Speed Laboratory Exercise

Laboratory Exercise 1 : Speed Controller Design

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Lab 1

Speed Control Experiment

Use the following data in your design.

Item	Symbol	Value	Units
Armature Resistance	$\boldsymbol{R}$	4.89	$\boldsymbol{\Omega}$
Armature Inductance	$\boldsymbol{L}$	0.00042	H
Motor Inertia	$\boldsymbol{J}$	0.0000109	kg/m^2
Viscous Damping	$\boldsymbol{B}$	0.0000464	Nm/(rad/s)
Torque Constant	$\boldsymbol{k_t}$	0.0348	Nm/A
Back EMF Constant	$\boldsymbol{k_e}$	0.0348	V/(rad/s)

Your plant transfer function is

$$\boldsymbol{G_p(s)} = \frac{\boldsymbol{\Omega(s)}}{\boldsymbol{V(s)}} = \frac{\boldsymbol{k_t}}{\boldsymbol{(Ls+R)(Js+B)+k_tk_e}}$$

This relates voltage in volts to speed in rad/s.

$$\boldsymbol{A} = \boldsymbol{G_p(s)}\Big|_{\text{DC Gain}} = \frac{\boldsymbol{k_t}}{\boldsymbol{RB+k_tk_e}}$$

Given that $\boldsymbol{L}$ is very small, $\boldsymbol{G_p(s)}$ can be approximated as,

$$\boldsymbol{G_p(s)} = \frac{\boldsymbol{k_t}}{\boldsymbol{RJs+RB+k_tk_e}}$$

Hence,

$$\boldsymbol{\tau_m} = \frac{\boldsymbol{RJ}}{\boldsymbol{RB+k_tk_e}}$$

$$\therefore \boldsymbol{G_p(s)} = \frac{\boldsymbol{A}}{\boldsymbol{(1+\tau_m s)}}$$

For the rest, follow the direct design procedure.