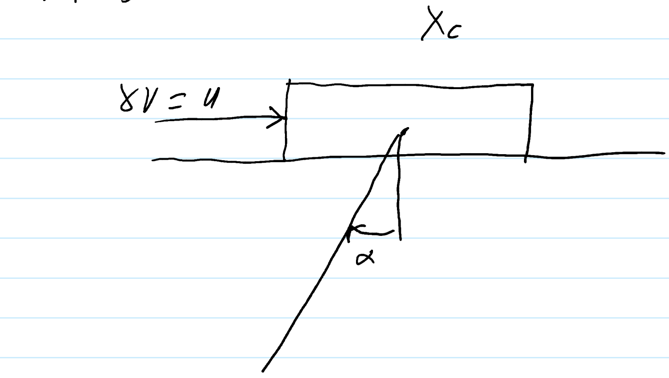
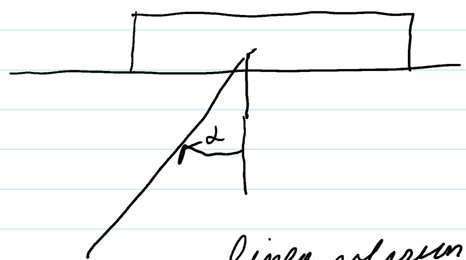
LAB 2



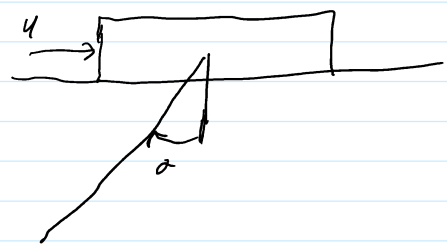


$L = 2l$

linear version

$$\boxed{\ddot{\alpha} + w^2 \alpha = 0} \leftarrow \boxed{\ddot{\alpha} + w^2 \sin(\alpha) = 0}$$

$W = 4.75$ and $\zeta = 1.32$



$\dot{X} = AX + BV$ $\quad A: \mathbb{C}^4 \to \mathbb{C}^4$ $\quad$ B vector of length 4

$\{A, B\}$ is controllable $\quad \text{rank}([B, AB, A^2B, A^3B]) = 4$

$$V = r - K_1 X_1 - K_2 X_2 - K_3 X_3 - K_4 X_4$$

$$V = r - KX \qquad K = [K_1 \; K_2 \; K_3 \; K_4]$$

$$X = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{bmatrix} \qquad X_1 = X_c \quad X_2 = \alpha \qquad X_3 = \dot{X}_c \quad X_4 = \dot{\alpha}$$

$$V = r - K_1 X_c - K_2 \alpha - K_3 \dot{X}_c - K_4 \dot{\alpha}$$

$$|K_j| \leq 200$$

Pole Placement

$\dot{x} = Ax + BV$

$V = r - Kx = r - k_1 x_1 - k_2 x_2 - k_3 x_3 - k_4 x_4$

$\dot{x} = Ax + B(r - Kx) = (A - BK)x + Br$

FEEDBACK SYSTEM

$$\boxed{\dot{x} = \underline{(A - BK)}x + Br}$$

Because $\{A, B\}$ is controllable we can choose K To place the eigenvalues of $(A-BK)$ Anywhere

$K = place(A, B, [\lambda_1, \lambda_2, \lambda_3, \lambda_4])$

$eig(A - BK) = \{\lambda_1, \lambda_2, \lambda_3, \lambda_4\}$

$|K_j| \leq 200$