

A Comparative Study Based on PI and Fuzzy Control of Inverter fed Induction Motor Drive

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Abstract

Induction motor drive draws heavy current during starting condition. The current is 4 to 7 times of rated current, if this current present in the motor for large time period not only it can damage insulation but conductors too. If this transient period for achieving rated speed is large it can causes above problems. The equipment which reduces the transient time of induction motor is controlled operation of *Voltage Source Inverter but using this one;* introduces harmonics in the machine and in system. These harmonics can cause overheating of the motor and supply system result in reduction in overall life span of motor, reduced efficiency, poor performance and unwanted failure of drive system causes economic Burdon on organization in form of less production. To solve these issues an attempt is made to make a comparative study on various open loop and close loop drive including PI controller & Fuzzy Logic controller for determination of their advantages and limitations for any particular operation of drive.

Keywords:

Simulink; THD; PI; Fuzzy controller

Introduction

An inverter is used at many levels for variable voltage & frequency outputs. The domestic and low voltage commercial operations of Inverter are at fixed frequency and voltage level. This one type of inverter only uses as backup power source while main power get failed but in industries The IGBT Switches are used for building three phase inverter. IGBT can be used effectively for low and high power applications. Three phase inverter output voltage, power quality has a great role on the equipment to which it is connected. THD is the important factors of power quality. In this Paper first harmonics are tested on simple three phase VSI fed induction motor. Then because of more presence of harmonics some close loop control methods are applied. These methods are PI controller of Induction motor and Fuzzy controller of Induction And also provide motor. we the comparison study of both controllers earlier the motor controller was a tough task and energy efficiency had been a stranger word among engineers. As the industrialization increases and economic has plays a vital role in operation and maintenance of any machine controlled output with less harmonics, fast control, energy efficiency became crucial issues. The achievement for above issues is possible only with solid state controllers. Now a day's controllers include both microprocessors and power electronics, enabling the control box to take on many more tasks such as Controlling the dynamics nature (speed, torque and efficiency of the machine or the position of



its moving elements.) of the machine and its impact on applied loads. It also provides self starting of the motor. Due to power electronics commutation the motor is protected and the controller is also protected from, Damages.

I. Open loop Inverter

The open loop control strategy is the simplest way to control the different parameters of a drive system. In this method the inverter input is not directly connected and bounded with output. The technique is initially set as per the desired output if output changes there will be requirement of some external measurement for change in input supply. Fig shows the three phase inverter circuit using 180 deg mode of conduction. This simulation is performed on Simulink. IGBT is used as switching device for the inverter. Pulse generator is used for gating signal for switching device. Then DC is converted in to AC which is fed to three phase resistive load. Then scope is used to measure all the voltage and current.





II. Close Loop Control using PI Controller

After getting results from open loop control, a close loop control of induction motor is applied. In this control method a PI controller is used to provide a control signal according to error from the output. Fig 3.1 shows the close loop control of induction motor using PI controller.





III. Close Loop Control using Fuzzy

Logic Controller

After getting non satisfactory result from the PI controller, a fuzzy controller is applied in close loop control of induction motor. This fuzzy controller improve the result of induction motor. And also improve the THD of induction motor. The simulink model of fuzzy controller applied on close loop control of induction motor shown in fig 4.1



Fig4.1: Close Loop Control using FuzzyController

IV. **RESULT**

Simulation Result of Open loop inverter

The below result shows the THD analysis of rotor current when fundamental freqency is applied. Fig shows the THD Analysis of rotor current



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Fig 5.1: THD Analysis of Rotor Current

The below result shows the THD analysis of stator current when fundamental freqency is applied. Fig shows the THD of stator current.



Fig 5.2: THD Analysis of Stator Current

Simulation Result of Closed loop using PI controller

After the calculation of normal speed, torque and current it is important to know the harmonics distortion of model.

THD analysis of rotor current



Fig 5.3: THD Analysis of Rotor

Current

THD analysis of stator current of induction motor is shown in fig 6.4





Simulation Result of Closed loop using fuzzy controller

After the calculation of normal speed, torque and current it is important to know the harmonics distortion of model. THD Analysis of Rotor Current





THD analysis of stator current of induction motor is shown in fig







Table 1:

Comparison results of THD in Open loop, Close loop PI and Close loop Fuzzy Controller

S.	No.	Open	loop	Close	Close
		inverter		loop PI	loop
					Fuzz
					У
		Freq	TH	THD	THD
		uenc	D %	%	%
		У			
1.	Stat	50Hz	18.9	17.15	8.65
	or		4		
	Cur				
	rent				
2.	Rot	50Hz	22.7	29.18	22.29
	or		5		
	Cur				
	rent				

V. Conclusion

The result obtained through simulation shows that close loop controller for IM drive system has superior over conventional and open loop controller. Even in close loop control; Soft controller are preferable. These controllers have vast range of applications in industrial and commercial segments and domestic uses too like Washing machines. VFD has been using vastly in all segments. These drives may get more efficiency and better performance using soft techniques like ANN & GA.

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