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Comparison of Various Voltage Control Techniques for Voltage Source Inverter

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Abstract

This project work deals with design and comparison of different voltage control techniques for three phase voltage source inverter feeding RL load. Two control techniques namely PI controller and Fuzzy logic controller has been presented in this project work. Initially the simulation of three phase inverter using sine PWM technique feeding RL load using MATLAB/Simulink has been presented. Further, design of LC filter has been done since the output of inverter is sine wave. In order to justify the comparison of controllers another parallel RL load is added such that it acts at some other time instant. Then design of PI controller with load side disturbance is simulated and presented. The Fuzzy logic controller rules obtained from input output mapping has been presented. In Fuzzy logic controller input depends on error and change in error with linguistic variable while output depends upon change in switching voltage of VSI. Then design of Fuzzy logic controller with load side disturbance is also simulated. Finally comparison of fuzzy controller with PI controller based on steady state error reduction has been discussed.

Keywords: *Proportional Integral(PI), Fuzzy Logic Controller(FLC), Voltage Source Inverter(VSI)'*

INTRODUCTION

Harmonics are not only in industrial application but in commercial buildings as well. This is due to new power conversion technologies such as the switch – mode power which can be found in virtually every power electric device. SMPS has excellent power supply but has high non – linear loads [1]. The PI controller requires precise linear mathematical models, which are difficult and obtain and may not give satisfactory performance under parameter variations, load disturbances etc. Recently fuzzy logic controllers have been introduced in various application and has the advantage that if no need an accurate mathematical model, can work with imprecise input, can handle non – linear are more robust than conventional PI controller.

BLOCK DIAGRAM:

Proposed system:

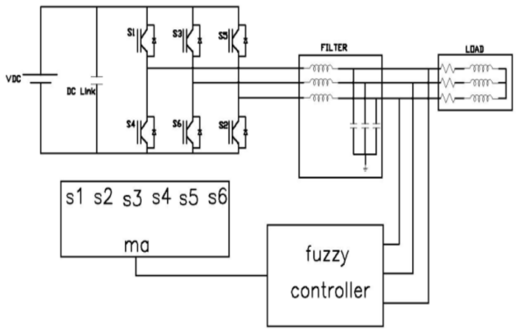

Fig-2.1: *Block Diagram Of FLC*

Conventional system:

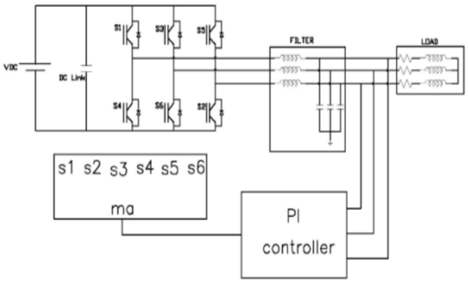

Fig-2.2: *Block Diagram Of PI Controller*

DESIGN OF CONTROLLER

Design of FLC:

This is the basic block diagram of Fuzzy logic system

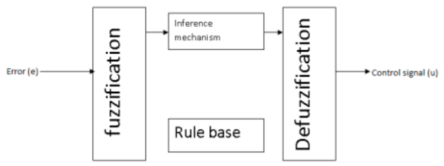

Fig-3.1:*Block Diagram Of Fuzzy System*

Fuzzy logic system requires minimal computational cost; a probable answer is to save a matrix of enter-output relation in memory area as a lookup desk structure. In FLC system membership functions is formed with inputs and outputs.

FUZZY LOGIC DESIGN

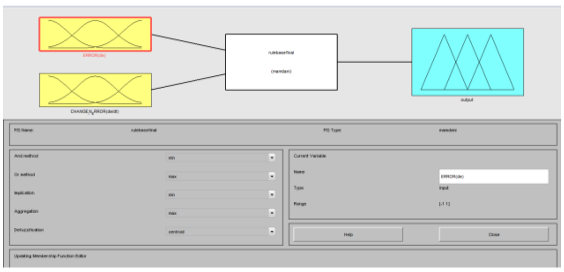

Fig-3.2 : *FIS editor block in MATLAB*

Fuzzy logic system provides algorithm which converts the linguistic control strategy into automatic control strategy (crisp set) based on knowledge.

ERROR(e)

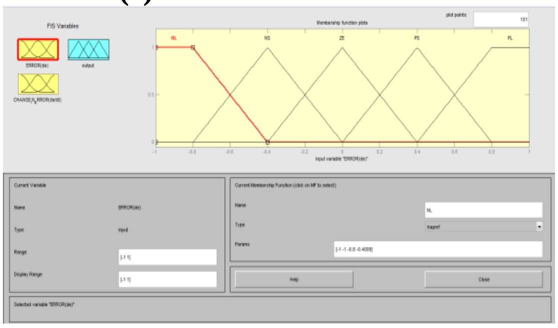

Fig-3.3 : *Member function for input1 Error*

CHANGE IN ERROR(de/dt)

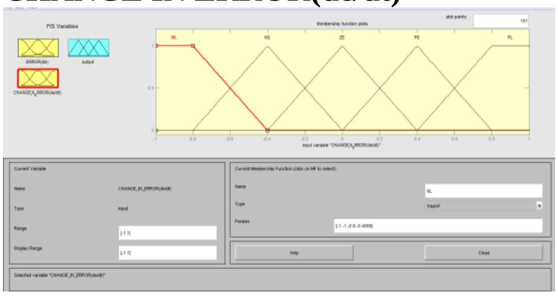

Fig-3.4: *MF for input 2 change in error*

OUTPUT

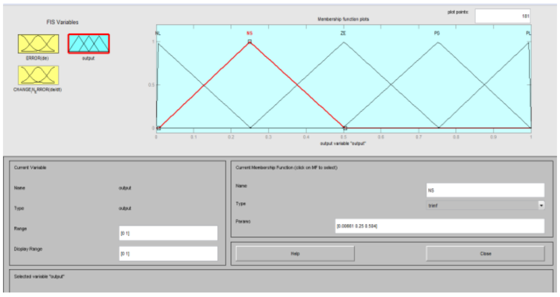

Fig-3.5: *Membership Function for Duty Cycle*

RULE TABLE

Table-1 *Control rules for fuzzyThe linguistic terms are*

de/dt \ E	**NL**	**NS**	**ZE**	**PS**	**PL**
NL	**NL**	**NL**	**NL**	**NS**	**ZE**
NS	**NL**	**NS**	**NS**	**ZE**	**PL**
ZE	**NL**	**NS**	**ZE**	**PS**	**PL**
PS	**NL**	**ZE**	**PS**	**PL**	**PL**
PL	**ZE**	**PS**	**PL**	**PL**	**PL**

***Table-2** linguistic terms*

NL	Negative and Large
NS	Negative and Small
ZE	Zero
PS	Positive and Small
PL	Positive and Large

RULES

After membership functions are chosen rule base is created, it consists of number of Fuzzy IF-THEN rules the complexity define the behavior of the system [2]. The rules are formed based on human thought process.

RULE BASE

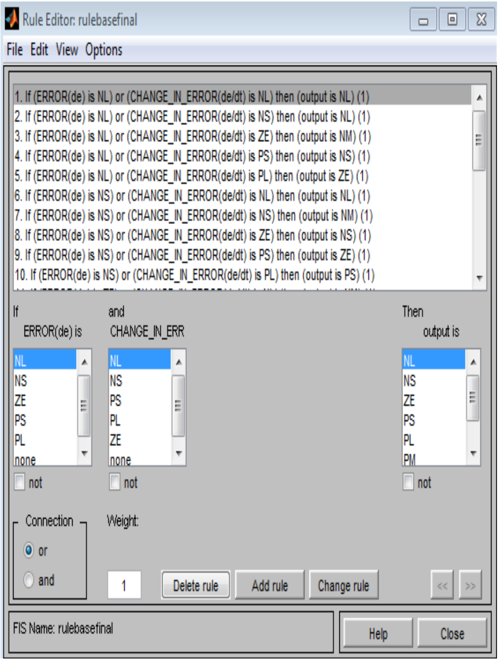

***Fig-3.6:** Rule editor*

RULE VIEWER

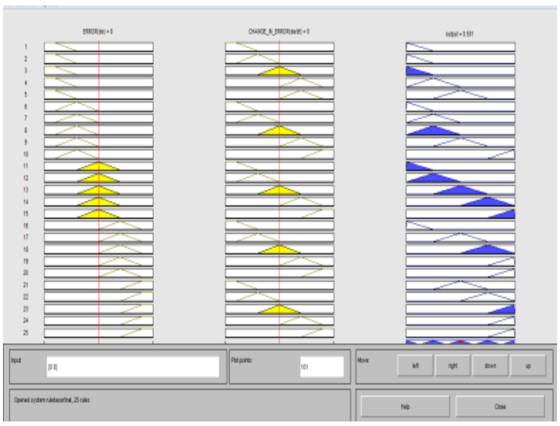

***Fig-3.7:** Rule viewer*

SURFACE VIEWER

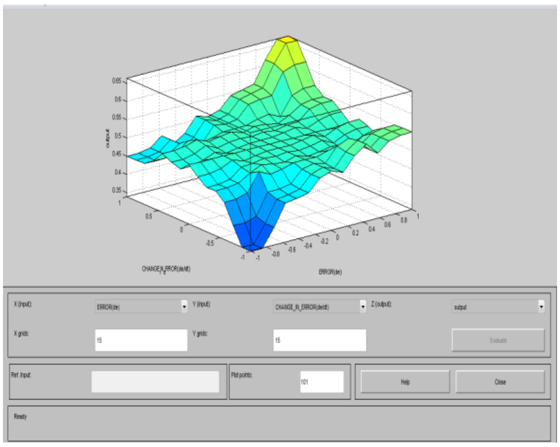

***Fig.-3.8** surface viewer*

PI CONTROLLER

Working:

When a load is connected to the inverter output, the output voltage is sensed and is given to a comparator which compares this load output with reference signal. This instantaneous error signal is given to PI controller. The Proportional in PI controller reduces the error whereas the integral term reduces the offset. P depends on present errors and I depend on past errors. So, step response of a system can be better improved with the use of PI controller. Also the integral term in PI controller helps in tracking by reducing the instantaneous error between reference and the actual value or desired value[3]. The resulting error signal output from PI controller decides the switching frequency and pulse width

SIMULATION RESULTS :

OPEN LOOP SIMULATION

GENERATION OF PWM PULSE

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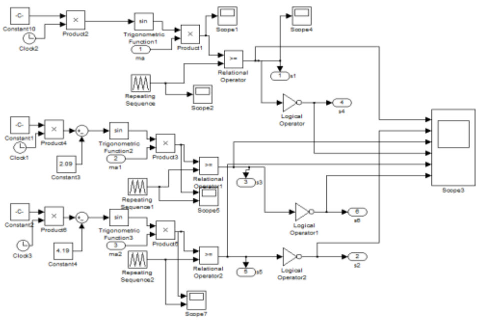


Fig-4.1:_Simulation diagram of generation of PWM pulses_

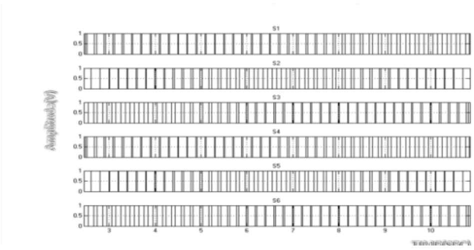


Fig-.4.2 _Output of Generation of PWM pulses_

OPEN LOOP WITHOUT FILTER

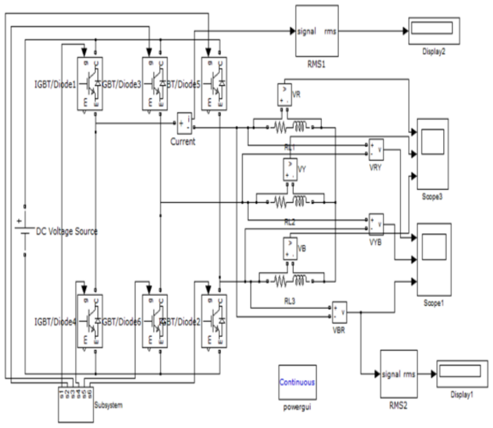
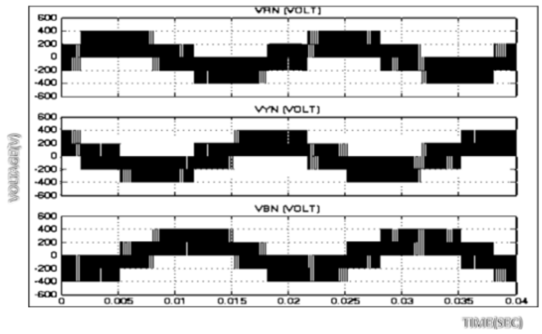


Fig-4.3 _Simulation diagram of open loop without filter_

OUTPUT:
PHASE VOLTAGE



LINE VOLTAGE

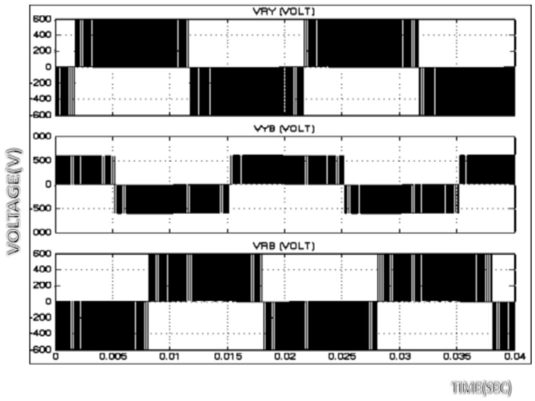


Fig-4.4 _Output waveform for open loop simulation without filter (a) Phase voltage (b) Line voltage_

CLOSED LOOP
WITHOUT PI CONTROLLER

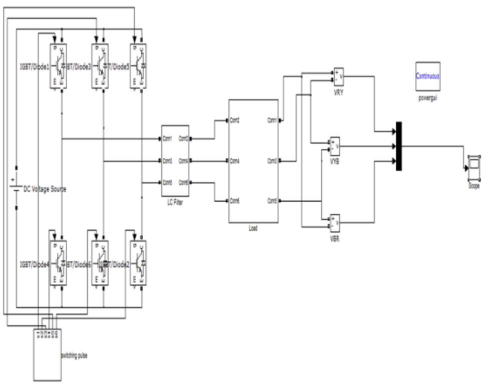


Fig-4.5 _Closed loop simulation without PI controller_

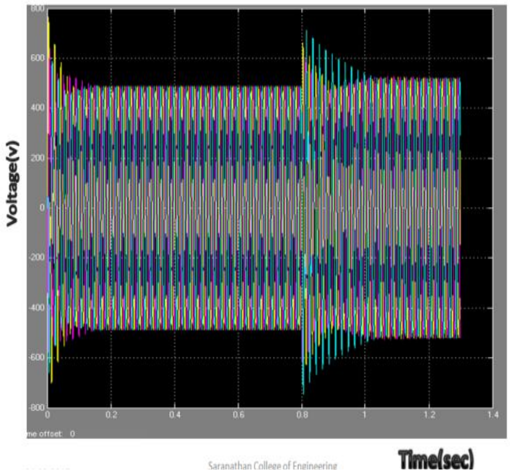


Fig-4.6 _Waveform of simulation without PI controller_

WITH PI CONTROLLER

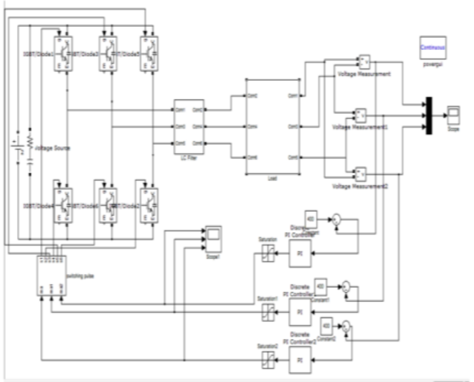


Fig-4.7 *Simulation of closed loop with PI controller*

OUTPUT WITH PI CONTROLLER

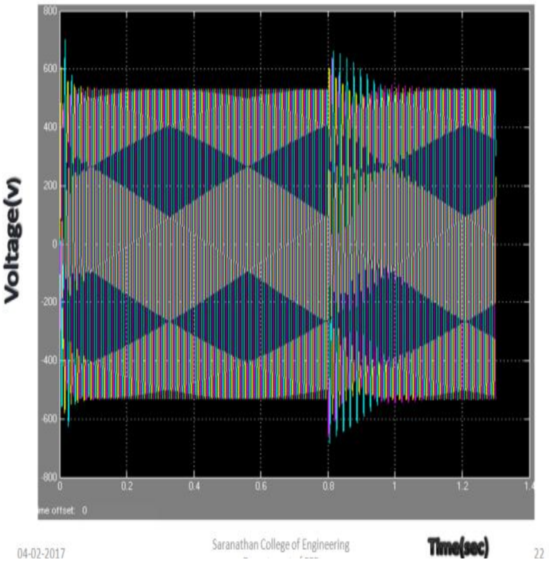


Fig-4.8 *Waveform of closed loop with PI controller*

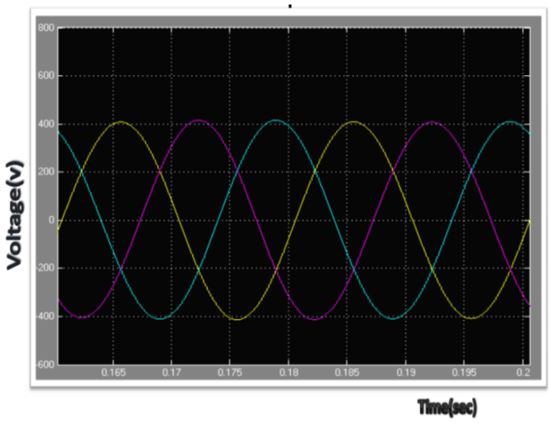


Fig-4.9 *Waveform of pure sine wave for closed loop with PI controller*

FLC SIMULATION

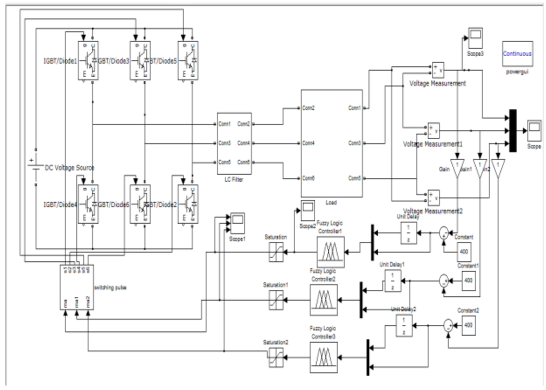


Fig-4.10: *Simulation diagram of FLC*

OUTPUT OF FLC

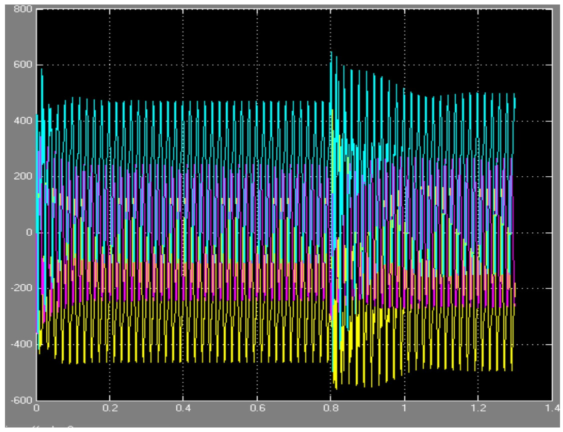


Fig-4.11: *Output Waveform of FLC*

CONCLUSION

FLC and PI controllers were studied and designed for RL load. The output voltage response of VSI using FLC is successfully simulated in MATLAB and compared with the output of PI controller. It is identified that FLC has FLC has better performance than PI controller. FLC have better performance over the conventional PI controller in both rise time and settling time [4]. Rise time of fuzzy is less compared to PI controller. FLC steady state error is zero whereas in PI controller has some steady state error. FLC has faster dynamic response as compared to PI controller.

REFERENCE

1. www.mirusinternational.com
2. Ravi prkash, Prof. Rishi kumarsingh, Rajeev ranjankumar "variable voltage

variable frequency speed control of induction motor using FPGA-Xilinx"
3. M.Venkatesan,R.Rajeswari,N.Deverajan "A Fuzzy logic based three phase inverter with single DC source for grid connected PV system three phase transformer" - member function.
4. Uchegbu C.E, Ekulibe James Ilo F.U "On using fuzzy logic based automatic voltage relay in distribution network".

