SEPTEMBER 26th 2013

$PV = \vartheta_{SHIP}$ $V_M = M_M, \omega_M, \omega_{SHIP}$ $V_C = I$

NEGLIGIBLE J_M, γ_M, τ (INERTIA, FRICTION, DELAYS IN THE MOTOR)

BUT NOT IN THE PROCESS ... $(\gamma_P ; J_P, \dots)$

$$M_M = M_0 + \gamma_P \omega_{SHIP} + J_P \dot{\omega}_{SHIP}$$

ω_{SHIP} = rotation velocity of ship $= K \omega_M$

$\gamma_P \omega_{SHIP}$ = PART OF THE TORQUE NEEDED TO WIN THE FRICTION

$J_P \dot{\omega}_{SHIP}$ = " " " " " " " " INERTIA AND BEGIN TO ROTATE

M_0 = EFFECTIVE " " " " " TO MAKE THE SHIP TO ROTATE

M_0 = force developed by the motor · distance from the application point (K)

$= M'_{SHIP} \cdot \dot{\omega}_{SHIP} \cdot d$ M'_{SHIP} = NEW MASS OF THE SHIP

THE MASS OF THE SHIP IS NOT CONSTANT BECAUSE AT EVERY TIME IS GIVEN BY THE "ORIGINAL" WEIGHT OF THE SHIP ITSELF + THE WEIGHT OF THE WATER INJECTED INTO THE BIG BASIN MOUNTED ON THE SHIP SIDE.

THE VOLUME OF THIS WATER IS PROPORTIONAL TO THE SPAN OF THE GATE VALVE THAT WILL BE RELATED TO THE ROTATIONAL MOVEMENT OF THE MOTOR ITSELF $K' \frac{\vartheta_M}{s}$

$$M'_{SHIP} = \left(M_{SHIP} + K' \frac{\vartheta_M}{s}\right) \Rightarrow M_0 = d\left(M_{SHIP} + K' \frac{\vartheta_M}{s}\right) s^2 \vartheta_M$$ NOT LINEAR PROBLEM!

BETTER TO USE A FF BLOCK WITH A TRANSDUCER THAT MEASURES HOW OPEN IS THE VALVE AND ELIMINATES THE CONTRIBUTION DUE TO THE BASIN

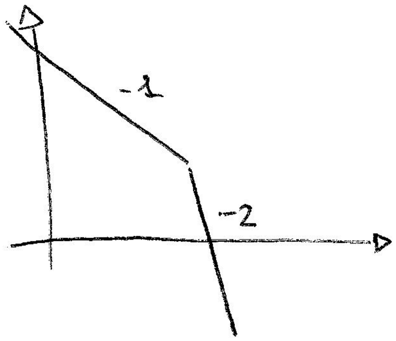
THEREFORE:

$$M_M = d M_{SHIP} \dot{\omega}_M K + \gamma_P \omega_M K + J_P K \dot{\omega}_M = K\left[\gamma_P s \vartheta_M + (J_P + M_{SHIP} d) s^2\right] = K s \vartheta_M \left[\gamma + (J_P + M_S d)\right]$$

$$G = \frac{PV}{V_c} = \frac{PV}{V_M} \cdot \frac{V_M}{V_c} = \frac{\vartheta_{SHIP}}{\omega_{SHIP}} \cdot \frac{\omega_{SHIP}}{\omega_{MOTOR}} \cdot \frac{\omega_{MOTOR}}{M_{MOTOR}} \cdot \frac{F_{MOTOR}}{I}$$

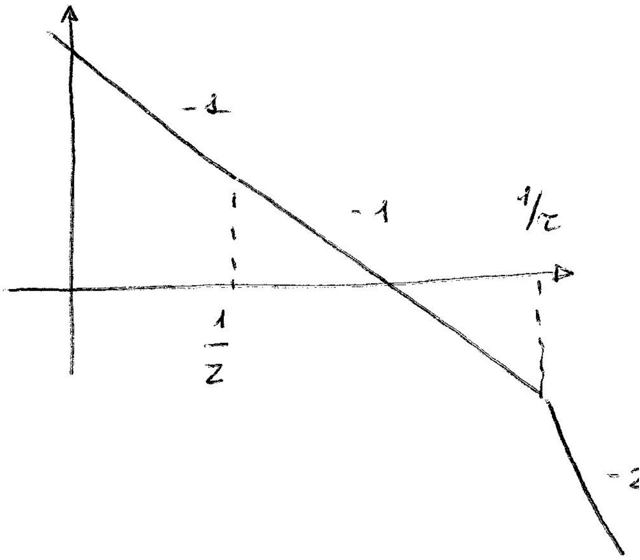
$$= \frac{1}{s} \cdot K \cdot \frac{1}{\gamma + (J_p + M_s d)} \cdot K^*$$

POTENTIALLY NOT AS MPTOTICALLY STABL



$$\frac{1+sz}{1+s\tau}$$

$\Rightarrow$



$$z = \left(\frac{Md}{J_p}\right)^{-1}$$

NOTICE THAT IN THIS MODEL WE HAVE NEGLECTED AN IMPORTANT ISSUE.
THE TRACKING ACTION EXERTED BY THE MOTOR SHOULD BE EQUIVALENT TO THE OPPOSITE MASS COMPONENT OF THE SHIP THAT IS $M \sin \vartheta_{SHIP}$ OR $M \vartheta_{SHIP}$ DUE TO THE SMALL ROTATIONS OF THE SHIP AS MENTIONED IN THE TEXT.
HOWEVER IN THIS CASE THE PROBLEM BECOMES NOT LINEAR AND CANNOT BE SOLVED WITH THE USUAL METHODS.

4) THE TRANSDUCER THAT CAN BE USED IS AN INCREMENTAL OR ABSOLUTE ENCODER MOUNTED ON THE MOTOR. BUT SINCE IN THIS CASE MORE THAN ONE ROTATION MUST BE DONE THE INCREMENTAL ENCODER IS THE RIGHT CHOICE

SEE SLIDES 20-22-23 TRANSDUCERS SECTION

$\log_2 \frac{100}{3} = \log_2 33 = 6$ bits BUT IN THIS CASE WE DO NOT HAVE AN ADC

IN THIS CASE THE PRECISION SHOULD BE 3% OF 360° ≃ 10.8° IN A INCREMENTAL ENCODER THIS CORRESPONDS TO HALF A WINDOW, THEREFORE WE NEED AT LEAST 17 WINDOWS FOR EACH OF THE 2 CIRCULAR CROWNS

5) CASCADE see "CONTROL ALGORITHMS" SLIDES 15-17