Final Report

Trey Dufrene, Alan Wallingford, David Orcutt, Ryan Warner, Zack Johnson

ME 407

Preliminary Design of Robotic Systems

Embry-Riddle Aeronautical University

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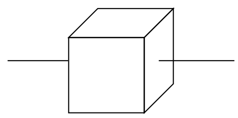
1 Motor Dynamics

$$H(\gamma)\ddot{\gamma} + n(\gamma, \dot{\gamma}) = \tau \tag{1}$$

$$\tau_a = Ki_a = J_a\ddot{\theta}_a + b_a\ddot{\theta}_a + \tau_L \tag{2}$$

$$V_a = i_a R_a + K\dot{\theta}_a$$



$$Ki_a = J_a N\ddot{\theta} + b_a N\dot{\theta} + \frac{\tau}{N\eta}$$

$$2\zeta\omega_n = \frac{b_a}{J_a} - \frac{KK_d}{R_a J_a N} + \frac{K^2}{R_a J_a} \tag{3}$$

$$\omega_n^2 = \frac{-KK_p}{R_a J_a N} \tag{4}$$

$$\%\ \text{Overshoot} = \left(\frac{\theta_{max} - \theta_{ss}}{\theta_{ss}}\right) \cdot 100 \tag{5}$$

$$\zeta = \frac{-\ln(\%\text{OS}/100)}{\sqrt{\pi^2 + \ln^2(\%\text{OS}/100)}} \tag{6}$$

$$\omega_n = \frac{\pi}{T_p\sqrt{1-\zeta^2}} \tag{7}$$

$$2\zeta\omega_n = \frac{R_a b_a N^2\eta - KK_d N\eta + K^2 N^2\eta}{R_a J_a N^2\eta + R_a J_m} \tag{8}$$

$$\omega_n = -\frac{KK_p N\eta}{R_a J_a N^2\eta + R_a J_m} \tag{9}$$