بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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Ain Shams University
Faculty of Engineering
Electrical Power & Machines Department

Modeling and Performance of Grid Connected Inverter Based Photovoltaic Systems

Ph.D. Thesis

By

Eng. Nourhan Mahmoud Hanafy Mahmoud Elbehairy

Submitted in partial fulfillment of the requirements for the Ph.D. degree in Electrical Engineering

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Cairo, 2020

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STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the requirements of Ph.D. degree in Electrical Engineering.

The included work in this thesis has been 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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Nourhan Mahmoud Hanafy Mahmoud

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ABSTRACT

Electricity is one of the prime factors of the growth. It determines the value of the different societies. A reliable, continuous supply of electrical energy is very essential for the functioning of today's modern complex and advanced society.

The renewable energy sources are considered the savior of the electricity generation as there is a great depletion of the conventional energy resources. The photovoltaic energy is one form of the solar energy resource that considered one of the greatest sources of energy in the world. The solar energy is green, renewable and available all the years especially in Egypt.

As the characteristics of the photovoltaic cells are not linear, therefore the maximum power may not be utilized as this depends on the operating conditions such as the irradiance and temperature. A maximum power point tracking algorithm should be applied to operate the photovoltaic arrays with its maximum output power.

One of the major problems in this type of systems is the shading conditions that the photovoltaic arrays may be subjected to. Hence, modified algorithms should be considered to overcome this problem. Some of these algorithms depend on artificial intelligence tools. This thesis introduces one of these methods which is the Flower Pollination Optimization Algorithm. A system modeling and simulation are performed using MATLAB/SIMULINK package to verify the applicability of using the proposed algorithm to solve the problem of maximum power point tracking under different shading conditions.

The problem of grid connection control is also studied in this thesis to control the voltage source inverter used in grid interfacing. The control architecture includes the phase locked loop control algorithm to satisfy a certain objective. The main objective of the control in this thesis is to improve the power quality of the grid and to control the reactive power flow. Also, reduction of the harmonics levels in the utility electrical currents. The simulations of this part of the thesis are also performed using MATLAB/SIMULINK package to verify the superiority of the proposed optimization tool that used to select the control parameters of the suggested control strategy.

Keywords: Photovoltaic energy resources, Maximum power point tracking, Flower Pollination Algorithms, Grid connected PV systems, Voltage source inverter, Power quality control and Reactive power flow.

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