

$$T_1 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0.395 & 0 \end{bmatrix}, T_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ -0.395 & 0 \end{bmatrix}, T_e = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0.395 & 0 & -0.395 & 0 \end{bmatrix}$$

Tilnærmet koeffisient i systemet  
 $\sum F = ma \Rightarrow F_{\text{grav}} + F_{\text{Luft}} + F_{\text{Burr}} = ma$

Kan ikke modelleres  
 Tross av PDA

$$\ddot{x} + 2\zeta\omega_n\dot{x} + \omega_n^2 x = 0$$

$$U = \dot{e} + e \quad (\dot{x}_s \approx 0, \dot{x}_o \approx 0)$$

$$= (\dot{x}_s - \dot{x}_o) \cdot k_d \cdot (x_s - x_o) \cdot k_p$$

$$\text{Linierisering} \quad \frac{1}{2} PC_D A \cdot |V| \cdot V \Rightarrow d^* = \frac{1}{2} PC_D A \cdot |V|$$

Beholder fortogen  
 $F_{\text{grav}} = d^* \cdot |V|$

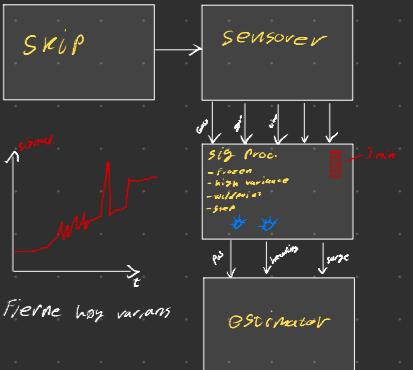
$$-d^* \dot{x} + (\phi - \dot{x}_s)k_d(\phi - \dot{x}_o)k_p = ma$$

$$a = \frac{1}{m}(-\dot{x}_s k_d - \dot{x}_o k_p - d^* \dot{x})$$

$$\dot{x} = -\frac{(k_d + d^*)}{m} \dot{x} - \frac{k_c}{m} x \Rightarrow \ddot{x} + \frac{(k_d + d^*)}{m} \dot{x} + \frac{k_c}{m} x = 0$$

$$\frac{k_d + d^*}{m} = 2\zeta\omega_n \Rightarrow k_d = 2m\zeta\omega_n - d^*$$

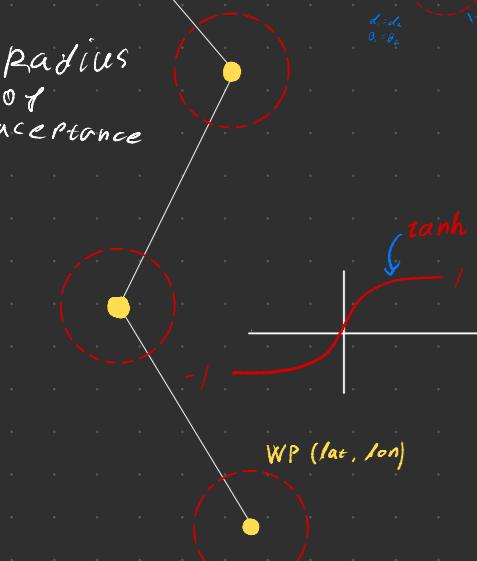
$$\frac{k_p}{m} = \omega_n^2 \Rightarrow k_p = m\omega_n^2$$



$$\begin{aligned} \dot{x} &= Ax + Bu & (\text{Systemet}) & n \text{-elementer} \\ \dot{y} &= Cx + \omega & (\text{Input}) & m \text{-elementer} \\ \dot{y} &= \dot{y} & (\text{Output}) & p \text{-elementer} \\ A &\rightarrow nxn \\ B &\rightarrow n \times m \\ C &\rightarrow p \times n = I \\ \omega &\rightarrow \text{White noise} \text{ størt i målverdi} \\ \dot{\dot{x}} &= \frac{d}{dt} \begin{bmatrix} P \\ V \end{bmatrix} \Rightarrow \begin{bmatrix} \dot{P} \\ \dot{V} \end{bmatrix} = A \begin{bmatrix} P \\ V \end{bmatrix} + BU \end{aligned}$$

$$\begin{aligned} \ddot{x} + \frac{(K_d + d^*)}{m} \dot{x} + \frac{k_p}{m} x = 0 &\Rightarrow a + \frac{k_p \omega^2}{m} v + \frac{k_p}{m} p = 0 \\ a = -\frac{k_p + d^*}{m} v - \frac{k_p}{m} p &\quad \int \dot{P} = V \\ \dot{v} = -\frac{k_p + d^*}{m} \dot{p} - \frac{k_p}{m} p &\quad \dot{V} = -\frac{k_p + d^*}{m} V - \frac{k_p}{m} p \end{aligned}$$

$$\begin{bmatrix} \dot{p} \\ \dot{V} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -\frac{k_p + d^*}{m} & -\frac{k_p}{m} \end{bmatrix} \begin{bmatrix} p \\ V \end{bmatrix}$$



$$\alpha = \arctan\left(\frac{a}{g}\right)$$

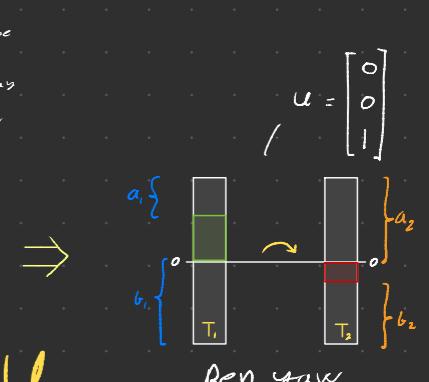
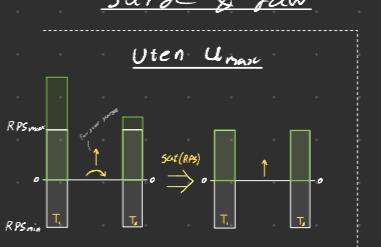
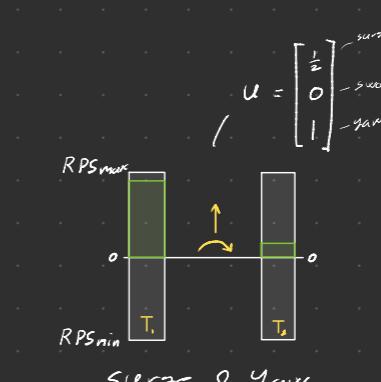
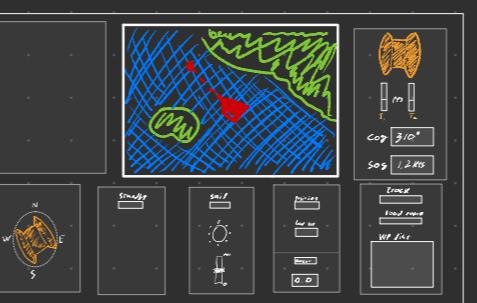
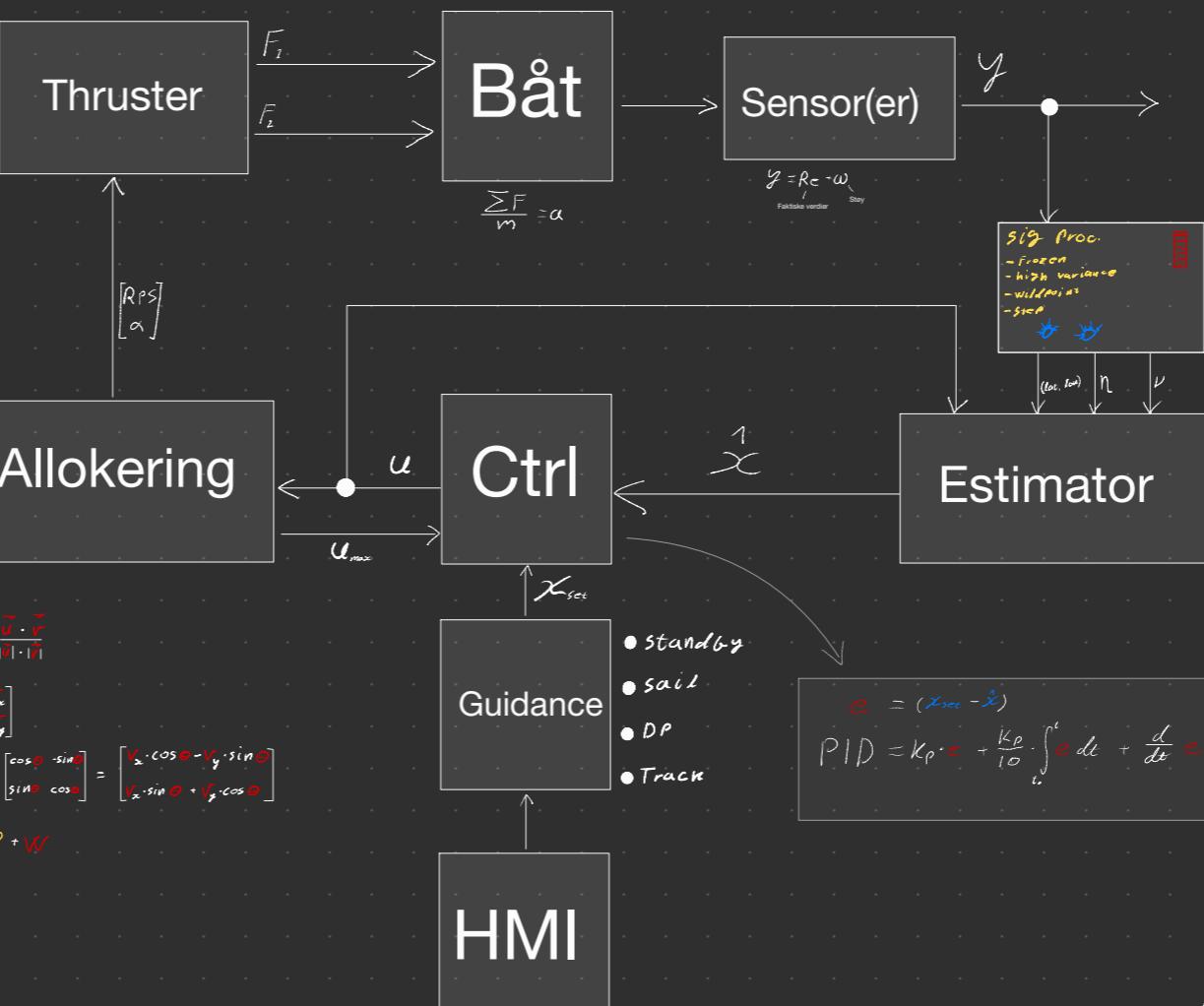
$$\theta = \frac{u - v}{|u - v|}$$

$$\tilde{v} = \begin{bmatrix} v_x \\ v_y \end{bmatrix}$$

$$w = \tilde{v} \cdot \begin{bmatrix} \cos \theta & \sin \theta \\ \sin \theta & \cos \theta \end{bmatrix} = \begin{bmatrix} v_x \cdot \cos \theta - v_y \cdot \sin \theta \\ v_x \cdot \sin \theta + v_y \cdot \cos \theta \end{bmatrix}$$

$$\tilde{p} = WP + w$$

$$\begin{aligned} \bar{a} &= \frac{a \cdot b}{a \cdot a} \cdot a \\ d &= p - \bar{p} \\ \varphi_l &= \arctan\left(\frac{a}{\bar{a}}\right) \\ \varphi_d &= \varphi_t - \varphi_l \\ \text{Heading setpoint} & \\ \text{Sgn}(d \times a) \text{ gir forceen til } \bar{a} \text{-vektoren} & \end{aligned}$$



$$\begin{aligned} a_1 < a_2 & ; \text{ surge}_{\text{max}} = a_1 \\ b_2 < b_1 & ; \text{ surge}_{\text{min}} = b_2 \\ (T_1 = RPS_{\text{max}} \wedge T_2 = RPS_{\text{min}}) = \text{yaw}_{\text{max}} & \\ -\text{yaw}_{\text{max}} = \text{yaw}_{\text{min}} & \end{aligned}$$