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Analysis of MPPT Techniques in PV System

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Abstract - In this study, the effectiveness of algorithms using and without using maximum power point tracking (MPPT) is compared. MPPT methods are perturb and observation and incremental conductance algorithms. The goal is to determine which algorithm extracts solar energy from solar cells more efficiently. To match the impedance between the PV array and load, boost converters are employed. Additionally, MATLAB/Simulink was used to simulate the suggested sans MPPT, perturb & observation, and incremental conductance techniques.
Keywords – Photovoltaic system; MPPT algorithms; Boost converter; MATLAB/Simulink.

I. INTRODUCTION

In order to address concerns with energy efficiency and power quality, there are currently significant investments being made in alternative energy solutions due to the rising global energy demand brought on by modern industrial uses and population increase. Photovoltaic energy is regarded as a main resource since it may be used in a number of tropical and temperate nations where direct sunlight densities can reach up to 1000W/m2.

Because of its many benefits, including ease of allocation, high dependability, desalination, low maintenance, versatility, low investment, and less noise and wear due to the absence of moving parts, photovoltaic (PV) generation is currently gaining importance as a renewable energy source application. Various cell conversion ranges include Efficiency ranges from 18% for inexpensive units to a maximum of 29% for very pricey ones. Despite these facts, the cost of contemporary power electronics systems and photovoltaic cells or systems has been on the decline, offering hope for future installations.

But photovoltaic generating has the disadvantage of being sporadic, weather-dependent, and a less dependable power source. MPPT forces the PV system to run at its greatest efficiency in order to provide stable and dependable electricity from the PV system for both loads and the utility grid. This enhances the overall power generation system's steady and dynamic behaviours.

II. MPPT TECHNIQUES

Maximum power point tracking is a technique which is used to maximize energy extraction from different sources and MPPT is widely used in Photovoltaic solar system.

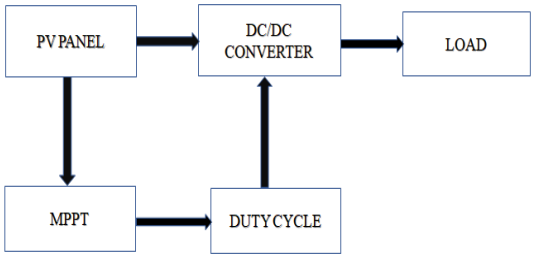

Fig1: Block Diagram of MPPT

In without MPPT technique the PV Panel output is directly connected to load with the help of converter. In the given figure 2 shows the Simulink model of the without MPPT technique.
In with MPPT technique the PV Panel output is connected to MPPT controller and then connected to load with the help of converter.

Type of MPPT is:
- Perturb & observe(PO)
- Incremental conductance(IC)

Perturb & observe technique.

The most often utilised MPPT algorithm in commercial PV products is the perturb and observe approach. In a sense, this is a "trial and error" approach. By using a low voltage ride through, the PV controller increases the reference for the inverter output power before detecting the actual output power. When the output power starts to decline, the controller lowers the reference to prevent the collapse of the photovoltaic output caused by the non-linear PV characteristic. If the output power is definitely increased, it will increase again until the

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output power starts to increase again. In the supplied figure 3 illustrates the Simulink model of the Perturb & observe technique.

Incremental conductance.

The complexity of the algorithm rises because the incremental conductance approach typically requires two voltage and current sensors to measure the output voltage and current of the PV array.MPP is obtained when this instantaneous conductance reaches parity with the conductance of the solar PV module system. Here, we are concurrently measuring the current (I) and the voltage (V). The primary principle underlying this method is to compare incremental conductance with instantaneous conductance, and depending on the results of their comparison, to either increase or decrease the operating voltage of the panel until the maximum power point is reached. The primary benefit of this approach is its ability to react fast and accurately to changes in irradiance conditions, which improves system efficiency and yields superior results. In the given fig 4 shows the simulink model of the incremental conductance technique.

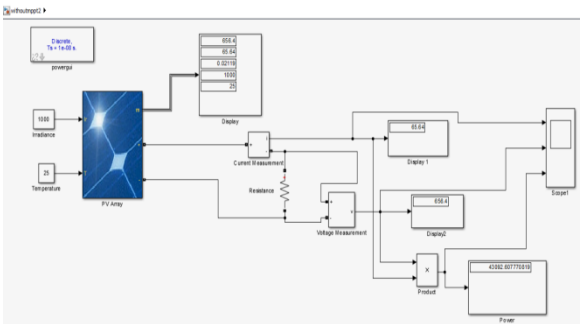

Fig 2: Shows the Without MPPT technique PV system.

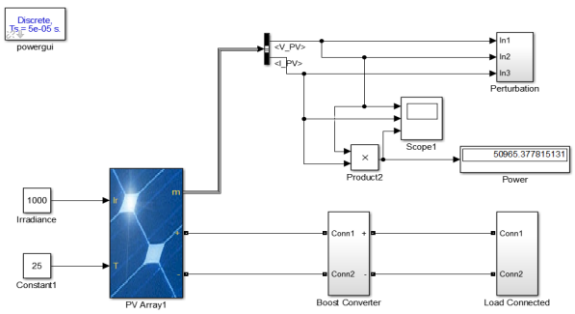

Fig 3: Shows the Perturb and Observe technique applied in PV system.

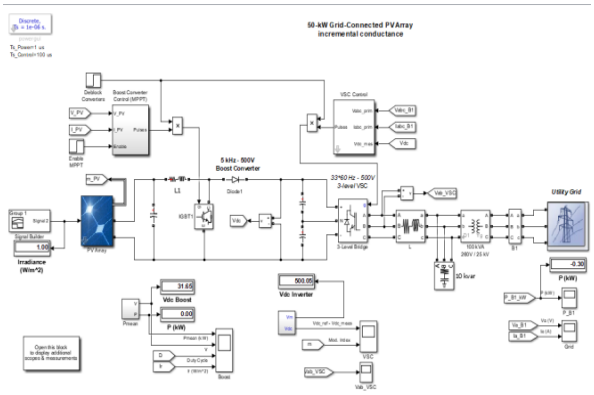

Fig 4: Shows the Incremental Conductance technique applied in PV system.

III. SIMULATION RESULTS

The simulation results of all three methods—incremental conductance, perturb & observe (IC, P&O) and MPPT—are compared in this section. And the output waveforms are shown in figures. 5, 6, 7, 8, and 9. The output waveform of the 53kV grid-connected system's output is used as the foundation for comparison of the results. The findings of the study using Without MPPT and With MPPT approaches are compared in Table 1.

Fig 5: Output of PV model array without MPPT

In Fig 5 X axis consists of Power, Voltage and Current and Y axis consists of Time.

Fig 6: P&O output voltage

In Fig 6. X axis consists of Voltage and Y axis consists of Time.

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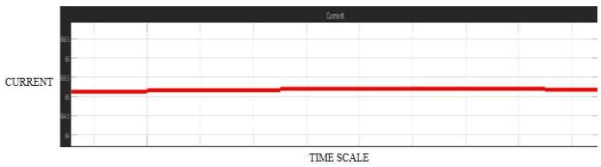

Fig 7: P&O Output current
In Fig 7, X axis consists of Current and Y axis consists of Time.

Fig 8: P&O Output power
In Fig 8 X axis consists of Power and Y axis consists of Time.

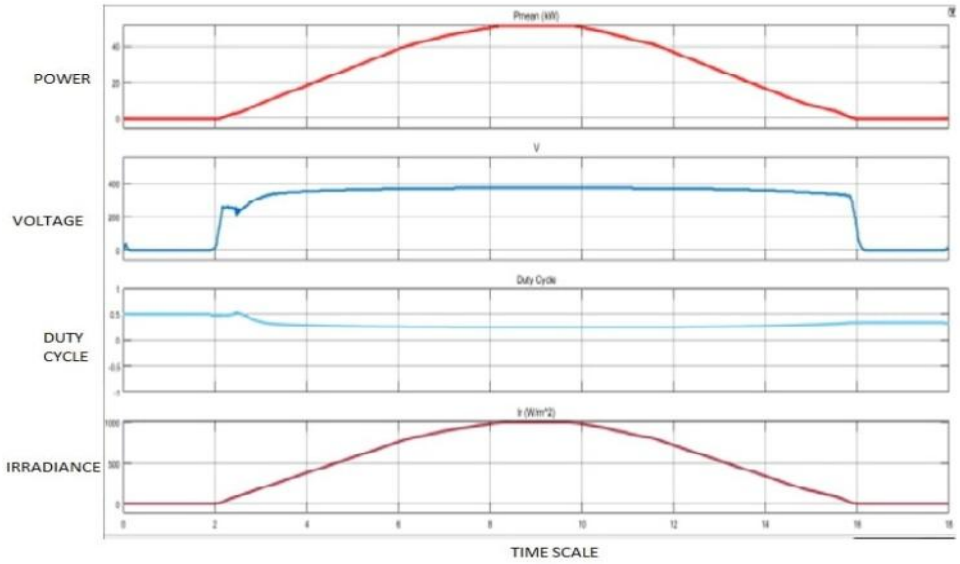

Fig 9: Incremental conductance output

In Fig 9, X axis consists of Power, Voltage and Duty cycle and Y axis consists of Time

TABLE: 1 COMPARING WITH AND WITHOUT MPPT TECHNIQUES.

Parameter	Without MPPT	P&O Technique	IC Technique
Current	65.66A	65A	129A
Voltage	656.5V	794.03V	395A
Power	43.11KW	51.54KW	51.4KW

IV. CONCLUSION

This suggested work successfully completes the examination of maximum power point tracking (MPPT) methods in PV systems. The methods considered in this proposed work are Perturb & Observe (PO), Incremental Conductance, and With MPPT (IC). The results of the simulations for the PV array are examined for load power at the converter end. Grid connectivity works well with boost converters.

According to the observation, the load power obtained with the MPPT method is more than the load power obtained without it.

Due to its rapid convergence, inexpensive iterations, precise and automatic module operating voltage adjustment, lack of oscillations and high rate of convergence the P&O algorithm performs better than IC algorithms and algorithms without MPPT.

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