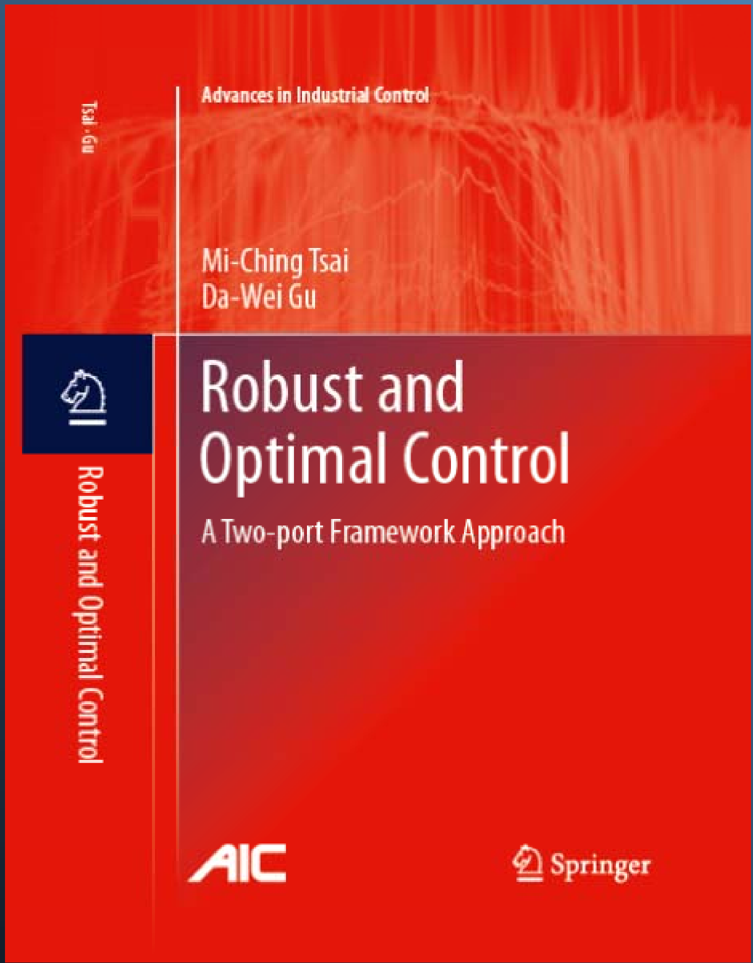

Robust and Optimal Control

A Two-port Framework Approach

Advanced PDFF controller

Content

- Introduction
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- Simulation
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Introduction

1. Purpose : Design a controller for velocity control of servo motor
2. Target : Minimize the tracking error
3. Controller : Advanced PDFF Controller

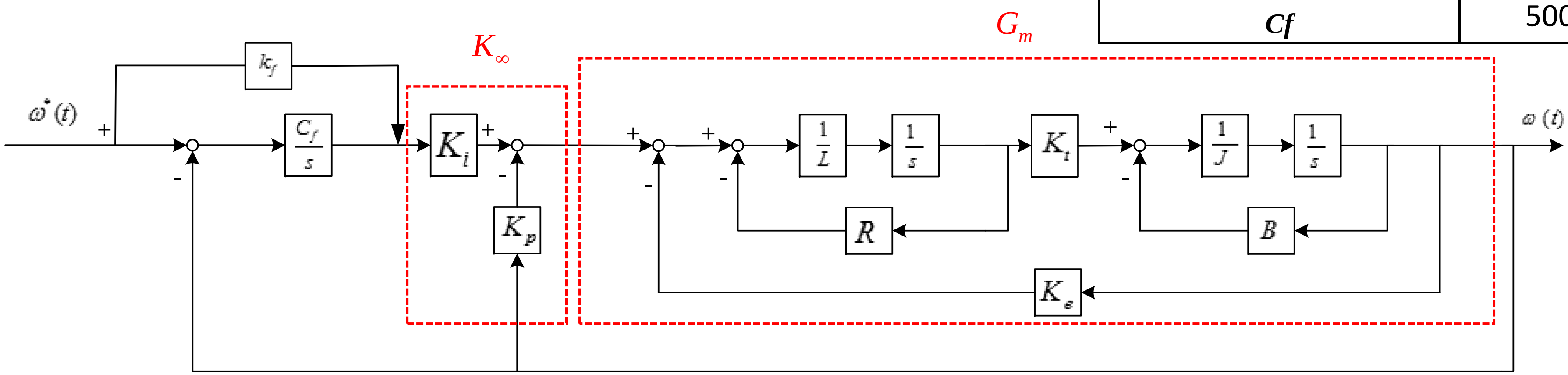
Simulation parameters:

Resistance, R_c	7.155
Inductance, L	0.0038
Inertia of motor, J_m	0.0000577
Damping ratio, B_m	0.00055
Back EMF constant, k_e	0.21
Torque constant, k_t	0.21
kf	0.5
Cf	500

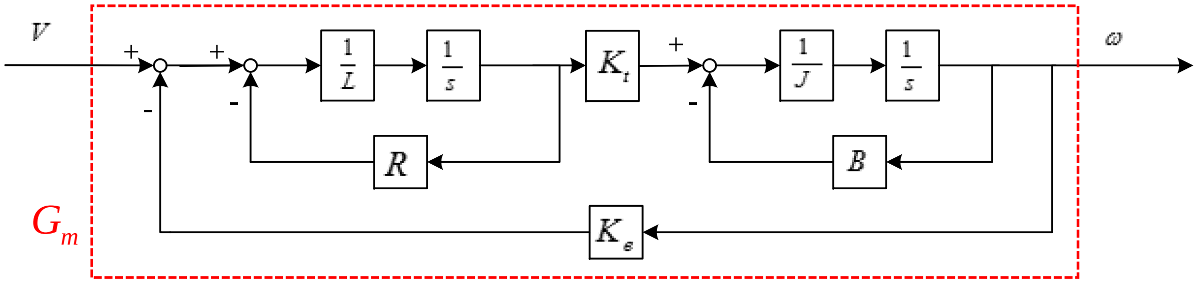
Dynamic equations of the motor:

$$\begin{cases} V = iR_c + L\dfrac{di}{dt} + k_e\omega \\ J_m\dfrac{d\omega}{dt} = k_t i - B_m\omega \end{cases}$$

Block diagram of velocity control:



Methodology : Normalized Coprime factorization



State space :

$$G_m \overset{s}{=} \left[\begin{array}{c|c} A_m & B_m \\ \hline C_m & D_m \end{array}\right] = \left[\begin{array}{cc|c} -\frac{R}{L} & -\frac{K_e}{L} & \frac{1}{L} \\ \frac{K_t}{J} & -\frac{B}{J} & 0 \\ \hline 0 & 1 & 0 \end{array}\right] = \tilde{M}^{-1}N$$

$pole\ of\ \ G = \{-1768.5,\ 123.97\}$

$zero\ of\ \ G = \{\}$

Normalized Left Coprime:

Because D_m is zero, the Riccati equation for SF simply to $YA_m^T + A_mY - YC_m^TC_mY + B_mB_m^T = 0$

$$\tilde{M}^{-1} \overset{s}{=} \left[\begin{array}{c|c} A_m & -H_m \\ \hline C_m & \tilde{W} \end{array}\right] = \left[\begin{array}{cc|c} -1883 & -55.26 & 19.55 \\ 3642 & -9.539 & 367.9 \\ \hline 0 & 1 & 1 \end{array}\right]$$

$poles\ of\ \ \tilde{M}^{-1} = \{-1768.5,\ 123.97\} \Rightarrow$ system poles

$zeros\ of\ \ \tilde{M}^{-1} = pole\ of\ \ \tilde{M} = \{-1672.5,\ -587.89\}$

$$\tilde{N} \overset{s}{=} \left[\begin{array}{c|c} A_m + H_mC_m & B_m + H_mD_m \\ \hline \tilde{W}C_m & \tilde{W}D_m \end{array}\right] = \left[\begin{array}{cc|c} -1883 & -74.81 & 263.2 \\ 3642 & -377.5 & 0 \\ \hline 0 & 1 & 0 \end{array}\right]$$

$poles\ of\ \ \tilde{N} = \{-1672.5,\ -587.59\}$

$zeros\ of\ \ \tilde{N} = \{\} \Rightarrow$ system zeros

Check:

$\tilde{N}(s)\tilde{N}^{\sim}(s) + \tilde{M}(s)\tilde{M}^{\sim}(s) = I$ **OK!**