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A Case Study of DC Motor Speed Control with PID Controller through MAT LAB

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Abstract: Conventional PID controllers are used to control the dc motor for various industrial processes from many years due to their simplicity in operation. In industrial area the of PID controller used in various level to improve efficiency of the industries or plant. A PID controller requires controlling the plant for different process and control applications. In this paper worked out, speed control analysis of DC motor using PID controller & Speed control of separately excited dc motor has done with using armature voltage control method. So that PID controller basics are verified and various tuning methods of PID controller are explained and the mathematical modeling of dc motor has done and it is simulated to Simulink. The control system consisting of PID controller dc motor is also simulated to Simulink. Response of dc motor is recorded as simulation result when step input to provide as reference signal. Therefore, the performance and analysis of dc the motor with PID controller is performed and calculating the various responses of the parameters such as maximum overshoot, rise time, settling time, etc.

Keywords: DC motor, PID controller, Tuning methods, modeling and simulation**.**

I. INTRODUCTION

DC machine are highly versatile and flexible machine. It has to satisfy demands of load requiring of high starting, torque accelerating and retarding torques. A dc machine is also easily adaptable for drives with range of speed control and fast reversal. They are widely used in industrial applications. The DC motors are used in rolling mills, in traction and in overhead cranes. They are also employed in many control applications as actuators and as speed or position sensors. In such applications, are such as position sensors and robotics, drives‟ performance must precisely follow the desired performance. A number of control schemes such as proportional (P), proportional integral (PI), proportional derivative integral (PID), adaptive and fuzzy logic controller (FLCs) are used for control the speed of DC motors. The proposed controller system uses the PID control scheme for speed control of dc motor.

II. DC MOTOR

Almost every mechanical movement that we have seen around of accomplished by an electric motor. Electric machines means of converting energy. Motors take electrical energy and produce mechanical energy. Electric motors are used to power hundreds of the devices and we use in everyday in life. Motor comes are in various sizes. Huge motors that can take loads of 1000's of Horsepower are typically used in the industry. Some examples of the large motor applications include elevators, electric trains, hoists, and heavy metal rolling mills. Examples of small motor applications include motors used in automobiles, robots, hand power tools and food blenders. Micro-machines are electric machines with parts the size of red blood cells, and find many applications in medicine. Electric motors are broadly classified into two different categories: DC (Direct Current) and AC (Alternating Current). Within these categories are numerous types, each offering unique abilities . In most of the cases, regardless of type, electric motors consist of a stator (stationary field) and a rotor (the rotating field or armature) and operate through the interaction of magnetic flux and electric current to produce rotational speed and torque. DC motors are distinguished by their ability to operate from direct current. There are different kinds of D.C. motors, but all work on the same principles. In this paper, we will study their basic principle of operation and their characteristics. It has to understand motor characteristics so we can choose the right one for application requirement.

III. CONSTRUCTION

DC motors consists of one set of coils, called armature winding and inside another set of coils or a set of permanent magnets, called the stator. Applying a voltage to the coils produces a torque in the armature, resulting in motion.

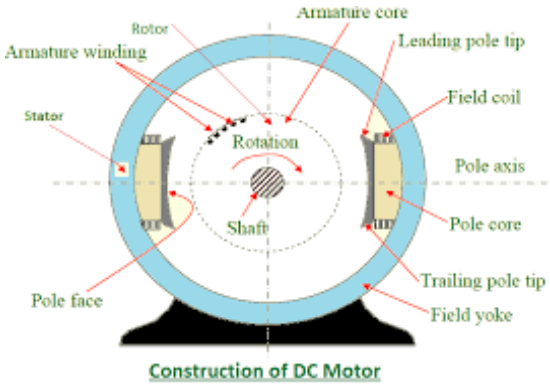

Fig. 3 Construction of DC Motor

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IV. STATOR

The stator is the stationary part of a Dc motor. Whereas stator has made of Permanent magnet Dc motor is composed of two or more permanent magnet pole pieces. The magnetic field can alternatively be created by an electromagnet. In this case, a DC coil (field winding) is wound around a magnetic material that forms part of the stator.

V. ROTOR

The rotor is the inner part of the dc motor and rotor is composed of windings are (called armature windings) which as connected to the external circuit through a mechanical commutator. Whereas stator and rotor are made of ferromagnetic materials.

VI. WINDING

A winding is made up of series or parallel connection of coils. It may be two types namely

(a) Armature winding - The winding through which the voltage is applied or induced.

(b) Field winding - The winding through which a current is passed to produce flux (for the electromagnet) Windings are usually made of copper.

VII. ENERGY CONVERSION

Electrical energy supplied conductor caring perpendicular to a magnetic field, the interaction of current flowing on the conductor and the magnetic field will be produced.

VIII. PID CONTROLLER

A PID controller is a control loop feedback mechanism (controller) and widely used in industrial control systems. A PID controller calculates the error value of the difference between a measured process variable and a desired set point. The PID controller algorithm involves three separate constant parameters, and is accordingly sometimes called three term control: the proportional, the integral and derivative values, may be denoted by P, I, & D. Simply put, these values can be interpreted in terms of time: P depends on the present error, I on the accumulation of past errors, and D is a prediction of future errors, based on current rate of change. The weighted sum of these three actions is used to adjust the process via a control element such as the position of a control valve.

IX. THE CHARACTERISTICS OF P, I, AND D CONTROLLERS

A PID controller is a control loop feedback mechanism and widely used in industrial control systems. A PID controller attempts to correct the error between a measured process variable desired set point by calculating and then outputting a corrective action that can adjust the process accordingly.

X. SIMULATION AND RESULT OF DC MOTOR USING PID CONTROLLER

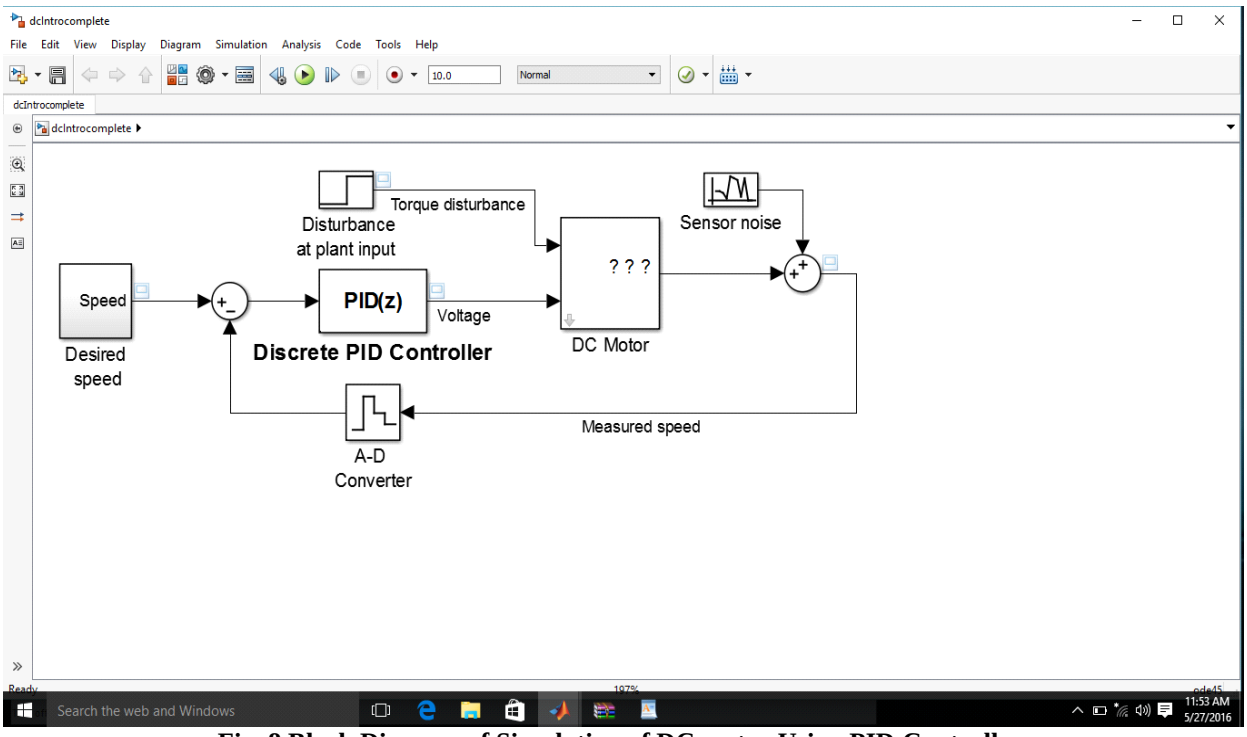

Fig. 8 Block Diagram of Simulation of DC motor Using PID Controller

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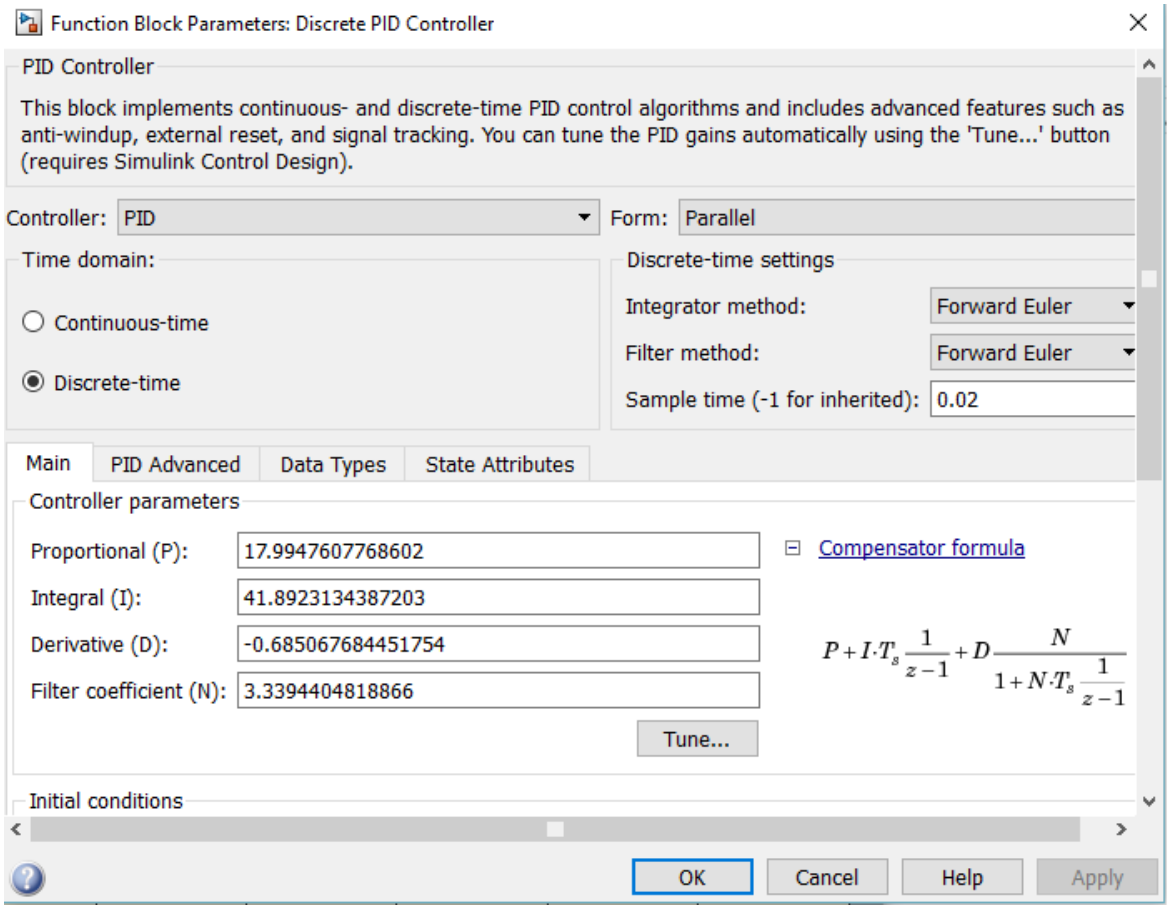
XI. FUNCTION BLOCKS PARAMETERS:-DISCRETE PID CONTROLLER



XII. SIMULATION OUTPUT RESULT (MEASURED SPEED, VOLTAGE TORQUE DISTURBANCE)

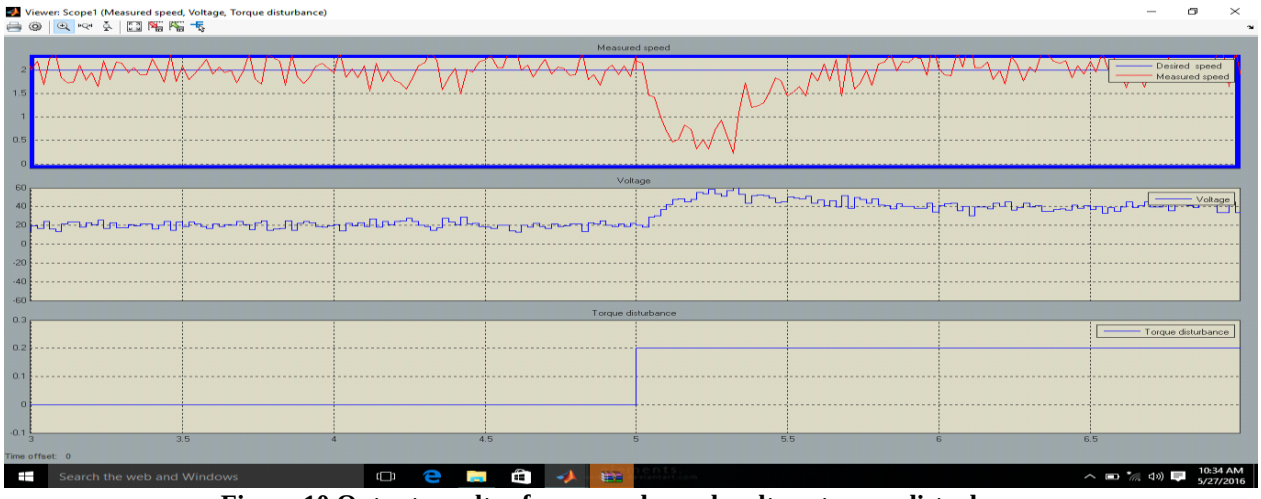


Figure 10 Output results of measured speed, voltage torque disturbance

XIII. RESULTS

In this paper PID controller is designed for speed control of dc motor. From the analysis has been done & its clear that PID is a simple controller based on the mathematical model of the system to be controlled. It has successfully & overcomes drawback of proportional-derivative (PD) controller of steady-state error as steady-state error are zero in PID controllers.

Dy-state error to zero an overshoot is observed. However overshoot can be reduced by increasing the derivative gain but the rise time also increases as a consequence. Hence, there exists between overshoot and the speed of response i.e. rise time which means that we have to sacrifice one for improving another. Overall, PID controller gives better speed response of all the linear controllers of its class.

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XIV. CONCLUSION

In this paper PID controller has to be designed for speed control of the dc motor& The proportional $_{plus}$ integral plus derivative controller (PID) operates the majority of the control system in the world. PID controllers provide robust and reliable performance for most of the systems. Graphical representation of the program &gives us clear understanding about the structure and data flow. It is better for control application while MATLAB is better for data manipulation**.**

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BIOGRAPHIES

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