Ain Shams University

Faculty of Engineering

Grid Connected Photovoltaic Using Multi Level Inverter

By

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A Thesis Submitted for the Requirement of Master Degree of Sciences in Electrical Power Engineering

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Cairo 2019

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Statement

This thesis is submitted to Ain Shams University in partial fulfillment of the requirements for the degree of Master of Sciences in Electrical Engineering.

The work included in the thesis was carried out by the author at the department of Electrical Power and Machines, Ain Shams University.
No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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Acknowledgement

I would like to thank **Prof. Dr. Ahmed Abd El-Sattar Abd El-Fattah,** one of my two thesis supervisors, for his invaluable directions, and supervision work, his wise advice, his patience and for allowing me the opportunity to develop this work.
I am greatly indebted to him, for his guidance, support, suggestions, encouragement and reviewing the drafts of the thesis and the time he offered me during supervision, without which this thesis would not has been possible.

Also, I would like to thank **Prof. Dr. Nagar Hassan Saad**, my thesis supervisor, for the guidance and advices during the research and for his continuous patience in reviewing the drafts during the preparation of this thesis.

Special thanks to my parents; my friend and my family for their endless support in my endeavors. The enrollment and pursuance of graduate studies would have been impossible without their continuous encouragement and motivation throughout the years.
Thanks for supporting me in this journey….
From bottom of my heart I wish to thank my mother, for her endless love, support and understanding.
Special thanks to all my friends

Finally, but certainly not least, I would like to thank Allah for giving me the opportunity of being the person that I am and for giving me the strength of developing personal and spiritually.

Abstract

This thesis presents Photovoltaic energy (PV) connected to three phase grid through back to back converter. It studies the maximum power point tracking (MPPT) for photovoltaic by two different methods.

First method is traditional one which is called incremental conductance method. In order to enhance the efficiency of tracking an intelligent method called particle swarm optimization (PSO) is used . A Back to Back converter composed of boost DC chopper and multi- level inverter (MLI) are used . Dc chopper is connected directly to the PV and is controlled to get MPPT .The MLI is used to interface with utility grid.

This Thesis deals also with the partial shading condition (PSC) phenomena which occurs most of the time .

The system is modeled and simulated by using the matlab programe. The performance of the system by using PSO shows better results compared with incremental conductance. Both of two MPPT methods feed the input of the grid tied inverter with the determined DC bus voltage.

Keywords: Photovoltaic (PV) ,Maximum power point Tracking (MPPT) ,particle swarm optimization (PSO),Incremental conductance (IC),Partial shading condition(PSC).

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LIST OF ABBREVIATIONS

MPPT: maximum power point tracking

PSC: partial shading conditions

IC: incremental conductance

PSO: particle swarm optimization

MOSFET**:** metal-oxide-semiconductor field-effect transistor

PV**:** photovoltaic

DC: direct current

LIST OF SYMBOLS

Ω: Ohm

℃**:** Celsius

µ: Micro

n: Nano

F: Farad

H: Henry

Chapter 1

Introduction

1.1 Background

Nowadays the demand of power is growing up and increases by increasing the luxury of our life. The conventional sources of power are not enough and have bad environmental effect. So that world is going to the renewable power sources like wind and solar energy to generate the electricity. The using of fuel energy causes many environmental problems like the global warming. The solar cell radiation seems to be one of the most promising renewable energy sources and can be directly converted into electricity using the photovoltaic (PV) devices. Solar energy can be presented as standalone source and also can be connected to the nearest utility grid. Therefore, solar energy can be used in the rural areas.

This thesis deals of investments in solar energy solutions to enhance the energy performance and to solve the power demand problems. Many solutions are presented in the power conversion nowadays to be easy in the use. Power electronics are updated and present many solutions and small size systems to help in this side. The most disadvantage of using renewable energy like the solar is the voltage fluctuations. To overcome this problem multi input converters can be used to reduce the voltage fluctuations. The cost and the efficiency of this systems are important factors to make the renewable energy resource strong and comparative in the global power markets.

In order to get the maximum benefits of this energy, many researchers try to reach maximum power extracted from solar cells by many methods and many technologies. The maximum power point tracking is a mechanism to enhance the efficiency of solar energy system and the whole renewable energy too .

1.2 Literature Survey

Many researchers are looking upon solar energy topic around the world. Solar energy was well known by low efficiency operation and need high control system for efficiency enhancement. So that researchers invented the maximum power point tracking (MPPT) techniques. It is a perfect control to increase efficiency of photovoltaic. Tutorial on how to use solar module physical model [2]. Zhou.Y and Huang.W publish a paper related to single stage boost converter for grid-connected photovoltaic system [5].

R.Sridhar explained the performance enhancement of the standalone photovoltaic systems under inhomogeneous irradiation [1]. Freitas.A has successfully depicted the modeling of high voltage gain DC-DC boost converter with couple indicators for photovoltaic systems [10]. Qahouq J.A has presented single maximum power point tracking controllers [12]. Karami.N has presented different maximum power point tracking techniques classification [14]. Nahla E.Zakzouk has included the low cost PV MPPT technique of Incremental Conductance method and how to improve the performance [15].

Mellit.A presented the maximum power point tracking based on the artificial intelligence techniques for photovoltaics systems[18]. Andre Tobon and Jorge Herrera gave types of algorithms for tracking the maximum power point [20]. Soufi.Y explained the fuzzy- PSO controller design for Maximum power point tracking in photovoltaic systems [21]. Soon.J presented the photovoltaic model identification using particle swarm optimization with inverse barrier constraint [22]. Hairul Nissah depicted comparison study between different algorithms of MPPT for PV systems [24] .