MODIFIED CONTROL TECHNIQUE FOR IMPROVING PHOTOVOLTAIC PERFORMANCE

By

Eng. Tarek Mohamed El-Sayed Abou Saltouh

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
ELECTRICAL POWER AND MACHINES ENGINEERING

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Title of Thesis :

Modified Control Technique for Improving Photovoltaic Performance

Key Words: **(**Photovoltaic, Maximum power point (MPP) tracker, perturb and observe (P&O), Sun tracker**)**

Summary :

This thesis provide modified control technique for improving photovoltaic performance to overcome the problems and to maximize the benefit from the photovoltaic as much as possible. This has been done in this thesis by proposing and implementing the both systems one of these system is to use a maximum power point (MPP) tracker and the other is to use a sun tracker. Both systems are mathematically modeled and simulated by using MATLAB-Simulink and M-file.. Moreover, the two systems are implemented experimentally by using AVR ATMEGA microcontroller.

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PV	Photovoltaic
MPPT	Maximum Power Point Tracker
P&O	Perturb and Observe
PWM	Pulse Width Modulation
n	Diode ideality constant
R_s	Module series resistance, Ω
R_{sh}	Module shunt resistance, Ω
N_s	Number of series cells
V_{pv}	Photovoltaic voltage, V
I_{pv}	Photovoltaic current, A
I_{ph}	The light-generated current, A
N_s	The number of cells connected in series
I_{mp}	Maximum power point current, A
V_{mp}	Maximum power point voltage, V
I_{sc}	The short-circuit current, A
V_{oc}	The open-circuit voltage, V
q	The electron charge (1.602×10^{-19} coulomb)
K	Boltzmann's constant, ($1.38\ 10^{-23}$ joule/°K)
T	Absolute temperature of P-N junction, °C
T_{ref}	Reference temperature of P-N junction, °C
I_o	The reverse leakage current, A
P_{maxs}	Maximum power of the PV module at STC, W
V_{mps}	Maximum power point voltage at STC, V
I_{mps}	Maximum power point current at STC, A
K_{Voc}	Open-circuit voltage temperature coefficient (= -0.0756 V/°C)
K_{Isc}	Short-circuit current temperature coefficient (= 0.0045 A/°C)

E_g	The band gap energy for silicon (1.121 ev)
G	Solar irradiance, W/m^2
G_{ref}	Reference solar irradiance W/m^2
I_{scs}	Short circuit current of the module at standard test conditions, A
V_{ocs}	Open circuit voltage of the module at standard test conditions, V
K_P	Proportional gain of the PI controller
K_I	Integral gain of the PI controller
D	DC-DC converter's duty cycle
ADC	Analog to Digital converter
α_s	The solar altitude angle in degrees
γ_s	The solar azimuth angle in degrees
θ_z	The solar zenith angle in degrees
δ	The declination angle of the sun in degrees
φ	The latitude in degrees
t_C	The local time, in hours
t_S	The solar time in hours
z_C	The time zone east of GMT in hours
λ	The longitude angle in degrees
E	The equation of time
ω	The hour angle in degrees
γ	The surface azimuth angle in degrees
β	The module tilt angle in degrees
θ_i	The incidence angle in degrees
G_{SC}	The extraterrestrial radiation in W/m^2
G_{on}	The normal extraterrestrial radiation in W/m^2