Fuzzy Logic Controller for Position Control of Servo Motor

J. Priya, A.Jeevanandham, K. Rajalashmi

Abstract-The Quanser servo motor is anopen-loop, unstable and nonlinear system.The standard linear techniques cannot model the nonlinear dynamics of the system. While simulating the system, the motor shaft rotates randomly without any control. The identification and control is a challenging task due to the characteristics of the Quanser servo motor. Hence a real time software is needed to controlQuanser servo motor. The dSPACE real time software was identified and found to be Suitable for the task to be done.Accurate modelling of the system is essential as the plant is used for controlling functions. Laboratory set up is establishedto find the transfer function of the Quanser servo plant modulecomprising of dSPACE , interface panel and Uninterrupted Control Unit. The UPM gives the nonstop input to the SRV02.Utilizing laboratory set up the transfer function of the SRV02 is found.In Previousresearch ,Position control was performed using PV(Proportional - Velocity), PIV(Proportional-Integral-Velocity) controller. In this paper PIV controller is replaced with fuzzy logic controller and the response is observed.

Key words:Quanser servo motor, Fuzzy logic controller, dSPACE, PV, PIV controller, DS1104 interface board, SRV02, UPM

I.INTRODUCTION

The system used here is Quanser servo motor (SRV02). The Quanser servo motor is a highly non-linear and exposed loop unsteady structure. The classical direct method cannot demonstrate the non-linear of the scheme. When the system is simulated the motor shaft rotates randomly without any control. The features of the Quanser servo motor mark the empathy and control additional stimulating. Thus the Quanser servo motor is attempted to control using the dSPACE real time software. The SRV02 servo plant comprises a inner gear box and motor making it appropriate for control of real time arrangements. Precise modelling of the system is required because the system is used for control applications. In the laboratory setup, the Uninterrupted Power Supply Module provides unremitting input to the servo plant. This module is mathematical representation of servo motor is found using Frequency responsetechnique. PIV controller is replaced with fuzzy logic controller and the response is observed. Quarc Q8 usb is used to control the speed of the SRV02 Quanser servo plant. Globally, Quanser board and Wincon software is utilized to performtest siteresearch[1]-[3]. Wincon software its many disadvantages.

II. LITERATURE REVIEW

Thus dSPACE software which is a real time software was proposed[4].

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Work on position control of DC servo motor[5], department of instrumentation and control proposed the idea of implementing PV and PIV control. Fuzzy logic manager on behalf of location controller of servo motor [6]-[7] emphasizes the need for Fuzzy controller in dSPACEenvironment.

III.PROBLEM DESCRIPTION

Due to the disadvantages of using Wincon software , the use of dSPACE software is proposed which includes DS1104 controller board. This ensures relatively superior position control than Wincon software. The servo rotary plant comprises a DC motor which is a high efficiency. The motor has its own internal gear boxes. The Quanser servo plant measures angular position with the help of potentiometer and a tachometer to portion the speed .Digital measurement of the load gear is done using Encoder circuit.. Thus the experimental model of the system is derived by frequency response method. PV and PIV controllers are designed to control the position of the motor. Quarc q8 usb is used to control the position and speed of the quanser servo plant.

IV.PROBLEM MODEL

A. Interface Quanser Servo Motor With Dspace Environment:

The proposed model consists of Computer System which is Connected to the experimental setup Via CLP board . The computer system is interfaced with DS1104 and Matlab Simulink is installed. Dspace system setup consists of both hardware and software.

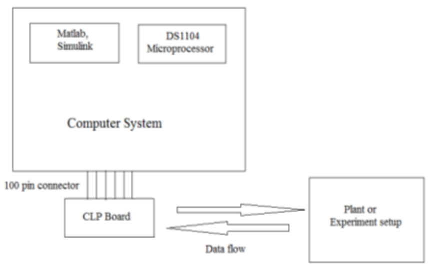

Figure1: Investigational arrangement of the unit using dSPACE

B. Demonstrating Of Srv02 Unit Experimental:

a. Frequency Response Method:

The input and output in this method are sine waves. The output is a sine wave of different amplitude but has the same frequency as that of the input.

b. PV Control:

Velocity is calculated by the product of proportional gain and error. The control value is obtained by the product of the previous result and the velocity gain

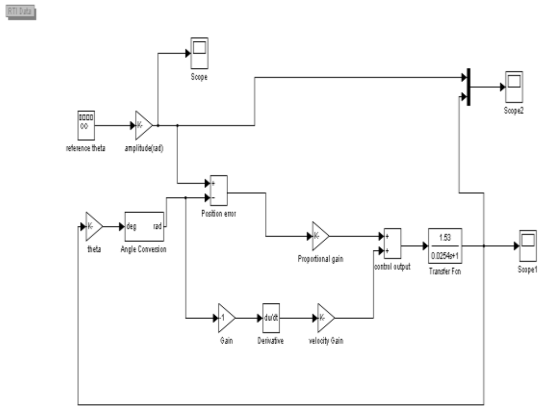

Figure2: Simulation diagram for PV control

c. Response Of PV Control:

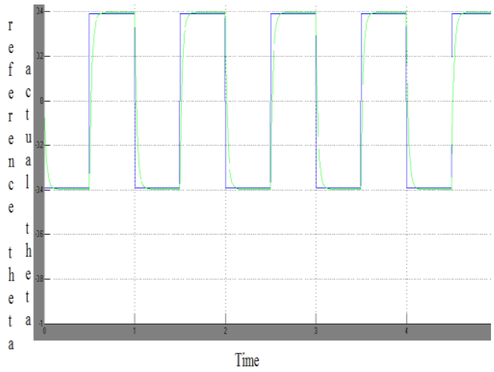

Figure 3: Response of PV control

d. Response Of PV Control In Dspace:

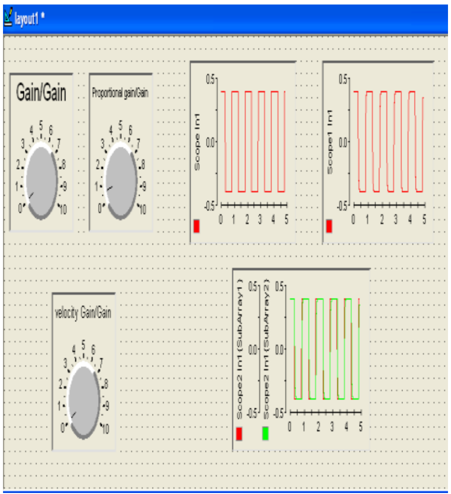

Figure4: Response of PV control in dSPACE

C.PIV Control:

Output of the system is enhanced by integrating the error value. Hence PIV control serves this purpose.

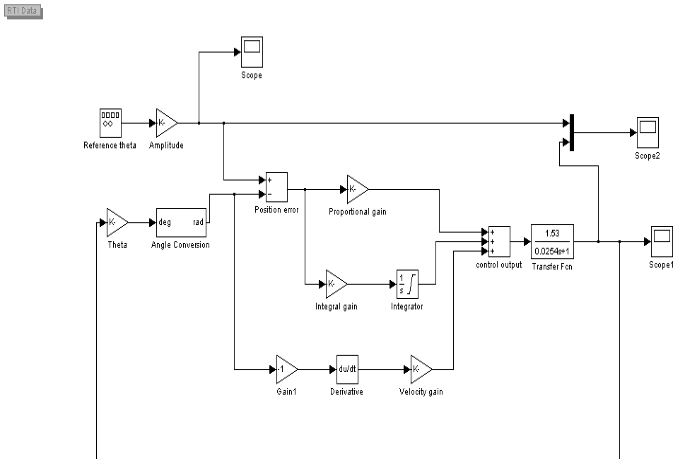

Figure 5: Simulation diagram for PIV control

D. Response Of PIV Control:

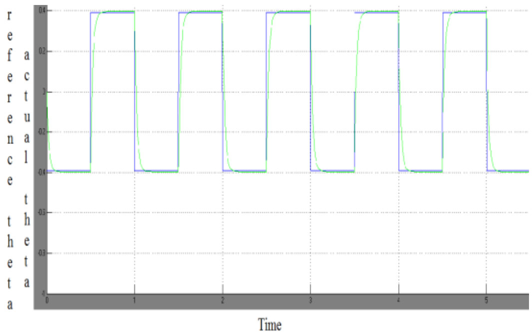

Figure 6: Response of PIV control

E. Response Of PIV Control In dSPACE

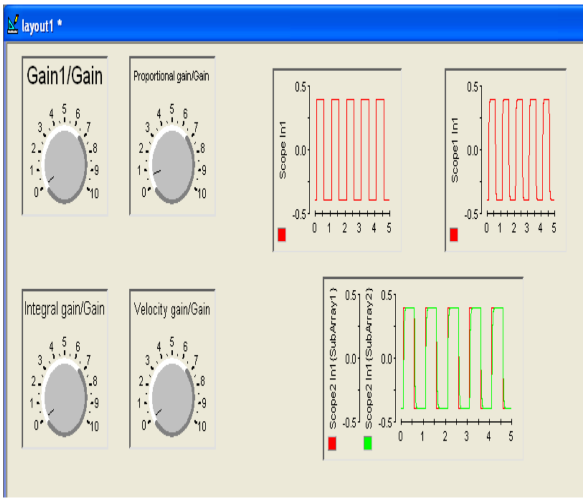

Figure 7:Response of PIV control in dSPACE

F. Fuzzy Logic Controller

PIV controller is replaced with fuzzy logic controller and the response is observed.

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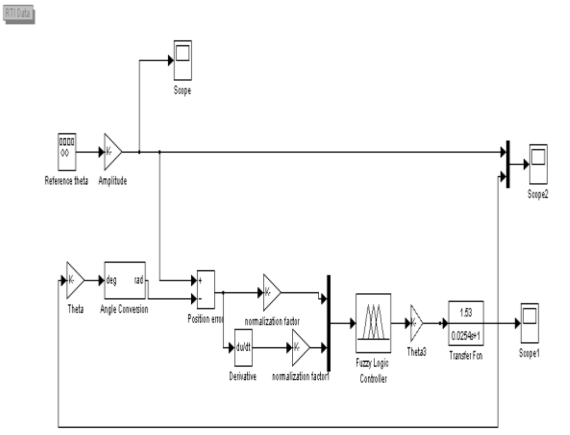

Figure 8: Model plan using fuzzy logic controller

G. Response Using Fuzzy Logic Controller

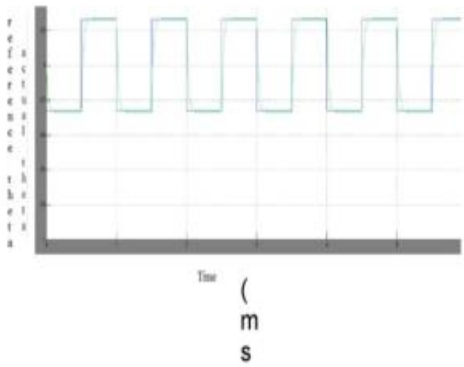

Figure 9: Response using fuzzy logic controller

H. Response using fuzzy logic controller in dSPACE

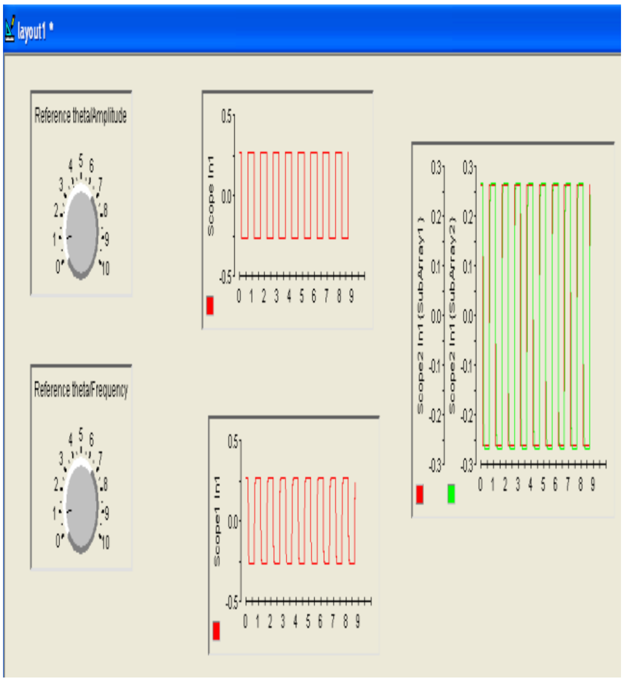

Figure 10: Response using fuzzy logic controller in dSPACE

I. Simulink Model

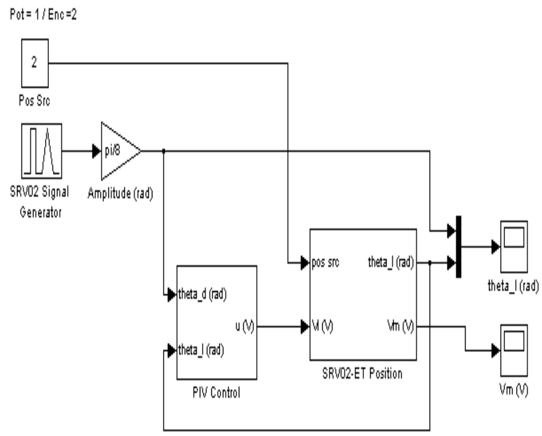

Figure 11: Model plan for position control using quarc

a. Measured Step Response

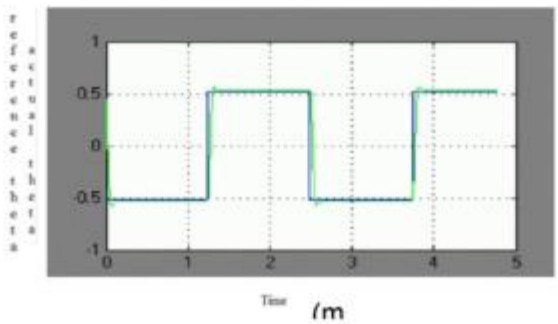

Figure12: Response for position control using quarc

b. Control Input Voltage

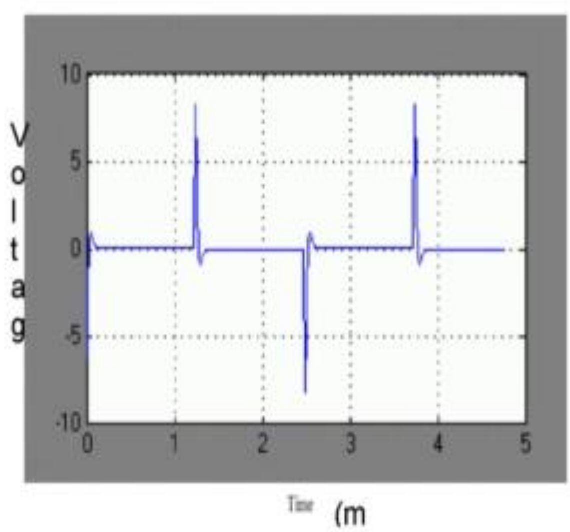

Figure 13: Voltage response

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V.SIMULINK MODEL FOR SPEED CONTROL USING QUARC:

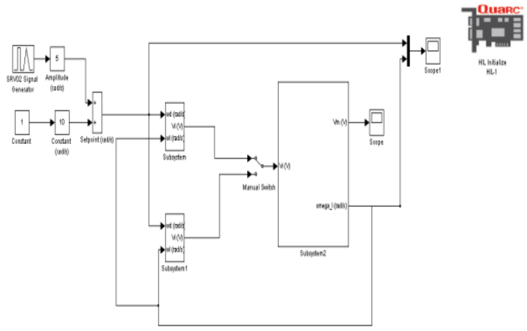
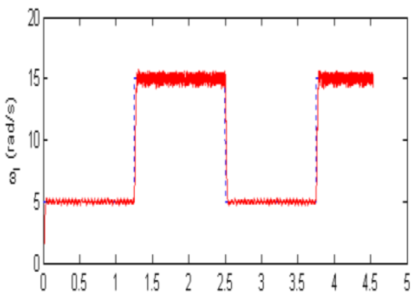
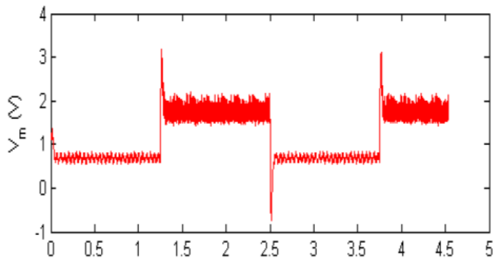


Figure 14: Model plan for speed control using quarc

A. *Speed Response Using Pi Control*



(a)



(b)

Figure 15: Speed response using PI control

VI.CONCLUSION

Transfer function of servo unit is found using incidence response technique. The collected statistics and data sheet was used to compute it precisely

The compensations of using DS1104 controller are as follows

a) Computation time is minimum.
b) Fewerperipheralmechanisms requirement.
c) Effect of temperature difference is minimum.
d) Greatercompetence.
e) Comparatively more flexible .

The PV and PIV control responses were obtained. PIV controller is replaced with fuzzy logic controller and response is observed.

Position control and speed control responses were obtained using quarc q8 usb and its performance were observed.

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