$$\dot{x}(t)=\underbrace{\begin{bmatrix}-1&0&1\\-2&1&1\\0&2&1\end{bmatrix}}_{A}x(t)+\underbrace{\begin{bmatrix}1&0\\0&0\\0&1\end{bmatrix}}_{B}u(t)+\underbrace{\begin{bmatrix}1\\0\\0\end{bmatrix}}_{P}w(t)$$

$u\in\mathbb{R}^m \quad m=2$

$y\in\mathbb{R}^p \quad p=2$

$w\in\mathbb{R}^d \quad d=1$

$x\in\mathbb{R}^n \quad n=3$

$$y(t)=\underbrace{\begin{bmatrix}1&0&0\\0&1&0\end{bmatrix}}_{C}x(t)+\underbrace{\begin{bmatrix}1\\0\end{bmatrix}}_{Q}w(t)$$ ← VARIABILE CONTROLLATA

$(x(t), w(t))$ MISURABILI $\qquad w(t)=\text{sen}(t) \qquad \omega=1$

$$y_{des}=\begin{bmatrix}1\\2t\end{bmatrix}$$

1) Costruzione Esosistema

$$S=\left[\begin{array}{c|c|c}S_1&0&0\\\hline 0&S_2&0\\\hline 0&0&S_3\end{array}\right]$$

$$S_1=\begin{bmatrix}0&-\omega\\\omega&0\end{bmatrix}=\begin{bmatrix}0&-1\\1&0\end{bmatrix} \qquad \tilde{w}_1(0)=\begin{bmatrix}1\\0\end{bmatrix}$$

$$S_2=0 \qquad \tilde{w}_2(0)=1$$

$$S_3=\begin{bmatrix}0&1\\0&0\end{bmatrix} \qquad \tilde{w}_3(0)=\begin{bmatrix}0\\2\end{bmatrix} \begin{matrix}\to \text{offset}\\ \to \text{pendenza}\end{matrix}$$

$$\tilde{w}(0)=\left[\begin{array}{c}\tilde{w}_1(0)\\\hline\tilde{w}_2(0)\\\hline\tilde{w}_3(0)\end{array}\right]=\left[\begin{array}{c}1\\0\\\hline 1\\\hline 0\\2\end{array}\right]$$

$$\tilde{w}(t)=\left[\begin{array}{c}\cos(t)\\\text{sen}(t)\\\hline 1\\\hline 2t\\2\end{array}\right]$$

$\cos(t)$ → ausiliare

$\text{sen}(t)$ ← $w(t)$

$1,\ 2t$ } $y_{des}(t)$

2 → componente ausiliare

2) $(\tilde{P}, \tilde{Q}, \tilde{C})$

$\tilde{C}=-C \qquad \tilde{P}\tilde{w}=Pw \Rightarrow \tilde{P}=[0\ P\ 0\ 0\ 0] \to 0_{n\times 1}$

$\tilde{Q}\tilde{w}=y_{des}-Qw \Rightarrow \tilde{Q}=[0\ -Q\ I_p\ 0] \to 0_{p\times 1} \qquad p=2$

③ H_1 $H_2 = (A, B)$ stabilizzabile

$$u = K x + L\tilde{w} = Kx + (\Gamma - K\Pi)\tilde{w}$$

$K = \text{place}(A, B, [\lambda_1, \lambda_2, \lambda_3])$

$K = -K$ $\quad\quad$ $\text{eig}(A+BK)$

$$(\Pi, \Gamma) : \quad \begin{aligned} \Pi S &= A\Pi + B\Gamma + \tilde{P} \\ 0 &= \tilde{C}\Pi + \tilde{Q} \end{aligned}$$

$$X = \begin{bmatrix} \Pi \\ \Gamma \end{bmatrix} : \begin{bmatrix} I & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \Pi \\ \Gamma \end{bmatrix} S = \begin{bmatrix} A & B \\ \tilde{C} & 0 \end{bmatrix} \begin{bmatrix} \Pi \\ \Gamma \end{bmatrix} + \begin{bmatrix} \tilde{P} \\ \tilde{Q} \end{bmatrix}$$

$$J \cdot X \cdot S = WX + \tilde{R}$$

$$\dot{x} = (A + BK)x + (\tilde{P} + BL)\tilde{w}$$

$$e = \tilde{C}x + \tilde{Q}\tilde{w}$$

$$\tilde{w} = \begin{bmatrix} \cos t \\ \sin t \\ 1 \\ 2t \\ 2 \end{bmatrix} \leftarrow W$$

$$y = Cx + Qw \overset{?}{=} f(x, \tilde{w})$$

$$y = Cx + Q_y\tilde{w}$$

$$Q_y\tilde{w} = Qw \quad Q_y = [\,\underbrace{0}_{0_{p\times1}}\ Q\ \underbrace{0\ 0\ 0}_{0_{p\times1}}\,]$$