$$g'(y) = N(x,y) - \frac{\partial}{\partial y}\int M(x,y)dx$$

$$F - kx - bx' = mx''$$

$$F(s) - kX(s) - bsX(s) = ms^2X(s)$$

$$F(s) = (ms^2 + bs + k)X(s)$$

$$\frac{X(s)}{F(s)} = H(s) = \frac{1}{(ms^2+bs+k)}$$

$$H(s) = \frac{\frac{1}{m}}{(s^2+\frac{b}{m}s+\frac{k}{m})}$$

$$\lim_{s\to 0} 2 \cdot H(s) = \lim_{s\to 0} 2 \cdot \frac{\frac{1}{m}}{(s^2+\frac{b}{m}s+\frac{k}{m})} = \frac{2}{k} = 0.1$$

$$then,\ k = 20N/m$$

$$t_r \approx \frac{1.8}{w_n} \approx 1$$

$$\therefore w_n = 1.8$$

$$w_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{20}{m}} = 1.8$$

$$then,\ m = 6.17\ kg$$

$$2\xi w_n = 3.6 \cdot \xi = \frac{b}{m} = \frac{b}{6.17}$$

$$M_p = 10\% \iff \xi = 0.6$$

$$then,\ b = 13.32\ N \cdot s/m$$

$$\frac{Y(s)}{R(s)} = H(s) = \frac{10}{s^2 + 55s + 10}$$

$$E(s) = R(s) - Y(s) = (\frac{1}{1 + \frac{10}{s(s+55)}})R(s)$$

$$\therefore e_{ss} = \lim_{s \to 0} s \cdot E(s) = \lim_{s \to 0} s \cdot \frac{1}{1 + \frac{10}{s(s+55)}} \frac{1}{s^2} = \frac{55}{10} = 5.5 \ (550\%)$$

$$H(s) = \frac{8.1}{s^2 + 3s + 9}$$

$$H(s) = \frac{8.1 \cdot \frac{1}{5}(s+5)}{s^2 + 3s + 9}$$

$$x(t) = v_0 cos(\theta)t$$

$$y(t) = v_0 sin(\theta)t - \frac{1}{2}gt^2$$

$$v_0 = 5m/s$$

$$n = \begin{bmatrix} -sin(yaw) \cdot cos(pitch) \\ sin(pitch) \\ -cos(yaw) \cdot cos(pitch) \end{bmatrix}$$

$$n = \begin{bmatrix} n_x \\ n_y \\ n_z \end{bmatrix}$$