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SIMULATION OF DIFFERENT SPEED CONTROL TECHNIQUES OF DC MOTOR (SHUNT, SERIES, AND COMPOUND) USING MATLAB

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Abstract: In this paper we learn about soft computing methods of speed control of direct current (DC) motor. In the past years so many techniques buildup for controlling names are Artificial Neural Networks (ANN's), Fuzzy Logic (FL) algorithm, Grey Wolf Optimizer (GWO), Particle Swarm Optimization (PSO) and so on. These techniques also used with conventional methods by hybridization of any two. In conventional methods, (P, PI, PD and PID) taking so much time for tuning its parameter. So we use these algorithms for tuning a parameter of conventional controller.

***Index Terms*-PID algorithm, Speed control, PID controller, DC motor, Response**

I. INTRODUCTION

The principle of soft computing techniques is to achieve approximation and getting a better performance. From few years ago so many control techniques are developed for control problem of DC motor. Because of the conventional techniques are used for control the DC motor, which are time taking and poor in performance. The conventional method, i.e. PID controller, is used for control of DC motor. In PID controller having a parameter is difficult to tune, so we use algorithms for tuning and getting a fast responses compare to conventional tuning method.

There are many varieties of control techniques, such as proportional P, proportional integral PI, proportional derivative (PD), proportional integral derivative, adaptive, genetic algorithms, particle swarm optimization (PSO), artificial neural networks (ANN's), fuzzy logic (FL's), cuckoo search (CS) meta-heuristic optimization techniques, grey wolf techniques (GWO) and combination of them.

The block diagram for the closed control system of DC motor is given below.

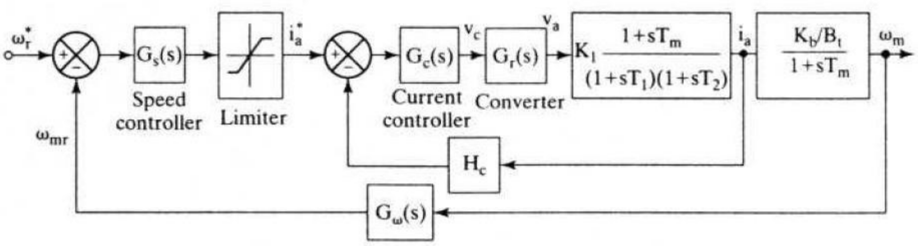

Fig.1. Block diagram of Speed control of DC motor

As it can be seen from block diagram, there is two loops i.e. inner current loop and outer speed loop. The design of control loops starts from the innermost (fastest) loop and proceeds to the slowest loop which in this case is the outer speed loop. The reason to proceed from the inner to the outer loop in the design process is that the gain and time constant of only on controller at a time are solved, instead of solving for the gain and time constant of all the controllers simultaneously.

II. EXPERIMENTAL DETAILS

The closed loop control system of separately excited DC motor is simulated by using MATLAB-2017 simulink.

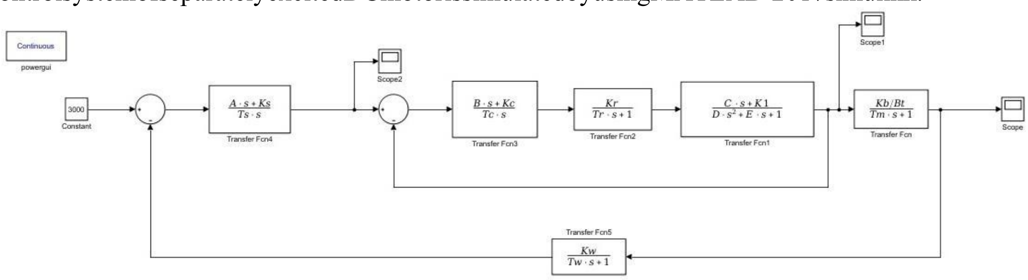

Fig.2. Simulation complete model of DC motor speed control

This paper includes two simulation models. The complete model of DC motor speed control is simulated without any approximation i.e. overall exact model of DC motor speed control loop.

The second model is speed control of DC motor with approximation. The current control loop is reduced to second order system taking following two assumptions:

[1] $[1+sTm]\sim sTm$
[2] $Tr < T2 < T1$

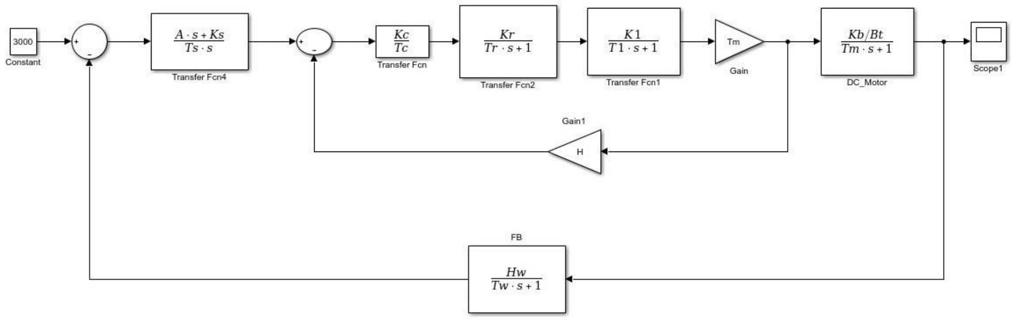

Fig.3.SimulationofDCmotorspeedcontrolwithapproximation

III. OBSERVATIONANDRESULTS

Here,thespeedresponseofcompletesimulationmodelofDCmotorspeedcontrolisgivenbelow.

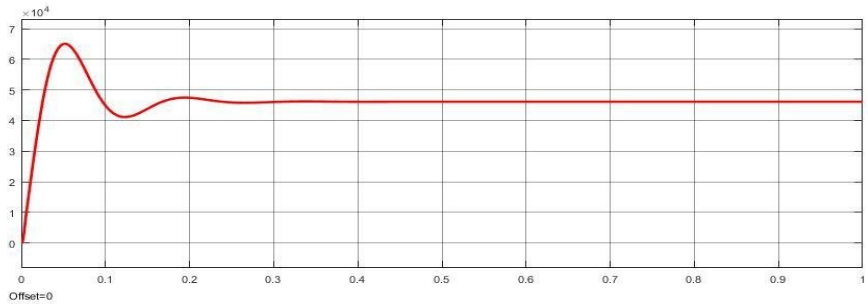

Fig.4.SpeedResponseofsimulationmodelofDCmotorspeedcontrolwithoutapproximation

ThespeedresponseofsimulationmodelofDCmotorspeedcontrolwiththeapproximationisgivenbelow.

Fig.5.SpeedResponseofsimulationmodelofDCmotorspeedcontrolwithapproximation

Thecomparisonofspeedresponseofbothsimulationmodelof DCmotorspeedcontrolwiththeapproximationandwithout approximationisgivenbelow.

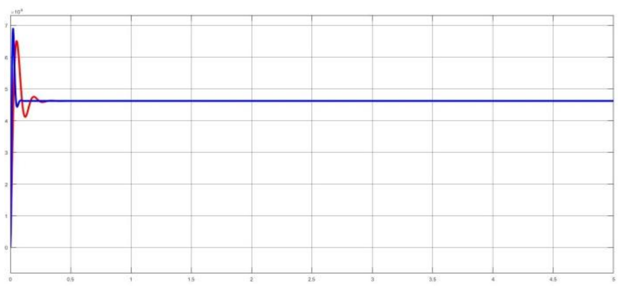

Fig.6.ComparisonofSpeedResponseofbothsimulationmodels

IV. DISCUSSIONANDCONCLUSION

Fromtheabove,wecanseethedifferencebetweentheresultsobtainedinbothcases.IncaseofcompletemodelingofDCmotorspeed control,thepeakovershootisgreaterincomparisontothemodelwithapproximation.

But, the settling time of the shown waveform obtained in case of DC motor speed control with approximation is less than that of without approximation.

This concept is used in designing of control loops. As the performance of outer speed loop is dependent on inner current loop. The dynamics of inner current loop can be simplified such that the tuning of inner loop has to precede the design and tuning of outer loop. So that, the impact of the outer loop on its performance could be minimized.

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APPENDIX:

Kr=31.05,Tr=0.00138
Kc=2.33,Tc=0.208
T2=0.208,Kb=1.26
Bt=0.0869,Tm=0.7
T1=0.1077,K1=0.0449
Tw=0.002,Kw=0.065
Ts=0.0188,Ks=28.73
K=38.8,Hc=0.355
A=Ts*Ks,B=Tc*Kc
C=Tm*K1,D=T1*T2
E=T1+T2