# Lab 2 - System I.D via Frequency Response

- In-class tasks are lettered (A, B, C...)
- Deliverables are numbered (1, 2, 3 ...)

Given the block diagram for our system (next page),

1) Solve for the plant, $P(s)$. ($P(s) = \frac{X(s)}{V(s)}$)

2) What is a 2nd-order approx. for $P(s)$?

(A) Implement the controller $C(s) = \frac{100(s+16.88)}{(s+30)}$.

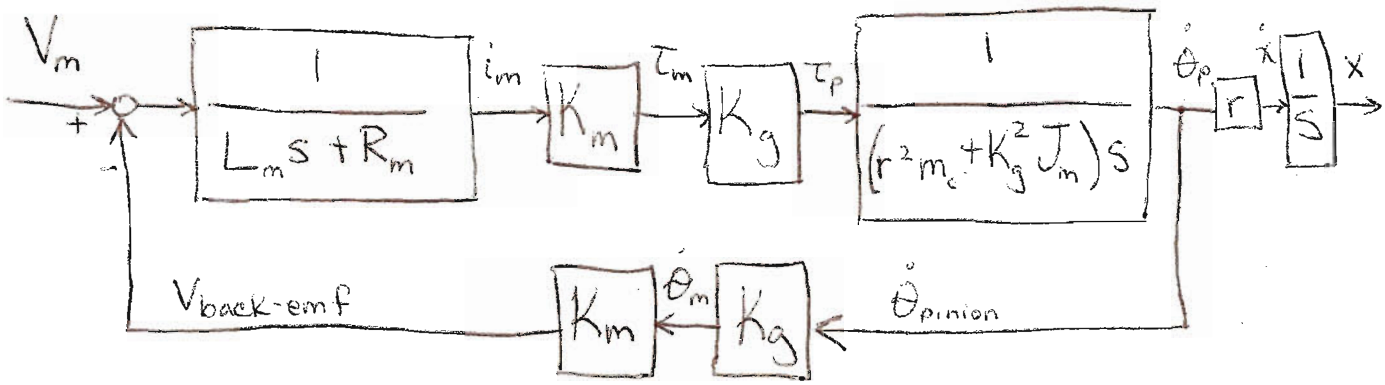
3) For $T = .001$ seconds, use backward Euler, $s \rightarrow \frac{z-1}{zT}$, to solve for $C(z) =$ ______.

(B) Drive closed-loop system (w/ $C(z)$ in a negative feedback loop) with a sine wave to move cart at an amplitude of a few centimeters at several frequencies. (Hint, see frequencies tested for Bode plot on last page...)

(C) SAVE DATA for $V_m(t)$, the commanded voltage, and for $x_c(t)$, the cart position, for each frequency tested. Make sure each lab partner gets data (e.g., via email).

4) Use the data from (C) to plot the experimental Bode plot for $P(s) = X(s)/V(s)$.

5) Use data (from (C)) to find a better approximation to $P(s)$ than you calculated in question 2).




$K_m = .007677 \left(\frac{V}{rad/s}\right)$ or $\left(\frac{Nm}{A}\right)$

$R_m = 2.6 (\Omega)$

$L_m = 180 \times 10^{-6}$ (H)

$J_m = 3.8 \times 10^{-7}$ ($kg\,m^2$)

$K_g = 3.7$ [no units: gear ratio]

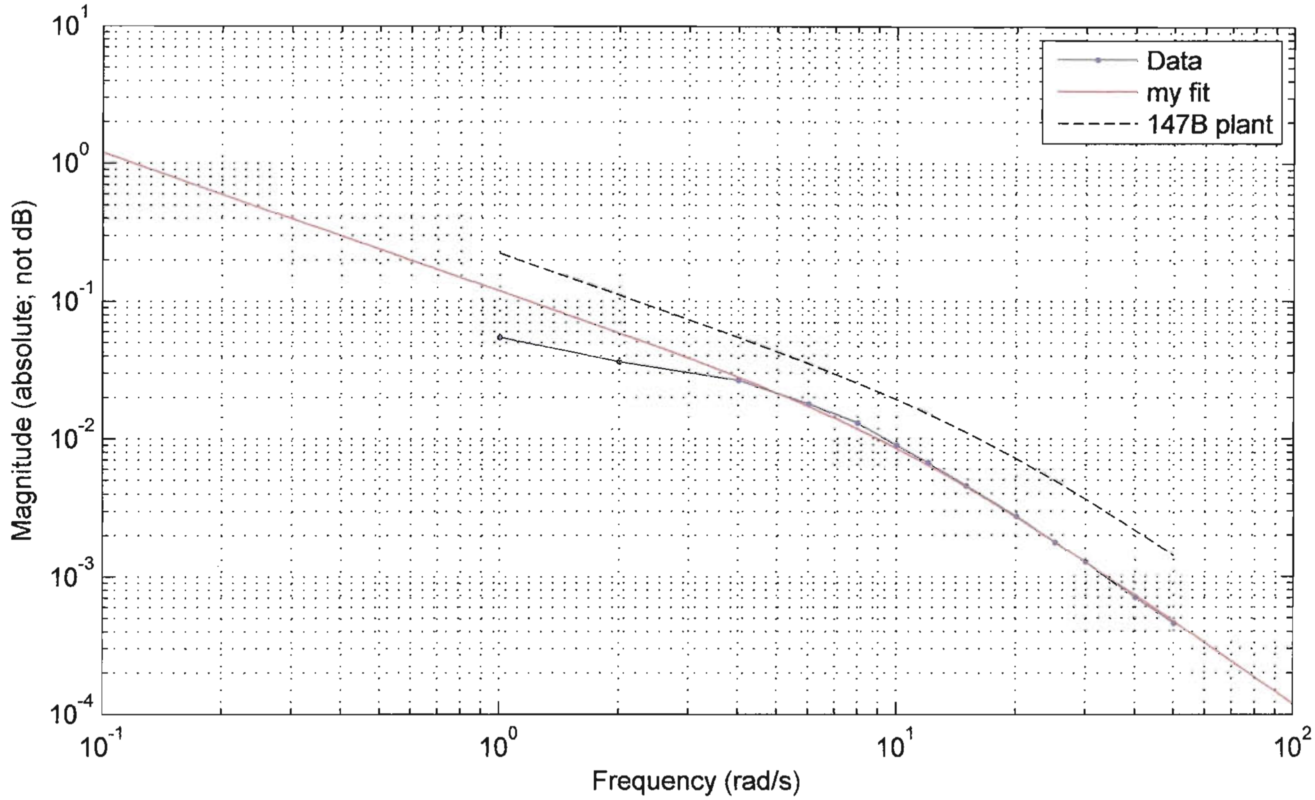
$r = .00635$ (m) [pinion radius]

$m_c \approx$ <u>.455</u> (Kg)

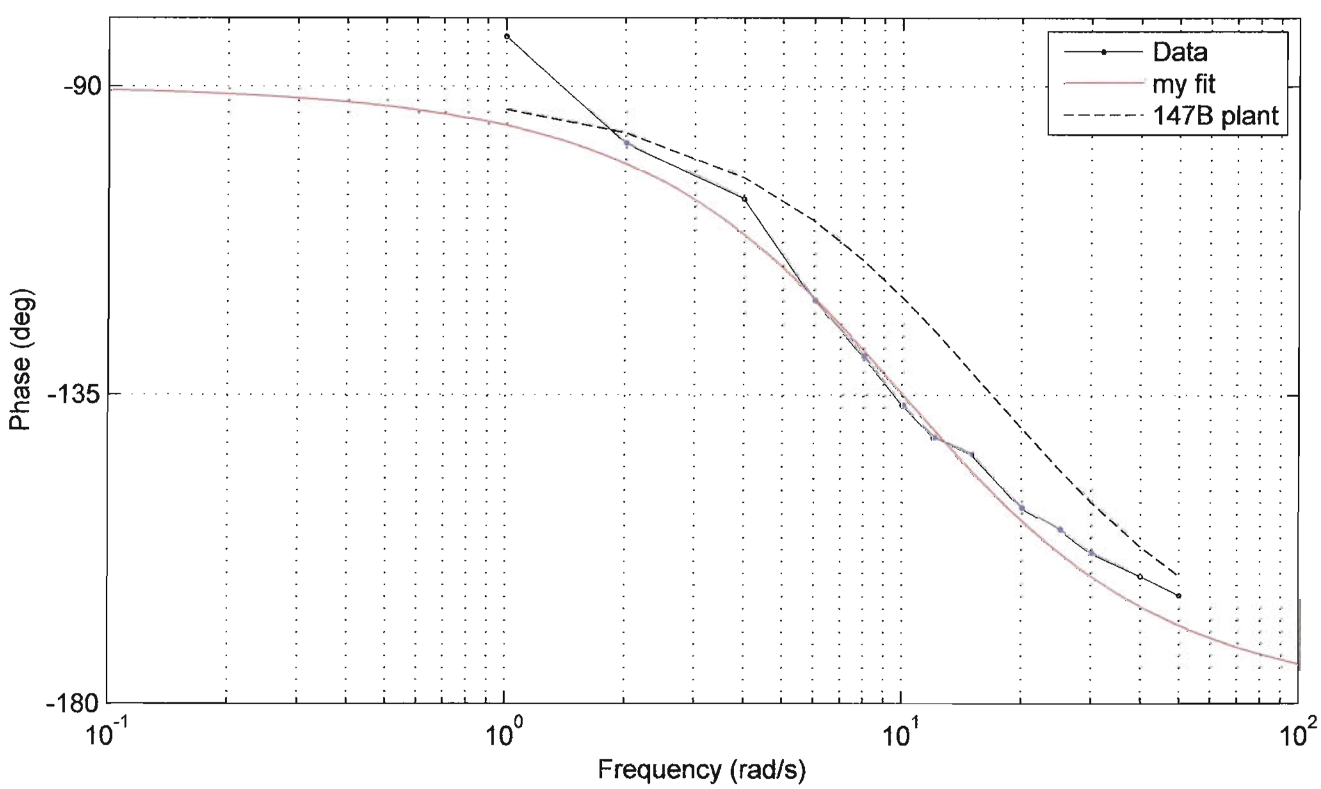
This value is <u>wrong</u>!

6 "E.C.") For <u>extra credit</u>, use your results to <u>estimate</u> the <u>true</u> mass, $m_c$!

7 "E.C.") ... Estimate any additional, mechanical DAMPING that <u>should</u> be in our model.



Data
my fit
147B plant
Magnitude (absolute; not dB)
Frequency (rad/s)

Data
my fit
147B plant
Phase (deg)
-90
-135
-180
Frequency (rad/s)