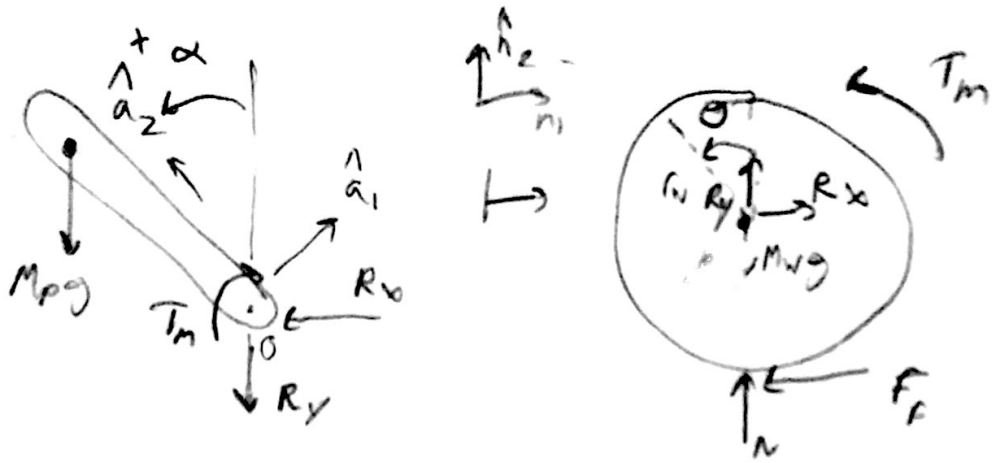


$$\Sigma F_x = -R_x = m_p a_x$$

$$\Sigma F_y = -m_p g - R_y = m_p a_y$$

$$\Sigma M_o = -T - R_x \cdot L\cos\alpha + R_y \sin\alpha = 0$$

$$\Sigma F_x = R_x - f_x = m_w \ddot{x}$$

$$\Sigma F_y = N - M_w g + R_y = 0$$

$$\Sigma M_o = -R \cdot F + T_m = I_w \ddot{\theta}$$

1. $-\frac{1}{m_p} \cdot R_x = \ddot{x} - L\ddot{\alpha}\cos\alpha + L\dot{\alpha}^2 \sin\alpha$
2. $-f + R_x = m_w \ddot{x}$
3. $-\frac{L}{m_p} R - g = -L\ddot{\alpha}\sin\alpha - L\dot{\alpha}^2\cos\alpha$
4. $N + R_y - m_w g = 0$
5. $-T - R_x \cdot L\cos\alpha - R_y \sin\alpha = 0$
6. $-R \cdot F + T_m = -I_w \frac{\ddot{x}}{R}$

State Space Var

$x_1 = x$ $\quad \dot{x}_1 = \dot{x} = x_2$

$x_2 = \dot{x}$ $\quad \dot{x}_2 = \ddot{x}$

$x_3 = \alpha$ $\quad \dot{x}_3 = \dot{\alpha} = x_4$

$x_4 = \dot{\alpha}$ $\quad \dot{x}_4 = \ddot{\alpha}$

$$-\dot{x}_2 + L\dot{x}_4 \cos x_3 - \frac{1}{m_p} R_x = L x_4^2 \sin x_3$$

$$m_w \dot{x}_2 - R_x + f = 0$$

$$L\dot{x}_4 \sin x_3 - \frac{1}{m_p} R_y = g - L x_4^2 \cos x_3$$

$$R_y + N = m_w g$$

$$-R_x \cdot L\cos\alpha - R_y \sin\alpha = U$$

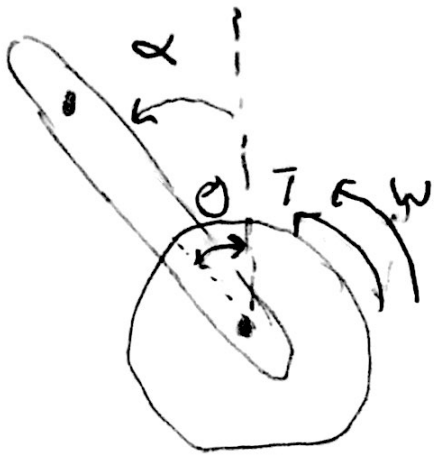
$$-I_w \frac{\dot{x}_2}{R} + R \cdot F = U$$

$$w = \dot{\theta} - \dot{\alpha}$$

$$T = K_t i \Rightarrow i = \frac{T}{K_t}$$

$$V = R_m i + K_B w$$

$$V = \frac{R_m T}{K_t} + K_B(\dot{\theta} - \dot{\alpha})$$



$$\theta = -\frac{x}{r}$$

$$\frac{R_m T}{K_t} = V - K_B(\dot{\theta} - \dot{\alpha})$$

$$T = \frac{K_t}{R_m}\left[V - K_B(\dot{\theta} - \dot{\alpha})\right]$$

$$T = \frac{K_t}{R_m}\left[V + K_B\left(\frac{\dot{x}}{r} + \dot{\alpha}\right)\right]$$

$$T = \frac{K_t}{R_m}\left[U + K_B\left(\frac{x_2}{r} + x_4\right)\right]$$