University of Toronto

Department of Electrical and Computer Engineering

ECE 356S – System and Signal Analysis II 1999

Exp 3: IMPLEMENTING CONTROLLERS FOR THE DC MOTOR

1 Purpose

The purpose of this experiment is to implement the controllers designed in Experiment 2.

2 Introduction

In Experiment 2, two feedback controllers for the DC motor system were designed and simulated with MATLAB. In this experiment these controllers will be implemented and their performances will be measured and compared with the calculated and simulated values.

3 Procedure

Equipment

- RC-01 Rate Control Experiment DC Motor Kit
- Function Generator
- Oscilloscope
- Volt Meter

3.1 Proportional Controller

1. Implement the proportional closed-loop controller circuit as shown in Figure 1. Take $R_e = R_f = 100\ K\Omega$ and the value of R_1 to achieve the designed K'_P. Note: You'll likely have to compromise on R_1 to the nearest standard resistor available. Also, you might try series or parallel connections of standard resistors to get closer.
2. Connect the potentiometer output voltage v_p to system input v_d. Apply v_d in the range of -3 V to +3 V and measure the tachometer voltage v_t. Calculate the average closed-loop DC gain from these data.
3. Measure the time constant of the closed-loop system.

3.2 Proportional + Integral Controller

1. Implement the PI controller as shown in Figure 2. Take $R_e = R_f = 100\ K\Omega$, $C_i = 1\ \mu F$, the value for R_1 to obtain the designed K'_P, and the value for R_i to obtain the designed K'_I.
2. Measure the DC gain of the closed-loop system as above.

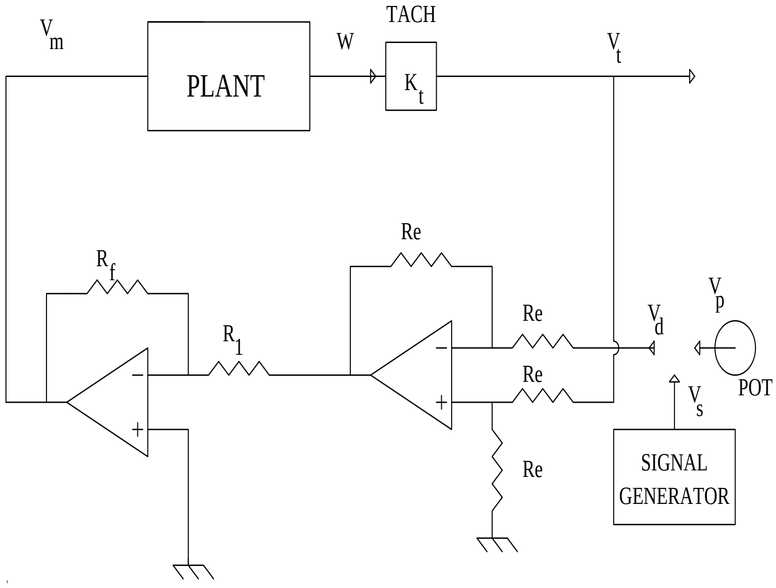

Figure 1: Proportional controller in closed loop.

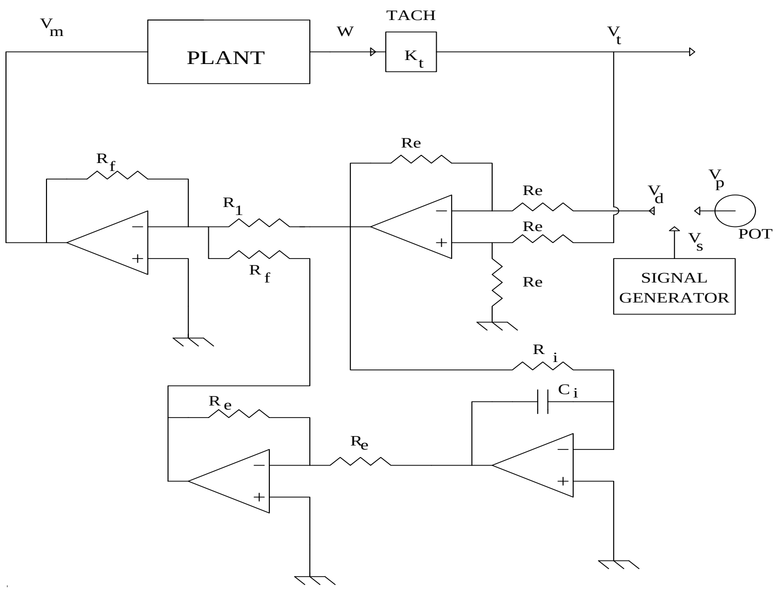

Figure 2: Proportional + Integral controller in closed loop.

3. Apply a train of square pulses to system input v_d. Observe the tachometer output voltage v_t on the oscilloscope and measure the peak time and overshoot.

4 Preparation

Determine the resistor values to achieve the designed controllers.

5 Results and Discussions

Compare the performance of the real system with the design specifications. Note: If you compromised on the resistors used, you'll have to re-run your simulations to be consistent.