DYNAMIC MODELLING OF INDUCTION MOTOR BASED ON ROTOR REFERENCE FRAME

Thesis is presented in partial fulfillment for the award of the

Bachelor of Electrical Engineering (Hons)

UNIVERSITI TEKNOLOGI MARA

NURANI SAH BT ZAKARIA
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA (UiTM)
SHAH ALAM
MAY 2011

ACKNOWLEDGEMENTS

First of all, I really would like to thank to Allah s.w.t for approval and blessing that made all this happened and came true. Nothing can be done without permission of Allah. Allhamdulillah.

A special and most honoured gratitude to my supervisor Ir. Mohamad Aris Bin Ramlan for his guidance, teachings and support throughout this project. I am truly honoured and humble to have him as my supervisor because his knowledge and expertise is very vast and wide. I am beyond doubt enjoyed the challenge of discussing and debating various aspects and topics regarding my project with him which later helped me improve my final project and knowledge about it.

I would also like to thank Cik Puteri Nurasyikin and Dr Nawawi Seroji for the evaluation of my technical paper presentation, technical paper and final report for this project.

Special thanks to my acquaintances for helping me with their precious suggestions and supports throughout the completion of this project. Your kindness will be embedded in my heart forever.

ABSTRACT

Induction machine is strong non-linear element, in which the electrical and mechanical transient process is independent. Induction machine has a stator and a rotor mounted in bearing and separated from the stator by an air-gap. It also can operate both as motor and generator. Induction motor are widely used, especially poly-phase induction motor, which are frequently used in industrial drives. But it is a multi variable, strong-coupling nonlinear system. Variable speed drives are converter-fed from finite source, unlike the utility sources due to the limitations of the switch rating and filter sizes. This will result in their incapability to supply large transient power. Most efficient induction motor will have steady-state in shortest time to achieve steady-state which means can operate with full efficiency in shortest time. In order to predict or measure the dynamic behavior of induction machine; the dynamic simulation is one of the key steps in validation of the design process of the motor drive systems, eliminating incompatible design mistakes and resulting errors in the prototype construction and testing. In order to do dynamic simulations, MATLAB program implemented to complete the step referring to reference frames. The objective of this project is to develop a dynamic mathematical model of a three-phase induction motor for purpose of performing simulation study and develop MATLAB programming simulation of the induction three-phase motor model to compared it with theoretical. The model is derived using rotor reference frame approach using MATLAB programming. A Runge-Kutta fourth order numerical method is used to solve the induction motor voltage differential equations. The obtained simulation results are compared with known results to determine the reliability of the developed model. Evaluation of the comparisons revealed that the developed model is reliable for use in performing dynamic simulation of three-phase induction motor.

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION

1.1 Overview

Induction motors especially the poly-phase types of induction machines are widely used many industrial drives. Induction motor operates in 3 phases which is small single phase, two-phase and three-phase. Small single phase in fractional horsepower rating is used in many household appliances. Two-phase is used primarily as servomotor in a control system and three-phase mathematical equation is transformed into its mathematical equation analysis can be developed in order to analysis the transient characteristic of induction machine. Increase interest in the use of induction machine has made it imperative to look at a simple, accurate and faster method of simulating the dynamic performance of the machine. This is important because the industrial engineer needs to be provided with valuable insight into the dynamic behavior of the machine prior to its construction including its predicted time function of the transient current, speed, electromagnetic and shaft torque characteristics of the machine [1]. Simulation using software developed using FORTRAN programming language has been reported in the literature. Chattopadhyay uses numerical integration technique of Runge-Kutta-Merson to simulate an adjustable-speed induction motor drive [1]. There are three generalized model of the induction motor in arbitrary reference frames are of general interest. There are stator reference frame model, rotor reference frame model and synchronous reference frame model. This paper uses MATLAB to implement computer program that can simulate and solve the non-linear differential equation that describe the dynamic behavior of an induction machine based on rotor reference frames model [3].