# Analysis of Buck-Boost Converter Controlled by MPPT to Ripple Out the Harmonic in Photovoltaic Systems

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***Abstract-It is essential to convert the energy obtained with photovoltaic panel from low efficiency to maximum possible efficiency. so concept of maximum power point tracking (MPPT) method is used as it ensures energy conversion with highest efficiency in the selected converter and inverter topologies. In this study, Boost converter fed by solar panels and controlled by PI-controlled MPPT Technologies along with filters are examined and analysis of output voltage by Matlab Simulink@ in order to determine the ripple free output voltage and conversion efficiency of photovoltaic system to its maximum possible level. perturb and observe (P&O) technique used to generate duty cycle of converters.***

***keywords-photovoltaic panel; Buck-Boost converters; maximum power point tracking.***

## I. INTRODUCTION

Continuous and clean electrical energy is the most important and indispensable requirement of mankind in daily life .In recent years, the rapid increase in the world population has caused a rapid decline in fossil fuel reserves [1].Moreover, the environmental impact of intensive industrialization and inefficient energy consumption has been boosted the energy demand. This situation necessitated that the management of energy production, transmission and distribution process with a more efficient and environmentally friendly systems [1],[2].

In Recent days solar energy based power generation has become most popular for off grid power generation. PV system installation requires higher initial cost with nil running cost. Moreover the return on investment (ROI) will be approximately five to ten years period depending upon the energy policy. The setup costs of these resources are higher than those of conventional ones. However low maintenance and operation costs have increased the interest in PV cells.[3]

Solar PV cells have a major drawbacks that it's shows nonlinear power-voltage (P-V) characteristices even at constant environmental condition. This nonlinear characteristics has maximum power at a certain operating condition. A point in PV based systems, considering the environmental conditions, MPPT based algorithm-perturb and observe (P&O) techniques decide the operating voltage and current level for the array to extract available maximum power in PV array.

PV system faces a lot of problem due to variation in temperature and spectral characteristics of sunlight. It is desirable to operate the PV cell to extract maximum power. The maximum power occurs only at certain output voltage and output current from solar panel. The output current from the solar panel. The primary objective is to facilitate increasing penetration levels of PV system by analyzing and quantifying the impacts of grid connected PV system. To maximize PV energy productivity and ensure high conversion efficiency, a Buck-Boost converter is used.

P & O based MPPT method was widely used because of its simplicity and effectiveness. In this method the power of PV system before and after perturbation is compared, based on that the controller will decide the next perturbation size. The conventional P & O method will cause oscillations around MPPT. As the perturbation step size increases oscillations, while smaller perturbation step size increases oscillations, while smaller perturbation step reduces the MPPT performance there should be an optimum step size with tradeoff.

## II. LITERATURE REVIEW

1 Reena Inyudam; 2 Roshan nayak proposed a paper that aims to design and simulation of different dc-dc converter namely- Boost, Buck-Boost and cuk converter and from the analysis of three converters, a suitable and best converter for grid connected system is chosen. The paper focus on the suitability of dc-dc converter for grid utility In the design of dc-dc converter, maximum power Tracking(MPPT) is also employed for producing the maximum output power. The analysis and design of proposed work is carried out using simulation.

1S.P singh, 2 A.K gautam, 3 S.P tripathi, 4 Bhavnesh kumar proposed a paper that deals with performance analysis and comparison of photovoltaic (PV) energy conversion system for two different maximum power point tracking (MPPT) techniques. A cuk converter is used in the PV system to implement the MPPT controller, two different MPPT controllers are designed to locate the maximum power point; perturb& observe and fuzzy logic based. T evaluate and compare the performances of the

designed MPPT controllers. PV system is operated with different environmental conditions.

1. S saravanan; 2 N. Ramesh Babu proposed a photovoltaic PV cell based power generation is best alternative developing for fossil fuels as it doesn't have pollution issues. This paper focuses on performance of boost and cuk dc/dc converter, used in MPPT based PV system perturb & observe (P&O) technique used to generate a duty cycle of converter. The Simulation study is performed using Matlab Simulink for the PV system and it has been observed that the cuk converter produces better results compared with Boost converter.

1.Haider Islam, 2. Saad Mekhilef, 3. Noraisagh binti mohammad shah, 4. Tey soon; 5. mehdi seyed mahmousian, 6. Belttoran, 7.Alexstojcevski proposed a paper that elaborates a comprehensive overview of a pv system model, and compares the attributes of various conventional and improved incremental conductance algorithm, perturbation and observation techniques, and other maximum power point tracking (MPPT) algorithm in normal and partial shading conditions. Performance evaluation techniques are discussed on the basis of the dynamic parameters of the PV system.

1. Mahir Dursun; 2. Alper Gurgun proposes a paper to convert the energy obtained with PV panel from low efficiency to maximum possible efficiency. For this Reason, the maximum power point tracking (MPPT) method is generally used in both thereotical and practical applications. The main purposes of MPPT is to ensure to get the energy conversion with highest efficiency in the selected converter and inverter topologies. In this study, cuk , buck-boost and sepic converters fed by solar panels and controlled by PI-controlled MPPT are examined and their performances compared by Matlab Simulink@ in order to determine which is most efficient in converting the energy wit photovoltaic system to its maximum possible levels. In the simulation, after modelling the designed system according to the vary irridatio and temperature ratios during the day, the efficiency of each converters are compared.

1Pratapsingh G. parmar, 2. urvashi d. patel proposed paper for review of inverter with different dc-dc converter is developed with focuses on low cost, high reliability and mass production for converting electrical energy from PV module to the grid various inverter topologies are presented, compared and evaluated against demands, lifetime, components rating and costs. Inverter based PV system to explain electrical performances subjected to different operating conditions. PV inverter is one of the most recent and popular type of inverter founds its applications in the system based on renewable energy. by using the inverter topology with single stage and dual stage dc-dc converter harmonic in the system reduced and efficiency of the inverter enhanced significantly.

## III. PROPOSED METHODOLOGY

The output power of the photovoltaic panel is continuously monitored by the P&O MPPT method. In this method, only the current an voltage values of the panel need to be read instantaneously. It is decided to increase or decrease the reference value by establishing a correlation between the change of the output power of the panel and the change of control variable. This allows the MPPT controller to adjust the pulse width ratio to keep the power at maximum point. It is preferred algorithm in the literature because of the low transaction volume and ease of control.

Solar PV panels have drawbacks such as very low energy conversion efficiency, the high manufacturing costs of energy and high dependence on environmental factors. The power of a PV array is unstable, and the current and voltage characteristics curve of a PV cell is non-linear at different solar irradiations, temperature and loads. so conventional maximum power tracking(MPPT) algorithm are designed fo uniform environmental conditions where the PV curve generates only one maximum power point(MPP).

So for this study, the design of MPPT working with the PI-controlled P&O method is performed. The current and voltage values taken from PV panel in the model and voltage values taken from the converter output are applied to MPPT. The MPPT generates switching angles to provide the desired reference voltage value at the converter output.

System consisting of PV panel, Buck-Boost converter and MPPT operate at varying irradiation and temperature Ratios are modeled. In addition for each type of Buck-Boost converter used error signals were analysed by monitoring the time to reach the reference value of the system. Buck-Boost converter are simple and inexpensive because they contain a coil and a capacitor as energy storage elements. However, the amount of Ripple in the input current of Buck nBoost converter is quite high. These Ripples increases the harmonic ratios.

So, In this methodology, the PV panel output are applied to the MPPT controller which provide switching angle to Buck-Boost converter by changing the duty cycle Ratio and output voltage are obtained from Buck-Boost converter which contain ripple, which is handled with the large capacitors or LC filters.

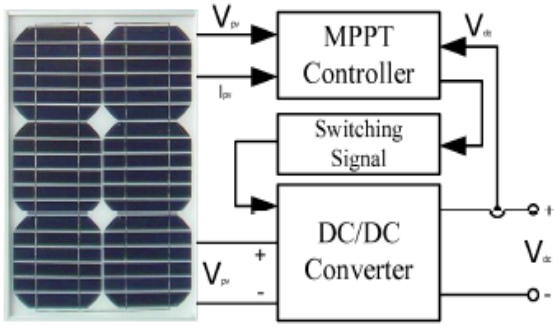


Figure 1. The block diagram of the designed system.

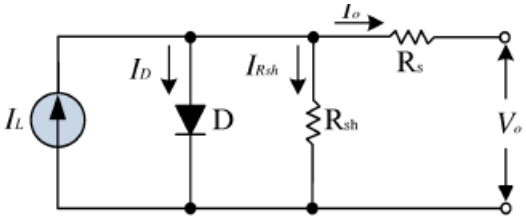


Figure 2. PV panel equivalent circuit.

Io=Irs*(T/Tn)^3*exp[(q*Ego*(1/Tn-1/T)/(n*K)]

Irs=Isc/[exp(q*Voc/n*Ns*K*T)]

Ish=[Isc+{ki*(T-298)}*G/1000]

I=Iph-10*[exp{(V+I*Rs)*q/(n*K*T*Ns)}-1]-Ish

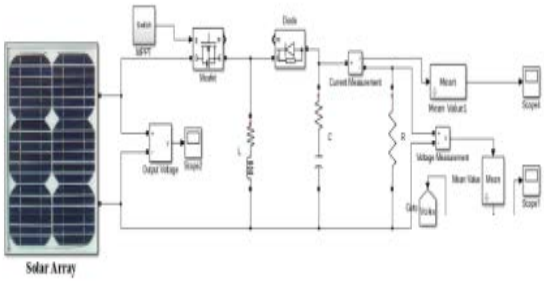


Figure 3. Buck-Boost Converter.

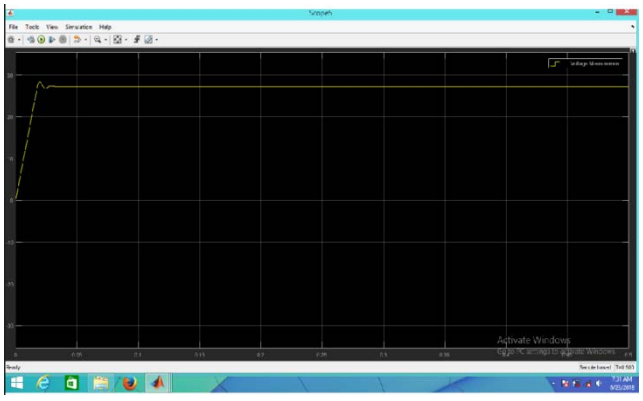

Fig-4. Simulink Results of Buck Boost Converter (voltage-time) Output characteristics.

## IV. CONCLUSION AND FUTURE SCOPE

In this study, design and performance analysis of Buck-Boost converters controlled by PI-controlled MPPT have been performed in photovoltaic panel in Matlab Simulink program. The converter are supplied with DC voltage obtained from designed PV panel output by getting a switching command from MPPT based P&O techniques to change the duty cycle ratio of converters to get the better output voltage.

The power obtained from PV panel changes due to instantaneous changes in irradiation and ambient temperature. PI-controlled MPPT design has been implemented in order to maximize the power and increase the efficiency.

The PI-controlled MPPT ensures that output voltage is fixed at reference value by changing the switching ratio of the converter. The MPPT system design according to the obtained results quickly catches the references value given . In addition , the designed control system can respond quickly to sudden change in inputs parameters. It has been seen that Buck-Boost converter gives the fastest response to the changing weather condition within the converter.

So, Solar power has the potential to become one of the main contributor of the renewable energy source to the future electricity supply with several advantages such as pollution free power generation low maintenance costs, low operation costs and no supply l limitations. This improvement in technology and continuous growth of the PV market has led to drastic reduction in the costs of solar PV system on the global market as work is done to increase the conversion efficiency.

## REFERENCES

[1] https://www.eia.gov/outlooks/ieo/electricity.cfm

[2] https://yearbook.enerdata.net/world-electricity production map graph and data html.

[3] peter fox-penner, smart power climate change the smart grid and the future of electric utilities; 2010,pp.1-6

[4] http://energyinformative .org/lifespan-solar-panels

[5] F.Blaabjerg,chenzhe,S.B kjaer;"power electronics as efficient interface in dispersed power generation systems."IEEE Trans power electronics, Vol.19,no-5, pp.1184-1197,2004

[6] B.K. Bose,"Energy, environment, and advances in power electronics,"IEEE trans power electronics, Vol.15,no.4,pp.688-701,2000

[7] J. Mahdavi, A.Emadi, H.A Toliyat, "Application of state space.Averaging method to sliding mode control of PWM dc/dc converters,"IEEE industrial applications conference,pp.820-827, Vol.2,5-9 october,1997,doi;10.1109/IAS.1997

[8] Vitor Femao pires;Jose fernando A.silva," teaching nonlinear modelling, Simulation;and and control of electronic converters using Matlab/Simulink;"IEEE transactions on Education ,Vol.45,no.3;pp.253-261,august 2002

[9] M.H Taghraee, M.A.M radzi, S.M Moosavain, H.hizam,and M.H Marhaban,"A current and future study on non-isolated dc-dc converters for photovoltaic applications," renewable an sustainable energy Vol.17,pp.216-227,2013

[10] R.F coelho, F.M Concer, and D.c Martins "Analytical and experimental analysis of dc-dc converters in photovoltaic . Maximum power point tracking Applications," In proc.IEEE.IECON 2010 ,PP.2778-2783,NOV-2010

[11] Jun W. JIN T, Smedley K,"A new interleaved isolated Boost converter for high power Applications ,"applied power electronics conference and exposition,APEC'06,twenty-first Annual IEEE,6-9(2006)

[12] D. Sera, R.Teodorescu, P. Rodriguez," PV pane model based on datasheet values,"proc.on ISIE07 PP.2392-2396,2007

[13] Kumar ,M.singh," Simiulation and analysis of grid connected photovoltaic system with MPPT "power India conference,2012 IEEE fifth pp.16.19-22 , dec2012

[14] Q.li and P. wolfs," Recent development in the topologies for photovoltaic module Integrated converters ,"in proc. IEEE.PESC,pp-1-8-22 June 2006,doij10.1109/pesc.2006.1712241

[15] Q.Mei,M.shan,L.liu,J.M guerrew," A novel improved variable step size Incremental resistance MPPT method for PV systems," IEEE Trans. Ind; Electron ;vol.58,no-6 pp.2427-2434,june-2011

[16] Morrison R., Egan M.G," A new modulation strategy for a Buck-Boost Input AC/DC converte power electronics, IEEE Transaction on,16/1);34-45/2001)

[17] K.S Tey; and S. me khilef," modified Incremental conductance Algorithm for photovoltaic system under partial shading conditions and load variations " IEEE Trans. Ind electron ; Vol.61,no 10,pp.5384-5392,oct 2014

[18] G.d cesare , D. caputo ; and A. Nascetti," maximum power point tracker for photovoltaic systems with resistive like load," solar energy Vol.80,no.8,pp.982-988,2006

[19] Roberto Faranda, S.L,"Enemy comparison of MPPT Techniques for PV system," WSEAS Trans on power systems, Vol.3,no.6,pp.446-445,2003

[20] K.kavitha, E jeyakumar,"A synchronous czu converter based photovoltaic energy system design and simulation ," International Journal of scientific and Research publications, Vol.2,no.10 oct. 2012.