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Review paper on Comparative Study of MPPT Techniques for Solar Photovoltaic System

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ABSTRACT

Production of fossil fuel energy is decreasing but the demand for electrical power is rapidly increasing day by day. Solar energy is used because it is clean energy, and also is abundant in nature and has a lot of scope for future development. Maximum power point tracking (MPPT) is an algorithm method used in power electronic circuits to extract maximum power from the solar Photovoltaic (PV) Systems. This paper summarizes the development of a photovoltaic solar system based techniques like Incremental conductance, Fractional open-circuit voltage, Perturb and observe, Fractional short-circuit current and Fuzzy logic that improves accuracy, stability, and efficiency of PV systems. This paper describes a new technique in maximum power point tracking (MPPT) of PV system which is based on fuzzy type-2 controller. The proposed fuzzy type-2 controller performance is compared with MPPT of fuzzy logic controller type-1 (FLC1). The PV system consist of a PV panel, DC-DC boost converter, PLC unit simulated in mat lab/Simulink. The experiment results indicate that the fuzzy type-2 controller has better improvement in providing MPPT.

Keyword: PV panel, maximum power point, boost converter, Fuzzy logic.

INTRODUCTION

In this paper we describe fuzzy logic control for high power point tracking in PV system. Maximum power available or MPPT is a concern of challenge if it is extracted in efficient manner. It can raise the energy demand at big levels. If the constraints of a system can be achieved precisely, then its control would be a straight forward problem and model-depend closes to PID and pole placement could be used. Meanwhile, in real industrial based system, it is the case that there exist difficulties in achieving a good model. However, when the model is sufficiently perfect, there are lot of other uncertainties example like the precision of the sensors, noise generated by the sensors, environmental based conditions of the sensors, and actuators nonlinear characteristics. In these cases, model-free closes are generally used both for modelling and control purposes [1]. The extreme useful model-free closes to use of fuzzy logic system (FLSs). This work will enhance the effect of intelligent and digital control techniques for PV system efficiency optimization. These methods resemble both physical as well as Type-2 fuzzy depend MPPT tracking methods.

REVIEW OF LITERATURE

MPPT algorithms are essential in PV applications since the MPP of a solar panel varies with temperature. Hence the use of MPPT algorithms is essential in order to achieve the maximum power from a solar array. Past to current time many techniques to obtain the MPP have been developed and published. These methods differ in many parameters such as requirement of sensors, complexity, range of effectiveness, cost, convergence speed, accurate tracking when irradiation or change of temperature, hardware required for the implementation or famous among others. From these methods, the P&O and the Incond algorithms are the most used [2]. These methods have benefits of an easy implementation but they also have demerits, these limitations are eliminated using fuzzy logic controller.

Both P&O and INC algorithms are depend on the principle of "hill-climbing" which are made of operation point moving of the PV array in the direction of power increases. Hill-climbing include a perturbation on the duty cycle of the power converter and P&O a perturbation in the operating voltage of the DC link between the PV array and the power converter [8]. In case of Hill-climbing, perturbing the duty cycle of the power converter indicates the modifying voltage of the DC link between the PV array and the power converter. Hence both names referred to the same methods. In this techniques, the last sign perturbation and the last increment in the power are used to calculate the next perturbation the limitation of these methods are of two types. The first and important one is that they can lose track easily of the MPP if there is a rapid change of irradiation. In case if step changes they track the MPP very well since there is an instantaneous change and the curve does not keep on changing [11]. As a result, it is not possible for the algorithms to predict whether the power change is due to increase in its own voltage or due to the irradiation changes [3]. To reduce we use fuzzy logic controller. Fuzzy logic controller handles with imprecise inputs, does not require better mathematical model and can deal nonlinearity [15]. Microcontrollers also helps in the popularity of fuzzy logic control. The fuzzy logic contains three stages: russification, inference system and defuzzification. Fuzzification Is the process of transforming numerical crop inputs into linguistic variables depend on the degree of membership to certain amount.

Perturb and observe method

P and O system is normally used technique and also implemented where hardware is used [5]. This technique is different from other techniques, in terms of cost, convergence speed, sensors castoff, complexity, range of usefulness, tracing during irradiation and/ or temperature difference. The voltage sensor is used for intelligence in solar array voltage. The mathematical condition for perturbing and observe is $dp/dv = 0$, where P is power and V is the voltage at the output of the module [1]. The price required is less and it is simple to install. The time required for the algorithm is low but while reaching near to MPP it does not stop and a disturbance is increasing in both directions. As this P&O technique reached to MPP then for limiting the disturbance we have to do an appropriate error setting. In this algorithm, perturbation is introduced and causes power loss [18]. Due to perturbation, power is increased and perturbation is continued in the equal direction. When it is reached to the maximum level of the MPP power is zero and after that, the reversal of perturbation. At the steady-state, the algorithm oscillates. For the less power variation, the perturbation should keep small. For reaching a particular voltage level a PI controller is used [21]. While changes in the atmospheric conditions it flops to track the power because of perturbation, then also this technique is in demand.

Incremental and Conductance

The main disadvantage related to the P&O technique that it does not have the ability to compare the array terminal voltage with operating voltage maximum power point. The advantage of the in

C algorithm over the conventional method is that it has better efficiency, easy to execute as well as provides greater tracking speed [17]. As rapidly varying the atmospheric condition the tracking of maximum power is eliminated by using the Incremental and conductance method. When incremental conductance MPPT has reached maximum power point then it will stop in perturbing the operating point. It is used to sense voltage & current with the help of the sensor for sensing the output of the solar panel. Simultaneously sensing both current and voltage this will help to eliminate the errors which occur due to change in irradiance.

Fractional open circuit voltage method

Under the changing condition of irradiance as well as the temperature level of the PV system, it develops the fractional Voc method. Relationship between VMPP and Voc of the solar panel is nearly linear [26].

VMPP = K1Voc

VMPP = K1Voc 7 Where, K1 is proportionality constant for different PV array, there are different temperatures and different irradiance. The value of K1 factor is between 0.71to 0.78. As the value of K1 is determined, VMPP can be calculated with Voc decreasing the power converter. One of the disadvantages is there is loss of power [29].

Fractional short circuit current

As an atmospheric condition changes Impp is nearly linear to the Isc of PV array which results in fractional Isc[31].

IMPP = K2 Isc

K2 is proportional to constant, where K2 is between the values of 0.78 to 0.92. During operation Isc is in trouble, therefore, one switch is additional toward the power converter. Because of that Isc be able to measure via the current sensor of the PV array.

Fuzzy logic control

The fuzzy logic controller is the most dynamic and useful research area and generally useful for the control of various physical methods. The human experience is used for the design of fuzzy logic than a mathematical model for the controlling system. FLC (fuzzy logic control) is used where the system is a very complex or highly nonlinear character [1].

It is also used to determine the duty cycle of the step-down converter. The input over FLC is error value and changes in error. The problem in mathematical models or limitations in control methods is one of the useful control schemes in FLC [45]. Fuzzy logic is a rule-based decision process and also developing various control rules. It is more robust than conventional controllers.

CONCLUSION

Solar energy is present in abundance in nature and thus can be used to solve many of the environmental problems. In this review paper, various types of MPPT algorithm techniques are explained. Each MPPT technique is different from one another having its own benefits and drawbacks. The method based on Perturb & Observe technique is most widely employed in commercial production. This P & O technique can be implemented with low-price. A fuzzy logic depend algorithm for tracking the maximum power is recommended in this work. In order to calculate and implement the algorithm, a system model is required. The various components and subsystems are determined, modeled, validated, and combined together to generate a complete maximum power point tracker model. Efforts have been made to get the maximum power point in less possible time.

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