Today's Satellite

4/1/08

Olympus

- ~~[illegible]~~ communications satellite.
- launched in 1989.
- earth sensors
- control-moment-gyros.
- damage to the solar array drive motors.
- earth horizon sensors ~~[illegible]~~ worn out
- used ground signals for horizon sensor.
- miss a beacon. → attempted sun pointing.
- satellite went dead (tumbling)
- 75 days later, re-acquired the satellite.
- satellite struck by perseid meteors.

$$\dot{y} + ky = u$$

$$u(t) = \int_{-\infty}^{\infty} u(\tau)\,\delta(t-\tau)\,d\tau$$

$$y(t) = \int_{-\infty}^{\infty} u(\tau)\,h(t-\tau)\,d\tau = u * h = h * u$$

$$u(t) = e^{st} \qquad y = H(s)\,e^{st}$$

$$H(s) = \int_{-\infty}^{\infty} e^{-s\tau} h(\tau)\,d\tau$$

$$u(t) = a\cos\omega t$$

$$y(t) = a\,|H|\cos(\omega t + \angle H)$$

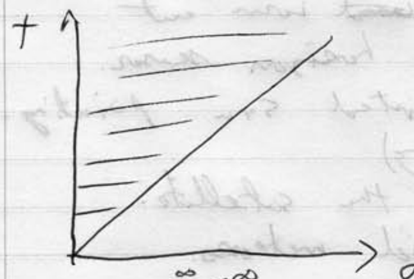
Laplace Transform

$$F(s) = \int_{0^-}^{\infty} e^{-s\tau} f(\tau)\,d\tau$$

$$Y(s) = \int_{0^-}^{\infty} e^{-st} y(t)\, dt$$

$$= \int_{0}^{\infty} e^{-st} \int_{0^-}^{t} u(\tau) h(t-\tau)\, d\tau\, dt$$

$$= \int_{0^-}^{\infty} \int_{0^-}^{T} e^{-st} u(\tau) h(t-\tau)\, d\tau\, dt$$



$$= \int_{0^-}^{\infty} \int_{\tau}^{\infty} e^{-st} u(\tau) h(t-\tau)\, dt\, d\tau$$

$$\nu \equiv t - \tau \quad \rightarrow \quad t = \nu + \tau$$

$$= \int_{0^-}^{\infty} \int_{0^-}^{\infty} e^{-s(\nu+\tau)} u(\tau) h(\nu)\, d\nu\, d\tau$$

$$= \int_{0^-}^{\infty} e^{-s\nu} h(\nu)\, d\nu \int_{0^-}^{\infty} e^{-s\tau} u(\tau)\, d\tau$$

$$= H(s)\, U(s)$$

$$\therefore \quad y(t) = \mathcal{L}^{-1}\left(H(s)\, U(s) \right)$$

$$\mathcal{L}(\dot{y}) = \mathcal{L}\left(\frac{dy}{dt}\right) = \int_{0^-}^{\infty} e^{-st}\left(\frac{dy}{dt}\right)dt$$

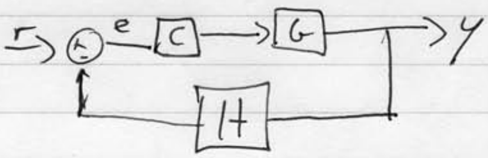
$$\int v\,du = uv - \int u\,dv$$

$$\mathcal{L}(\dot{y}) = y(t)\,e^{-st}\Big|_{0^-}^{\infty} + \underbrace{\int_{0^-}^{\infty} s\,y(t)\,e^{-st}\,dt}_{Y(s)}$$

$$= -y(0) + sY(s)$$

$$Y(s) = \frac{y(0^-)}{s+k} + \frac{u(s)}{s+k}$$

$$h(t) = \mathcal{L}^{-1}\left(\frac{1}{s+k}\right) = e^{-kt}$$



$$y = CGe = CG(r - Hy)$$

$$\frac{y}{r} = \frac{CG}{1 + CGH}$$

$$e = r - Hy = r\,H(CGe)$$

$$\frac{e}{r} = \frac{1}{1 + CGH}$$

Final Value Theorem

$$\lim_{t \to \infty} e(t) = \lim_{s \to 0} sE(s)$$

Axisymmetric Spin stabilized.

ex// $M_3 = J_3 \dot{\omega}_3$

$M_3 = -K_p \omega_3 + u(t)$

$J_3 \dot{\omega}_3 + K_p \omega_3 = u(t)$ → $\dot{y} + k = u$! Same system.