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Speed Controlling of DC Motor Using Pid Controller

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ABSTRACT

The paper deals with the optimized tuning of P.I.D controller, which is employed to regulate the D C Motor. During this research work different PID tunings techniques are discussed. D.C. Motor thanks to its very simple regulated characteristics is employed during this paper. thanks to this fact D.C. Motors are widely utilized in many industrial applications like steel mills, electric trains and lots of more. Here G.A-P.I.D (Genetic Algorithm – P.I.D) with different performance indices namely Mean Square Error (M.S.E) and Integral of your time multiplied by Absolute Error (I.TA.E) optimization technique is compared with standard P.I.D parameter adjustment technique i.e. Ziegler & Nichols method. Comparison of results are supported standard step responses parameters i.e. maximum overshoot, steady state and rise time.

1. INTRODUCTION

PID control strategy may be a regular feedback controlling technology and it covers 90% of normal controllers in engineering sector. The function of the controller is to implement an algorithm supported the control input and thus output is maintained at certain point to form negligible discrepancy between the system method variable and therefore the point . Thanks to their functional simplicity and reliability PID controllers delivers consistent and robust performance for nearly every system dynamics and thus it are often tuned to ensure a suitable closed-loop system performance. By employing a PID controller transient response of a system improves by decreasing the increase time, eliminating the height overshoot and shortening the settling time of a system. Proper functioning of a system highly depends on PID parameters, in order that they should be optimized and tuned wisely. Many standard methods are introduced for parameter tuning includes Ziegler-Nichols Ultimate-cycle tuning, Cohen-Coon's.

2. LITERATURE SURVEY

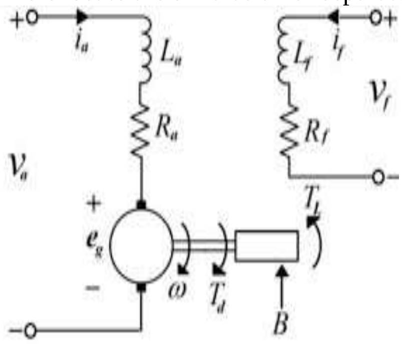
From the paper 'DC control using PID controller', we found that, It are often an honest basic starting reference for us. The PID controller design and selecting PID parameters consistent with system response are proposed during this paper. Here PID controller is employed to regulate DC motor speed and Matlab program is used for calculation and simulation. Choosing PID parameters are demonstrated by several contrast experiments and how for setting PID parameters values is discussed. From their experimental results we get to understand that the proportional controller (kp) will have the effect of reducing the increase time and can reduce; but never eliminate the steady-state error, an integral control (ki) will have the effect of eliminating the steady-state error, but it's going to make the transient response worse .a derivative control (kd) will have the effect of accelerating the steadiness of the system, reducing the overshoot, and improving the transient response.

Closed Loop Respon-se	Rise TIme (SEC)	Maximum Overshoot (%)	Setling Time (SEC)	Steady State Error
As Increase of Kp	Decrease	Increase	Small Change	Decrease
As Increase of Ki	Decrease	Increase	Increase	Eliminate
As Increase of Kd	Small Change	Decrease	Decrease	Small Change

3. MODELLING OF SEPERATELY EXCITED D.C MOTOR

To realize the D.C Motor drive as an impact system transfer function, following steps to be wiped out MATLAB: Initiative is to characterize the equivalent DC motor circuit diagram. Then step 2 is to characterize system equations from the circuit diagram. Subsequently, step 3 is then to derive transfer function from derived system equations. then Step 4 is that the Realization of the equivalent diagram of system drive. Finally, in step 5 .m file is made for model simulation and to research the results.

A. DC Motor Equivalent Circuit now To execute the simulation of separately excited DC motor drive .



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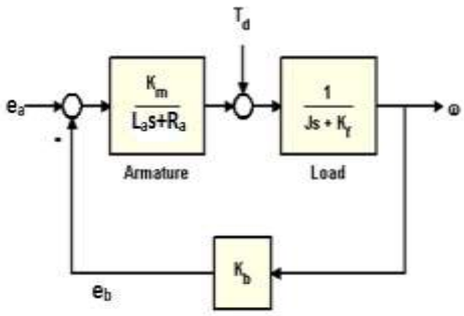
B. DC Motor Equivalent Circuit within the current research methodology, D.C motor model is modeled during which the rotor is assumed to be one coil having equivalent inductance expressed as La and the equivalent resistance as Ra, therefore representing generated back E.M.F represented as eb. In separately excited dc motor, flux remains constant.



The model of separately excited D.C Motor are described by following dynamic equations:

$ea=eb+ia.Ra+La.dia/dt$ (1)

The relation between generated torque Tm and armature current ia is given by following equation:

$Tm=Km.ia$ (2)

The relation between generated back E.M.F eb and therefore the angular speed is given by thesubsequent equation:

$eb=Kb.\omega$ (3)

from equation (1) and (3), we get

$ea=Kb.\omega+iaRa+La.dia/dt$ (4)

The equivalent dynamic equation for system of motor is as follows:

$Tm = Kmia = Jd\omega dt + Kf\omega + T$ (5)

C. Model Block Diagram Using Laplace transformation technique for equation (4) and (5), following equations are derived:

$ea(s) = Kb.\ \omega(s) + ia(s).\ Ra + La(s).$ (6)

and subsequently

$Tm(s) = Km.\ ia(s) = J.\ \omega(s) + Kf.\ (s) + T(s)$(7)

Therefore, from equation (6), armature current is expressed as

$ia(s) = [ea(s) - Kb.\ (s)]\ [Ra + La/(s)]$ (8)

and from equation (7), output speed is represented as:

$(s) = [Tm - T(s)]/[\ J + Kf]$

Where,

ea = Armature Voltage (V)

La = Armature Inductance (H)

Ia = Armature Current (A)
Ra = Armature Resistance (ohm)
J = Mechanical Inertia (kg-m2)
eb = Back EMF (V)
Kf = Friction Coefficient (N-m/ rad/ sec)
Td = Torque Disturbance (N-m)
Km = Motor Torque Constant (N-m/ rad)
ω = Angular Speed (rad/sec)
Kb = Back EMF Constant (V/rad/sec)
Tm = Mechanical Torque Developed (N-m)

Control system closed-loop system system shown in Fig. 2 has the system Laplace function and electrical system Laplace function stated separately. They're further combined to understand the output motor speed (ω) and from which we will estimate the position of rotor. From this transfer function we will also study about output armature current of motor. Transfer thus obtained is of second order system. Then to regulate this system ,P.I.D. controller utilized in forward path. From motor equations and by using specific standard values of parameters, D.C motor model is realized. The D.C motor parameters utilized in this research paper are defined in equation (10).

Kf = .018,
Km = Kb = 1.4,
Ra = 2 ohms,
La = 16.2 mH,
J = 0.117 KgM2
Va = 220 volts,
Td = 1 N-m

Thus, the ultimate of transform function is shown in equation (11).

$$\omega = 1.4 / s2(0.001895) + 0.2349s + 1.996 \quad (11)$$

By equation (11) the expression of rotor position of motor is additionally calculated. Analyzing the position of rotor of D.C Motor is additionally a really keen aspect and difficult because the transfer function of position is of third order system. Position of rotor is expressed as Ɵ expressed and its transfer function is expressed in equation (12).

$$\theta = 1.4 / s3(0.001895) + 0.2349s2 + 1.996s \quad (12)$$

Thus, this paper uses the transfer function of rotor position of motor as its plant function and to the present PID controller is attached to regulate the position of motor.

4.PID PARAMETER TUNING STRATEGIES

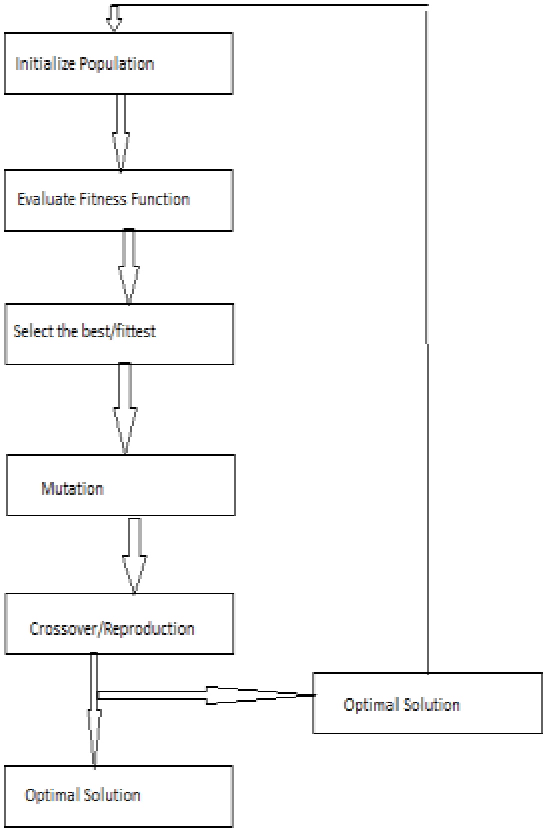
In this section, 2 PID parameter tuning methods those namely are ‘Ziegler-Nicholas’ Method & ‘Genetic Algorithm’ which are discussed below.

A. Conventional Approach – Ziegler-Nichols Method

The extremely substantial step for operating the PID controller is that the adjusting of its parameters. The control dynamics of any system provides very poor performance result and its characteristics comes bent be impractical, if proper optimize tuning of controller isn't done. Sometimes a stable control operation becomes unstable system. Therefore, for correct and good performance proper choice of tuning parameters may be a necessity of system. Tuning of parameters includes the identification of best values of Kp, Ki, Kd when P.I.D controller is employed in system. Identification of parameters generally may be a subjective and iterative process and highly depends on the sort of system and process therefore change and wish to tune them accordingly. Ziegler Nichols Method may be a broadly acknowledged technique mainly used for adjusting parameters. the thought is extremely simple and straightforward to implement. Initially there's a requirement to regulate only P (proportional gain Kp) to a minimal value. Now after this by changing load to alittle value, results thus obtained are analyzed. If output result's very inactive or not up to mark this suggests Kp value is low. Then to form response active, value of parameter Kp must be increased by some multiple factor generally two and again analyze the response by changing load to small value. This process keeps on repeating until the output response of system becomes incessant oscillatory.

B. Genetic Algorithm for Optimal Tuning

This algorithm begins with zero prior inputs or any predefined information of the precise result and rely totally on outputs from its surroundings and progression parameters like reproduction, crossover and mutation to urge the simplest possible optimized result. By starting with different self-supporting objectives and hunting parallelly, the procedure thus escapes i.e. it doesn't stop at local minima value of system and thus it converges to some.



5. EXPERMINETS AND TESTING

Matlab Simulink:

Simulink may be a diagram environment for multi domain simulation and Model-Based Design. It supports system-level design,simulation. Simulink provides a graphical editor, and solvers for modeling and simulating dynamic systems. it's integrated with MATLAB, enabling you to include MATLAB algorithms into models and export simulation results to MATLAB for further analysis.

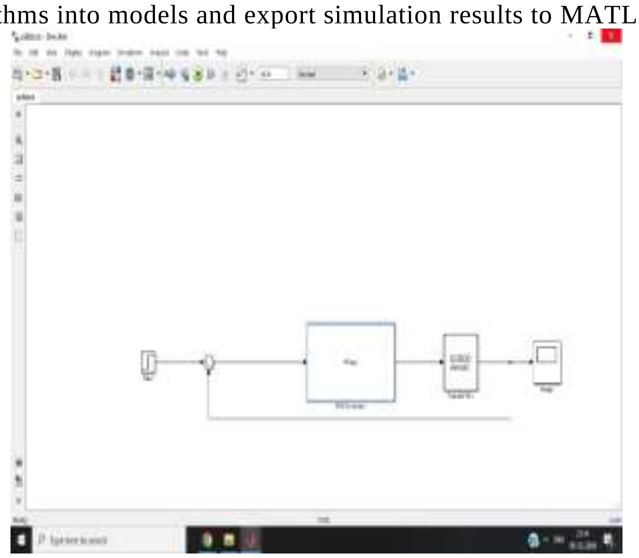


Fig.PID Controller Simulink

6. RESULT

Before tuning of the PID the output isn't stable nor unstable, But it keeps on oscillating with reference to time.After tuning of PID , Transient reaction time reduces and oscillations are vanished and output reaches to steady state within very very short span of your time **.**

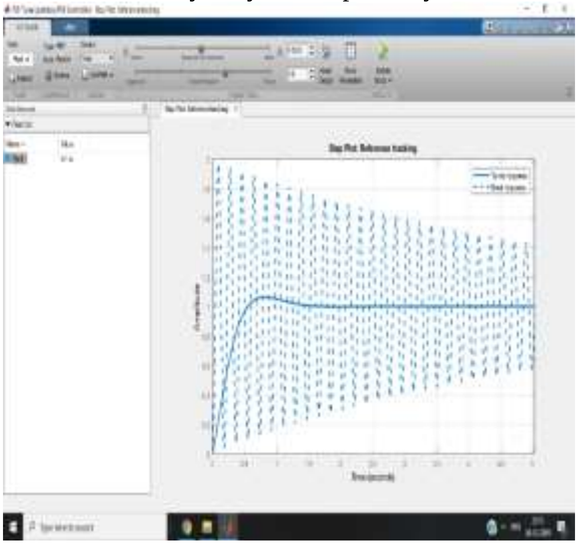
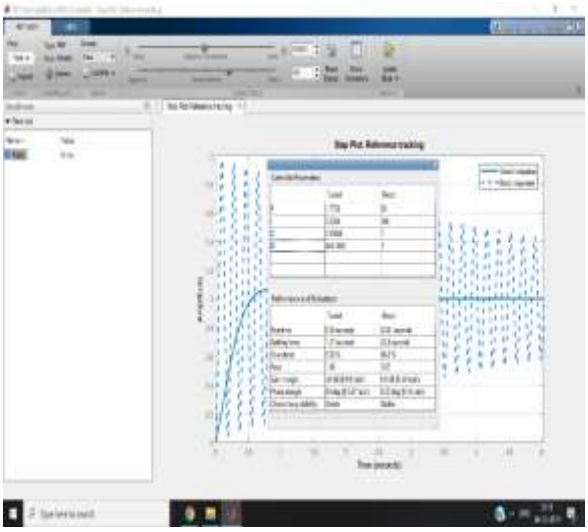


Fig. Tuned Response And Block Reponse.



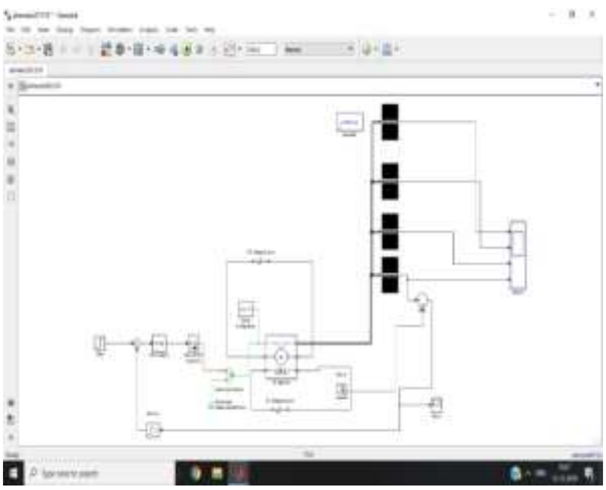
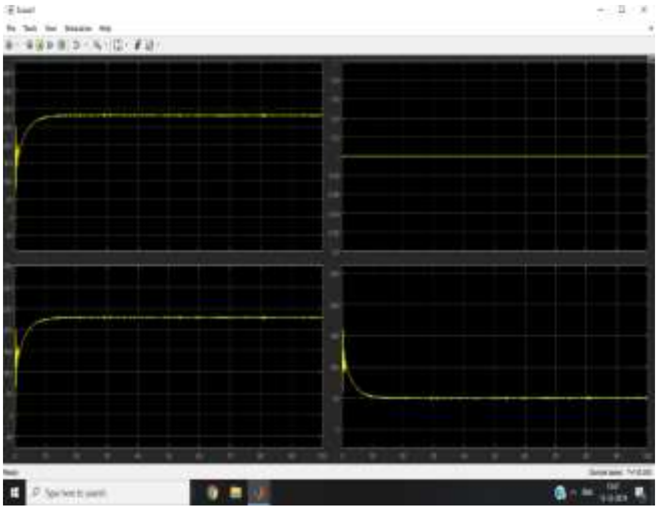
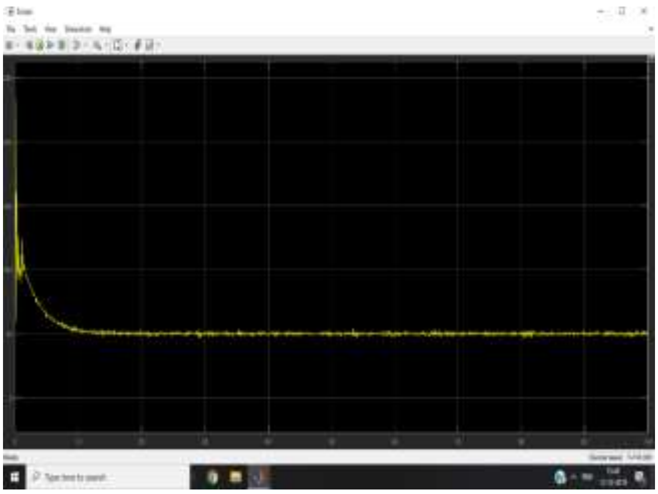


Fig. DC MOTOR USING PID CONTROLLER





7. CONCLUSIONS

P.I.D controller constructed during this paper has far swifter response when being compared with standard or classical method. The classical method are often won't to generate the initial values of P.I.D parameters which then want to evaluate optimized parameters through controller designed by using different objective functions give the higher leads to terms of maximum overshoot and rise time. By analyzing the results and discussions stated during this research, Tuned PID control method is the best method for precise position or speed control of D.C Motor.

8. REFERENCE

[1] M. Araki, "Control systems, Robotics and Automation", Vol. II– PID Control, Kyoto University, Japan.
[2] K.J Astrom and T. Hagglund, "The future of PID control", Control Eng. Pract. 9. 11. Pp.1163–1175. 2001.
[3] G. Ziegler and N. B. Nichols, "Optimum settings for automatic controllers", Trans. ASME, 64,759-768. 1942.
[4] Yodyium tipsuwan, Mo-Yuen Chow "Fuzzy Logic Microcontroller Implementation for DC Motor Speed Control", IEEE Trans. syst. pp. 1271-1276, 1999.s