AE 457/641 – Navigation and Guidance

Tutorial 6, October 19, 2007

1. Use the linearized equations for proportional guidance to obtain the miss distance $y(t)$ as a function of time resulting from a step target lateral acceleration assuming the initial missile launch error and flight control system lags to be zero. Find the terminal value of the miss distance. Find the commanded lateral acceleration as a function of time. Find the initial, final, and maximum value of the commanded lateral acceleration. (Hint: In the class, we had performed a similar exercise for miss due to launch errors assuming the target acceleration to be zero.) (**Chetan Lalwani (04D01007)** + partner)

2. The equations given below describe the kinematics and dynamics of a missile trajectory. In these equations, y denotes the miss distance, while n_{M} and n_{T} denote the missile and target lateral accelerations, respectively. Nominally, the missile is supposed to intercept the target at $t = 6$s from the start of the engagement. During the engagement, the target can initiate an evasive maneuver by undergoing a step lateral acceleration of unit magnitude at any time between $t = 0$ (start of engagement) and $t = 6$ (nominal intercept time). Draw a block diagram of the adjoint system that needs to be simulated to generate the terminal miss distance as a function of the time to go (that is, the flight time remaining when the evasive maneuver is initiated). Use SIMULINK to simulate the adjoint system and plot the miss distance as a function of the time to go. Assume zero initial conditions for y and n_{M}. (**Amit Garg (04001003)** +partner)

$$
\begin{aligned}
\dot{y} &= 500(6-t)(2n_{\mathrm{T}} - 5n_{\mathrm{M}}),\\
\dot{n}_{\mathrm{M}} &= 1.5 \times 10^{-4}\frac{(t^2 - 6t - 36)}{(6-t)^2(1+1.5t)}y - \frac{5}{3}n_{\mathrm{M}},\ 0 < t < 6.
\end{aligned}
$$

3. Show that, if the output y and input u of a system are related by

$$c_2(t)\ddot{y}(t) + c_1(t)\dot{y}(t) + c_0(t)y(t) = u(t),$$

then the output y^* and input u^* of the adjoint system are related by

$$\frac{d^2}{dt^2}[c_2(t_{\mathrm{f}} - t)y^*(t)] + \frac{d}{dt}[c_1(t_{\mathrm{f}} - t)y^*(t)] + [c_0(t_{\mathrm{f}} - t)y^*(t)] = u^*(t).$$

(**Mahesh Bairwa (04001004)** + partner)