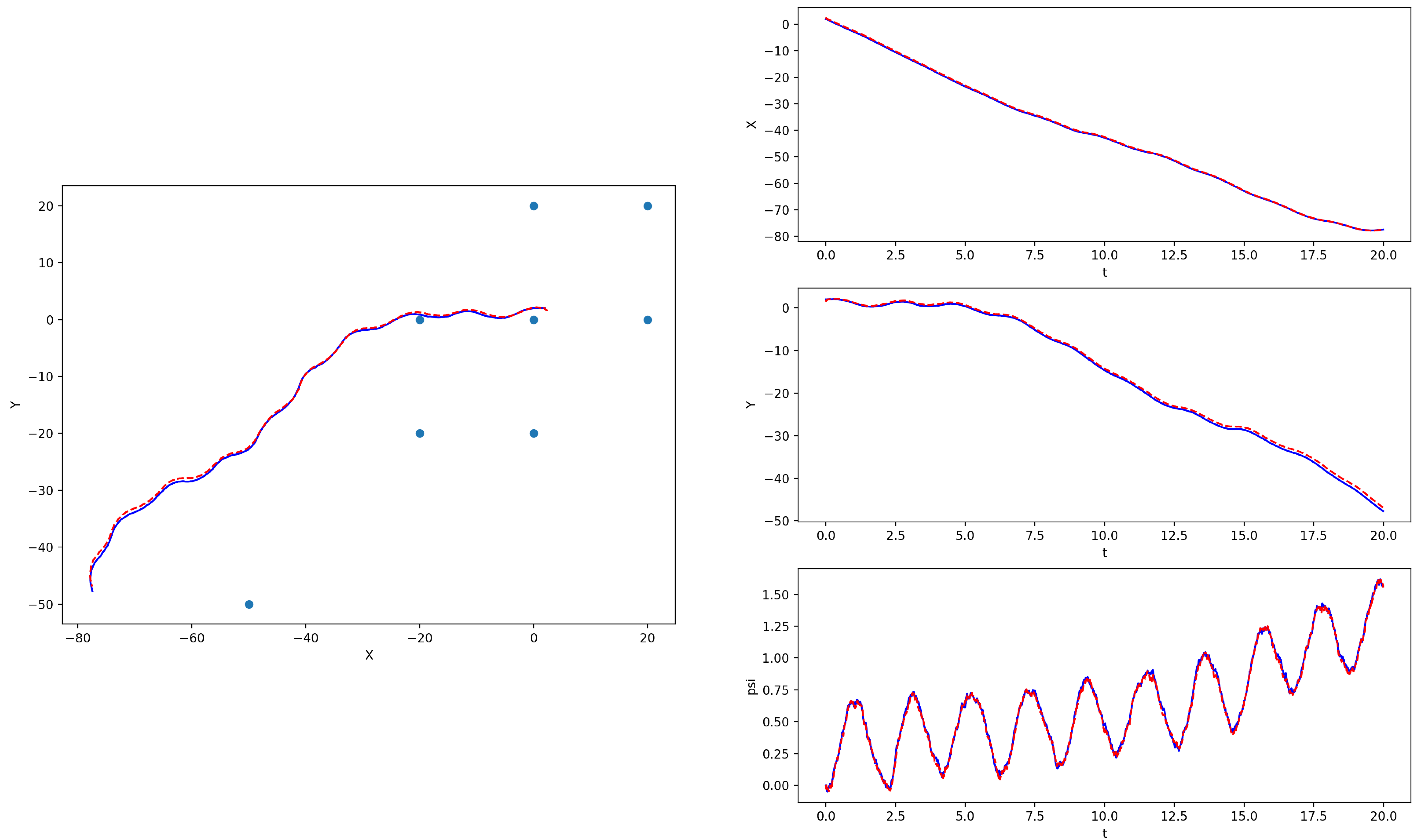
Figure 1 (on 1125836cf4b5)




Activities
Matplotlib
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/root/Downloads/P4_student/P4_student/worlds/automotive_new.wbt (P4_student) - Webots R2021b (on 1125836cf4b5)
Figure 1 (on 1125836cf4b5)
Y (m)
X (m)
delta (rad)
Time (s)
xdot (m/s)
Time (s)
ydot (m/s)
Time (s)
psi (rad)
Time (s)
psidot (rad/s)
Time (s)
minDist (m)
Time (s)
F (N)
Time (s)
a*(lf - lr))/(m*xdot)], [0, 0, 0, 1], [0, -(2*Ca*(lf - lr))
y[node,1],trajectory[node+forwardIndex,0]-trajectory[node,0]
(X - trajectory[node+forwardIndex,0])*np.sin(psiDesired)
jectory[-1,0]-trajectory[node,0])
ry[node,0])*np.sin(psiDesired)
Console - All
True   X, Y, psi: -13.553746151983088 -11.11949290046828 0.6910960245534978
Estimated X, Y, psi: -13.340354341123307 -11.006073828431996 0.6898935399867471
