IJARESM
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING, SCIENCE & MANAGEMENT

FUZZY LOGIC BASED METHOD OF SPEED CONTROL OF DC MOTOR

Ankur P Desai[1], Rakesh J. Motiyani[2],
Assistant Prof., Electrical Department. SNPITRC, Umrakh, Bardoli, Gujarat, India[1]
Associate Prof., HOD & Electrical Department. SNPITRC, Umrakh, Bardoli, Gujarat, India[2]

ABSTRACT: Various method of speed control of DC motor is available in the literature. This paper presents design and implements of fuzzy logic in the speed control of DC motor. Fuzzy logic has found high application as a speed control techniques because of its ability to take into account vague and uncertainties [1]. This paper presents a MATLAB simulink model for speed control of DC motor using fuzzy logic.

Key words: -*Fuzzy Logic, Fuzzy Control, DC Motor.*

I. INTRODUCTION

Recently, Fuzzy logic control has found many applications in the past decade. This is so largely because fuzzy logic control has the capability to control nonlinear, uncertain systems even in the case where no mathematical model is available for the controlled system. A fuzzy logic controller can be regarded as a real-time expert system that employs fuzzy logic to manipulate qualitative variables.

Fuzzy logic control is a control algorithm based on a linguistic control strategy, which is derived from expert knowledge into an automatic control strategy. Fuzzy logic control doesn't need any difficult mathematical calculation like the others control system. While the others control system use difficult mathematical calculation to provide amodel of the controlled plant, it only uses simplemathematical calculation to simulate the expert knowledge. Although it doesn't need any difficult mathematical calculation, but it can give good performance in a control system. Thus, it can be one of the best available answers today for a broad class of challenging controls problems.

II. THE MODELLING OF DC MOTOR

The model presented in this paper did not use the inbuilt MATLAB DC motor from Simulink, instead the DC motor has been designed from its characteristic differential equation and it is shown in Fig.1.

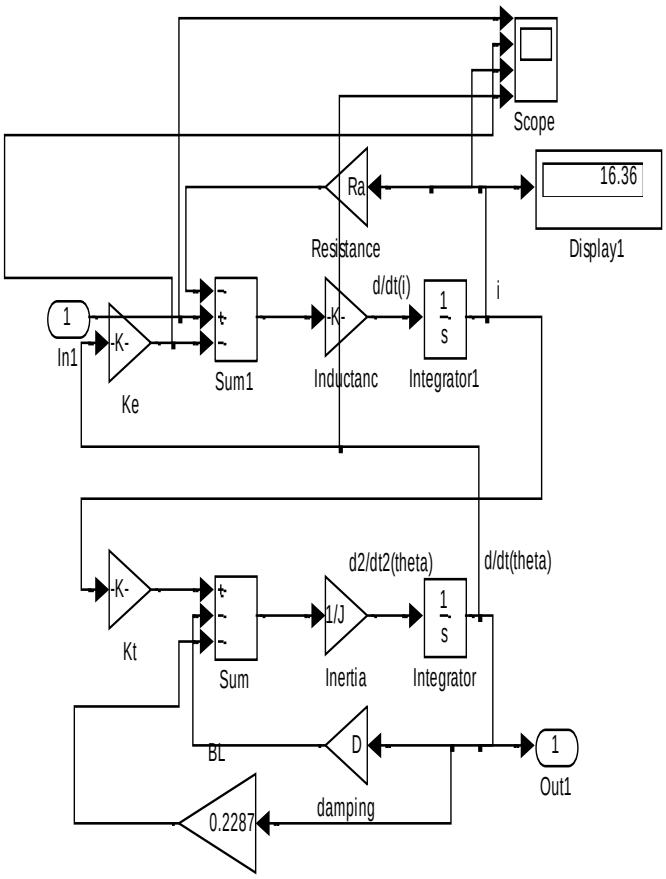

Fig.1D.C.Machine Model in Matlab Simulink

III. FUZZY LOGIC BASICS

The fuzzy logic foundation is based on the simulation of people's opinions and perceptions to control any system. One of the methodsto simplify complex systems is to tolerate to imprecision, vagueness and uncertainty up to some extent [4]. An expert operator develops flexible control mechanism using words like “suitable, not very suitable, high, little high, much and far too much" that are frequently used words in people's life. Fuzzy logic control is constructed on these logical relationships. Fuzzy Sets Theory is first introduced in 1965 by Zadeh to express and process fuzzy knowledge [5, 6]. There is a strong relationship between fuzzy logic and fuzzy set theory that is similar relationship between Boolean logic and classic.

Advantage of using fuzzy technique

1. Inherent approximation capability
2. High degree of tolerance
3. Smooth operation
4. Reduce the effect of Non-linearity Fast adaptation
5. Learning ability

The design procedure of FLC contains three steps as

A. Defining input and output.

B. Defining membership functions and rules.

C. Adjusting membership functions and rules.

IV. PROPOSED FUZZY LOGIC BASED SPEED CONTROL OF DC MOTOR

The matlabSimulink of fuzzy logic based speed control of DC motor is shown in Fig.2

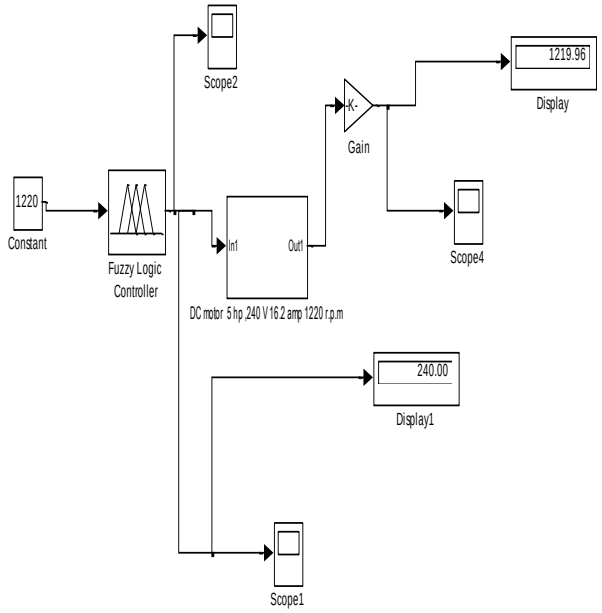

Fig.2Matlab Simulation of Fuzzy logic based Speed control of D.C.Machine.

Proposed fuzzy logic based controller work as per following steps:

We need to control the speed of a motor by changing the input voltage. When a set pointis defined, if for some reason, the motor runs faster, we need to slow it down by reducingthe input voltage. If the motor slows below the set point, the input voltage must beincreased so that the motor speed reaches the set point.

Let the input status words be:

Too slow

Just right

Too fast

Let the output action words be:

Less voltage (Slow down)

No change

More voltage (Speed up)

Define the rule-base:

1. If the motor is running too slow, then more voltage.
2. If motor speed is about right, then no change.
3. If motor speed is to fast, then less voltage.

V. FUZZY LOGIC CONTROLLER (FLC)

There are specific components characteristic of a fuzzy controller to support a design procedure. Controller consists of between the pre-processing block and post processing block.

The fuzzification block matches the input data with the conditions of the rules to determine. There is degree of membership for each linguisticterm that appliesto the input variable.

Rule Base

The collection of rules is called a rule base. The rules are in "If Then" format and formally the If side is called the conditions and the Then side is called the conclusion. The computer is able to execute the rules and compute a control signal depending on the measured inputs error (e) and change in error, d (e). In a rule based controller the control strategy is stored in a more or less natural language. A rule base controller is easy to understand and easy to maintain for a non- specialist end user and an equivalent controller could be implemented using conventional techniques.

Defuzzification

Defuzzification is when all the actions that have been activated are combined and converted into a single non- fuzzy output signal which is the control signal of the system. The output levels are depending on the rules that the systems have and the positions depending on the non- linearity's existing to the systems. To achieve the result, develop the control curve of the system representing the I/O relation of the systems and based on the information; define the output degree of the membership function with the aim to minimize the effect of the non-linearity.

Post processing

The post processing block often contains an output gain that can be tuned and also become as an integrator.

Fuzzy Membership –Function

The membership function of input, output, fuzzification process and fuzzy rule based in proposedmaltab simulation used in this control of DC motor is shown in Figure. 3(a), 3(b) , 3(c) and 4(d).

Fig.3(a) Input Membership Functions.

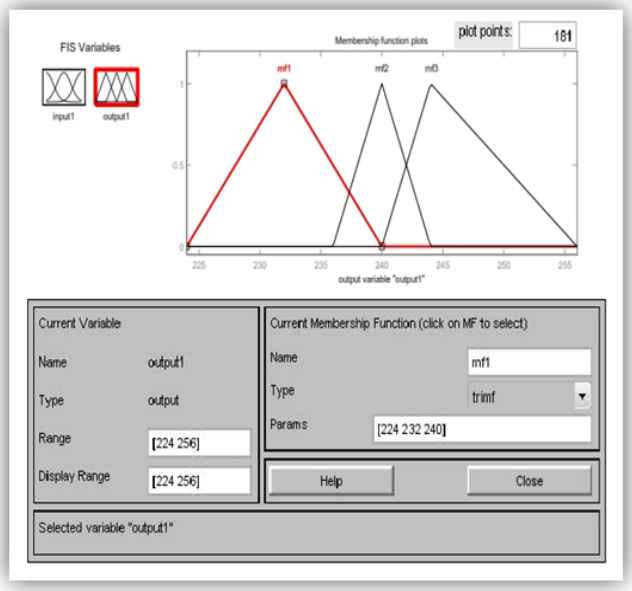

Fig.3(b) Output Membership Functions.

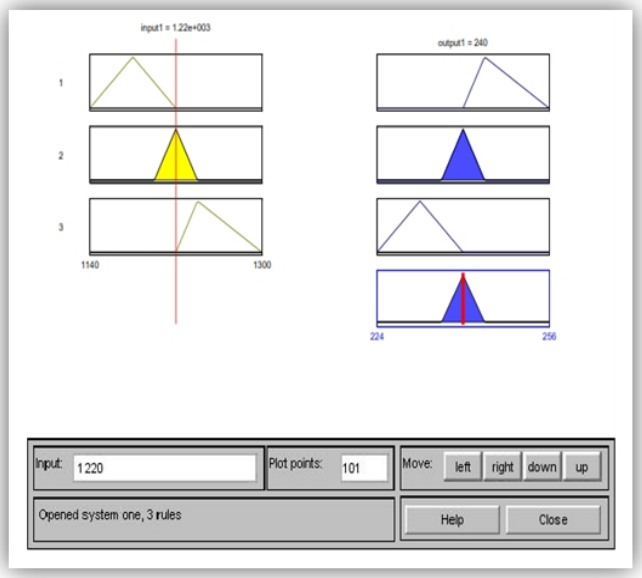

Fig.3(c) Fuzzification process.

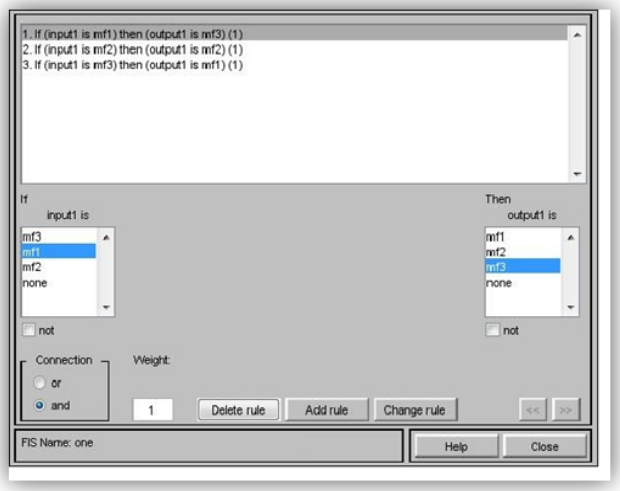

Fig.3(d) Rule Base For Fuzzification

Preprocessing

The inputs are most often hard or crisp measurement from some measuring equipment rather than linguistic. A preprocessor, the first block in Fig. 3(c) shows the conditions the measurements before enter the controller.

Fuzzification

The first block inside the controller is fuzzification which converts each piece of input data to degrees of membership by a lookup in one or several membership functions.

VI. RESULT

Input membership functions shown in fig.3 (a) are defined triangles (mf1, mf2 and mf3). Rangefor mf1 is 1140 to 1220 rpm. Range for mf2 is 1200 to 1240 rpm.Range for mf3 is 1220 to 1300 rpm.Output membership functions are defined triangles (mf1, mf2 and mf3).Ranges are between 224 volt to 256 volt shown in fig.3 (b). As shown in fig.2 input speed is given to fuzzy logic controller block then it will calculate output cript value of voltageto achieve required speed.Fig 4(a) Speed v/s Armature Voltage Response of fuzzy logic controller.Fig.4(b) shows speed response of motor as input speed given to maltabSimulink of 1200rpm.

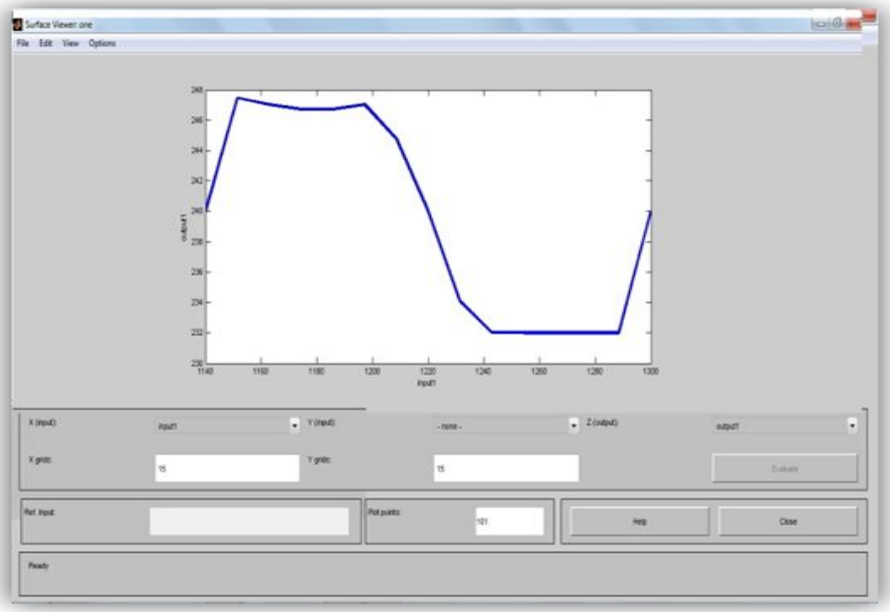

Fig.4(a) Speed v/s Armature Voltage Response.

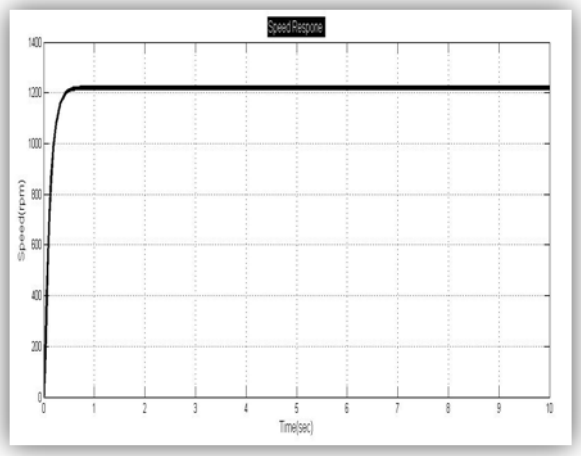

Fig.4(b) Speed v/s Time Response.

VII. CONCLUSION

There is a wide range scope of applicationsof high performance DC motor drives in area such as rolling mills, chemical process, electric trains, robotic manipulators and the home electric appliances. They require speed controllers to perform tasks. Hence, a fuzzy based DC motor speed control system was designed the simulation model is implemented in MATLAB/simulink environment. From the output speed wave form, we can see that the proposed fuzzy logic controller is able to sensitiveness to methodgives a smooth speed control with less overshoot and nooscillationsvariation of the reference speed attention.

REFERENCE

[01] D. Ran, B. Ryan and P. Power, Using fuzzy logic toward intelligent system, Prentice Hall, New York, 1994.

[02] L. Sesimi, Lab VIEW of electric circuits, machines, drives, and laboratories, Prentice Hall, New Jersey, 2002 [Online]. Available: www.nl.com/,2002.

[03] K.Dlir, Seorge, "Fuzzy Sets and Fuzzy Logic Theory "

[04] M.Klir, Reorge, Zuan, Bo., "Fuzzy Sets and Fuzzy Logic Theory And Applications"

[05] Q. K. Dadeh, "Fuzzy Sets" informant Control, vol.8, pp 338-353,1965.

[06] L. B. Gadeh, "Outline of a new approach to the analysis complex systems and decision processes" IEEE Trans. Syst.

[07] N.Senthilkumar, V.Sadasivam, K.Prema,. "Design and simulation of fuzzy controller for closed loop of chopper fed embedded DC drives," IEEE International conference powercon, Singapore, 2004.

[08] H.A.Yousef and H.M.Khalil ,"A fuzzy logic based control of series DC series motor drives," Proceeding of the IEEE International symposium on vol.2, Issue 10-14,pp 517-522, jul 1995.

[09] M.Murugandam&M.Madheswaran," Modeling and Simulation of modified fuzzy logic controller for various types of DC motor drives IEEE International conference on control systemjune 2009.

[10] G.Uma and C.Chellamuthuu,"Design and implementation of fuzzy logic control speed control system for a converter fed DC drive using 8097 microcontroller," ISIE,mexico 2000.

[11] MuhammedH.Rashid ,Power electronic, Oxford University press,1998.

[12] K. B. Mohanty, "Fuzzy remote controller for converter DC motor drives", Paritantra, Vol.9, No.1, June 2004.

[13] Singariv.s.rPavankumar and Y.B.Venugopal "A Neuro-Fuzzy Based Speed Control of Separately Excited DC Motor" IEEE International conference, 2010.

