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## Multi Variable Speed Control of Induction Motor Using Z-Source Inverter.

### Ravi Kumar DNS<sup>1</sup>, and Hema Devi J<sup>2</sup>.

<sup>1</sup>Assistant Professor, EEE Department Sathyabama University Chennai Tamil Nadu <sup>2</sup>Assistant Professor ,ECE Department Jeppiaar SRR Engineering College Chennai Tamil Nadu

#### ABSTRACT

This paper presents the speed control of Induction motors using ZSI. V/F control is well adapted for the control of induction motor . The overall method of controlling the Induction motor by v/f control using ZSI has been presented in this paper. ZSI is the common control scheme is the control of induction motor . In this paper the ZSI has been modeled of using inductors and capacitors of cross connection and output of this ZSI as fed to the Induction motor. A MATLAB code was developed to implement the open-loop and closed loop control of ZSI fed three phase squirrel-cage IM and the torque as found to be constant for various speeds of the motor. The advanced PIC16F microcontroller is used for generating the gate pulses for the universal bridge circuit.

Keywords: Speed control, Z-source inverter, v/f control, Induction motor, power factor



\*Corresponding author:



#### INTRODUCTION

Now-a-days in many of the applications, AC machines are most desirable over DC machines because of its simple and robust constructions without any mechanical commutators, addition to several load situations and low cost acquisitions [5]-[9]. In AC machines Induction Motors are most extensively used motor for the appliances like industrial control and automation fields. Therefore, they are often termed as workhorse of the motion industry [9], [11]. As far as the machine efficiency, robustness, reliability, durability, power factor, ripples and torque are concerned, three phase induction motor placed at the top of the order [9]. The main reasons or the popularity of Induction motors are very cheap compared to DC and Synchronous motors. In present it is the first requirement or any machines [5]. Due to its economy and installation purpose Induction motor plays a vital role in industry. Especially the squirrel cage Induction motor is chosen for this paper because of its following advantages:

- 1. 1.Very rugged in construction because of its robustness it enables them to be used in all kinds of environment and for long duration of time.
- 2. It have high efficiency of energy conversion and also very reliable. Owing to their simple construction they have very low maintenance costs.
- 3. It have very high starting torque, this property is useful in applications here the load is applied before starting of the motor. The very most advantage of Induction Motors over other motors is speed can be controlled easily.

#### THE V/F CONTROL METHOD

The speed control is a necessary of Induction motor because it ensures smooth operation, provides control of torque and acceleration control. There are various methods for controlling the speed of Induction motors. Several methods have been taken in the field of vector control system for its better dynamic response [5], [11]. However the scalar control [5], presents a simple structure characterized by low steady-state error. Therefore, the constant voltage frequency (v/f) also called as scalar control is implemented in this paper because of its wide application in industrial fields [5].The motor developed torque is directly proportional to the stator flux and angular velocity. This gives the flux produced in stator is directly proportional to the ratio of applied voltage and frequency of supply.

Therefore, by varying the voltage and frequency by the same ratio, the torque can be kept constant throughout the speed range [9].



Fig 1: Speed torque characteristics of the induction motor

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i.e., stator voltage (V)  $\infty$  [stator flux ( $\Phi$ )] \* [Angle velocity ( $\omega$ )]



From the equation 1 and 2 we can say that the scalar control is the most common speed control technique of an Induction motor. The Induction motor torque developed is directly proportional to V/f ratio by changing the voltage and frequency, by keeping constant ratio, and then the torque developed will remain constant for all the speed values.

#### IMPEDENCE SOURCE INVERTER

Z-source inverter is the type of power inverter, in which a circuit that converts direct current to alternating current. Without making use of DC-DC Converter Bridge it functions as a buck-boost inverter due to its unique circuit topology. Z-source inverter can be used as buck or boost converter i.e., as a (CSI) Current source inverter and also voltage source inverter (VSI). This is the very most advantage compared to CSI or VSI. Because before used inverter either VSI or CSI were used to control the speed of the Induction motor. Z-source inverter consists of six switches i.e., MOSFET(Metal Oxide Semiconductor Field Effect Transistor). The voltage obtained by VSI and CSI is minimum that is not sufficient for proper control of speed of Induction motor. Z-source inverter is used for filtering circuit as well as driver circuit.

It allows to switches of the same leg to be gated in the circuit, therefore it will eliminate the shoot through fault occurring in traditional inverters. The constant voltage source inverter is obtained by linking a large capacitor across the DC source. The constant current source inverter is obtained by linking a large inductor in series to the DC source. These VSI and CSI having following disadvantages:

- 1. It behaves in a boost or buck operation only. Thus the establish output voltage range is limited.
- 2. Produce EMI noise so the device damaged easily in either open or short circuit conditions.
- 3. The main switching devices of both the inverters cannot inter changeable. To over-come these disadvantages composition of VSI and CSI to form a cross coupled network of the two capacitor known as ZSI.



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A voltage type ZSI is taken, inspite of the traditional voltage source inverter or current souce inverter to give the electrical energy from the DC source to the Squirrel cage Induction motor. To obtain the buck-boost output, the pulse width modulation technique should be used to control the ZSI to generate the shoot through state. There are three devices condcted in the non shoot-through modes as shown in the fig 2.a and ig 2.b during the shoot through modes, five devices are conducted when shoot through occurs in one phase arm. Fig 2.c shows that switches in S1 and S6 are fired to feed the phase a and b windings, the switch S4 is used to shorted the arm,and sketch of firing signals to the switches S1, S6 and S4.



Figures - Scop	ie .					0
Scope ×						
00.00			INPUT DC VOL	TAGE		
0.000	1	1				
0.000						
0.000			1			
0.007						
18.88						i.
1878						
3.976						
9.974	i	1	1	1	1	i
0.9569	0.9569	0.9569	0.9569	0.9569	0.9569	0.9569

#### Fig 4: Input DC voltage









#### Fig 6: Torque

#### CONCLUSION

This paper implements a Z-Source inverter fed Induction motor drive. This drive system has the advantages of both Induction motor and Z-source inverter. Using V/f control technique open and closed loop outputs are verified. The system configuration, operation principle and control method have been analyzed in detail. Simulation results were checked and the power factor is improved upto 0.9345.

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