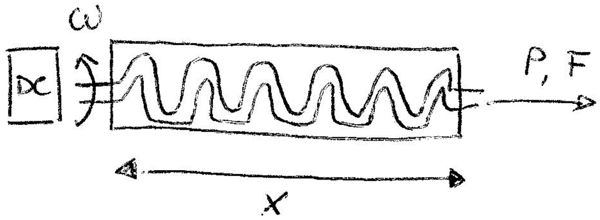
15th NOVEMBER 2018

PV = LEVEL OF THE SEA h

V_M = PUMP (HELICOIDAL + DC MOTOR)

$V_C = I$



$$M_M = M_0 + \gamma_{MOTOR}\,\omega_M + J_{MOTOR}\,\dot{\omega}_M$$ WHAT IS M_0?

$$M_0 = M_{AIR} \text{ acceleration} \cdot \text{distance} = M_{air} \cdot \dot{\omega}_M \cdot R \text{ (radius)}$$

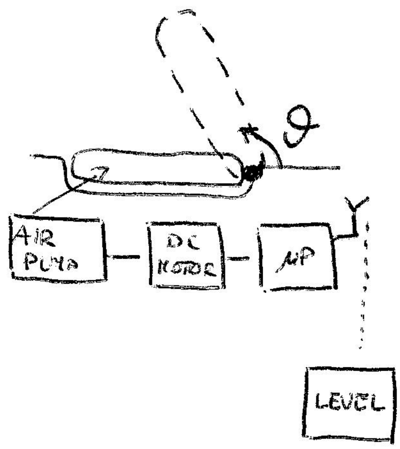
$$M_M = M_{air} R \dot{\omega}_M + \gamma_{MOTOR}\,\omega_M + J_{MOTOR}\,\dot{\omega}_M \Rightarrow \frac{\omega_M}{M_M} = \frac{1}{\gamma_{MOTOR} + s[M_{air}R + J_{MOTOR}]}$$

+ eventual friction of the pump

THE MECHANICAL MOMENT TURNS OUT TO BE PROPORTIONAL TO THE FORCE WITH WHICH THE FLUID EXITS FROM THE PUMP THEREFORE WE CAN SUPPOSE A LINEAR RELATIONSHIP WITH THE PRESSURE. INSTEAD THE FLOW RATE IS DEPENDENT ON THE VELOCITY OF THE FLUID THEREFORE $M \propto K s F$

THE FLOWRATE IS INTERESTING SINCE ITS INTEGRAL CORRESPONDS TO THE VOLUME OF THE AIR INJECTED IN THE GATES, CAUSING A VARIATION (DIFFERENCE) OF INTERNAL PRESSURE THAT MAKES THEM TO ROTATE, OF AN ANGLE ϑ

THE μP WILL ASSOCIATE A SUITABLE ANGLE ϑ^* TO THE LEVEL OF THE TIDE ON THE BASIS OF AN INTERNAL LOOK UP TABLE.



SUMMARISING:

$V_M = M_M, \omega_M, F, Vol, \vartheta_{ROT}$

$$G = \frac{PV}{V_C} = \frac{PV}{V_M} \cdot \frac{V_M}{V_C} = \frac{h}{\vartheta_{ROT}} \cdot \frac{\vartheta_{ROT}}{Vol} \cdot \frac{Vol}{F} \cdot \frac{F}{\omega_M} \cdot \frac{\omega_M}{M_M} \cdot \frac{M_M}{I}$$

ON THE BASIS OF WHAT WE HAVE SEEN:

$$G = K_{TABLE} \cdot \frac{K_1}{S^2} \cdot \frac{K_2}{S} \cdot K_3 \cdot \frac{K_4}{\gamma_{MOTOR} + [S R M_{air} + J_{MOTOR}]} \cdot K_5$$

REMEMBER THAT THE $VOL_{AIR} \Rightarrow \Delta P_{VARIATION} \propto$ ROTATION MOMENTUM OF THE GATES $\propto \ddot{\vartheta}$

MOREOVER WE HAVE TO INCLUDE A DELAY DUE TO THE TRANSMISSION OF PV TO THE μP

CONSIDER THAT THE TRANSDUCER IS A FLOW METER AND THE LEVEL h IS PROPORTIONAL TO THE VOLUME OF WATER IN A PREDEFINED SURFACE THEREFORE WE SHOULD INCLUDE ALSO A FURTHER "$1/S$" TERM IN THE EQUATION OF G.

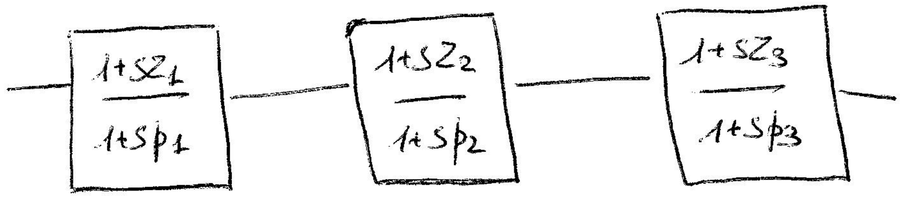
JUST TO AVOID ANY OTHER COMPLICATION LET'S CONSIDER IT INCLUDED IN THE LOOK UP TABLE.

A VERY PROBLEMATIC SYSTEM! 3 POLES IN THE ORIGIN AND ONE IN $\frac{J_{MOTOR}}{R M_{AIR}}$ + A DELAY

NO CASCADE CONTROL: WE HAVE ONLY ONE POLE IN THE ACTUATOR.

DYNAMIC COMPENSATION WITH $\frac{(1+sz_1)(1+sz_2)(1+sz_3)}{(1+sp_1)(1+sp_2)(1+sp_3)}$ WITH $z_3 = \frac{J_{MOTOR}}{R M_{AIR}}$

NUMERICAL IMPLEMENTATION



EACH BLOCK IMPLEMENTED AS WE HAVE SEEN AT LESSON

DELAY ⇒ SMIT PREDICTOR IMPLEMENTED AS A RC CASCADE SINCE THE TIME FOR THE TRANSMISSION COULD BE NOT SHORT (≃ 300 msec)

4) THE PV IS h BUT IS OBTAINED FROM A FLOW METER, WHAT KIND TO USE?

ULTRA SOUND: OK DIFFICULT TO PLACE AND TO GENERATE THE BEAM

VENTURI TUBE: OK, VERY OK BUT NOT LINEAR

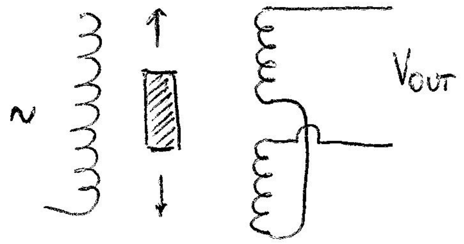
ELECTROMAGNETIC: OK BUT COMPLEX FOR THE GENERATION OF THE MAGNETIC FIELD

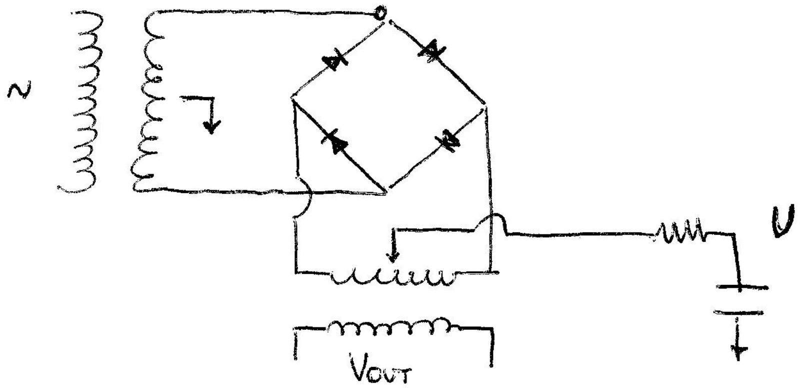
TURBINE: OK NOT SO PRECISE AND INVASIVE (NOT A PROBLEM IN THIS CASE) BUT OK

⇒ INCREMENTAL ENCODER. PRECISION ⇒ $\frac{100}{2 \cdot 1.3} = \frac{76.92}{2}$ $\frac{39}{2}$ WINDOWS PER CROWN

QUESTIONS

i) DIFFERENTIAL TRANSDUCER IS A BIDIRECTIONAL TRANSDUCER





ii) SEE "CONDITIONING NETWORK" SLIDE 26

$$sync = \frac{\sin \omega t}{\omega t}$$

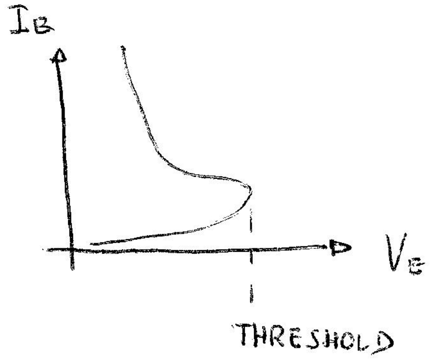
NOT ALWAYS EMBEDDED μP HAVE A FPU

THEREFORE THE CALCULATION IS PERFORMED THROUGH AN ALGORITH

SLOW, COMPLICATE, NOT ACCURATE

BETTER TO OVER SAMPLE

iii)



iv) SENSIBILITY OF AN ABSOLUTE ENCODER

SENSIBILITY THE MINIMUM VARIATION AT THE BEGINNING OF THE SCALE ABLE TO CAUSE AN OUTPUT $\neq \phi$.

IN AN ABSOLUTE ENCODER THE SENSIBILITY IS EQUIVALENT TO THE RESOLUTION (THAT IS APPLIED TO THE COMPLETE RANGE OF VALUES)

THEREFORE $\frac{360}{2^N}$ N = n° of bits of the encoder