A Review on Significance of PID Controller for Speed Control of DC Motor

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***Abstract* -** This paper presented a review study of importance of Proportional Integral Derivative (PID) Controller for speed control of DC motor. Even though the maintenance cost of DC motor is higher than the induction motor, it is widely used in industries as the speed control of DC motor is highly attractive feature for researchers. The PID controller is the very commonly used for control of nonlinear systems. This controller is widely used in many different areas like manufacturing, aerospace, process control, automation etc. The tuning of PID parameter is very tedious. There are various soft [1] computing techniques which are also used for tuning of PID controller to control the speed control of DC motor. Design of PID parameters is important because these parameters have a great impact on the performance of the control system. The affecting parameters in speed control of Dc motor have been discussed.

***Keywords* -** *PID, DC motor, GA, PSO, Fuzzy logic.*

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I. INTRODUCTION

DC motor is an electrical device that converts direct current electrical power into mechanical power. DC motor is commonly used in many industrial applications where wide speed ranges are required. The main advantage of DC motors is the speed control facility. The term speed control stands for intentional speed variation done by automatic controllers or by manual means.

DC motors are most appropriate for wide range speed control. Hence these are used in many variable speed drives. Since speed is directly proportional to armature voltage and inversely proportional to magnetic flux produced by the poles and adjusting the armature voltage and/or the field current will change the rotor speed. DC motors have usually been used in industrial applications especially electric cranes, electric vehicles and robotic manipulators because of its simple and continuous control characteristics.

Control plays a vital role in industrial applications to ensure the economy and safety. Proportional-Integral-Derivative (PID) controller has been used for several decades in industries for process control applications. Although PID controller is well accepted format of control, it has some disadvantages specifically; the undesirable speed overshoot and the sluggish response due to sudden change in load torque and the sensitivity to controller gains. The performance of this controller depends on the accuracy of models and parameters of the given system. To overcome the disadvantages of PID, soft computing techniques are sometimes recommended.

The speed torque characteristics of DC motors are much better to that of AC motors. Also DC motors provide excellent control of speed for acceleration and deceleration. DC motors have a long practice of use as adjustable speed machines and a wide range of options have evolved. In these applications, the motor should be accurately controlled to give the desired performance. The controllers of the speed that are conceived for objective to control the speed of DC motor to execute many tasks. There are several conventional and numeric controller types such as Proportional Integral (PI), Fuzzy Logic Controller (FLC) [2] or the combination between them: Fuzzy-Genetic Algorithm [3-4], particle

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swarm optimization [5]. PID controller operates the majority of the control system in the world. In industries 90% controllers are PID type because of its simple structure and ease of application.

II. PID CONTROLLER

PID controller is a familiar format of feedback control mechanism widely used in industries. An error value which is the difference between measured process variable and a desired response is calculated. The controller attempts to minimize the error by manipulating the process input. The PID controller calculation (algorithm) involves three constant parameters called the proportional (P), integral (I) and derivative (D) values. These values can be interpreted in terms of time. P depends on the present error, I on the accumulation of past error, and D is a prediction of future error, based on current rate of change .The weighted sum of these three actions is used to adjust the process via a final control element such as the position of a control valve, or power supplied to a heating element [6].

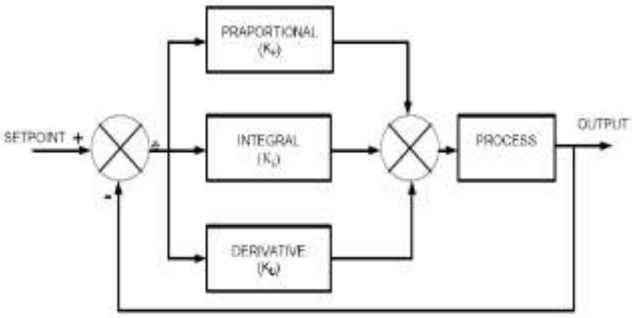

Fig. 1: PID Control Structure

$$Y(t) = e(t)\, K_P + K_I \int_0^t e(t)\, dt + K_D \frac{de(t)}{dt}$$

Speed control means intentional change of the drive speed to a value required for performing the specific work process. Speed control is a different concept from speed regulation where there is natural change in speed due change in load on the shaft. Speed control is either done manually or by means of some automatic control mechanism. One of the important features of DC motor is that its speed can be controlled with relative ease. The expression of speed control DC motor is given as [7];

$$N = KV - \frac{I_a(R_a + R)}{\phi} \qquad (2)$$

Therefore speed (N) of 3 types of dc motor – SERIES, SHUNT AND COMPOUND can be controlled by changing the quantities on right hand side of above equation. So speed can be varied by changing terminal voltage of the armature V, external resistance in armature circuit R and flux per pole φ. The first two cases involve change that affects armature circuit and the third one involves change in magnetic field. Therefore speed control of dc motor is classified as armature control methods and field control methods.

III. CONCLUSION

In this paper, an effort has been made to review significance of PID Controller for Speed Control of DC Motor. The affecting parameters on speed control of DC motor have also been discussed. This review article is also presenting the current status of tuning of PID controller for speed control of DC motor using soft computing techniques.

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