First Order System Adjustment:

$\frac{dy}{dt} = -ay + bu$

$G(s) = \frac{Y}{U} = \frac{b}{s+a}$

$\frac{dy_m}{dt} = -a_m y + b_m u$

$G(s) = \frac{Y_m}{U} = \frac{b_m}{s+a_m}$

Use the control law : $u(t) = t_o u_c(t) - s_o y(t)$

$U = t_o U_c - s_o Y = Y \frac{s+a}{b} \quad \Rightarrow \quad \frac{Y}{U_c} = \frac{t_o}{\frac{s+a}{b}+s_o} = \frac{b_o t_o}{s+a+bs_o}$

$b_m = bt_o$ $\qquad$ $a_m = a + bs_o$

$e = Y - Y_m = \frac{bt_o}{s+a+bs_o} U_c = \frac{b_m}{s+a_m} U_c$

$\frac{\partial e}{\partial t_o} = \frac{b}{s+a+bs_o} U_c = \frac{b}{s+a_m} U_c$

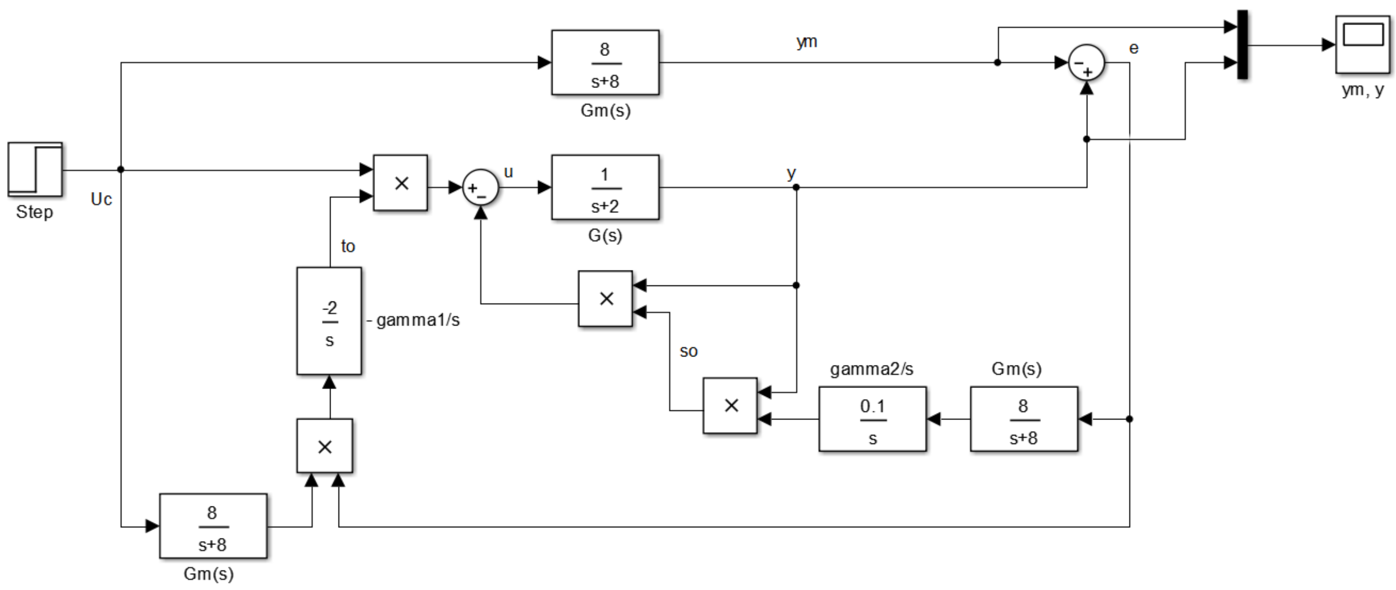
$\frac{\partial e}{\partial s_o} = \frac{-b^2 t_o}{(s+a+bs_o)^2} U_c = \frac{-b}{s+a+bs_o} Y = \frac{-b}{s+a_m} Y$

$\frac{d\theta}{dt} = -\gamma \frac{\partial e}{\partial \theta} e$

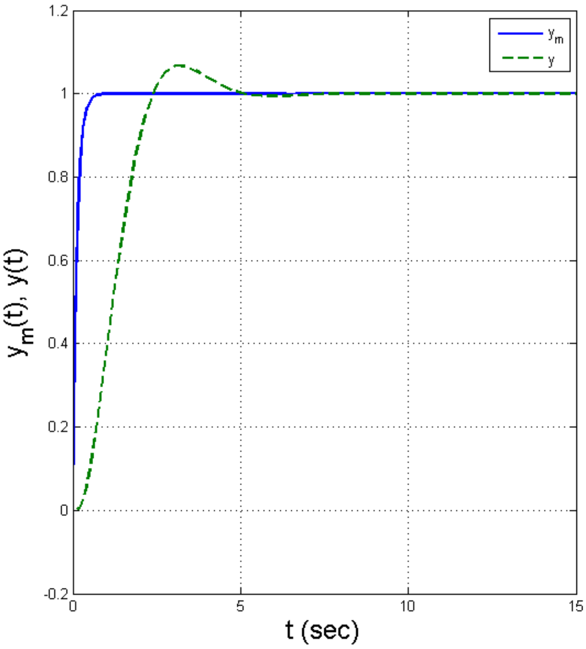
$\frac{dt_o}{dt} = -\gamma_1 \left[\frac{b}{s+a_m} U_c \right] e$

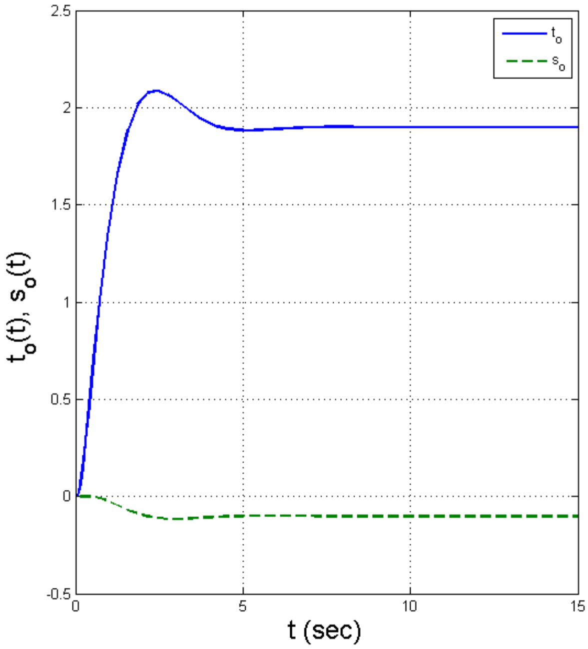
$\frac{ds_o}{dt} = \gamma_2 \left[\frac{b}{s+a_m} Y \right] e$

Let $a = 1, \quad b = 2, \quad a_m = 8, \quad b_m = 8$

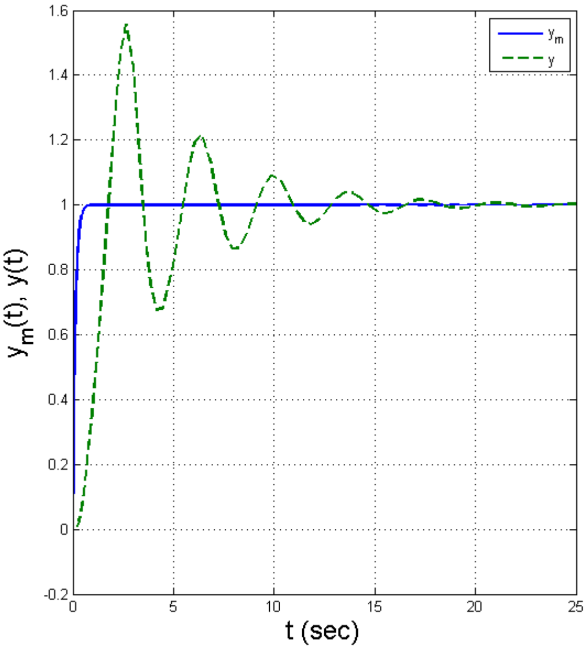


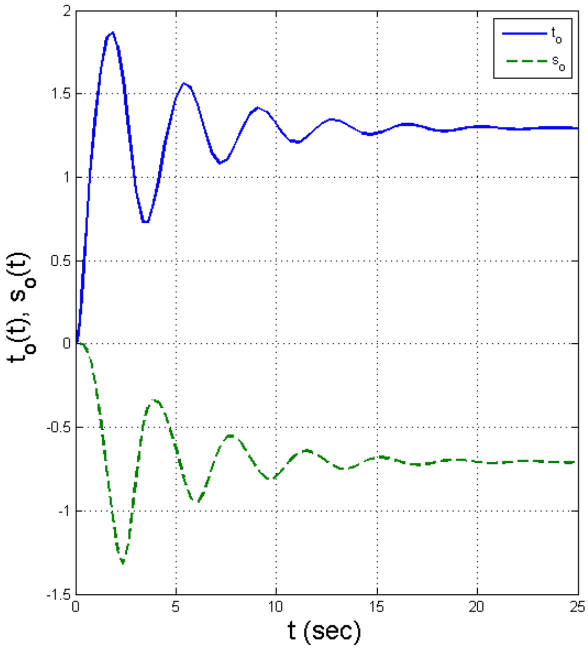
At $\gamma_1 = 2, \quad \gamma_2 = 0.1$



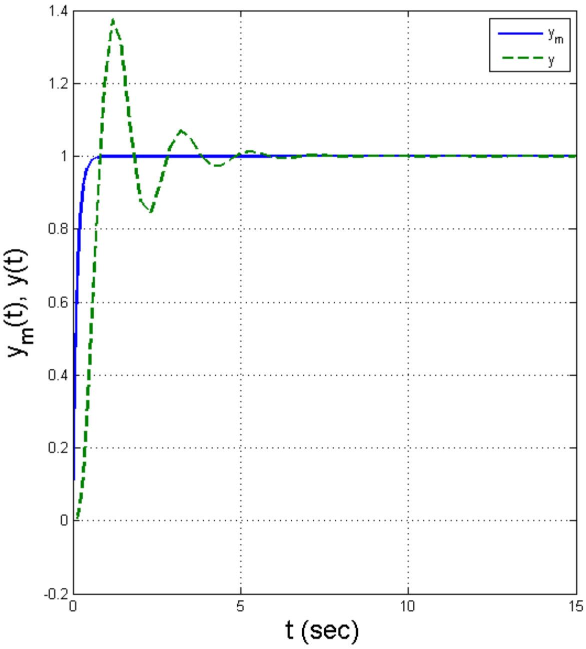


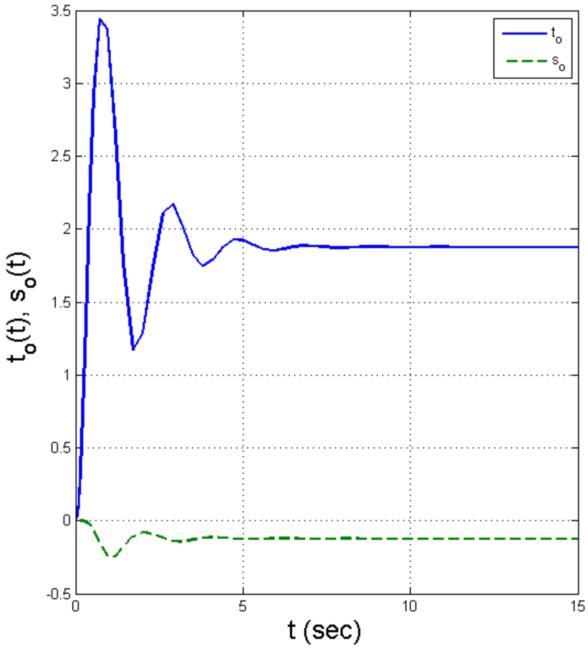
At $\gamma_1 = 2, \quad \gamma_2 = 1$





At $\gamma_1 0 = 2, \quad \gamma_2 = 0.5$





At $\gamma_1 = 1, \quad \gamma_2 = 0.05$