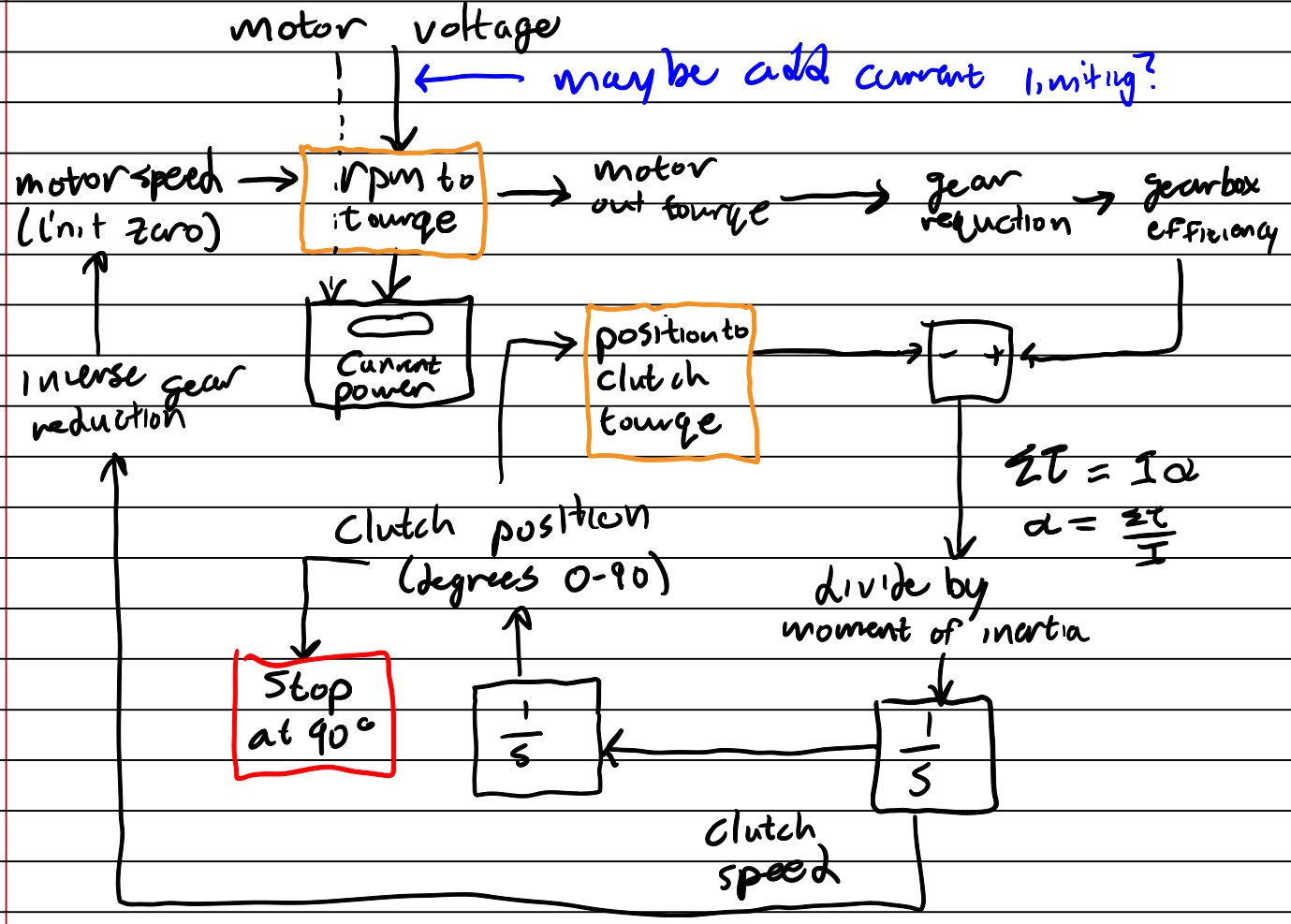
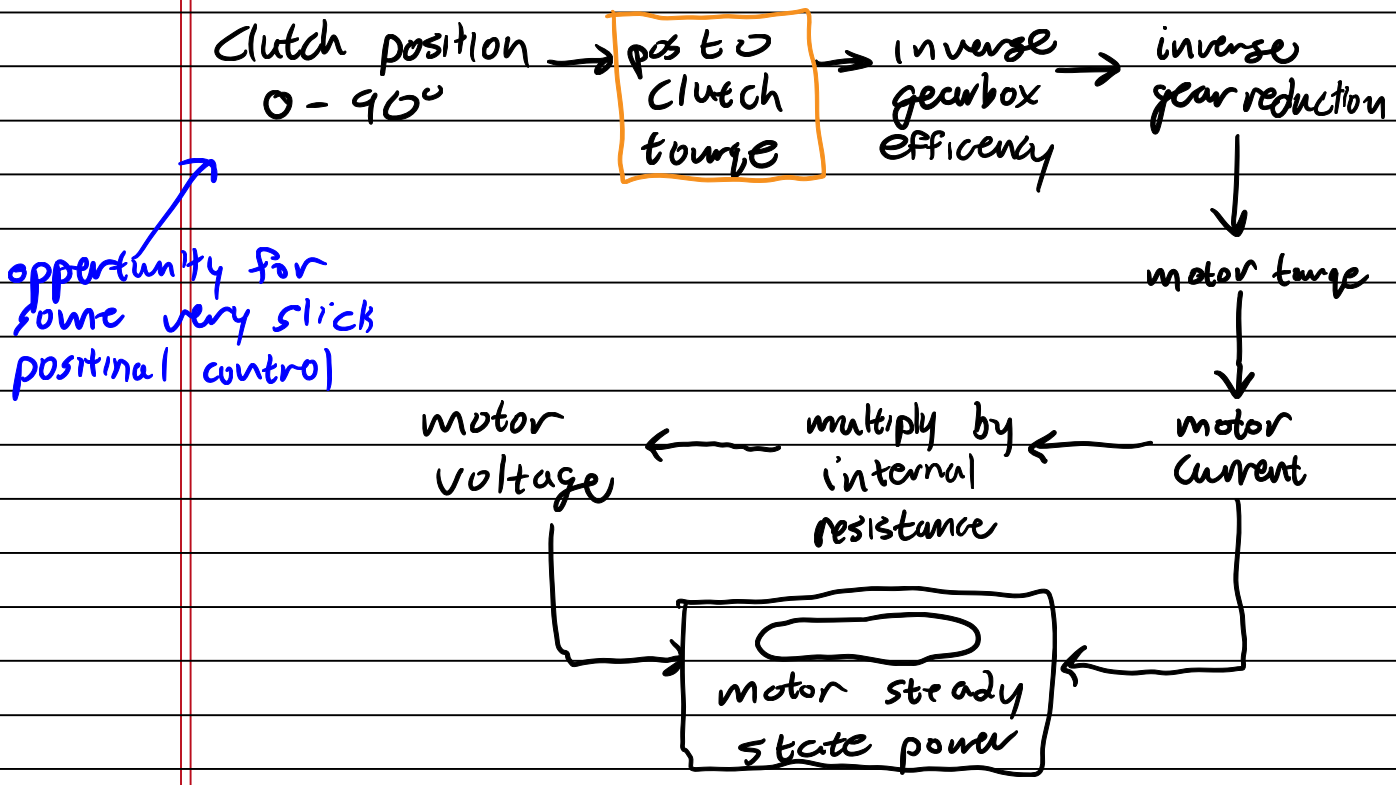
Clutch Model planning

Calvin Meltzer

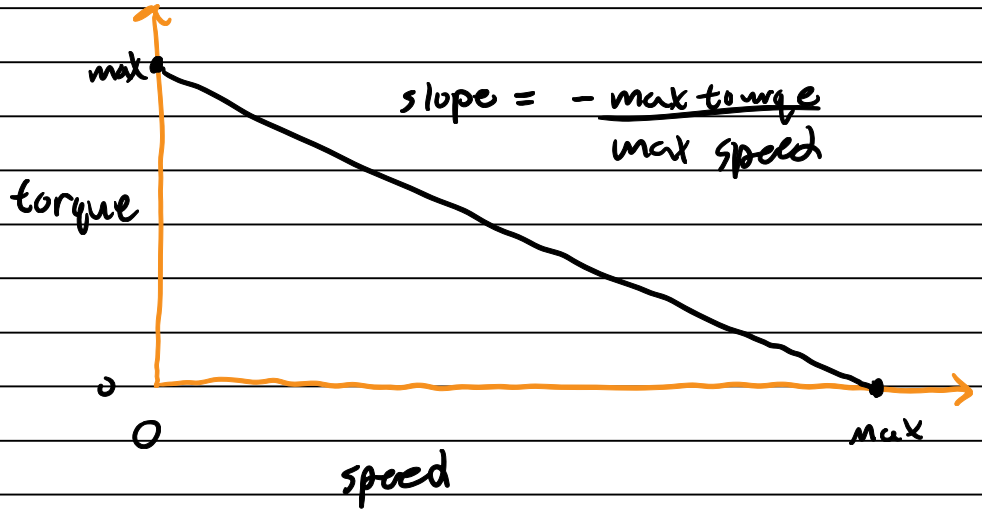
Clutch transient (get as much torque as possible to actuate as fast as possible (max voltage)



Steady state holding (minimize current to keep the cluth hold out)



Motor RPM + motor voltage → motor tourque



$$\text{max tourque} = \left(\frac{\text{max voltage}}{\text{internal resistance}}\right)\left(K_T\left(\frac{Nm}{A}\right)\right)$$

$$\text{max speed} = \left(\text{max voltage}\right)\left(KV\left(\frac{RPM}{\text{volt}}\right)\right)$$

$$\text{slope} = \frac{-\text{max tourque}}{\text{max speed}} = \left(\frac{\text{max voltage}}{\text{internal res}}\right)K_T \cdot \frac{1}{\text{max voltage} \cdot KV}$$

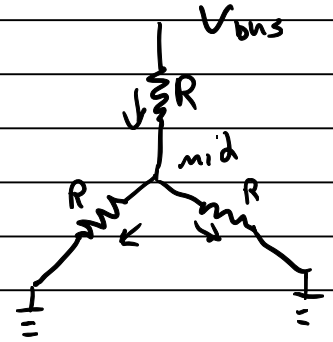
$$\text{slope} = \frac{-K_T}{(KV)(iR)}$$

$$\text{intercept} = \text{max tourque} = \frac{\text{max voltage}}{\text{internal res}}\,K_T$$

$$\text{Tourque} = \frac{V K_T}{iR} - \frac{K_T}{(KV)iR}(\text{speed})$$

$$\text{Torque} = \frac{K_T}{iR}\left(V - \frac{\text{speed}}{KV}\right)$$

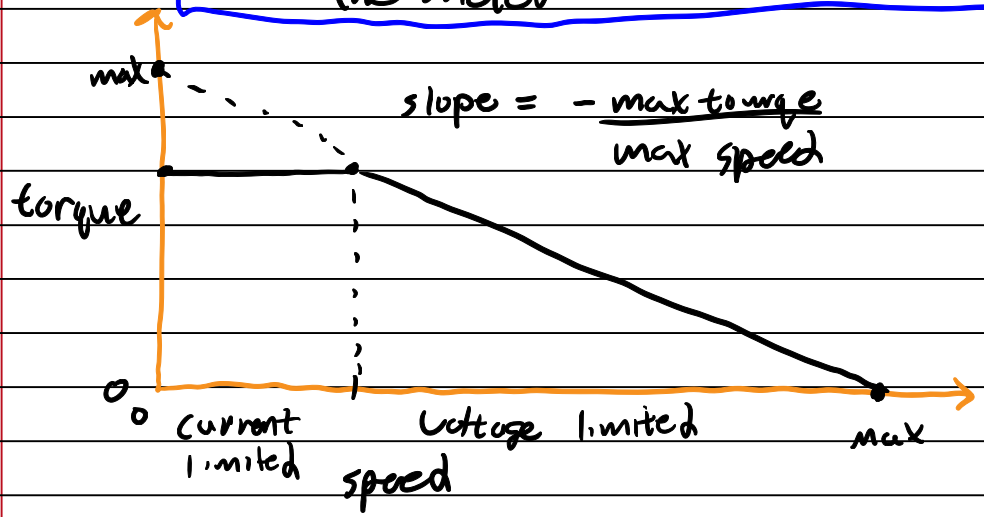
Coil Resistance → internal resistance



$$iR = R + R \| R$$

$$iR = \frac{3}{2}R$$

Calculating voltage and current in the motor



- Current is mostly limited by heat dissapation in the motor

$$\text{Power diss}(W) = (\text{motor current})^2 (iR)$$

- Torque output can give us current
- Current can give us power dissapated
- power dissapated + mechanical power gives total power
- (motor current)(motor voltage) = total power

Block diagram:

Calc current.

↳ if current too high, set the torque to the max possible torque using the current limit

↓

set new current accordingly

Clutch position → clutch torque

at 0°, torque = ?

at 90°, torque = ? $T_0 < T_G$