

# LabVIEW Based Speed Control of DC Motor Using PID Controller

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**Abstract:** This research paper is about developing a PID (proportional-integration derivation) controller for controlling the speed of DC motor. The software used for designing the controller is Lab VIEW 2011. The methodology is divided in two parts first one is software development and second one is hardware implementation. In software development calculation of DC motor transfer function and then simulation for finding out the parameter values of PID and developing the software controller. To obtain the value for Kp, Ki and Kd Ziegler-Nichols Closed-Loop Method is used. Finally to interface the controller with the hardware myDAQ will be used. After finishing both parts, speed control of DC motor can be tuned by using the PID parameter values for analyzing of its response.

**Keywords:** DC motor, Lab VIEW, PID (proportional-integration derivation) controller.

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## I. INTRODUCTION

Speed control of DC Motor is vital in many applications. The speed control of separately excited DC motors by PID controller is widely used in industry. In this project, we will be controlling the speed of the DC motor using LabVIEW. By the LabVIEW aided PID controller, the parameters are adjusted to control the motor speed. We will apply several methods in order to obtain best process response for tuning parameters of PID controller. Optimum controllability, peak overshoot, less sensitivity, optimum transients, optimum settling time will be obtained.

## II. LITERATURE REVIEW

**Remya Ravindran:** DC Motor control are realized with two approaches: Hardware and Software. On increasing the load on the DC motor the voltage of the Driver circuit decreases, which leads the connected LEDs to glow showing that the peak value of the motor RPM is reached. The output of the given system is achieved from the GUI of the LABVIEW; the coding is done using Visual Basic.

**Zhu Haishui:** The controller take user input to control the speed and drive the motor at that speed free from of load. The speed control is accomplished in an operational amplifier (op amp) circuit configured for proportional integral control. This provides fast, smooth motor response to the user input speed and keeps the speed regulated as the motor sees with increased load. The controller allows the motor to be driven at the maximum current load of 50A for five seconds before shutting down the motor and requiring a user reset.

**Nikunj Bhagat:** The motor is modelled as a first order system and its response is studied. The speed control using PI and PID control modes is explained and an implementation of the controller using OP-AMPS.

**P. Meshram:** Weighted tuning methods of a PID speed controller for separately excited Direct current motor is presented, based on Empirical Ziegler-Nichols tuning formula and modified Ziegler-Nichol PID tuning formula. Both these methods are compared on the basis of output response, minimum settling time, and minimum overshoot for speed demand application of DC motor.

**G. Huang:** LabVIEW-aided PID designed controller to monitor DC motor speed and uses the software simulation of Vis Sim to analysis its response. To take out the analog signal through D/A converter at the same time, acquire the signal via the NI DAQ USB-6008 card. The front panel will display the speed of DC motor on the screen. The simulation results are quite match with the theoretical prediction for the behavior of the PID controller.

**Oscar M.:** The PID controller was tuned using the Ziegler-Nichols. In base of the obtained quantitative and qualitative measures and observations, conclusion is that the fuzzy controller performance outperformed the PID controller; moreover, the tuning process using the STA method was easier than using the Ziegler-Nichols method.

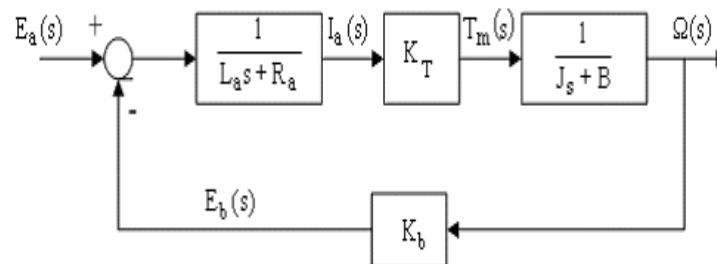
**Kiran Raj S.:** Interface the PMDC motor to PC using NI USB-6008 DAQ card. The state-space model of the closed loop speed control system using LabVIEW System Identification Toolkit. The state-space model derived from this system can be used in the model based fault detection technique for finding out the faults which could occur in the system or for model based controls.

**Kenshi M.:** A specific speed control system for a small DC motor including an Ethernet network is inserted. However, the network always has a delay time and it seems to be varied randomly on the surface. Therefore, we discuss the control characteristics and the problems when the DC motor is driven under the system including the Ethernet network. Especially, the relation between the distribution of delay time and control characteristics is examined at the new point of view.

### III. PROCESS OF PROJECT

#### 1. DC MOTOR MATHEMATICAL MODEL:

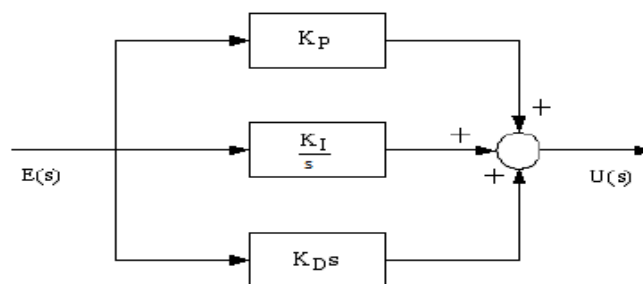
We will calculate transfer function of DC motor.



Block Diagram of DC Motor

We will use PID controller for getting optimum result.

#### • PID CONTROL THEORY and TUNING ALGORITHM:

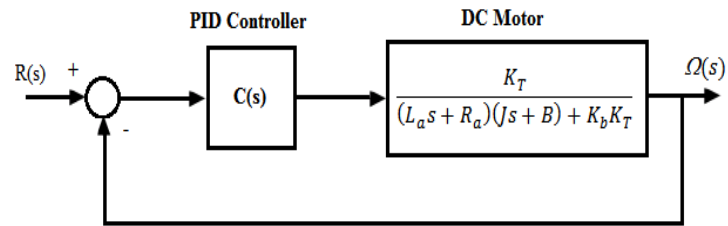


Block diagram of PID controller

A PID controller is a feedback mechanism control loop (controller) mainly used for controlling industrial systems. A PID controller determines an error value as the difference between a measured process variable and a desired set point. The controller minimizes the error by adjusting the process through a manipulated variable.

Some applications use only one or two actions to provide the good system control. This is obtained by setting the other parameters to zero. A PID controller will be called a PD, PI, I or P controller in the absence of the respective control

actions. PI controllers are common, since derivative controller is sensitive to measurement noise, whereas the absence of an integral controller may prevent the system from reaching its required value due to the control action.



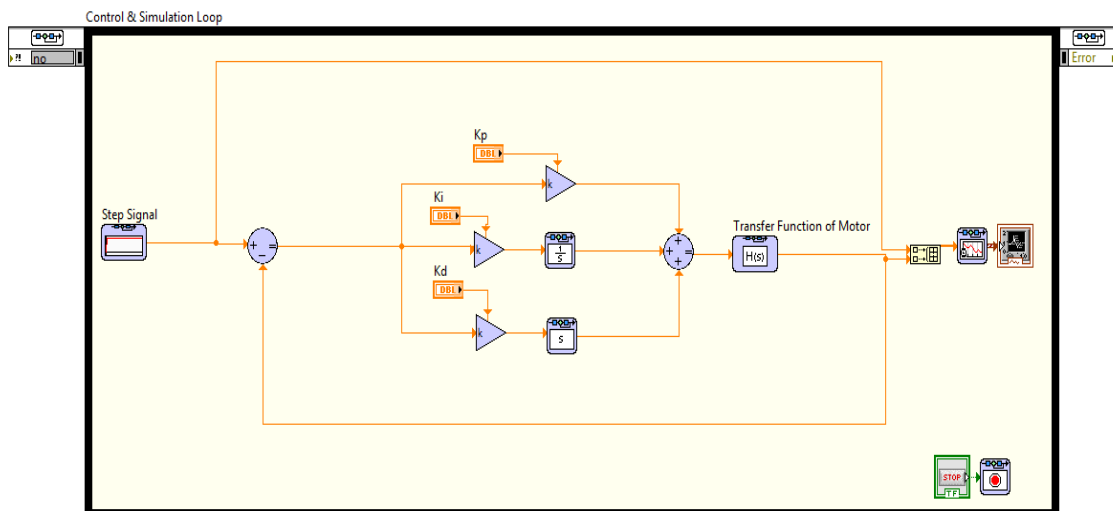
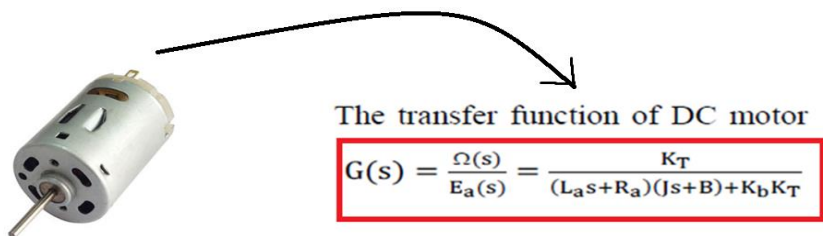
PID controller with DC motor

PID controllers are tuned in terms of A, B and C. There are many methods available for tuning of PID controller. We can use the following four methods for tuning.

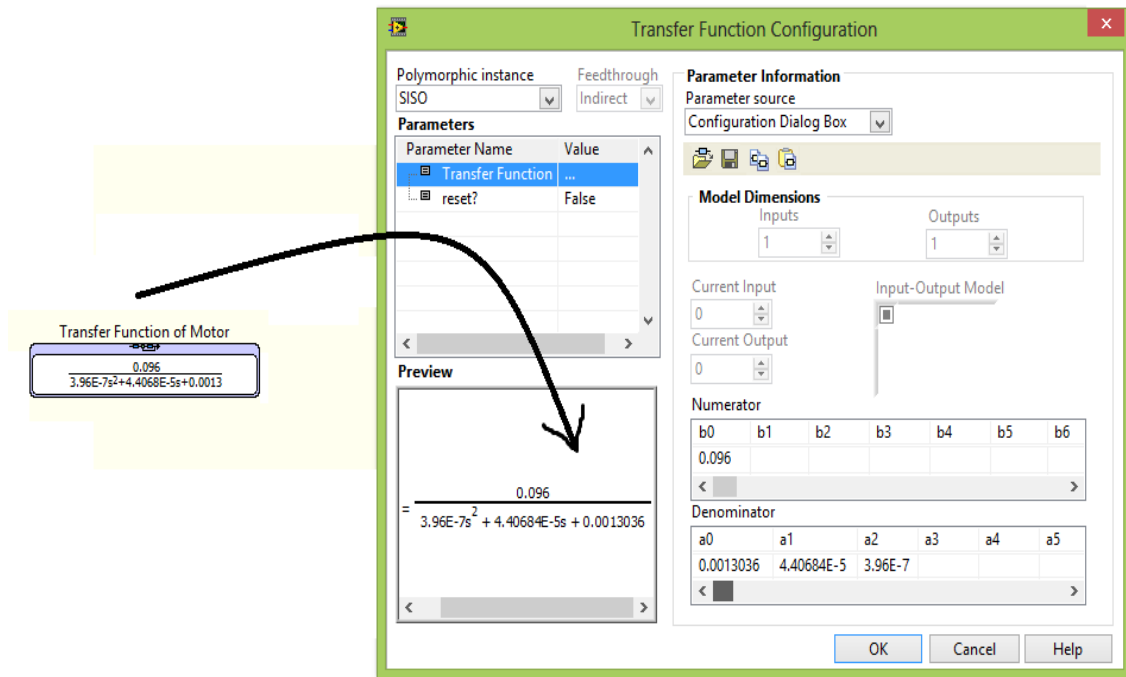
- Process reaction curve
- Tyreus and Luyben
- Ziegler Nichols method
- Cohen and Coon

#### IV. IMPLEMENTATION OF PROJECT

- Model of the DC Motor represented in the Lab VIEW Math-Script Node.
- Model of the DC Motor control using PID in Block diagram window.
- Simulation results

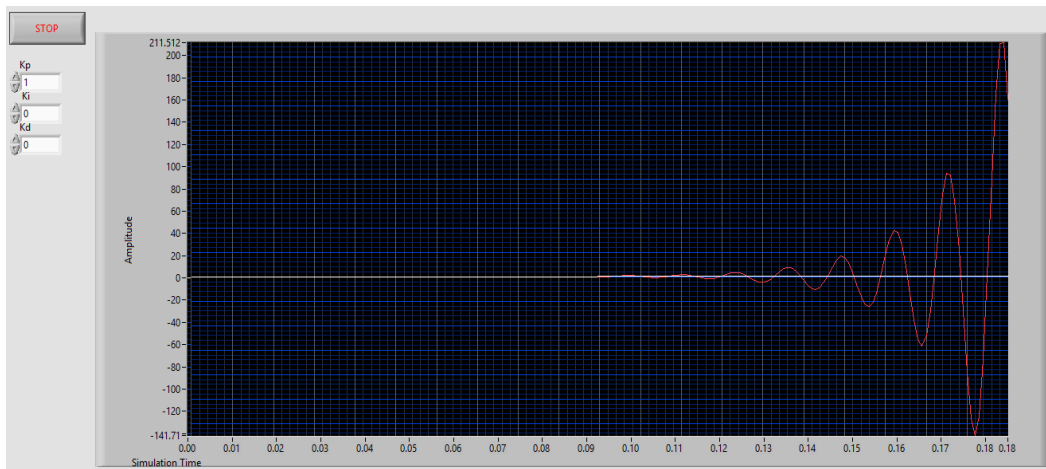


Lab VIEW VI WINDOW

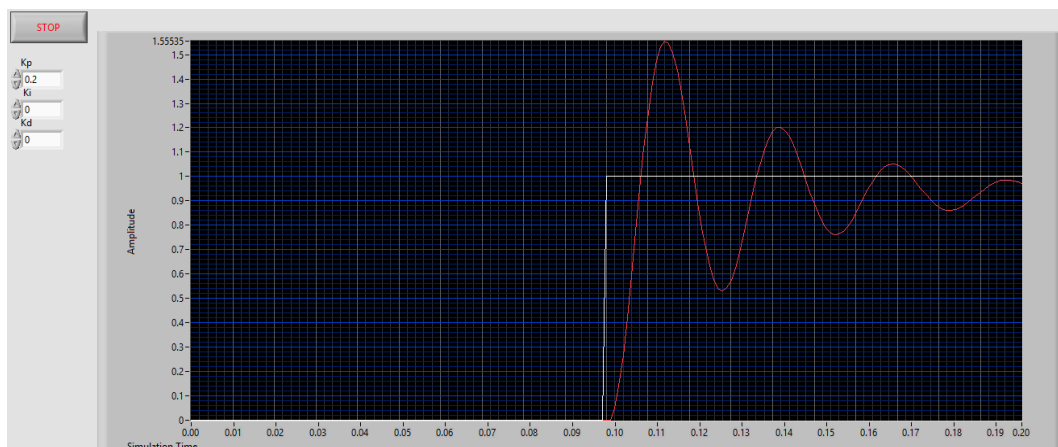


Transfer Function of Motor

## V. SIMULATION RESULTS



Simulation Result for  $K_p=1, K_i=0, K_d=0$



Simulation Result for  $K_p=0.2, K_i=0, K_d=0$

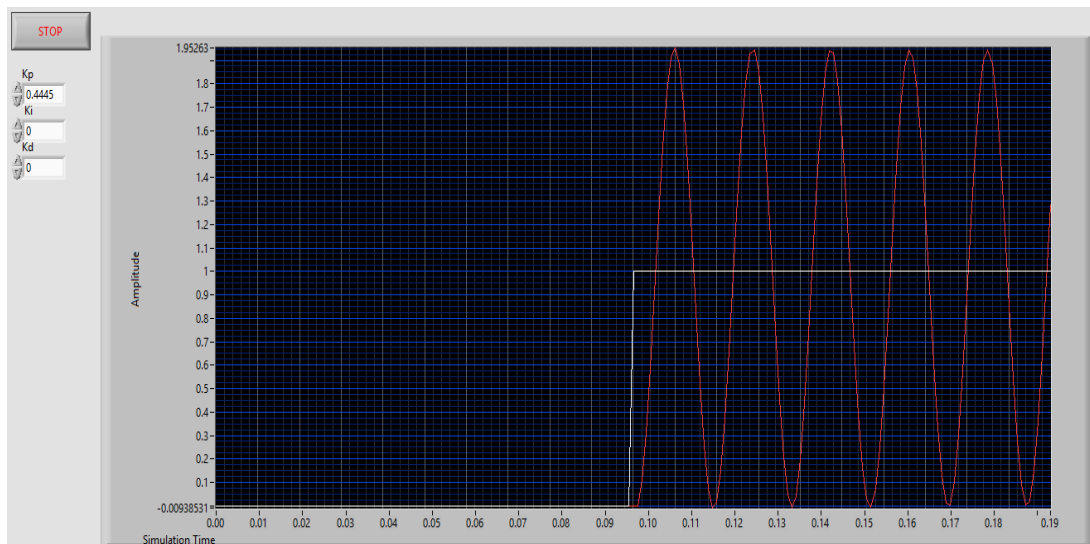
Controller	$K_P$	$\tau_I$	$\tau_D$
P	$0.5K_u$	$\infty$	0
PI	$0.45K_u$	$\frac{P_u}{1.2}$	0
PID	$0.6K_u$	$\frac{P_u}{2}$	$\frac{P_u}{8}$

Table for Ziegler Nichols parameters

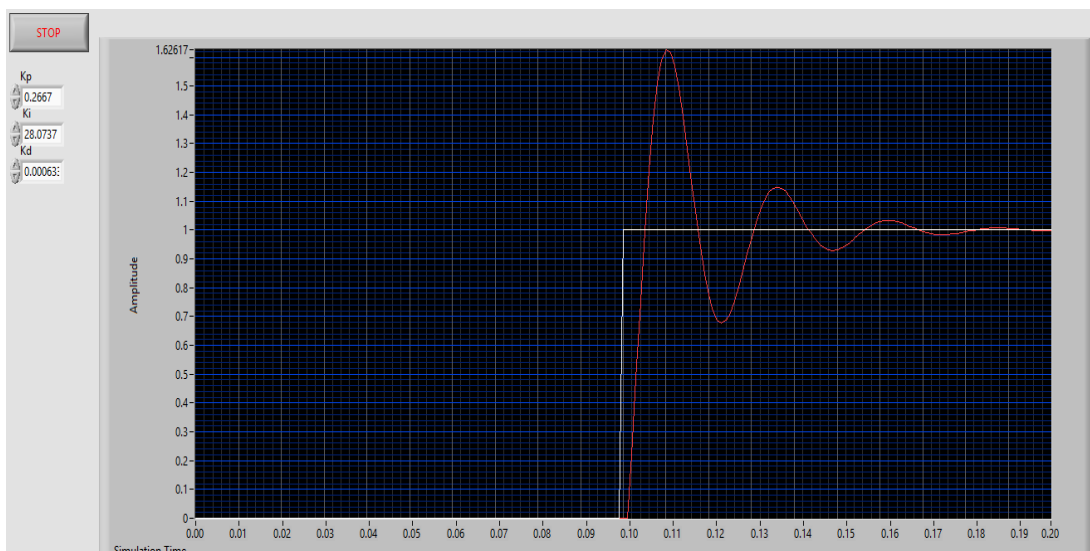
Ultimate Gain ( $K_u$ ) = 0.4445

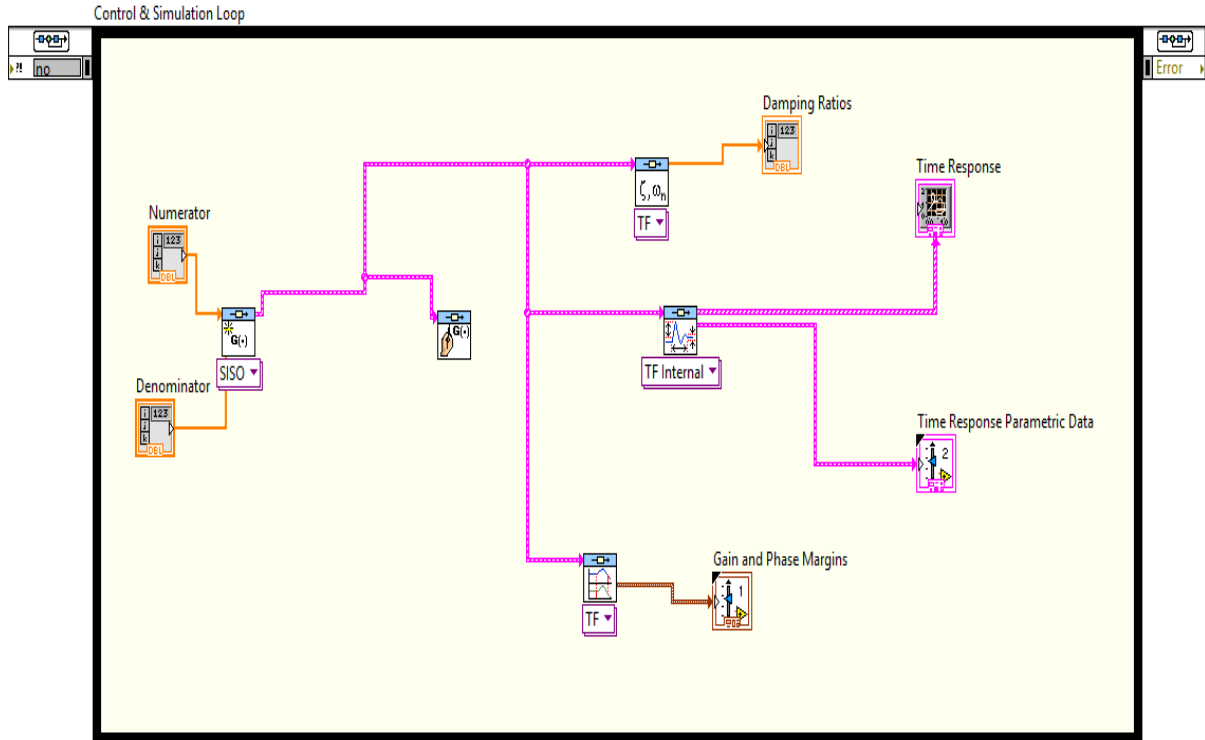
Ultimate Period ( $P_u$ ) = 0.019

Controller	$K_p$	Ki	$K_d$
P	0.222250	0	0
PI	0.200025	12.63318	0
PID	0.266700	28.073684	0.000633412



Simulation Result for  $K_p=0.4445$ ,  $K_i=0$ ,  $K_d=0$





Now, VI for calculating performance parameters is built.

<b>Response Specification</b>	<b>Ziegler Nichols Result for PID controller</b>
Damping Ratio	0.27
Peak Overshoot	41.9%
Phase Margin	82.97
Gain Margin	Infinity
Peak Value	1.41896
Peak Time (s)	0.0119722
Rise Time (s)	0.00460468
Settling Time (s)	0.0718331

Simulation Result for  $K_p = 0.2667$ ,  $K_i = 28.073684$ ,  $K_d = 0.000633412$

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