

CURRENT MODE FUZZY BASED CONTROLLER FOR MULTILEVEL
INVERTER

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Dedicated to my beloved father & mother

Misiran Bin Mastary & Siti Missiah Binti Ramtimin

My Beloved Wife

Fadila Binti Lazim

My Beloved Children

Ridzwan Bin Mohamad Anim

Adelia Binti Mohamad Anim

And

My Entire friend in MEP programme

For their encouragement

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ABSTRACT

The thesis presents the control design for H-bridge cascaded multilevel inverter using current mode fuzzy based controller. The cascaded multilevel inverter synthesizes a five level output voltage from a several independent source. Using multilevel technique, the amplitude of the voltage is increase, stress in the switching device is reduce and the overall harmonics profile is improve. Fuzzy logic is utilized to compensate any changes at the output due to disturbance, system parameters changes, nonlinearities and etc. The full inverter system, is designed and simulated using Matlab-Simulink. From the simulation results, it was shown that the controller is capable to compensate disturbances hence verify the design.

ABSTRAK

Tesis ini mempersembahkan pengawalan rekabentuk jambatan-H jujukan berbilang aras litar penyongsang menggunakan kaedah arus logic kabur sebagai pengawalan. Jujukan berbilang aras litar penyongsang dapat menjana lima aras keluaran voltan daripada berbagai pemacu sumber yang tidak bersandar. Menggunakan berbilang aras teknik, amplitude voltan akan meningkat, tekanan dalam pensuisan alat peranti akan berkurangan dan keseluruhan profil harmonic akan lebih baik. Logik kabur dapat mengimbangi setiap perubahan pada gangguan keluaran, pertukaran sistem penghuluran, ketidakseragaman dan sebagainya. Sistem litar penyongsang penuh telah direka dan ditiru menggunakan Matlab-Simulink. Dari hasil keputusan peniruan, dapat menunjukkan bahawa pengawalan berkebolehan untuk mengimbangi gangguan justeru telah mengesahkan rekabentuk.

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LIST OF ABBREVIATION

THD Total Harmonic Distortion

PWM - Pulse Width Modulation

CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays many applications such as uninterruptible power supply (UPS), adjustable speed AC motor drive and AC home appliance are use inverter type. Its convert direct current (dc) to alternate current (AC). The purpose of inverter circuit is to convert an AC voltage from the source of DC voltage normally comes from battery or other DC source. This project will concentrate to produce AC output from the DC input with close loop by using current mode fuzzy logic as base controller to control inverter. The main impetus for this is the fact that electrical equipment and machineries have begun to demand for power converters in the range of several Megawatts to be connected to a medium voltage network (2.3-6.9kV) [1]. For the large power conversion systems, one approach inverter to solve which to use for high power connected to the grid, the multilevel inverter to be proposed. The multilevel inverter can improve harmonics performance which eliminate for switching losses reduction. In contrast, where the proportional to the number of output voltage level, the stress on each switch can be reduce.

1.2 Problem Background

An inverter change a DC or battery power into AC or household power through waves which called either sine waves or modified waves. Single stage inverter produced low voltage output and harmonics contain. Recently, the multilevel inverters have received more attention in literature due to their ability to synthesize waveforms with a better harmonic spectrum and to attain higher voltages[2]. The output voltage waveform of a multilevel inverter is composed of a number of levels of voltages starting form three levels and reaching infinity depending upon the number of the dc sources[3]. System need in close loop operation to remains stable output even any external disturbance occur. In open loop, the stability of the appliances will effect due to efficiency needed. Compared with open loop control system, the close loop operation control has the advantage of gaining precise inverter output voltage.

The study is expected to find way of reducing harmonics which effected from switching components and produce higher voltage for supply to the load. The fuzzy logic approach has been objected of an increasing interest and has found application in many domains of control problem. The main advantages of fuzzy logic control method as compared to conventional control techniques resides on the fact that no mathematical model is required for controller design and also it does not suffer much from the stability problem but it need the experts experience[4]. The considerations from the simulation result will be explained throughout the report.

1.3 Problem Statement

The topology of single phase H-bridge inverter and multilevel inverter has been defined. In this project, the multilevel inverter has been constructed base on single phase single inverter from the basic H-bridge fundamental. The output voltage waveform from the open loop and close loop has been analysed. The switching method by using pulse width modulation(PWM) using ideal switch from the MATLAB simulink at certain injected frequency have been observed. The low pass passive filter from desired value will be calculated and adjusted to produce better waveform output similar which AC needed. Incorrect chosen filter will effect to the output waveform voltage.

The idea from the sine wave output implemented to the multilevel inverter with additional expandable from the control switch. At the beginning stage, the project implemented to multilevel inverter facing due to get better sinusoidal voltage output. Mostly the selection low pass passive filter effect the waveform output and the control unit which combination a few of logic gate and signal generator is important thing need consideration. Finally stage all the value and parameters with close loop operation with combination of fuzzy logic based on current mode has been successfully define and simulation result will be explained throughout the report.

1.4 Objective

Few objectives have been identified in this study:

- a) To proposed a current mode fuzzy based controller for cascaded in multilevel inverter.

- b) To develop stable AC output and clean which provide by monitoring by fuzzy logic regardless of the load type connected to it.
- c) To develop relevance multilevel inverter simulate using MATLAB simulink software.
- d) To compare the performance of these methods.

1.5 Project Scope

This study will reflect the estimation of close loop current mode with fuzzy logic controller for output sinusoidal output waveform. The scope of this study as shown below:

- a) The method concentrates on the design H-bridge cascade multilevel inverter with minimum two stage and five output level voltage. The cascaded multilevel inverter synthesizes a desired from a several independent source of DC voltage obtained from batteries.
- b) Each single DC source is associated with a single H-bridge inverter then the AC terminal voltage of a different level inverter are connected in series. Using multilevel technique, the amplitude of the voltage is increased, stress in the switching device is reduced and the overall harmonic profile is improved.
- c) Simulation based on MATLAB simulink will be conducted and the methodology of inverter employs fuzzy logic control has two control input, which are error(e) and change of error(\dot{e}).

1.6 Significance of Project

There are increasing worldwide home appliance, heavy industries, automotive and power system network used inverter concept such as multilevel inverter. A past few years the inverter have been increasing on demand for high power application. The small important feature if inverter can only produce a small total harmonic distortion. Cascade multilevel inverter proposed in this project with control circuit current mode fuzzy logic to control output voltage using sinusoidal pulse width modulation. Mostly PWM is useful for many electronics circuit due to comparing fundamental voltage and carrier voltage in certain frequency was not complex circuit. The importance of safety, reliability economically wise of inverter module in market increasing the demand. Beside accuracy, the effectiveness of fuzzy logic based current mode controller able to detect voltage and current at sudden fluctuate due to load change.

1.7 Organization of Report

The report consists of five chapters. Chapter 1 presents the introduction of the study, problems statement, objectives and project scope. Chapter 2 gives literature reviews on the methods. The introduction of controller and methodology of entire work is discussed Chapter 3 and Chapter 4 discussed the simulation and the result. The conclusion and suggestions for future work are explained in Chapter 5.

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