Augmented proportional guidance:

We have seen that target acceleration can ~~cause~~ contribute to the miss distance in the presence of FCS lags.

Intuitively, one expects that the miss distance will reduce if the target acceleration could be taken into account in the guidance command. To see how this can be done, ~~consider~~ recall that the LOS angle is related to the perturbation y by

$$\beta = \frac{y}{V_c t_{go}}.$$

Hence LOS rate $\dot{\beta} = \frac{y}{V_c t_{go}^2} + \frac{\dot{y}}{V_c t_{go}} = \frac{y + \dot{y} t_{go}}{V_c t_{go}^2}$

Hence the proportional guidance LATAX command is

$$\delta n_c(t) = \frac{\lambda V_m}{V_c} \frac{(y(t) + \dot{y}(t) t_{go})}{t_{go}^2}.$$

In the absence of target acceleration, $\ddot{y} = -\delta n_m$.
Hence, if the missile were to hold its course on the time interval $[t, t_F]$, then the resulting miss distance

$$y(t_F) = y(t) + \dot{y}(t) t_{go}.$$

Thus $y(t) + \dot{y}(t) t_{go}$ represents the miss distance that results at t_F if the missile puts in zero maneuvering effort starting from time t. This miss distance is called the zero effort miss (ZEM).

Hence the proportional guidance command can be written as

$$\delta n_c \Big|_{PG}(t) = \frac{\lambda V_m}{V_c} \frac{ZEM|_{PG}(t)}{t_{go}^2}$$

If the target maneuvers with a constant ~~lateral~~ LATAX of δn_T, then the zero effort miss at time t is

$$ZEM(t) = y(t) + \dot{y}(t) t_{go} + 0.5\, \delta n_T\, t_{go}^2$$

The target acceleration can be accounted for by using the above expression for the zero effort miss. The resulting guidance strategy is called augmented propotional guidance (APG). Thus the LATAX command in augmented propotional guidance is

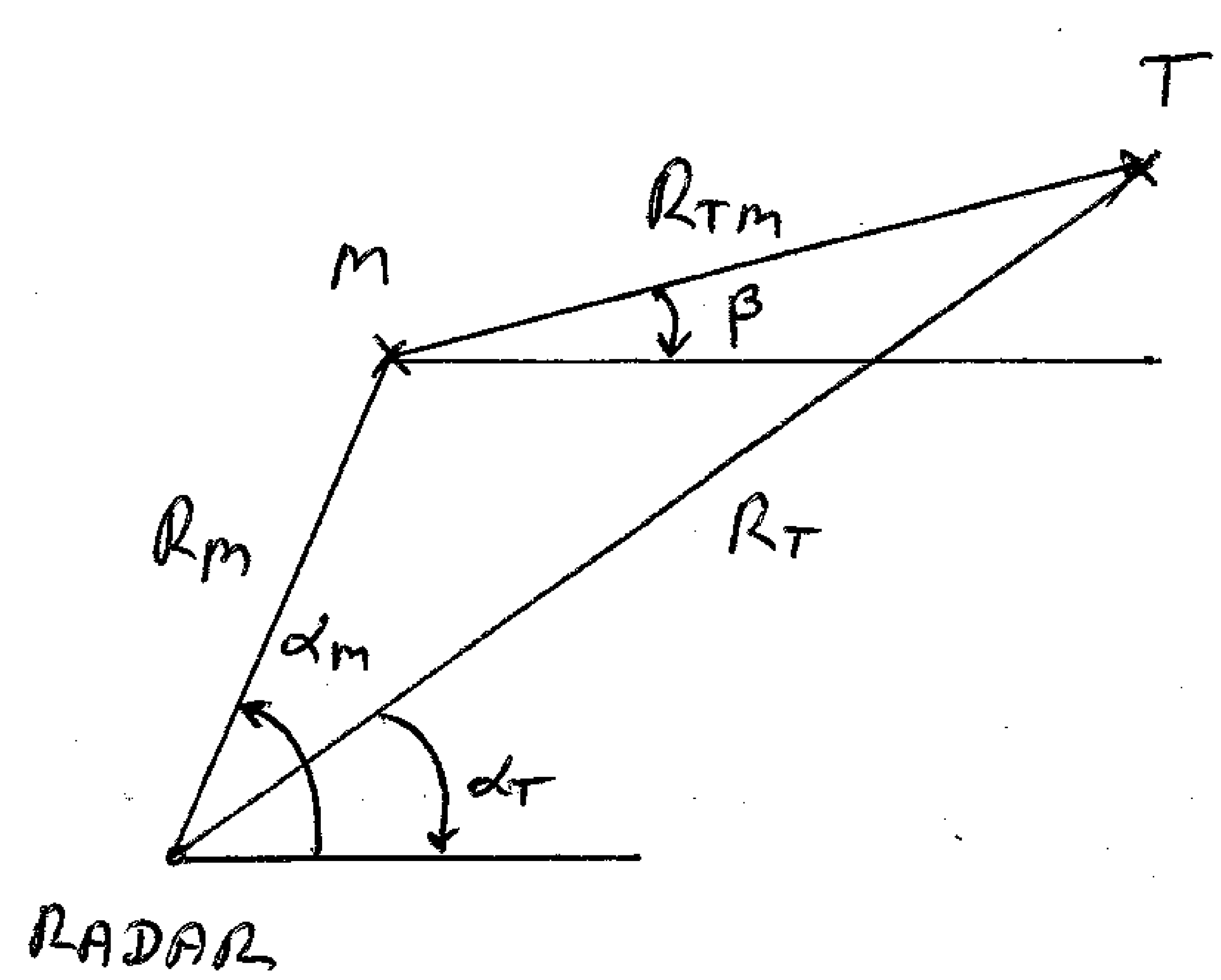
$$\delta n_c\big|_{APG}(t) = \frac{\lambda V_m}{V_c}\,\frac{ZEM|_{APG}}{t_{go}^2}$$

$$= \frac{\lambda V_m}{V_c}\,\frac{y(t) + \dot{y}(t)\,t_{go} + 0.5\,\delta n_T\,t_{go}^2}{t_{go}^2}$$

Augmented propotional guidance can result in smaller miss distances ~~due~~ in the presence of constant target ~~accel~~ lateral acceleration. However, APG requires additionally sensing target LATAX.

Propotional Command Guidance:

In this command guidance strategy, the missile as well as the target are tracked by a radar (that may be located on ground or on the ~~a~~ launching aircraft), as shown below.



R_{TT} – target range to radar
R_{TM} – missile range to radar
R_{TM} – range between missile & target

The command guidance system computes β & $\dot{\beta}$ from the radar measurements R_T, R_M, α_T, α_M, and uplinks guidance commands to the missile.

In the figure, target position $= [R_T \cos\alpha_T \;\; R_T \sin\alpha_T]^T$

missile position $= [R_M \cos\alpha_M \;\; R_M \sin\alpha_M]^T$

$$\therefore \beta = \tan^{-1}\left(\frac{R_T \sin\alpha_T - R_M \sin\alpha_M}{R_T \cos\alpha_T - R_M \cos\alpha_M}\right)$$

A filter with derivative action estimates $\dot{\beta}$ from β.

~~The effect~~