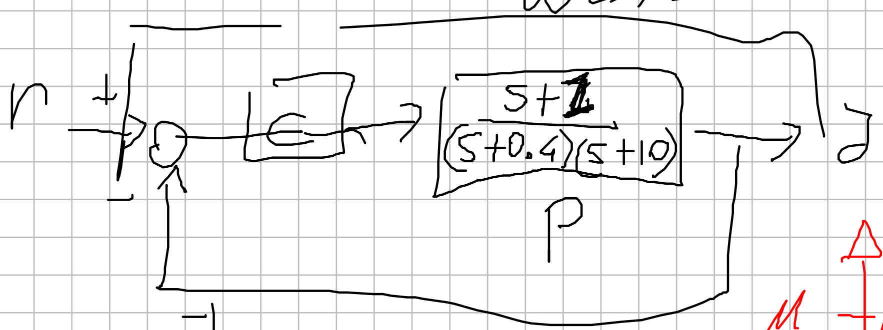
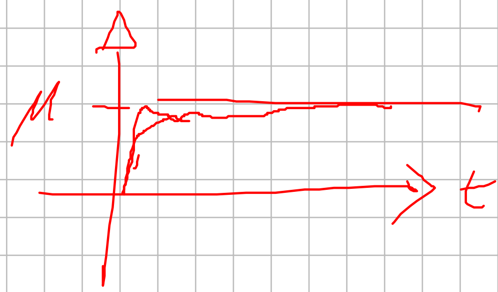
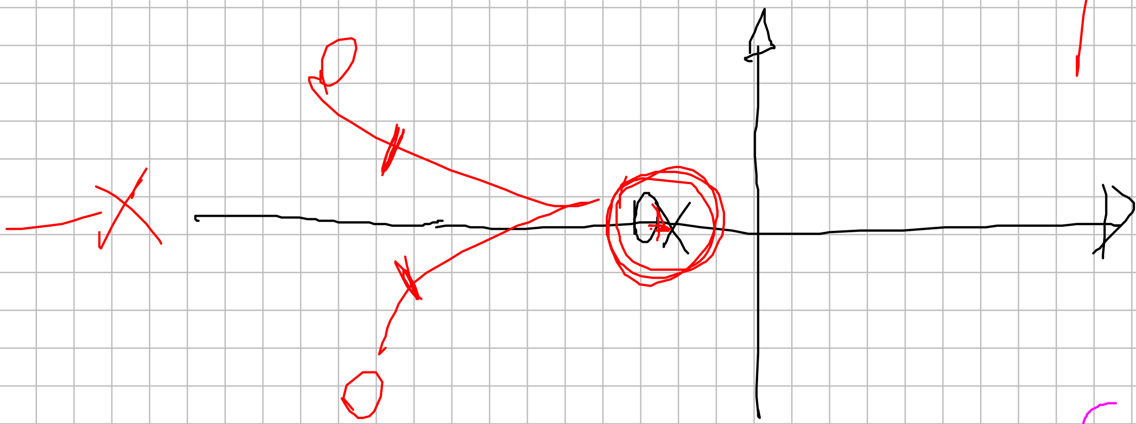
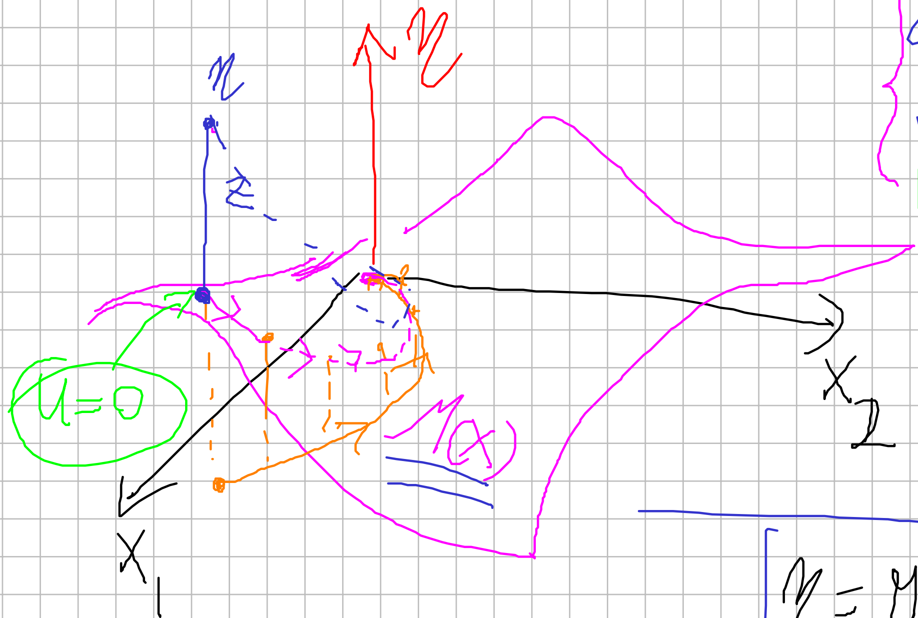
$W(s) = $ desiderat



$$C(s) = P^{-1}\Delta C$$







$$\begin{cases} \dot{\eta} = h(x) - \eta \\ \dot{x} = f(x) + g(x)u \end{cases}$$

LAS + GAS

$M(x)$:

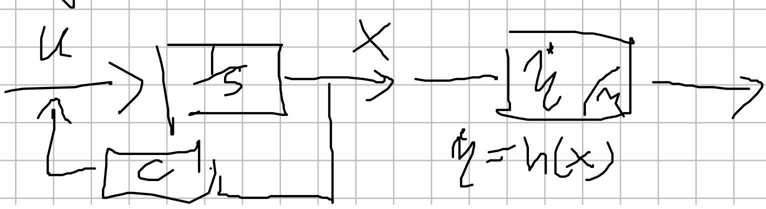
$$\frac{\partial M}{\partial x} f(x) = h(x)$$

$$\boxed{\eta = M(x)}$$

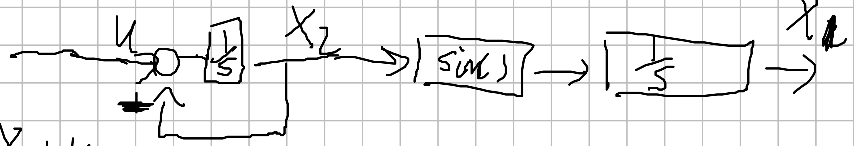
$\int h(\hat{x})$

$\dot{\hat{x}} = f(\hat{x})$

$\hat{x}(0) = x$



$$\begin{cases} \dot{x}_1 = \sin(x_2) \\ \dot{x}_2 = x_1 + \bar{u} = -x_2 + u \end{cases}$$



$$\bar{u} = x_1 - x_2 + u$$

$$\begin{cases} \dot{x}_1 = \sin(x_2) \\ \dot{x}_2 = -x_2 + u \end{cases} \longrightarrow \begin{cases} \dot{x}_1 = \sin(x_2) \\ \dot{x}_2 = -K^2 x_1 - K x_2 \end{cases}$$

$$u = x_2 - K x_2 - K^2 x_1$$

$\downarrow$ lin. $\quad$ LES

GAS?

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -K^2 & -K \end{bmatrix} x$$

$K > 0$

$$V(x) = x' P x, \quad P = P' > 0$$

$$P = \begin{bmatrix} p_1 & p_2 \\ p_2 & p_3 \end{bmatrix}, \quad p_1 > 0, \quad p_1 p_3 - p_2^2 > 0$$

$$\dot{V} = \dot{x}' P x + x' P \dot{x} = \left(\sin(x_2), -K^2 x_1 - K x_2\right) [P] \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} +$$

$$(x_1, x_2) [P] \begin{bmatrix} \sin(x_2) \\ -K^2 x_1 - K x_2 \end{bmatrix} < 0 \qquad \boxed{A'P + PA} = -Q = I$$

$$x_1 \left(\sin(x_2) p_1 + (-K^2 x_1 - K x_2) p_2 \right) + \left(\sin(x_2) p_2 - (K^2 x_1 + K x_2) p_3 \right) x_2$$

$$+ (x_1 p_1 + x_2 p_2) \sin(x_2) + (x_1 p_2 + x_2 p_3)(-K^2 x_1 - K x_2)$$

$$= x_1 x_2 \frac{\sin(x_2)}{x_2} p_1 - K^2 x_1^2 p_2 - K x_2 x_1 p_2 + x_2^2 \frac{\sin(x_2)}{x_2} p_2 +$$

$$- K^2 x_1 p_3 x_2 - K x_2^2 p_3 + x_2 x_1 \frac{\sin(x_2)}{x_2} p_1 + x_2^2 p_2 \frac{\sin(x_2)}{x_2} +$$

$$-\cancel{x_1^2 P_2 K^2} - x_1 x_2 P_2 K + x_2 x_1 P_3 K^2 - \cancel{x_2^2 K P_3}$$

$$= -x' Q(x) x \quad , \quad P_i : Q(x) \succ 0 \quad \forall x$$

$$= -K^2 x_1^2 P_2 - K x_2^2 P_3 - x_1^2 P_2 K^2 + x_2^2 P_2 \frac{\sin(x_2)}{x_2} - x_2^2 K P_3$$

$$x_2 x_1 \Big(\underbrace{2P_1 \frac{\sin(x_2)}{x_2} - 2K P_2 - 2K^2 P_3 + \cancel{P_1 \frac{\sin(x_2)}{x_2}} - \cancel{P_3 K}}_{2\Delta(x_2)} \Big)$$

$$= [x_1, x_2] \begin{bmatrix} 2K^2 P_2 & -\Delta(x_2) \\ -\Delta(x_2) & 2K P_3 - P_2 \frac{\sin(x_2)}{x_2} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \cdot (-1)$$

$$= +Q(x) \succ 0$$

$$2K^2 P_2 > 0$$

$$P_2 > 0$$

$$\Delta(x_2) = P_1 \frac{\sin(x_2)}{x_2} - K P_2 - K^2 P_3$$

$$2K^2 P_2 \left(2K P_3 - P_2 \frac{\sin(x_2)}{x_2}\right) - \left(P_1 \frac{\sin x_2}{x_2} - K P_2 - K^2 P_3\right)^2 > 0$$

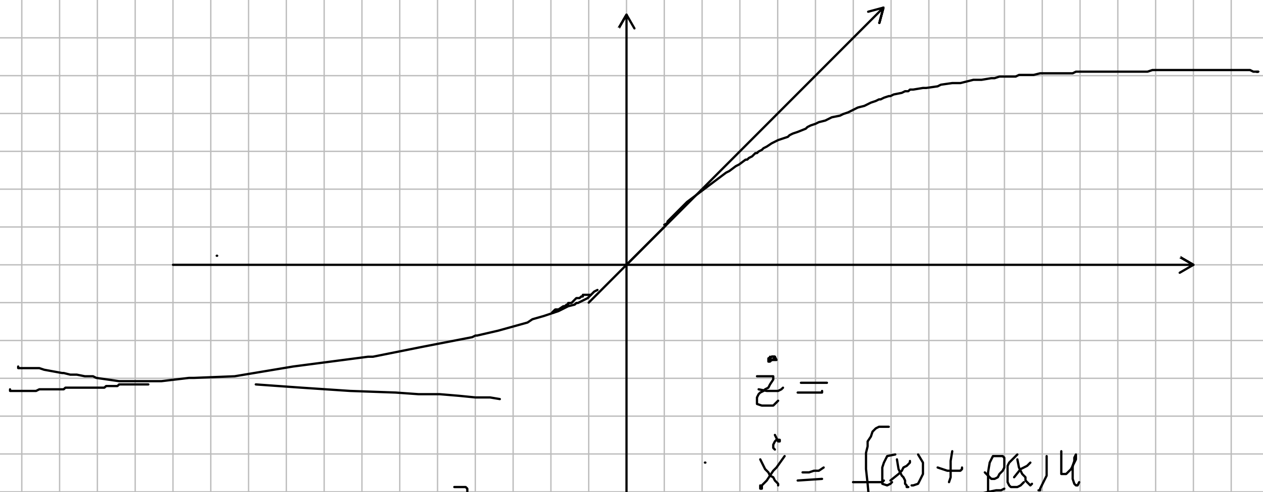
K, P_2, P_3, P_1

± 1 ± 1

$$P_1^2 \left(\left(4K^3 - 2K^2 \frac{\sin(x_2)}{x_2} \right) - \left(\frac{\sin x_2}{x_2} - K(1+K) \right)^2 \right) > 0$$

$P_1 = 2P_2 = P_3$ $-K(1+K)P_1$

(K, x_2)



$$\dot z =$$

$$\dot x = f(x) + g(x)u$$

$$e = -x + \xi$$

$$W_r = \quad V(x,t) = \frac{z^2(t)}{2r(t)}$$

$$\dot W_r = \frac{\partial V}{\partial x}\left(f(x) + g(x)u\right) + \frac{z}{r}\dot z - \frac{z^2}{2r^2}\dot r$$

$$= \frac{\partial V}{\partial x}\left(f(x) + \underline{g(x)u}\right) + \frac{z}{r}\left(-e^{T}\Delta(x,e)f(x) - \frac{\partial M(x,0)}{\partial x}g(x)u\right)$$

$$: x'\Delta(x,-x)f(x) - \frac{\partial M}{\partial x}(x,0)\underline{g(x)u}$$

$$= \left(\frac{\partial V}{\partial x} + \frac{z}{r}x'\Delta(x,-x)\right)f(x) + \left(\frac{\partial V}{\partial x} - \frac{z}{r}\frac{\partial M(x,0)}{\partial x}\right)g(x)u$$

$$- \frac{z^2}{r^2}\dot r$$