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Designing And Modelling Of Multilevel Inverter With Reactive Power Control Ability For Connecting PV Cells To The Grid And Improve The Voltage Profile At Load Side

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Abstract: Photovoltaic system is gaining increased importance as a renewable source because of its advantages such as the absence of fuel cost, little maintenance and no noise and wear due to the absence of moving parts. But there are still two principal barriers to the use of photovoltaic systems: the high installation cost and the low energy conversion efficiency. The main idea is to utilize inverter for reactive power injection during active power decrement. Using a low pass filter and power limiter in control system, produced oscillations due to unbalanced load is eliminated and inverter works in safe condition simulation results show the proposed method to be viable in controlling inverter.

***Index Terms* – Photo voltaic system, Renewable source, Low pass filter, Multi-level inverter.**

I. INTRODUCTION

A PV panel is a non-linear power source, i.e., its output current and voltage (power) depend on the terminal operating point. The maximum power generated by the PV panel changes with the intensity of the solar radiation and the operating temperature. To increase the ratio of output power/cost of the installation, the PV panel should operate in the maximum output power point. The output of solar PV cell is a Direct Current (DC), where the current is determined by the area of the cell and amount of exposed solar irradiation. The voltage of the individual silicon cell is in the order of 0.5V. Thereby, the cell has to be connected in a series to constitute modules with reasonable voltage level. The maximum power is delivered at the operating point, where the magnitudes of PV system and load resistance are equal. This is usually performed by an interfacing DC-DC power converter employing certain MPPT technique and algorithm. The operating point is held at MPP by regulating either the current or voltage of the MPPT converter.

PV systems are usually used in three main fields: 1. Satellite applications, where the solar arrays provide power to satellites, 2. Off-grid applications, where solar arrays are used to power remote loads that are not connected to the electric grid, and 3. On-grid, or grid connected applications, in which solar arrays are used to supply energy to local loads as well as to the electric grid. The main focus of this research is to identify the proper DC-DC converter which uses the adaptive perturbs and observe MPPT algorithm to maximize energy extraction from the solar PV module and to increase the conversion efficiency of MPPT system.Using distributed generation has been widespread recently, especially those which use renewable energies. Photovoltaic (PV) cells are used in order to convert solar energy into electrical energy. For connecting PV cells to the grid, equipment such as DC-DC converters, energy storage devices, inverters and filters must be used. So designing and controlling each equipment is of great importance.

Upcoming challenges of connecting solar generators to the grid include maximum power point tracking (MPPT), least harmonic injection to the grid and supplying local load appropriately that all can be reached by properly controlling these equipment. One of the important issues in connecting PV generators to the grid which includes local load is injection of active power equal to MPP and also injection of demanded reactive power of the load, as much as possible. In other words, correcting power factor in order to reduce the power absorbed from the grid. In this approach in addition to occupying capacity of inverter after compensating reactive power that causes fluctuation in injected power, there will be some problems in control system that increase THD [2].

II. EXISTING AND PROPOSED SYSTEM

The demand for electric energy increases rapidly due to the global population growth and industrialization. The increase in the energy demand requires electric utilities to increase the generation. To overcome the problems associated with generation of electricity from fossil fuels, renewable energy sources can be blended in the energy mix. One of the renewable energy sources is the light received from the sun. A significant advantage of photovoltaic system is the use of the abundant and free energy from the sun. The sun light can be converted to clean electricity through the photovoltaic process. Despite the increasing use of PV systems, these systems still face a major obstacle due to the high capital cost and low efficiency when compared with other renewable technologies. In addition, the fluctuations in the output power due to non-linearity might lead to undesirable performance. These obstacles can be overcome by utilizing the recent technology in developing low-cost PV cells and efficient power conditioning system. As a result, many research works address the development of power conditioning system in recent years with improved performances.

To maximize the overall power generation of solar PV powered system, the operation point of each PV module is at its own MPP and improves converter conversion efficiency of power conditioning system. The DC-DC converters used in solar power conditioning system are highly non-linear circuits, a great variety of strange phenomena have been observed, including sub-harmonics, quasi-periodic oscillations, and chaotic behaviours. In particular, it has recently been observed that a large number of power electronic circuits can exhibit deterministic chaos. Even though most of the approaches proposed until now are very interesting, they mainly present theoretical or simulated results. As a consequence, there is a lack of experimental analysis on the parameter domains for which chaotic behaviour may occur in solar PV system. Therefore, this research work aims at bridging this gap by presenting an experimental study of some dynamic phenomena that can occur in voltage mode controlled boost converter based solar PV system.

III. OBJECTIVES

- To model the solar PV module for studying the effect of temperature and irradiation on the performance of the PV module.
- To analyse, simulate and implement the direct control Adaptive Perturb and Observer MPPT algorithm with boost converter using micro-controller to track maximum power from solar PV module.
- To implement and compare different control methods in terms of their performance in suppressing ripples, reducing peaky electromagnetic inference and increasing converter conversion efficiency in MPPT circuits of the solar PV powered boost converter system with good steady state performance.
- To investigate experimentally and control the non-linear dynamics such as chaos non-linearity in boost converter-based solar PV system.
- To design a voltage controller for regulating the output voltage of the solar PV module so that the input voltage of the DC-DC boost converter-based solar PV system is chaotic free and regulated for the change in irradiation. The stability of the DC-DC boost converter-based solar PV system is analysed for the supply disturbances.
- The dc voltage controller is used to produce the reference current value for the id current controller. Its aim is to keep the voltage constant on the dc side in normal condition or during rapidly changing atmospheric conditions.
- This process continues until the increase in irradiance slows down or ends.
- To overcome the proposed MPPT enables us to decouple the change in power caused by the simultaneous increment perturbation and irradiation variation.
- The irradiation variation is estimated by using the signal error of the PI controller of the dc voltage control.

IV. METHODOLOGY

The main purpose of this project is to reduce the total harmonic distortion below 54% which is already produced the 54% of losses. Such that the following methodology is used to improve voltage profile are;

- By using maximum power point trace.
- Design of filters and also using MATLAB/ Simulink.
- By reactive power compensation.
- Using PLL (Phase loop lock) And by comparing SPWM and SVPWM.

T h e efficiency of energy conversion depends mainly on the efficiency of the PV panels that generate the power. Weather conditions also influence the efficiency, which depends non-linearly on the irradiation level and temperature. When a PV array is directly connected to a load, the system's operating point will be at the intersection of the I–V curves of the PV panel and load. The non-linear variations in the output voltage and current, which depend on solar-radiation levels, operating temperature and load current, can cause a low electrical efficiency. To solve these problems with the utilization of solar arrays for electrical power, the MPP of the PV system (at given conditions) is tracked using offline or online algorithms, where the system operating point is forced towards optimal conditions. The PV array has an optimum operating point called the

MPP, which is never constant over time and varies depending on cell temperature and the present irradiation level.

To obtain the maximum power from a PV array, an MPPT is applied. The location of the MPP in the I–V plane is not known in prior. It can be calculated using a model of the PV array and measurements of irradiance and array temperature, but making such measurements is usually too expensive for this application, and often the required parameters for the PV array model are not known adequately. Thus, the MPPT must continuously search for the MPP of the solar PV module. Many techniques for MPPT of solar PV have been proposed to track maximum power from solar PV module. Some important useful techniques such as as hill climbing / Perturb And Observe (PAO), Incremental Conductance (IncCond), fractional open-circuit voltage, fractional short-circuit current, fuzzy logic control, neural network, and Ripple Correlation Control (RCC). The studied system in this paper that is also used in many research papers like [2] and [3] is depicted in Figure 1.

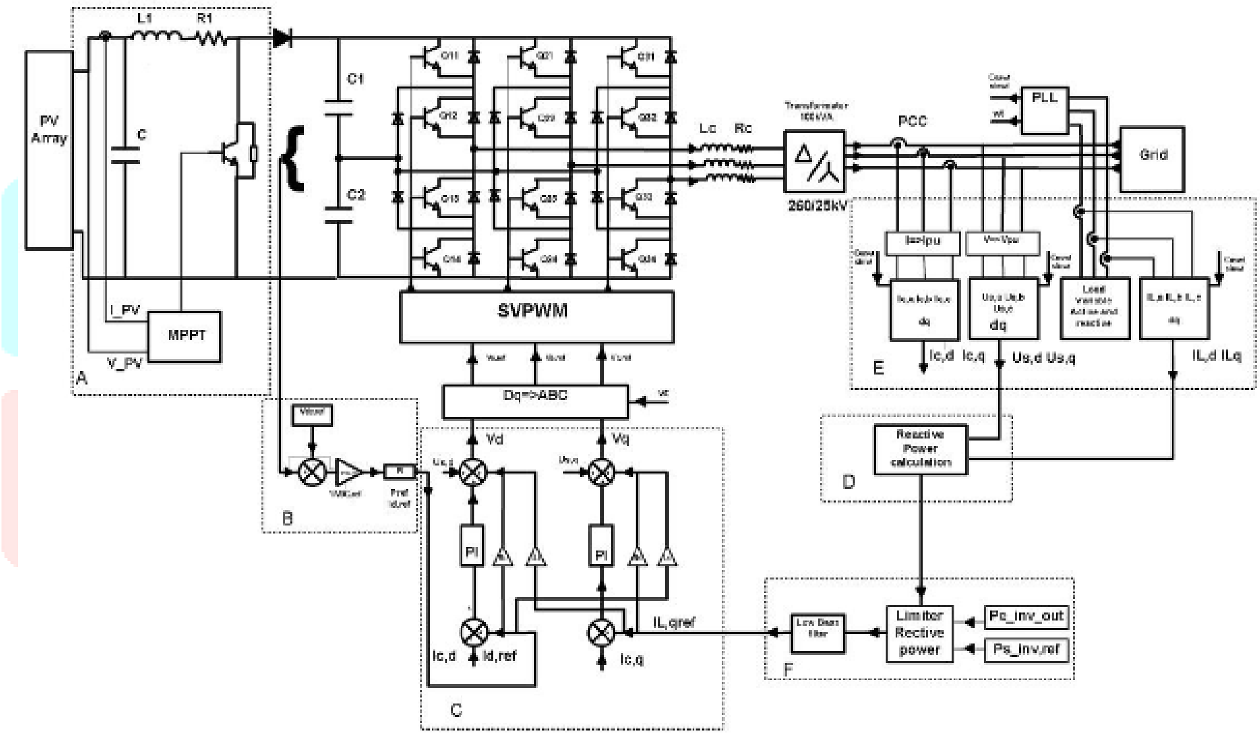


Figure 1: Studied System

1. Solar cells:: Solar cells are used as the active power source. In this paper the common model which is presented in [9] is studied and includes MPPT control circuit to gain the maximum active power. The Incremental Conductance (INC) is used for MPPT as shown in block A.

2. DC-DC converter:: This converter is to increase and stabilize the output voltage of PV and also to implement MPPT; mechanism and performance of this converter are available in [3].

3. DC bus capacitors: Two capacitors are used for DC bus to reduce DC voltage fluctuations; the common point of these two capacitors represents the neutral point of the inverter.

4. NPC type multilevel inverter:: Because of its high voltage level and appropriate harmonic conditions this inverter is used for connecting high power DG to the grid. Its structure and operation are completely described in [4]. These inverters are controlled by switching methods such as sinusoidal pulse width modulation or space

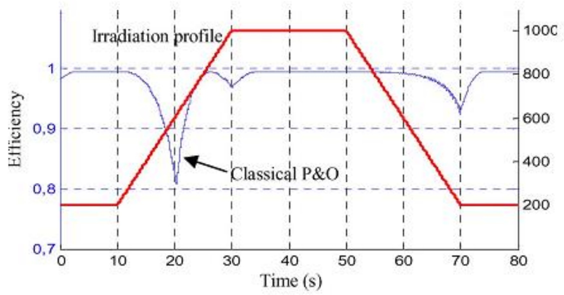
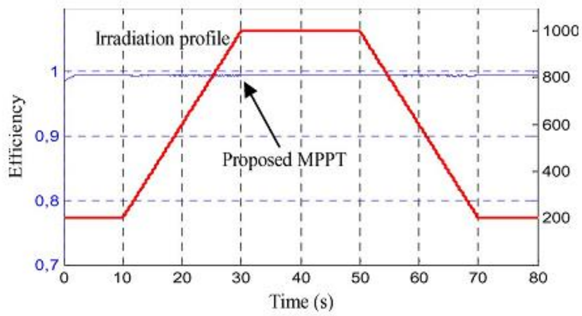
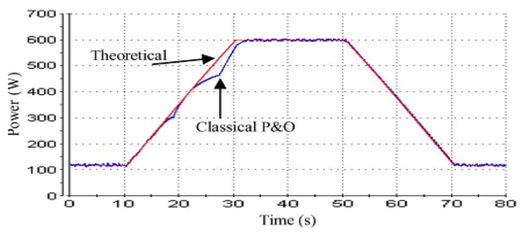
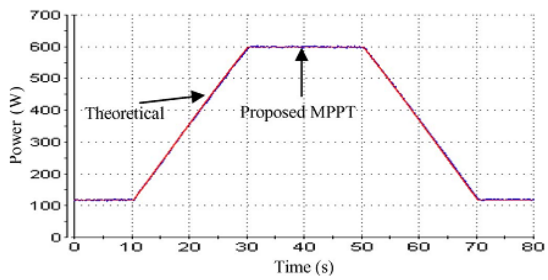
vector modulation, which the space vector method is of greater use because of its better harmonic characteristic and higher voltage amplitude [5].

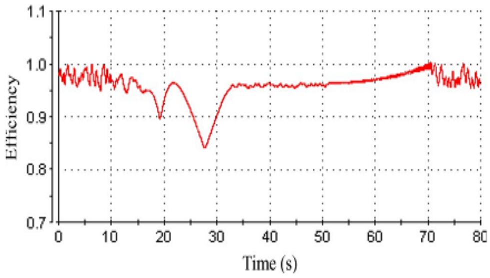
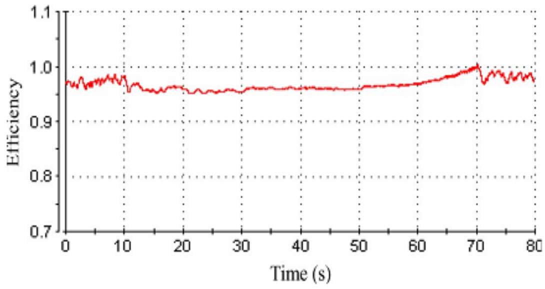
5. Output filter and transformer: This filter is to eliminate higher order remained harmonics at the output of inverter and turning the wave to a purely sinusoidal one. Design procedure for values of the filters is presented in [6].

.6. Local load:: This load needs variable active and reactive power. It is clear that for economical reasons, PV cells must supply maximum available power. If demanded power is more than the supplied power, providing remained power is duty of network. On the contrary the excess power is absorbed by the network. In supplying reactive power the network is at higher priority. When the intensity of light is low, produced active power decrease and unused capacity of inverter can be utilized for reactive power injection.

7. The grid:: According to this fact that solar cells cannot supply the load in every hour of a day, there must be either an energy storage system or the grid near them. The important issue is to synchronize the inverter with the grid and this is done by PLL block.

V. SIMULATION RESULT OF EXISTING AND PROPOSED METHOD:

Existing Method	**Proposed Method**
• Simulation measurement of the instantaneous efficiency with classical P&O during a trapezoidal irradiation profile. 	• Simulation measurement of the instantaneous efficiency with proposed MPPT during a trapezoidal irradiation profile. 
• Experimental measurement of the PV array power during a trapezoidal irradiation profile, using the classical P&O MPPT method, compared to the theoretical MPP power. 	• Experimental measurement of the PV array power during a trapezoidal irradiation profile, using the proposed MPPT method, compared to the theoretical MPP power . 

• Experimental measurement of the instantaneous MPPT efficiency of the classical P&O algorithm.	• Experimental measurement of the instantaneous MPPT efficiency of the proposed MPPT method.
	

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References

[1] Rahul Shukla and Rahul Shukla, “Mechanization of Agriculture: Implications for the Farming Community in India”, Department of Humanities and Social Sciences Indian Institute of Technology Guwahati, Perspectives on Global Development and Technology 14 (2015) 430-447.

[2] GeorgiosTsengenes, Thomas Nathenas, Georgios Adamidis,” A three-level space vector modulatedgrid connected inverter with control scheme based on instantaneous power theory", Simulation Modelling Practice and Theory 25 (2012) 134–147

[3] S. Kouro, K. Asfaw, R. Goldman, R. Snow, B. Wu, and J. Rodríguez, NPC Multilevel Multistring Topology for Larg Scale Grid Connected Photovoltaic Systems,2010 2nd IEEE international Symposium on Power Electronics for Distributed Generation Systems.

[4] Georgios A. Tsengenes, Georgios A. Adamidis, Study of a Simple Control Strategy for Grid Connected VSI Using SVPWM and p-q Theory,XIX International Conference on Electrical Machines - ICEM 2010, Rome

[5] César Trujillo Rodríguez, DavidVelasco de la Fuente, Gabriel Garcerá, Emilio Figueres, and Javier A. Gua can eme Moreno, Reconfigurable Control Scheme for a PV Microinverter Working in Both Grid-Connected and Island Modes,IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 60, NO. 4, APRIL 2013 .

[6] A. Ravi , P.S. Manoharan , J. Vijay Anand ,Modeling and simulation of three phase multi leve inverter for grid connected photovoltaic systems,Solar Energy 85 (2011) 2811–2818

[7] Miguel Castilla, JaumeMiret, Antonio Camacho, José Matas, and Luis García de Vicuña,Reduction of Current Harmonic Distortion ThreePhase Grid-Connected Photovoltai Inverters via Resonant Current Control ,IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 60, NO. 4, APRIL 2013 20161st International Conference on New Research Achievements in Electrical and Computer Engineering(ICNRAECE)

[8] Miguel Castilla , JaumeMiret , JoséMatas , Luis García de Vicuña, and Josep M. Guerrero ,Linear Current Control Scheme With Series Resonant Harmonic Compensator for Single-Phase Grid-Connected Photovoltaic Inverters

[9] RiadKadri, Jean-Paul Gaubert, and Gerard Champenois,An Improved Maximum Power Point Tracking for PhotovoltaicGrid-Connected Inverter Based on Voltage-Oriented Control,IEEE

TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 58, NO. 1, JANUARY 2011
[10] Georgios Tsengenes, Georgios Adamidis,A multi-function grid connected PV system with three level NPC inverter and
voltage oriented control, Solar Energy 85 (2011) 2595–2610