CHAPTER ONE

INTRODUCTION

1.1 Introduction

The use of induction motors has increased tremendously since the day of its invention. They are being used as actuators in various industrial processes, robotics, house appliances (generally single phase) and other similar applications. The reason for its day by day increasing popularity can be primarily attributed to its robust construction, simplicity in design and cost effectiveness [1].

The principle of vector control (FOC) is to make a condition that AC motor work similar to DC motor and produces optimal torque. In DC motor the MMF which is produced by the armature current $i_a$is remained at a right angle to the field flux is produced by the stator by employing the commutator and brushes. In contrast with AC machine, both of these fields in DC machine are stationary. The electromagnetic torque T_e which is developed in DC machine is related to the armature current $i_a(T_e = Ki_a)$, Where K is a constant[1] .

Therefore, if it is wanted that the torque change as a step, it is simply needed to change the armature current by a step. So, the goal in FOC is to cause the angle between the armature MMF and the field MMF remained 90 degree for producing optimal torque. Thus, in vector control of induction motor, the stator current space vector is(t) is divided to two d and q rotating axis Hence, the stator phase currents are controlled in such manner thatI_{qs} delivers the desired torque while I_{ds}The maintain the rotor flux density at the rated value.I_{qs}which is known as torque producing component and the ids I_{ds} which is known as flux producing component have only dc components in steady state condition. Thus, they are ideal to be used as control variables. Furthermore, the rotor flux linkage is moving at a speed equal to the synchronous speed. Therefore, the speed error which is obtained from the difference between the reference speed ω^* and the actual rotor speedω, is used to generate the reference torqueT^*[1] .

The field of power electronics has contributed immensely in the form of voltage-frequency converters which has made it possible to vary the speed over a wide range [2,3]. However, the highly non-linear nature of the induction motor control dynamics demands strenuous control algorithms for the control of speed. The conventional controller types that are used for the aforementioned purpose are may be numeric or neural or fuzzy. The controller types that are regularly used are: Proportional Integral (PI), Proportional Derivative (PD), Proportional Integral Derivative (PID), Fuzzy Logic Controller (FLC) or a blend between them.

The only problem associated with use of conventional PI, PD and PID controllers in speed control of induction motors is the complexity in design arising due to the non-linearity of Induction Motor dynamics [4,5].

The conventional controllers have to linearize the non-linear systems in order to calculate the parameters [6].

To overcome the complexities of conventional controllers, fuzzy control [7] has been implemented in many motor control applications. In the last three decades, fuzzy control has gained much popularity owing to its knowledge based algorithm, better non-linearity handling features and independence of plant modeling. The Fuzzy Logic Controller (FLC) owes its popularity to linguistic control. Here, an exact mathematical model for the system to be controlled is not required [8].

Hence, Fuzzy logic basically tries to replicate the human thought process in its control algorithm. The FLC has thereby proven to be very beneficial in the industries as it has the proficiency to provide complex non-linear control to even the uncertain nonlinear systems. In addition to the aforementioned attributes, a fuzzy logic controller also makes good performance in terms of stability, precision, reliability and rapidity achievable [8].

It takes two inputs, viz. error and rate of change of error to model a FLC with the help of simple if-then rules. No complicated hardware is required for the same. The modeling of an FLC has been explained in Chapter 3.

1.2 Statement

Most of the industrial applications contain induction motor need to vary their speed. However, induction motors can only run at their rated speed when they are connected directly to the main power supply. This is the reason why variable speed drives are needed to vary the rotor speed of an induction motor

- In conventional field oriented control, a PI controller is used to control the speed of the induction motor drive. The use of PI controller induces many problems like high overshoot, oscillation of speed and torque due to sudden changes in load and external disturbances.

1.3 Objectives

- To control speed of induction motor by using fuzzy pi controller in the place of pi controller.
- To analyze the performance of induction motor, when use these controllers.

- To make comparisons between the results(speed, torque and current) of fuzzy pi controller& pi controller

1.4 Methodology

This research aims to obtaining high accuracy, quick response and smoothness of speed and torque of three phase induction motor drive through its simulation by indirect vector control using MATLAB SIMULINK software, when using fuzzy pi& pi controller.

1.5 Thesis layout

Chapter one includes introduction about three phase induction motor, conventional control, vector control (FOC), fuzzy and pi controller

Chapter two shows literature overview about the induction motor, speed control techniques (scalar control, vector control, pi control, fuzzy logic control and direct torque control).

Chapter three represents mathematical model of the three phase induction motor, indirect vector control, and MATLAB software model of fuzzy controller.

Chapter four includes MATLAB SIMULINK software results, when using fuzzy pi controller &pi controller, and make comparisons between them.

Chapter five includes conclusions and recommendation.