Dynamic Modeling VII

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12:35 PM

Vertical Axis - Solve for numeric values

$$I_{Tot,v} = \left(I_{CM,0} + m_0 L_0^2\right) + I_{cm} + m\left(L_c^2 + (\sin(\theta_c)L)^2\right)$$

Model payload moment of inertia as solid sphere for simplicity, with a radius of 30 cm (parameterize in firmware to allow real values to be entered)

L_m = length of motor

$$I_{cm} = \frac{2}{5} m \cdot (0.3\,m)^2 = 0.036m\,[kg \cdot m^2]$$

Let $m = 6kg \Rightarrow 0.036 \cdot 6kg = 0.216\,[kg \cdot m^2]$

$$I_{cm,0} = \frac{1}{3} m_0 \cdot L_m^2 = \frac{1}{3} \cdot 5.9kg \cdot (0.259m)^2 = 0.132\,[kg \cdot m^2]$$

$$I_{Tot,v} = \left[0.132\,[kg \cdot m^2] + 5.9[kg] \cdot (0.02[m])^2\right] + 0.216\,[kg \cdot m^2] + 6[kg]\left(0.01[m]^2 + (\sin(\theta_c) \cdot 0.41[m])^2\right)$$

for $\theta_c = \frac{\pi}{2}$: $I_{Tot,v} = 1.360\,[kg \cdot m^2]$

for $\theta_c = 0, \pi$: $I_{Tot,v} = 0.351\,[kg \cdot m^2]$

for $\theta_c = \frac{\pi}{6}, \frac{5\pi}{6}$: $I_{Tot,v} = 0.603\,[kg \cdot m^2]$

$p = 3789395$, $q = 321.3$, $u = 48495$

$a, b, c = \sin(\frac{\pi}{4}) \cdot 15.707(1+j) = 11.11 + 11.11j$

$$k_d = \frac{(a^2c^2 - 4abc^2 - 4a^2bc - 4ab^2 + b^2c^2) I_{Tot}}{p} - C_F$$

$$= \frac{\left[(11.11+11.11j)^4 - 4(11.11+11.11j)^4 - 4(11.11+11.11j)^4 - 4(11.11+11.11j)^3 + (11.11+11.11j)^4\right] I_{Tot}}{3789395} - C_F$$

$$= \frac{\left[-7(11.11+11.11j)^4 - 4(11.11+11.11j)^3\right] \cdot 1.360}{3789395} - C_F$$

$$\frac{[426594 + (10971 - 10971j)]\,1.360}{3789395} - C_F$$

$$k_p = \frac{(-2a^2bc^2 - 2ab^2c^2 - 2a^2b^2c)I_{Tot}}{p}$$ ← also will be complex

$$k_I = -\frac{a^2b^2c^2 I_{Tot}}{p}$$