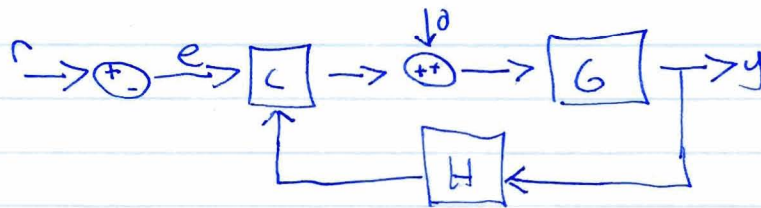


4/3/08

SOHO Solar and Heliospheric Observatory
 Launched Dec 95
 Rate Gyros
 Sun Sensor
 Reaction wheels / Thrusters



$$J\ddot{\theta} = u$$

$$G(s) = \frac{\Theta(s)}{U(s)} = \frac{1}{Js^2}$$

$$u = k_p e$$

$$C(s) = \frac{U(s)}{E(s)} = k_p$$

Case Study:

$$\begin{bmatrix} \dot{w}_1 \\ \dot{w}_2 \\ \dot{w}_3 \end{bmatrix} = \begin{bmatrix} c_2 c_3 & s_3 & 0 \\ -c_2 s_3 & c_3 & 0 \\ s_2 & 0 & 1 \end{bmatrix} \begin{bmatrix} \dot{\theta}_1 \\ \dot{\theta}_2 \\ \dot{\theta}_3 \end{bmatrix}$$

Need to linearize these systems for Control Theory

$$\approx \begin{bmatrix} 1 & \theta_3 & 0 \\ -\theta_3 & 1 & 0 \\ \theta_2 & 0 & 1 \end{bmatrix} \begin{bmatrix} \dot{\theta}_1 \\ \dot{\theta}_2 \\ \dot{\theta}_3 \end{bmatrix}$$

Assume small Angles and Angular rates

$$\approx \begin{bmatrix} \dot{\theta}_1 \\ \dot{\theta}_2 \\ \dot{\theta}_3 \end{bmatrix}$$

4/3/08

$$\vec{H} = J_1 \omega_1 \hat{b}_1 + J_2 \omega_2 \hat{b}_2 + J_3 \omega_3 \hat{b}_3$$

$$\dot{\vec{H}} = (J_1 \dot{\omega}_1 + J_w V_1) \hat{b}_1 + (J_2 \dot{\omega}_2 + J_w V_2) \hat{b}_2 + (J_3 \dot{\omega}_3 + J_w V_3) \hat{b}_3$$

$$M = \dot{H} + S(\omega)H$$

$$\begin{bmatrix} M_1 \\ M_2 \\ M_3 \end{bmatrix} = \begin{bmatrix} J_1 \dot{\omega}_1 + J_w \dot{V}_1 \\ J_2 \dot{\omega}_2 + J_w \dot{V}_2 \\ J_3 \dot{\omega}_3 + J_w \dot{V}_3 \end{bmatrix} + \begin{bmatrix} 0 & -\omega_3 & \omega_2 \\ \omega_3 & 0 & -\omega_1 \\ -\omega_2 & \omega_1 & 0 \end{bmatrix} \begin{bmatrix} J_1 \omega_1 + J_w V_1 \\ J_2 \omega_2 + J_w V_2 \\ J_3 \omega_3 + J_w V_3 \end{bmatrix}$$

$$M_1 = J_1 \dot{\omega}_1 + J_w \dot{V}_1 + \cancel{(J_3 - J_2) \omega_2 \omega_3} + J_w (\cancel{\omega_2 V_3} - \cancel{\omega_3 V_2})$$

$$M_2 = J_2 \dot{\omega}_2 + J_w \dot{V}_2$$

$$M_3 = J_3 \dot{\omega}_3 + J_w \dot{V}_3$$

$$M_1 = J_1 \ddot{\theta}_1 + J_w \dot{V}_1$$

$$M_2 = J_2 \ddot{\theta}_2 + J_w \dot{V}_2 \rightarrow$$

$$M_3 = J_3 \ddot{\theta}_3 + J_w \dot{V}_3$$

$$M_1 + u_1 = J_1 \ddot{\theta}_1$$

$$M_2 + u_2 = J_2 \ddot{\theta}_2$$

$$M_3 + u_3 = J_3 \ddot{\theta}_3$$

M 's are considered
a disturbance