Review of Control of Dc Motor Using Soft Computing Method

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Abstract

This paper deals with the control of a DC motor using soft computing techniques. For control of DC motor we have a CEA-DCMCM which is the DC motor control module. In this module introduce analog and digital control methods used to control DC motor. This module makes use of real time windows based software which is VCLS (Virtual control laboratory software) and control laboratory I/O interface module (PCIM). This replaces a number of different traditional instruments, eliminating the need for separate signal generator, oscilloscope, multimeter or controller.

Keywords: *DCMCM (DC motor control module), PCIM (PC interface module), VCLS (Virtual control laboratory software), Command potentiometer*

1. Introduction

The basic principle of the direct current (DC) motor is a device which converts DC energy into mechanical energy. When the current carrying armature is connected to the supply end through commutator segment, brushes are placed within the north south poles of permanent magnet or electromagnets. By using these electromagnets operating principle depends on the Fleming's left hand rule to determine the direction of the force acting on the armature conductors of the DC motor.

A DC motor is supposed to operate at an accurate and constant speed even if the load on the system is increased or decreased. DC motors are used extensively in adjustable speed drives and position control applications. DC motor plays a crucial role in research, laboratory experiments and Electric traction, high speed tools applications in an industry because of their simplicity and low cost. The speed of DC motor can be controlled by varying flux/pole, armature resistance and applied voltage [7].

1.1 Speed control of dc motor: Let us consider a feedback speed control system whose objective is to move the load at desired speed. This is easily achieved using the armature controlled DC motor by providing a feedback control loop where in the voltage proportional to speed of generated by a tachometer coupled the motor armature is fed back negatively and is subtracted from the reference voltage creating the difference (error) signal. This error signal is amplified to control the armature current such that motor acquires the desired speed.

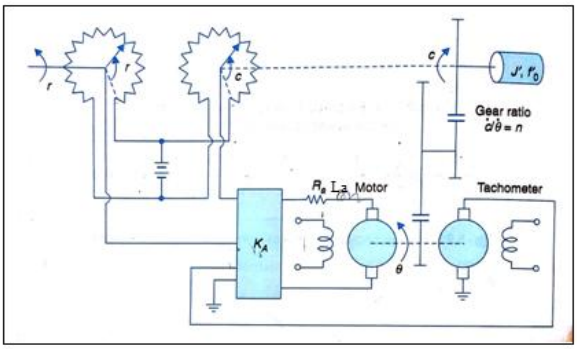

Figure 1. Block Diagram of DC Motor Control

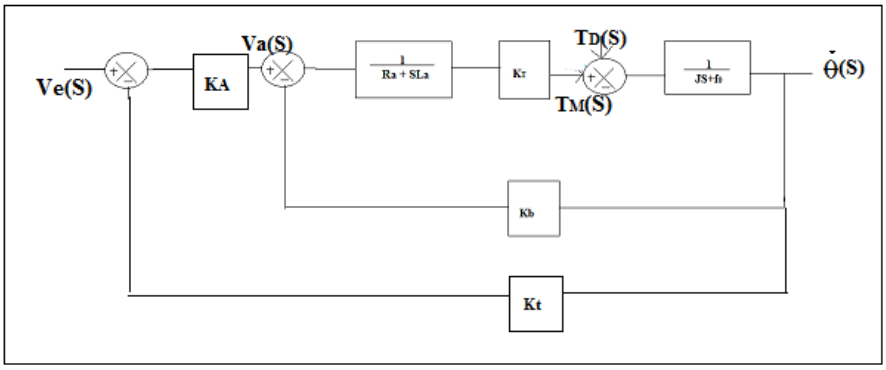

Figure 2. Block of Speed Control

The armature circuit inductance La is usually negligible. Therefore the simplified block diagram of the speed and position control is given below [9].

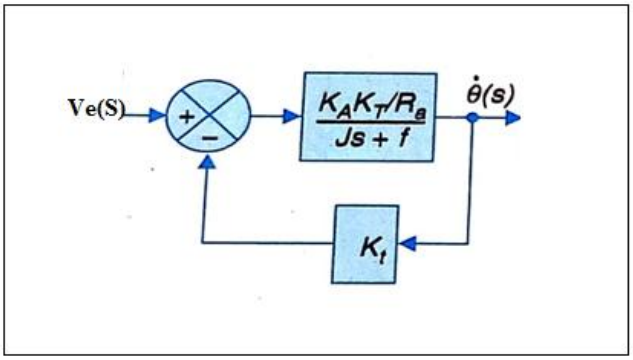

Figure 3. Modified block of Speed control

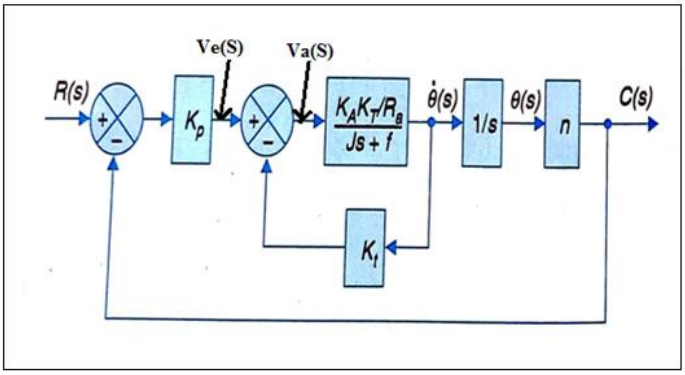

Figure 4. Block of Position control

Different controllers can be used to control of a DC motor. Few of them listed below

1. PID Controller
2. Artificial Neural Network (ANNs)
3. Fuzzy Logic Controller
4. Analog and Digital Control
5. CDM (coefficient diagram method)
6. Metaheuristic methods
7. Combination of above methods

2. Objectives: To study the Velocity voltage for different input signal, to control Speed of DC Motor, to plot/determine the Position of Rotor at every instant, to develop an algorithm for the interfacing module to control the DC motor.

3. Literature Review:

In [1], Sadiq et.al. introduced fuzzy based speed control of DC motor using combined armature voltage and field current. The aim of this work is to control the speed of a separately excited DC motor using combined armature voltage and field current control method.

Nawikavatana and Thammarat [2] give the optimal design of I-PD controller for DC motor speed control system by cuckoo search (CS) method [2]. The I-PD controller, one of the modified versions of the PID controller.

Mohamed Amine Benbrahim, Afef Abdelkrim, Mohamed Benerjeb in [3] introduced soft computing approaches of modeling and control of a DC machine. This paper deals with modeling and control of a DC motor using soft computing techniques namely the exploitation of artificial neural networks and fuzzy logic controller.

Kaushik Ranjan Das et.al. [4] gives an optimal tuning of PID controller using GWO (Grey Wolf Optimizer) algorithm for speed control in DC motor.

Buzi and Marango [5] give a comparison of conventional and nonconventional methods of DC motor speed control. In this paper we study the speed control of a DC motor with conventional (PID) and nonconventional neural network (NN) methods.

Surekha Bhusnur and Shashwati Ray [6] introduced robust control of integrating systems using CDM (Coefficient diagram method) based two-loop control structure.

4. DCMCM (DC motor control module):- For control of DC motor we have a CEA-DCMCM which is the DC motor control module. In this module introduce analog and digital control methods used to control DC motor. This module makes use of real time windows based software which is VCLS (Virtual control laboratory software) and control laboratory I/O interface module (PCIM). This replaces a number of different traditional instruments, eliminating the need for separate signal generator, oscilloscope, multi-meter or controller.

It performs as a function generator to supply the command input signal in various form for example step, DC, saw-tooth inputs. It supplies a wide range of different adjustable controller configurations for example open-loop, PID, DAC, ADC. It also provide different panel to display command input, position output, velocity voltage output. In this module control techniques splits into two sections. The first explain the techniques associated with analog interfacing and second with digital interfacing [8].

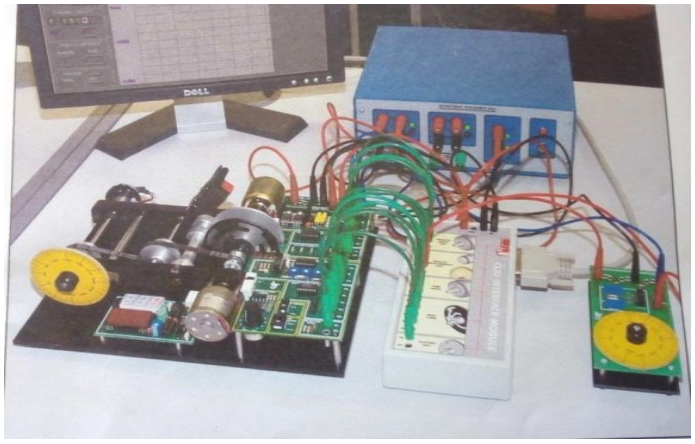

Figure 5. CEA-DCMCM

5. Interfacing of Module with Software: - Operate the software controls to drive the DC motor and observe its behavior, changing speed using the command potentiometer.

- Channel 1/White/Input; the angle above 180, the drive voltage is positive and shaft rotates anticlockwise
- Channel 2/Blue/Position; toward 360, trace moves up +5v and -5v equivalent to 0 degree (approximately).
- Channel 4/Purple/Velocity; follows the command input Stop the motor by setting the command potentiometer to 180 degree.

In fig (6) graph shows speed control in open loop. There is not a linear relationship between input voltage and speed which is taken from the output of tacho-generator in volts which is nothing but velocity voltage. To run the motor at half speed the input has to be set approximately 56% of its range.

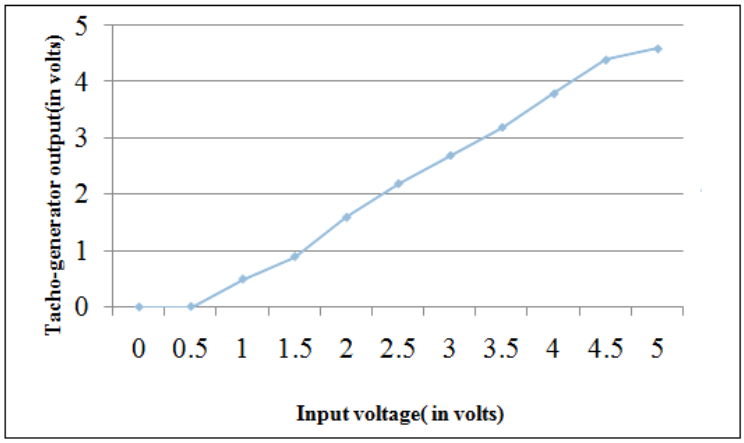

Figure 6. Speed control of open loop

The velocity output is now being fed back and compared with the input. This is feedback control system or closed loop control system.

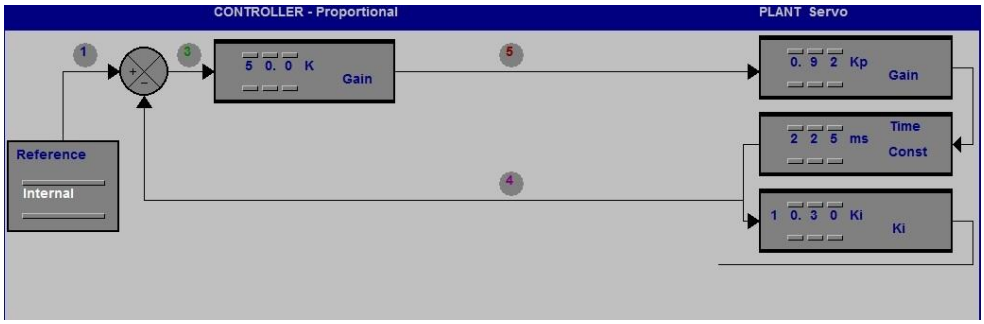

Figure 7. Block diagram of closed loop with proportion controller

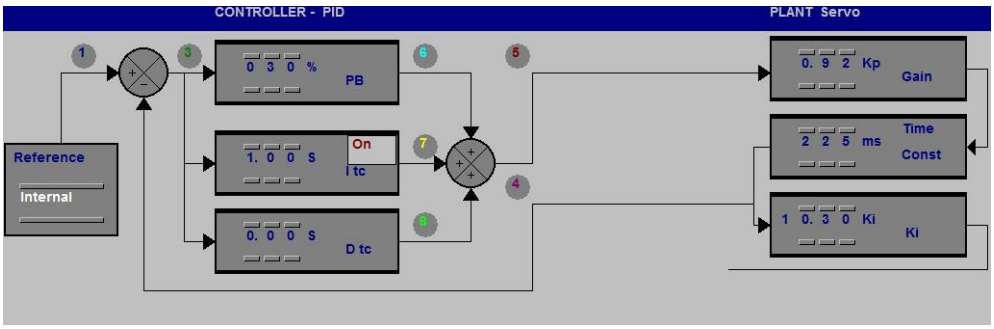

Figure 8. Block diagram of closed loop with PID controller

7. RESULT: - Figure shows waveforms of different controller.

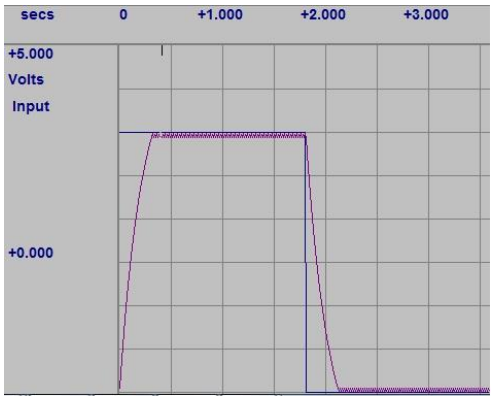

Figure 9.

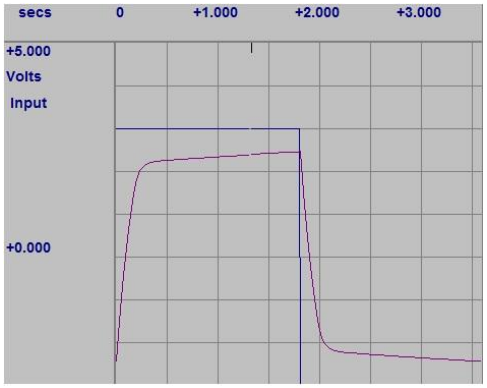

Figure 10.

8. **Conclusion: -** DC motor can be adjusted or controlled easily to a great extent to provide easy controllability and high performances. This is increased with the development and application of power electronic devices. Combined armature voltage and field current method gives the more wide range of speed control of DC motor. PID controller is the most efficient control technique among the P, PI and PD. To tune the value of constant K's, different soft computing techniques are used e.g. ANN, FLC and Cuckoo Search etc. In addition to PID, I-PD controller also gives better performance.

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