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A Review on Renewal energy based smart grid system using solar energy by implementing MATLAB simulink

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Abstract— *The objective of this review paper is to evaluate the performance of Perturb and Observe (P&O) Maximum Power Point Tracking (MPPT) algorithm implemented in a photovoltaic system to harvest maximum power in MATLAB/SIMULINK. Special attention has been paid to the well-known Pertub and Observe algorithms to achieve this goal. The algorithm is tested in real-time under changes in insolation and load disturbances in grid system. The P&O algorithm is an MPPT technique used in a photovoltaic system to monitor and operate the system at the maximum power point (MPP) to extract maximum power from the photovoltaic system under changing weather conditions. MPPT controller, DC/DC boost converter, working to supply resistive load. Important extraction results are presented to justify the proposed overall PV system control scheme.*

Keywords: Solar Panel, pertub and observe, Maximum Power Tracking.

I. INTRODUCTION

The world's population growth has led to a sharp increase in global energy consumption. Solar energy from the sun is effective without polluting the environment. It does not consume the earth's resources and does not cause global warming. A solar panel is a device made up of multiple solar cells connected in series/parallel devices used to convert solar energy into electricity. Solar panels are used more and more every day. Because it has a built-in solar panel, all you need is sunlight to generate energy. The economic value of solar panels makes them a popular choice to avoid rising electricity costs. Although solar energy technology has been developed over the years, it is used more today than ever. The main reason for its increasing use is its reproducibility. The sun will always provide the Earth with more energy than humans consume.

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Although various MPPT techniques have been used in the past, the Perturb & Observe (P&O) algorithm remains the most widely used algorithm as it is the most widely adopted and preferred algorithm in the industry due to its simplicity and ease of implementation. The controller measures the power by adjusting the voltage using the P&O algorithm, and if the measured power is greater than the previous value, it adjusts in the same direction until there is no power increase. Common MPPT methods include disturbance and observation (P&O), incremental conductance (INC), and voltage source controller.

Objective

The main purpose of this paper is to propose a Perturb and Observe (P&O) Maximum Power Point Tracking (MPPT) algorithm with variable step size for a two-phase three-phase grid-connected photovoltaic (PV) system. A pre-stage boost circuit provides maximum power point tracking control. On the inverter side of the backstage, DC bus voltage stability and grid connection current regulation are achieved. A fixed step size is adopted when the distance is far from full power using an innovative variable step size P&O algorithm point, the step size is halved each time the point of actuation crosses the peak point, until the last step is less than the set threshold and the actuation point remains constant at the maximum energy point. Therefore, in this paper, we propose a technique to control MPPT parameters according to the illuminance level to reduce interharmonic emission without degrading the MPP tracking performance.

Other areas for further investigation are:

1. PV cell, module and array are simulated and the effect of environmental conditions on their characteristics is studied.
2. The maximum power point of operation is tracked for both the systems using the P&O algorithm.
3. Both systems are integrated, and the hybrid system is used for battery charging and discharging.

II. Review work

Although various studies have already been done in the field of solar system. Energy systems have become an interesting topic in recent years, and many grid projects have been proposed. The demand for renewable energy has increased significantly over the years due to the scarcity of fossil fuels. At the same time, interest in renewable energy is increasing due to the increasing demand for pollution-free green energy. Solar energy is the most natural and sufficient renewable energy source to meet the rapidly increasing energy demands [1]. For efficient operation, it is necessary to monitor the maximum power of the solar array. There are several methods for monitoring the maximum power of solar panels in the literature. In this paper, we consider the confusion and observation algorithm because of its simplicity. A boost converter is used to optimize the power point tracking algorithm [2]. The energy output of a solar panel varies from time to time and with the light level. Therefore, to make the system more reliable, a battery is included in the system. Bidirectional converters are also used to control the flow of electricity from battery to battery [3]. As inverters are used in PV systems, they use a proportional integral (PI) controller approach to maintain the output sine wave, control power factor uniformity, and achieve high dynamic efficiency in rapidly changing atmospheric conditions. Provide simulation results to validate the proposed control system.

III. Methodology

In this paper, a modified variable step size MPPT algorithm for grid-connected PV systems is proposed that overcomes the problems associated with classical P&O algorithms. A faster tracking speed with less steady-state oscillation is achieved using this method. It shows better dynamic response during any change in atmospheric condition. The proposed scheme is implemented using MATLAB/SIMULINK based environment. Comparison between Fixed Step Size MPPT Algorithm and Proposed Scheme provided. The effectiveness and improvement of the proposed algorithm have been demonstrated in transient, static and dynamic responses, particularly under rapidly changing atmospheric conditions such as ripples, overshoots and response times.

Common P&O MPPT Algorithm

The P&O algorithm is a commonly used MPPT algorithm. The structure is simple and easy to implement. The standard step P&O perturbs the PV voltage according to equation and calculates a new value of the PV array power P(k).

$$D(k) = D(k-1) \pm \Delta D \qquad (1)$$

Where ΔD= the fixed step size,

Power is comparison with the past perturbation cycle P(k-1). If power increases, perturbation is continued in the same direction otherwise the perturbation is stored. This cycle is repeated loop wise until the maximum power is reached ($\Delta P = 0$) [12]. Figure shows the flowchart of the common P&O algorithm.

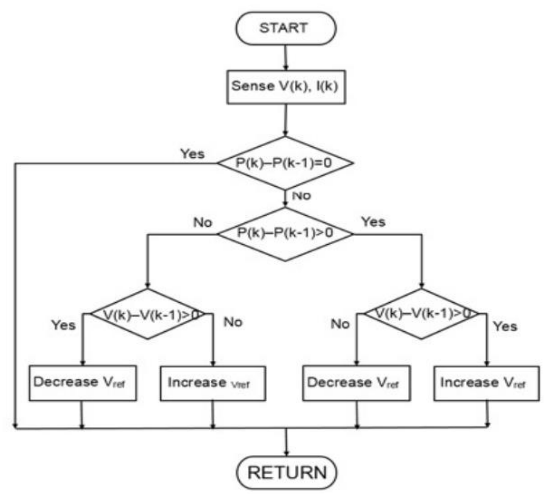

Figure 1: P&O MPPT Algorithm

Improved P&O Algorithm

A typical P&O algorithm uses a fixed step size, which is determined by accuracy and tracking speed requirements. Larger step size results in faster tracking but lower accuracy and smaller step size improves accuracy but slows MPPT. To obtain fast tracking speed with high steady-state accuracy, a step size MPPT algorithm is used where the step size varies with the slope of the P-V curve as shown in Eq.(2)

$$D(k) = D(k-1) \pm M * (\Delta P / \Delta V) \qquad (2)$$

The accuracy of this method is very high for a fixed value of solar radiation. If there is a sudden change in the Sun Radiating, the variable step size MPPT algorithm loses its accuracy and produces large oscillations. This is important This is because, for a step change in solar radiation, the PV power changes abruptly without much change in

PV voltage. as Consequently, the step size from Eq. $M * (\Delta P/\Delta V)$, change suddenly. This causes large oscillations in the PV curve.

To get a better response to sudden changes in the atmosphere Modifications for conditional, variable step size MPPT An algorithm has been proposed. MPPT controller Change in current with change in voltage (ΔI) and power. For a fixed insolation value, ΔV and ΔI will have the opposite sign. PV output current I is Components of the directly occurring photogenerated current Iph Proportional to insolation. If there is a sharp increase In the probe I will increase and ΔI will be positive. for someone If ΔV is also positive, then the next perturbation of the PV voltage, ΔV and ΔI are both positive and represent A sharp increase in insolation. Now about detection Rapid increase in insolation, MPPT controller Fixed step size of +0.05 to lower the PV voltage. this This is done because the PV array's MPP is at a lower voltage. For higher insolation values compared to that Low values of insolation. Similarly, if you investigate If there is a sudden decrease, both ΔV and ΔI become negative. this time, the MPPT controller uses a fixed step size of -0.05 and Increase the PV voltage. After this temporary period, The controller again uses a variable step size. proposed The system will prevent any undue vibration in the operating point. Steady-state vibration protection due to double grid Frequency voltage ripple in the DC link of the connected grid PV systems, modifications have been proposed. Equation (2) You can write it like this:

$$Vi = V_o * (1 - D) \qquad (3)$$

V_i is the PV voltage and V_o is the dc link voltage. If there is a voltage ripple Δvo present in the dc link, the net dc link voltage becomes $V_o + \Delta_{vo}$. If we add a small ripple(Δd) to the duty cycle as well, equation becomes

$$Vi = (V_o + \Delta_{vo}) * (1 - D - \Delta d) \quad (4)$$

Equation (4) can be further simplified as

$$Vi = Vo *(1-D)+(1-D)*(\Delta vo)-Vo *(\Delta d)-(\Delta vo)*(\Delta d) \quad (5)$$

To get a ripple free PV voltage, the ripple component of equation (9) must be zero. Therefore,

$$(1 - D) * (\Delta vo) - Vo * (\Delta d) - (\Delta vo) * (\Delta d) = 0 \qquad (6)$$

From equation (6), we get

$$(\Delta d) = \{(1 - D) * (\Delta vo)\} / (Vo + \Delta vo) \qquad (7)$$

Thus, by adding a small ripple Δd to the duty cycle generated by the MPPT controller, oscillations in the PV voltage due to the dc link voltage can be prevented.

IV. ENERGY STORAGE MANAGEMENT

A battery energy storage system includes a battery, power electronics for switching between alternating and direct current, and a control system. Batteries convert electrical energy into chemical energy for storage. Different types of battery chemistries have different advantages and trade-offs in terms of power and energy capacity, size, weight, and cost. In large grid applications, the most common batteries are typically sodium-sulfur, lead acid, or lithium-ion chemistries. Various chemistries have been used in pilot projects and laboratory experiments, and a discussion of various electrochemistry can be found in Ref. [2]. Bidirectional power must be transmitted through an electronic interface. Power electronic interfaces are often referred to as power conversion systems (PCS). The PCS regulates the flow of power between the battery and the power grid and is able to respond to changes in power commands at sub-cycle time scales much faster than conventional peak-fired power plants. Power electronics can receive independent control signals for real and reactive power on the AC side of the PCS, allowing the BESS to provide power factor and voltage support. This operation is called quadrant operation and does not require system components such as capacitor banks with interconnected solar panels and grids.

V. EXPECTED OUTCOMES

This paper is mainly used to build the proposed simulation model for the solar power generation system, and it is performed together with the P&O technique for peak-peak power tracking. The purpose of the thesis, namely to develop an efficient and optimal system, is achieved. The maximum power point tracker must match the load to the maximum power available from the high-efficiency PVG (PV generator). This is achieved by consolidating P&O. Algorithm of MPPT controller. The duty of the boost converter is controlled by the above algorithm. A typical method is implemented in a Matlab/Simulink environment. Many countries of the world are located in tropical and subtropical regions where the intensity of sunlight can reach up to 1000 W/m2. Influence of environmental parameters ie. Temperature and irradiance changes can also be observed in the simulated properties. A boost converter is used to boost the PV array output with a perturbation and observe a technique to control the duty ratio of the boost converter switch.

VI. CONCLUSION

In this proposed method, the MPPT technique is designed to control the photovoltaic system. This command considers the random change of atmospheric conditions. The investigated system includes a 240 W photovoltaic panel, a DC-DC boost converter and a resistive load. Integrated Sliding Mode Control (ISMC) takes the reference voltage generated by fuzzy logic and uses it to vary its duty cycle, DC to follow the maximum power. The simulation results clearly showed the effectiveness (response speed, robustness and accuracy) of this approach to monitor MPP under varied and uniform weather conditions.

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