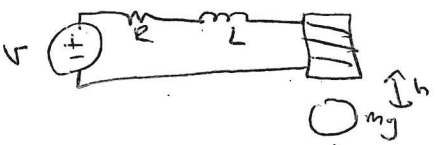
NAME MT-28 COURSE ENGR 4020

DATE

LESSON State Space Control Example PAGE 1 of 1

ctms.engin.umich.edu

Magnetically suspended Ball



$$m\frac{d^2h}{dt^2} = mg - \frac{Ki^2}{h}$$ ← from geometry of coil

$$V = L\frac{di}{dt} + iR$$

let $m = 0.05$ kg $\quad K = 0.0001$

$L = 0.01$ H, $R = 1\ \Omega$, $g = 9.81$ m/s²

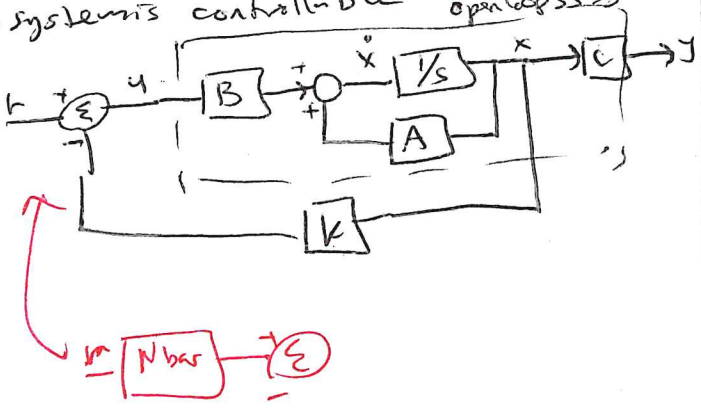
Assume system at equilibrium and we can linearize at $h = 0.01$ m to get state space — linearization not the topic of this course

let $x = \begin{bmatrix} \Delta h \\ \Delta \dot{h} \\ \Delta i \end{bmatrix}$ ← change in height, current

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 980 & 0 & -2.8 \\ 0 & 0 & -100 \end{bmatrix}$$

$$B = \begin{bmatrix} 0 \\ 0 \\ 100 \end{bmatrix} \qquad C = \begin{bmatrix} 100 \end{bmatrix}$$

- poles show me this is unstable
- ball will go to ∞ (or hit floor)
- system is controllable open loop system



Repeat in simlink