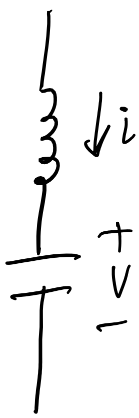
Lecture 12

Wednesday, 15 February 2023 10:03 AM

$$\bar{x} = \bar{\bar{A}}\bar{x} + \bar{\bar{B}}\bar{u}$$

$$\bar{y} = \bar{\bar{C}}\bar{x} + \bar{\bar{D}}\bar{u}$$

$$s\bar{x} \neq \bar{x}s = s\bar{\bar{I}}\bar{x}$$



KVL

$s\dot{i} =$

$s v =$

KCL

$\dot{v}$

$$\sum f = Ma = M\dot{v} = MsV$$

$\dot{f}$

$$f = kd$$

$$\dot{f} = k\dot{d}$$

$$= kV$$

$$sf = kV$$

Compression → +'ve

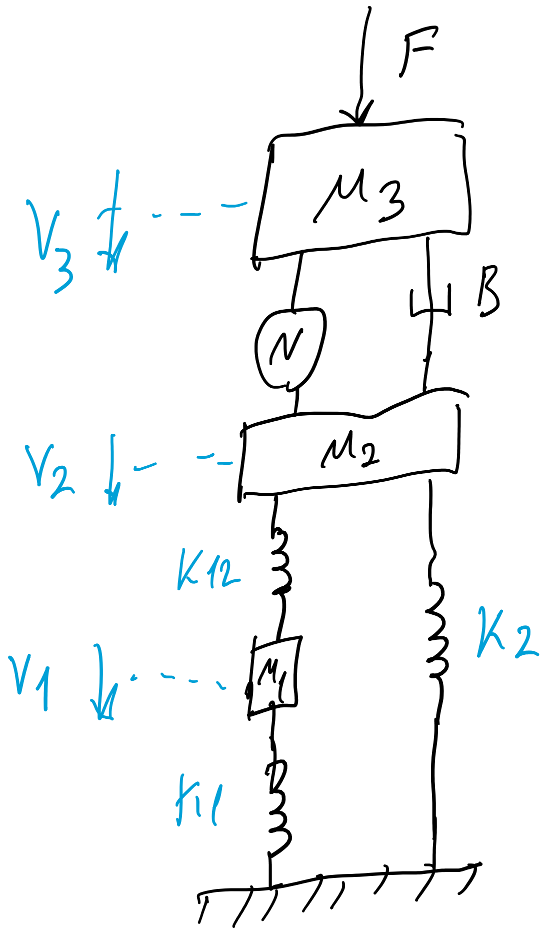
if we

$$\delta v = \frac{1}{M}\left(\Sigma F\right)$$

lock in place M_2 & M_3

" can move

M_1 sti



$$\bar{X} = \begin{bmatrix} v_1 \\ v_2 \\ \cancel{v_3} \\ f_1 \\ f_2 \\ f_{12} \end{bmatrix}$$

dep

Masses

$C = \infty$

$C \to M = \infty$

Spring

$L = \infty$

$L \to \frac{1}{k} = \quad k = 0$

Spring force = 0?

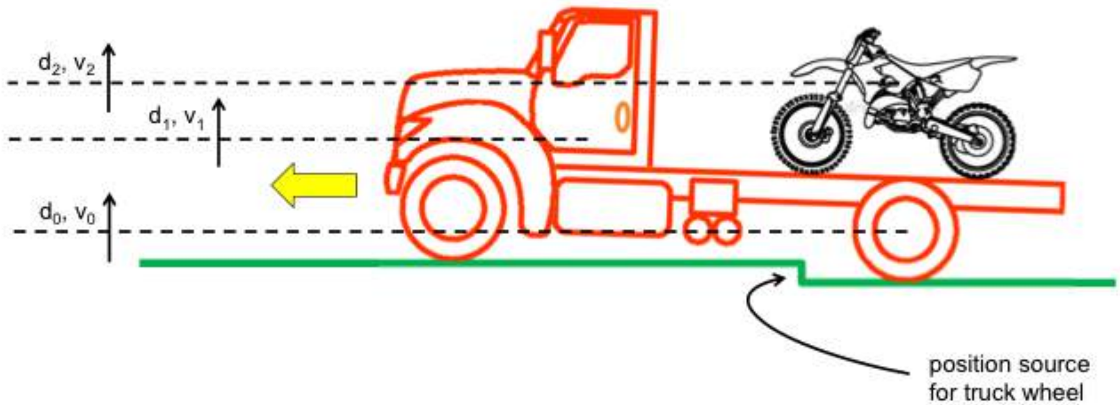
break all others

mass vel = 0?

pin all others

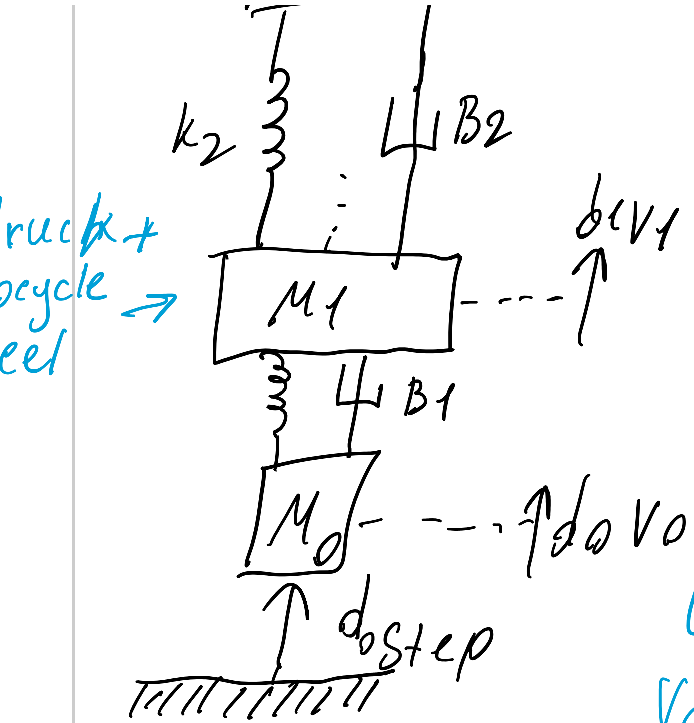
Mc body

State-Space Example (Mech)



$$
s\begin{bmatrix} d_1 \\ d_2 \\ v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ \dfrac{-K_1 - K_2}{M_1} & \dfrac{K_2}{M_1} & \dfrac{-B_1 - B_2}{M_1} & \dfrac{B_2}{M_1} \\ \dfrac{K_2}{M_2} & \dfrac{-K_2}{M_2} & \dfrac{B_2}{M_2} & \dfrac{-B_2}{M_2} \end{bmatrix} \begin{bmatrix} d_1 \\ d_2 \\ v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ \dfrac{K_1 + sB_1}{M_1} \end{bmatrix} d_0
$$

$$
\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} d_1 \\ d_2 \\ v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} d_0
$$

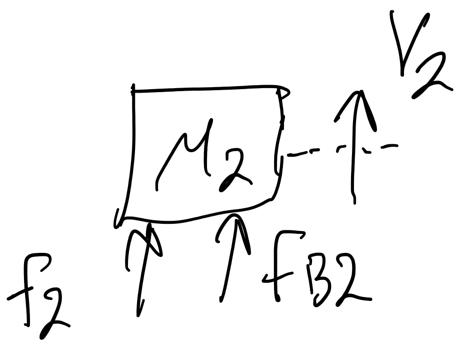


$$X = \begin{bmatrix} v_2 \\ f_1 \\ f_2 \end{bmatrix}$$

related to springs

$u = d_0$

$V_0 = s d_0$



$$f_2 + F_{B2} = M s V_2 = f_2 + B$$

$$F_{B2} = B(V_1 - V_2)$$

$$M s V_2 = B V_1 - B V_2 + f_2$$

$$s V_2 = \frac{B}{M} V_1 - \frac{B}{M} V_2$$

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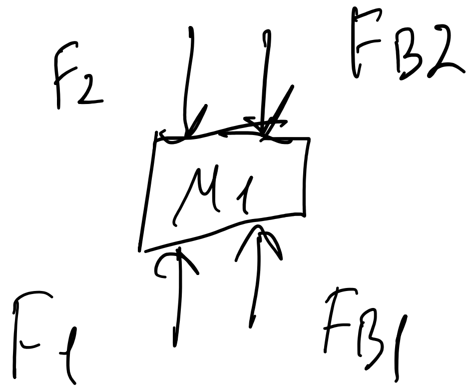
$s f_1 =$ ~~

$$\dot{f}_1 = k_1 (\underset{v_0}{\dot{d}_0} - \underset{v_1}{\dot{d}_1})$$

$$s f_1 = k_1 (v_0 - v_1$$

$$s F_2 = k_2 v_1 = k_2 v_2$$



$$F_1 - F_2 + F_{B1} - F_{B2} = M s V$$

$$F_{B1} = B_1 (V_0 - V_1)$$

$$M_1 s V_1 = B_1 V_0 - B_1 V_1 - B_2$$

$$s V_1 = \frac{-(B_1 + B_2)}{M_1} V_1 +$$

1)