Critical Sampling Period Determination for an Open -loop Perturb and Observe Mppt Grid-connected Solar Photo Voltaic System

Mr.P. Suresh,
AP/ EEE,
Shree Venkateshwara Hi-Tech Engineering College,
Gobichettipalayam, Erode
sureshharish@gmail.com

G. Kathirvel
Department of EEE,
Shree Venkateshwara Hi-Tech Engineering College,
Gobichettipalayam, Erode
kalaikathir05@gmail.com

T. Kaviyarasu,
Department of EEE,
Shree Venkateshwara Hi-Tech Engineering College,
Gobichettipalayam, Erode
kathirvelkathir232@gmail.com

P. Aranganadhan
Department of EEE,
Shree Venkateshwara Hi-Tech Engineering College,
Gobichettipalayam, Erode
nadhanece15@gmail.com

ABSTRACT:

Solar PV panels have a distinct maximum power point and nonlinear voltage-current characteristics. The MPP is not consistent over time and is dependent on several external atmospheric conditions like as sun irradiation and cell temperature. The size of the perturbation step and the sample time are two crucial factors that affect the oscillation characteristics. Implementing a critical sample interval is necessary to maintain low overshoot and settling time. Consequently, improve the system's natural angular frequency performance, which is hard to calculate for the actual system. The primary focus of this study is to examine how the sample period affects the open loop oscillation characteristics of a P&O MPPT grid-connected solar PV system. This work presents a thorough analysis and comparison of four maximum power tracking methods: fuzzy logic based, incremental conductance (InC), perturb and observe (P&O), and tracking method as well as a lesser-known one that just measures the PV current. The operating point of the three investigated methods—P&O, InC, and one sensor algorithm—oscillates around the maximum power point in steady state, resulting in the waste of the output panel's available energy. Comparing the suggested fuzzy logic controller (FLC) to the other approaches under study, simulation findings demonstrate that the FLC can track maximum power more quickly and steadily.

I.INDRODUCTION

An alternate technology that should help us move away from our reliance on fossil fuels for electricity is solar power. Solar panel technology's main issue is that the Solar power systems still have low efficiency and, for the most part, prohibitively high costs per kilowatt-hour (kWh) as compared to petroleum-based energy sources. The actual efficiency of solar panels in converting sunlight into energy is just about 30%. Nevertheless, the solar power system's charge controllers and other components are also rather expensive and inefficient. Our objective is to create a Maximum Power Point Tracker (MPPT), a specialised type of charge

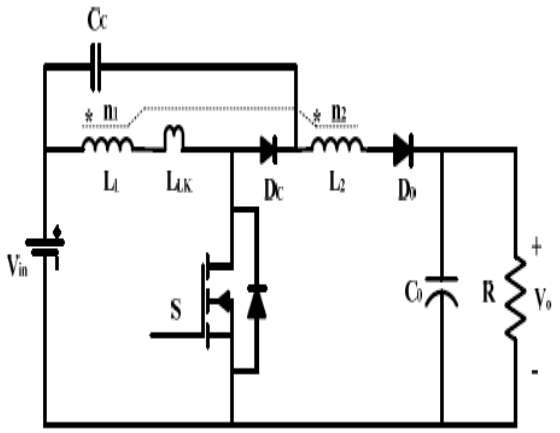
controller that will make the most of the solar panel. The MPPT is a charge controller that modifies a solar cell's fluctuating voltage and current characteristics. The panels are tricked by the MPPT into producing a different voltage and current, which deceives the solar cell into believing the load is changing when in reality it cannot be changed, allowing more power to enter the battery or batteries. The MPPT finds the operating point that will give the batteries the maximum amount of power possible by monitoring the output voltage and current from the solar panel. The efficiency of the solar cell will rise if our version of the MPPT can precisely track the constantly shifting operating point when the power is at its maximum.

II.EXISTING METHOD:

According to the inquiry, one of the first signs of interharmonics in the framework current is the discomfort from the MPPT calculation. Improving the performance of hidden photovoltaic clusters under both stationary and cyclic weather patterns is the primary goal of all MPPT algorithms. PI-based dq regulators cannot be used directly since single-stage frameworks have fewer information signals available than three-stage frameworks. In single-stage frameworks, the conventional procedure is to combine a stage signal symmetrical to the basic sign of the single-gradually easing framework to obtain dc values via the interpretation of (αβ to dq). In order to govern the power flow of four inverters at a predetermined operational frequency, a system management controller (SMC) system with excellent performance is introduced.

II.BLOCK DIAGRAM:

Since array temperature and sun irradiation are known to affect the maximum power point (MPP) of a photovoltaic power generation system, it is essential to continuously monitor the solar array's MPP. Research on different MPP control algorithms to extract the solar array's maximum output has been underway for years. This part uses numerical simulation to thoroughly examine the efficacy of these four distinct control algorithms.



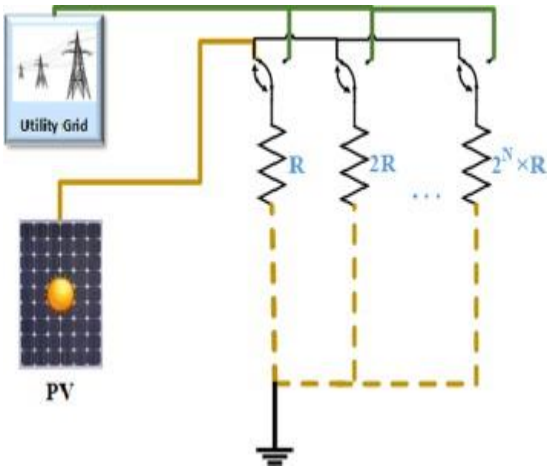
III.CONVENTIONALMPPT TECHNIQUES:

Several conventional MPPT techniques have been proposed and there has been considerable research on them. Among the conventional techniques mentioned in these publications are perturbation and observation (P&O), hill climbing (HC) algorithm, fractional open circuit voltage and short circuit current methods, switching ripple correlation, sliding mode control, incremental conductance (IC), constant voltage and some other techniques.Amongst the conventional MPPT techniques, the P&O and HC algorithms are considered the most popular ones due to their ease of implementation [20]. The working principle of both algorithms depends on changing the control parameter by a constant value and exploring whether the MPP has been captured or not. The direction of changing the control parameter is determined based on the increase in the power produced. Besides, the IC algorithm is considered one of the most used conventional algorithms due to its high performance. It is based on computing the differential of the PV power to PV voltage to determine the location of the operating point, where the differential is zero at the MPP.

IV.SYSTEM STRUCTURE:

The MPPT methodology that has been suggested is predicated on modifying the load in order to divide it into several pieces. While the remaining load segments can either remain disconnected or be connected to the AC supplied by the main grid, the load segments that meet the MPPT condition are switched to the PV source. The

hardware connecting PV and grid sources to the load portions is depicted in Fig. 1.



The loads that can function well with either DC or AC sources are appropriate for this kind of arrangement. Without the need for extra hardware, thermal loads like water heaters, boilers, ovens, stoves, and chillers are an example of loads that run on both sources. The only hardware needed to make them is to use heating coils that are divided into different values. Each segment has a two-way control relay (or solid-state switches) connecting it to the terminal supply (PV or Grid). The relay changes load segments to PV or the grid in accordance with the control signals generated by the MPPT controller.

V.PHOTOVOLTAIC SYSTEM:

A basic illustration of a photovoltaic system incorporating MPPT is shown in Figure 1. In a solar array consisting of an equal number of photovoltaic cells connected in series, the voltage and The same type of solar cells will have higher current. Using the DC-to-DC converter's competition (resistance), the panel that is configured to operate with the load's Photovoltaic systems are a sustainable and renewable energy source, contributing to the reduction of greenhouse gas emissions and dependence on non-renewable resources. They are commonly used in residential, commercial, and industrial settings, as well as in remote areas where traditional power sources may be impractical or unavailable.

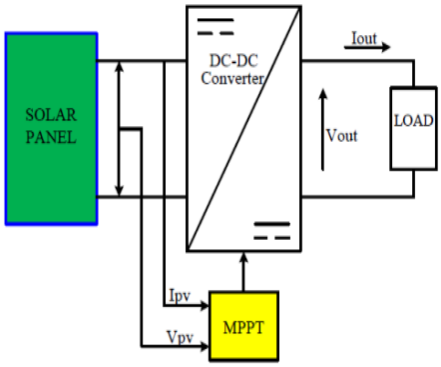


Figure 1. Schematic diagram of photovoltaic system

which changes depending on the painting cycle [7]. The lift converter's output is a solar panel that is connected to the entry, and the weight is connected to the output of the lift converter. The MPPT block is in charge of the judgements taken and the signs that the solar panel produces. Strength conversion was given to a series of pulses that were thought to be discharges from the MPPT block. These pulses then control how the Converter operates [8], ensuring that the photovoltaic device operates during the time when the most electricity is produced (MPP). Figure 2 displays the total performance of the photovoltaic cell system. The theory at the core of how it generates power from sunlight is the photovoltaic effect (in the form of photons). Photons are capable of holding all of the energy and power found in the sun's spectrum. A photovoltaic cell may absorb photons when exposed to light, which can subsequently be utilised to generate energy when the light reaches the cell. ted parameter adjustment to calculate the value of perturbing. In P&O, the conversion process uses an alternative that does not resolve the conflict between strong country performance and strong reaction. Generally speaking, the size of the boom within the hobby cycle should be small in a stable condition and excessive during a short period of time The power conversion is too high at the start of the procedure, causing the tuner to supply an extra fee of "a" from the previously mentioned amount. This enormous array of "a" satisfies the desire for a prompt response. As the strength conversion is low in a solid situation, the tuner will allow the controller to provide only a tiny amount of "a", which is utilised to reduce the stability

of the solid situation and to satisfy the requirements for a solid response [11]

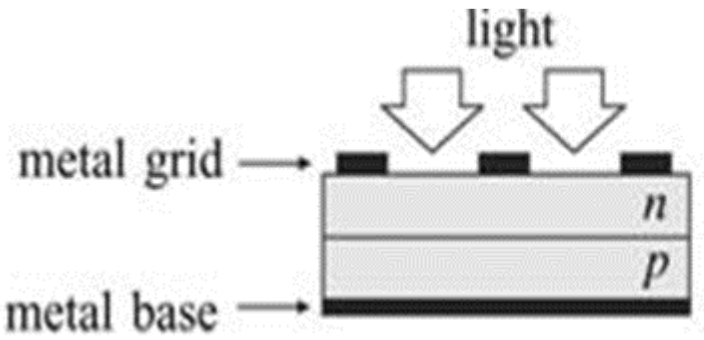


Figure 2. Structure of photovoltaic cell

VII. DC-DC CONVERTER

The output of the photovoltaic panel is sent on to the DCDC converter so that it can either Buck or Boost the voltage. This is demonstrated in Figure 5. It serves this purpose, and one of the other names for it is the step-up converter. Inductor, diode, and capacitor are all components of it. Turning the switch on and off will sometimes cause the increase converter to function. While the transfer is in the "ON" position, the inductor stores the power, and when it is in the "OFF" position, the quantity of ind uctor strength and supply appears in the "yield" (output) position. The normal yield (Output) voltage is accompanying condition given: Instead of using equal or current

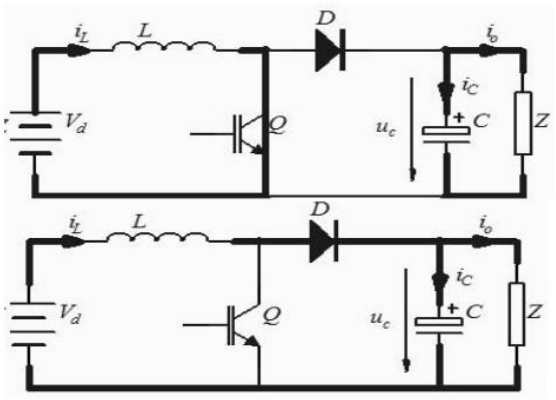


Figure 3. Circuit diagram of boost converter

VI.CONCLUSIONS:

The tracking tactics that are used to monitor the maximum quantity of energy from a solar-powered equipment are known as maximum energy factor tracking strategies. To follow upon oscillations and the corresponding exchange-off issue, the P&O approach with a constant perturb value is applied. On the other hand, in weather-related conditions, it cannot sing for a brief time. Consequently, in order to attain improved performance, adaptive strategies are applied. A photovoltaic array simulation and a correlation analysis of numerous different approaches, such as P&O, adaptive P&O, and modified adaptive P&O approaches, are presented in this research. The application of all these various techniques has led to a higher degree of performance being recorded in adaptable strategies compared to The tracking strategies for maximum energy factor are those that are employed to monitor the maximum amount of energy produced by a solar-powered machine. To monitor the P&O method with a constant perturb esteem is used to solve oscillations and the related exchange-off problem. However, in weather-related conditions, it cannot sing for a brief period of time. Adaptive strategies are therefore used to attain higher performance. In addition to a correlation analysis of multiple methods, such as P&O, adaptive P&O, and modified adaptive P&O approaches, this article presents a simulation of a photovoltaic array. The outcomes of putting all of these various strategies into practice have led to more performance being recorded in adaptable strategies than

VIII.REFERENCES:

[1] Wu, T.F., Chang, C.H., Liu, Z.R., Yu, T.H. (1998). Single-stage converters for photovoltaic powered lighting systems with MPPT and charging features. In APEC'98 Thirteenth Annual Applied Power Electronics Conference and Exposition, Anaheim, CA, USA, pp. 1149-1155. https://doi.org/10.1109/APEC.1998.654041

[2] De Broe, A.M., Drouilhet, S., Gevorgian, V. (1999). A peak power tracker for small wind turbines in battery charging applications. IEEE Transactions on Energy Conversion, 14(4): 1630-1635. https://doi.org/10.1109/60.815116

[3] Ameli, M.T., Moslehpour, S., Shamlo, M. (2008). Economical load distribution in power networks that include hybrid solar power plants. Electric Power Systems Research, 78(7): 1147-1152. https://doi.org/10.1016/j.epsr.2007.09.009

[4] Joni, Numberi, J.J., Tambing, E., Siregar, S.P., Setiawan, R.P.A., Tambunan, A.H., Siregar, K. (2023). Evaluating the application of bubble wet scrubber systems for gas cleaning in gasification. Instrumentation Mesure Métrologie, 22(1): 21-27. https://doi.org/10.18280/i2m.220103

[5] Salas, V., Olias, E., Barrado, A., Lazaro, A. (2006). Review of the maximum power point tracking algorithms for stand-alone photovoltaic systems. Solar Energy Materials and Solar Cells, 90(11): 1555-1578. https://doi.org/10.1016/j.solmat.2005.10.023

[6] Esram, T., Chapman, P.L. (2007). Comparison of photovoltaic array maximum power point tracking techniques. IEEE Transactions on Energy Conversion, 22(2): 439-449. https://doi.org/10.1109/TEC.2006.874230

[7] Chermitti, A., Boukli-Hacene, O., Mohamed, B. (2012). Improvement of the "perturb and observe" MPPT algorithm in a photovoltaic system under rapidly changing climatic conditions. International Journal of Computer Applications, 56(12).

[8] Altas, I.H., Sharaf, A.M. (2007). A photovoltaic array simulation model for Matlab-Simulink GUI environment. In 2007 International Conference on Clean Electrical Power, Capri, Italy, pp. 341-345. IEEE. https://doi.org/10.1109/ICCEP.2007.384234

[9] Domathoti, B., Ch, C., Madala, S., Berhanu, A.A., Rao, Y.N. (2022). Simulation analysis of 4G/5G OFDM systems by optimal wavelets with BPSK modulator. Journal of Sensors, 2022. https://doi.org/10.1155/2022/8070428

[10] Abdelsalam, A.K., Massoud, A.M., Ahmed, S., Enjeti, 78 P.N. (2011). High-performance adaptive perturb and observe MPPT technique for photovoltaic-based microgrids. IEEE Transactions on Power Electronics, 26(4): 1010-1021. https://doi.org/10.1109/TPEL.2011.2106221

[11] Xiao, W., Dunford, W.G. (2004). A modified adaptive hill climbing MPPT method for photovoltaic power systems. In 2004 IEEE 35th Annual Power Electronics Specialists Conference (IEEE Cat. No. 04CH37551), Aachen, Germany, Vol. 3, pp. 1957-1963. IEEE. https://doi.org/10.1109/PESC.2004.1355417

[12] De Cesare, G., Caputo, D., Nascetti, A. (2006). Maximum power point tracker for portable photovoltaic systems with resistive-like load. Solar Energy, 80(8): 982-988. https://doi.org/10.1016/j.solener.2005.07.010

[13] Salas, V., Olias, E., Lazaro, A., Barrado, A. (2005). New algorithm using only one variable measurement applied to a maximum power point tracker. Solar Energy Materials and Solar Cells, 87(1-4): 675-684. https://doi.org/10.1016/j.solmat.2004.09.019

[14] Lim, Y.H., Hamill, D.C. (2000). Simple maximum power point tracker for photovoltaic arrays. Electronics Letters, 36(11): 1.

[15] Liu, F., Kang, Y., Zhang, Y., Duan, S. (2008). Comparison of P&O and hill climbing MPPT methods for grid-connected PV converter. In 2008 3rd IEEE Conference on Industrial Electronics and Applications, Singapore, pp. 804-807. IEEE. https://doi.org/10.1109/ICIEA.2008.4582626

[16] Sreenivasulu, A., Subramanian, S., Raju, P.S. (2023). Design and simulation of advanced intelligent deep learning MPPT approach to enhance power extraction of 1000 W grid connected photovoltaic system. Journal of Intelligent & Fuzzy Systems, 44(3): 3987-3998. https://doi.org/ 10.3233/JIFS-221465

[17] P.Suresh “Four switch Buck Boost Converter for Dc-Dc Power Spply in Telecom Applications” National Conference on Power Electronices (IEEE-Computer SocietyBombay Chapter) ISBN:978-93-80757-74-2,March 2009 .