CHAPTER - I

INTRODUCTION

1.1 GENERAL

In industrial applications requiring variable speed drive, D.C. motors are generally preferred because DC motor is able to provide high torque at low speed, also it has wide speed range over which it may operate. On the other hand A.C. motors have low cost long life, low maintenance and are highly reliable at fixed speed. The main reason behind it is non availability of commercial variable frequency sources. After the invention of thyristor and short turn-off time devices it has now become possible to have low power inverters on commercial scale. The most significant and desirable feature of an ac motor is the absence of commutators. Induction motors of squirrel cage type are more commonly used. Now a days induction motor is the most widely used machine for many application with drive system.

Though the cage induction motor is the most popular machine for industrial applications, it is also the most complex from the viewpoint of drive and control. The complexity arises from the fact that the machine's readily controllable variables like stator voltage and currents are highly non-linearly related to the controlled variable, the electromagnetic torque. Field orientation theory [1, 2], provides the most attractive possibility of a linear control relationship between the machine primary electromagnetic torque. This is achieved by orientation of the primary current vector appropriately with respect to the position of the total rotor flux linkage. A current-source type linear machine model, in which the magnetizing current and torque current are primary input variables and the electromagnetic torque produced is in proportion to the product of the torque current and motor flux can be achieved[3]. The task of the system then becomes the control of the primary current-vector, its orientation and magnitude.

A great deal of research has been directed to the implementation of field-orientated control and impressive results have been obtained [3-11]. However, practical realization is difficult and very complex schemes are often employed.

1.2 REVIEW OF THE LITERATURE

The field oriented control of an induction motor requires the use of multiprocessing and custom hardware circuits [12-15], regardless of the type of inverter or orientation method used. In all cases, one of the problem facing the designer is the minimization of custom hardware. Related to the problem is the efficient replacement of components by software, as is the generation of gating signals to a PWM inverter in order to obtain the desired amplitude, frequency and phase angle. Using the concept of precalculated gating patterns stored in the single-board computer as described by Rajeshkara and Vithayathil [19], this paper describes an answer to the problem and related difficulties in the implementation of voltage control. Voltage control with compensation decoupled effectively the current components responsible for rotor flux and torque, minimizing the effect of the variation of the rotor circuit time constant on the control scheme.

Besides dynamic performance, power efficiency is also an important factor to be considered in the controller design of induction motors. Many people works on control of induction motors concern either high dynamic performance or high power efficiency, however, some people consider control of induction motors for both high dynamic performance and high power efficiency[17].

The controllers [20-25] can control induction motors to behave like dc motors. In particular, the controllers proposed recently in [23] and [24] can control induction motors with speed and rotor flux dynamically decoupled. However, these results concerns only dynamic performance but not power efficiency. Many researchers shown that high power efficiency can be obtained by controlling the slip speed optimally. There are many high - frequency power devices, such as MOSFET's or insulated gate bipolar transistors that are employed in various-capacity PWM inverters. Because PWM inverters are driven by high-frequency PWM signals, these devices have ensured better generating efficiency of the motor torque and less magnetic noise generated by PWM control.

However, other problems have appeared due to oscillations that are generated when induction motors are driven by PWM inverters operated using high-frequency PWM signals. Instability phenomenon have been reported where oscillations are generated in low-speed regions when induction motors are driven by variable - frequency inverters. Generation of these oscillations is attributed to the exchange of energy between the dc link filter components and the magnetic field and rotor of the machine. An analysis has shown that these oscillations do not occur in idealized induction machines that do not have a primary resistance or leakage inductance. This means that the instability exists in the induction motor itself. Even if the induction motor has an inherent instability factor, no practical problems arise if the motor is given by PWM signal with a comparatively low frequency of less than 0.5 kHz. However, if the frequency of the PWM signal is more than this value, another problem occurs from the large primary current distortion due to the dead time of the PWM signals. This distortion causes the motor speed to fluctuate. If the fluctuations of the motor speed are produced in regions where the induction motor becomes unstable, the rotor of the motor will begin to oscillate remarkably. This new oscillation causes the primary current to increase to a level such that it may reach the inverter protection level. As a result the inverter will be forced to trip, or power devices in the inverter will be damaged.

All these oscillation states vary with motor parameters such as motor constants, the number of poles and the moment of inertia, the inverter parameters such as dead time of the PWM signals, the output-voltage of the inverter, and the inverter frequency. Accordingly, a method is needed to suppress the oscillations, even if these parameters are varied. It is easy to realize in a system that drives a motor with known motor parameters using a speed regulator or a current regulator, such as in an ac servo system, because gain of these regulators can be adjusted according to the motor characteristics and the oscillations can be suppressed. For these reason the knowledge of motor parameter is very essential.

Modeling and simulation have been widely used both at the designer and user stages for predicting and studying steady-state and transient behaviour of induction motors. The utility of these approaches has been further confirmed in induction motor drive analysis and the results seem to conclude that a more correct motor simulation can be achieved through an accurate parameter selection, rather than by using a sophisticated model.

In order to improve motor parameter estimation new procedures have been applied suggesting alternative use of sophisticated optimization algorithms. However, more correct results can be expected from identification methods, as parameter estimation is worked out through experimental measurements on the machine during its normal operating conditions following natural or impressed perturbations.

An accurate knowledge of the motor parameters is required in order to operate in abnormal conditions, where faults from normal operation can be expected. In such cases, fault detection techniques can be simplified by or even based on a real-time knowledge of the machine parameters achieved through on line identification procedure.

Although important, the on-line determination of the induction motor parameters does not present wide applications, because of the difficulties connected with a correct acquisition of the needed experimental data and also because of the difficulty in accurate implementation of the available identification procedures. Moreover, due to the complexity of the process at hand, an on-line identification system for electrical machines based on a multi-microcomputer mainframe structure requires an accurate prior knowledge of the motor modeling and a careful choice of the identification algorithm.

These problems are faced in the present work in order to identify the rotor parameters of an induction motor by using a personal computer-based data acquisition system.

1.3 STATEMENT OF THE PROBLEM

Until recently it has been universal practice to use dc motors for variable speed drives. After the introduction of thyristors, there has been lot of development in the field of three phase drives. The fast power devices like microprocessors has made it a simpler matter to construct complex control system with reasonable cost.

Three phase induction motors have some advantages over the dc motors because of their simple and robust construction. As use of AC motors increases in industrial application, its correct on line performance testing becomes very essential.

The conventional method to measure various performance data such as power factor, horse power, percentage efficiency and speed of any rotating electrical drive, one has to note various electromechanical meter readings and finally calculate the desired values. This method is laborious as well as time consuming and continuous information under operating conditions cannot be readily obtained.

In order to overcome these difficulties, it is proposed to develop a personal computer based system for measuring the performance parameters of the motor and display them one after the another. To achieve this electronic hardware will be designed and fabricated for sensing and signal conditioning, the different motor parameters like current, speed and voltage etc. The hardware will then be interfaced with personal computer through the data acquisition card. The various measurements will be carried out on induction motor under no load and full load conditions. The necessary software will be written in order to estimate power factor, horse power, percentage efficiency and speed of the motor. The processed information will be displayed in a graphical form so as to analyze it very easily.

1.4 ABOUT THE DISSERTATION

The different phases of the work that has been carried out in the present project is divided into five different chapters.

The Chapter I deals with a brief account of the survey related to the induction motor, its drives etc.

The Chapter II of the present work will represents the theoretical background of the induction motors.

Design of the system with interfacing card and its testing in laboratory is carried out in Chapter III.

Chapter IV deals with the development of the software to perform the different task. The system calibration is important and is carried out in the same chapter.

Chapter V discuss the performance of the system. The results obtained from the system are also discussed. Overall summary of the dissertation is presented in the chapter VI.

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