☼ Renewable Energy Systems Assignment

Topic: MPPT Techniques in Solar PV Systems
Selected Methods:

a. Incremental Conductance (IncCond)
b. Perturb and Observe (P&O) Methods

CSE - A

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Maximum Power Point Tracking Using Incremental Conductance and Perturb & Observe Methods

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1. Introduction

Maximum Power Point Tracking (MPPT) is a vital technique used in photovoltaic (PV) systems to extract the maximum possible power under varying environmental conditions. Solar panels have a non-linear I-V and P-V characteristic curve, and the point at which the product of current and voltage (power) is maximum is called the Maximum Power Point (MPP). The two most commonly used MPPT algorithms are Incremental Conductance (INC) and Perturb & Observe (P&O).

2. Objective

The primary objective of this project is to implement and compare the performance of two MPPT techniques - Incremental Conductance and Perturb & Observe - using MATLAB/Simulink. The simulations are carried out using a Buck-Boost converter to regulate the output voltage and improve efficiency.

3. Methodology

3.1 Incremental Conductance (INC) Method

The INC method is based on the principle that the derivative of power with respect to voltage (dP/dV) is zero at the MPP. It uses the relationship between incremental conductance (dI/dV) and instantaneous conductance (I/V) to track the MPP.

- **At MPP:** dP/dV = 0 ⇒ dI/dV = -I/V
- **Left of MPP:** dI/dV > -I/V ⇒ Increase V
- **Right of MPP:** dI/dV < -I/V ⇒ Decrease V

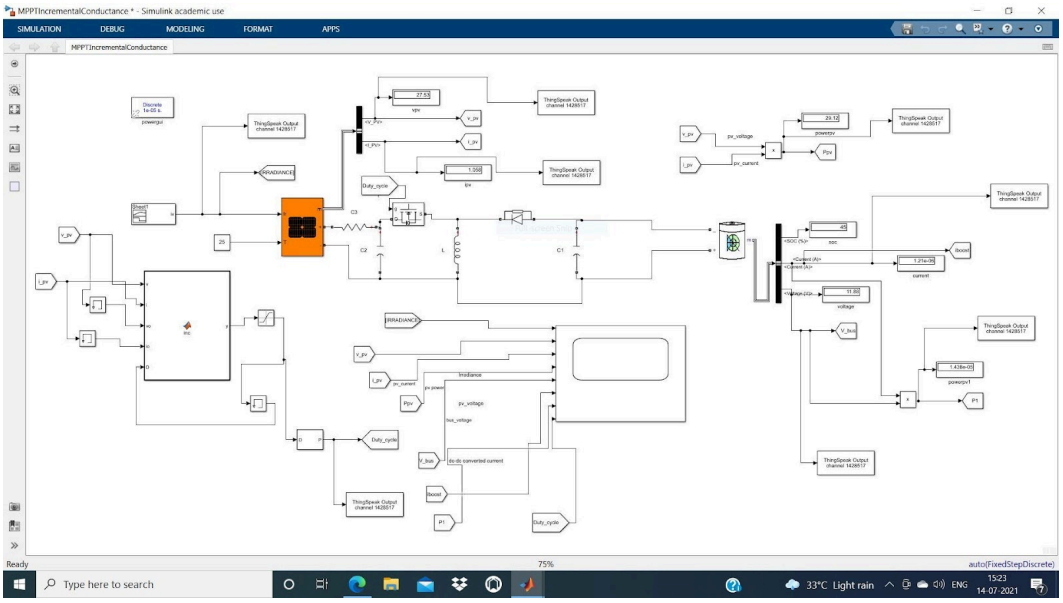

Figure 1: Incremental Conductance MPPT Simulink Model

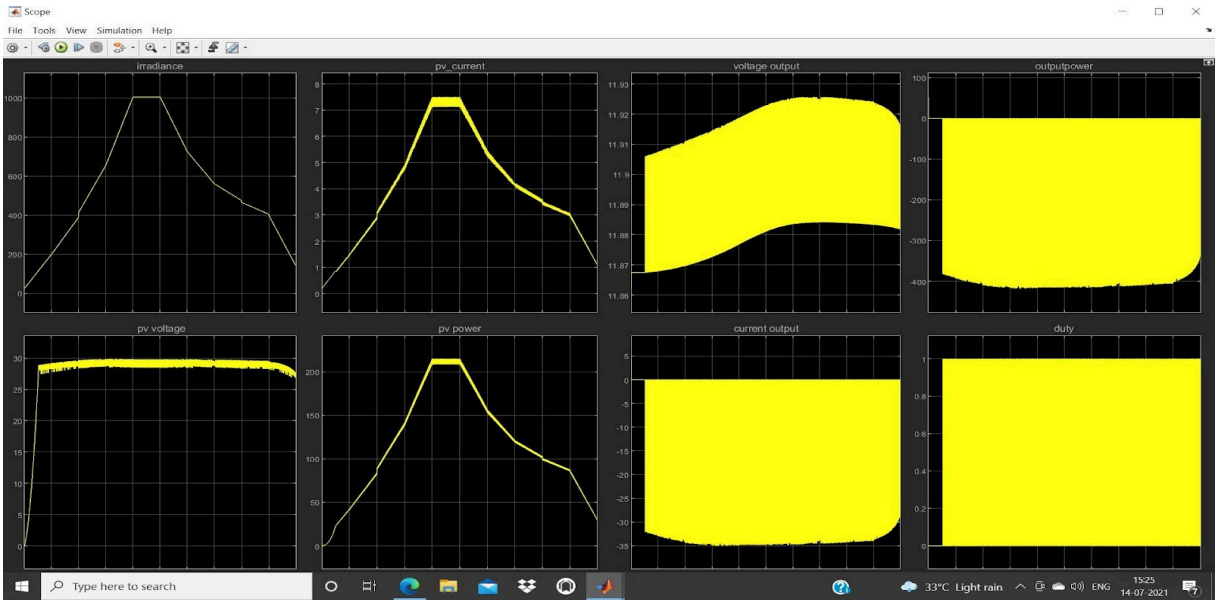

Figure 2: Simulation Results for Incremental Conductance MPPT

3.2 Perturb and Observe (P&O) Method

The P&O method perturbs the operating voltage of the PV panel and observes the change in power. If the power increases, the perturbation is continued in the same direction. If the power decreases, the direction is reversed.

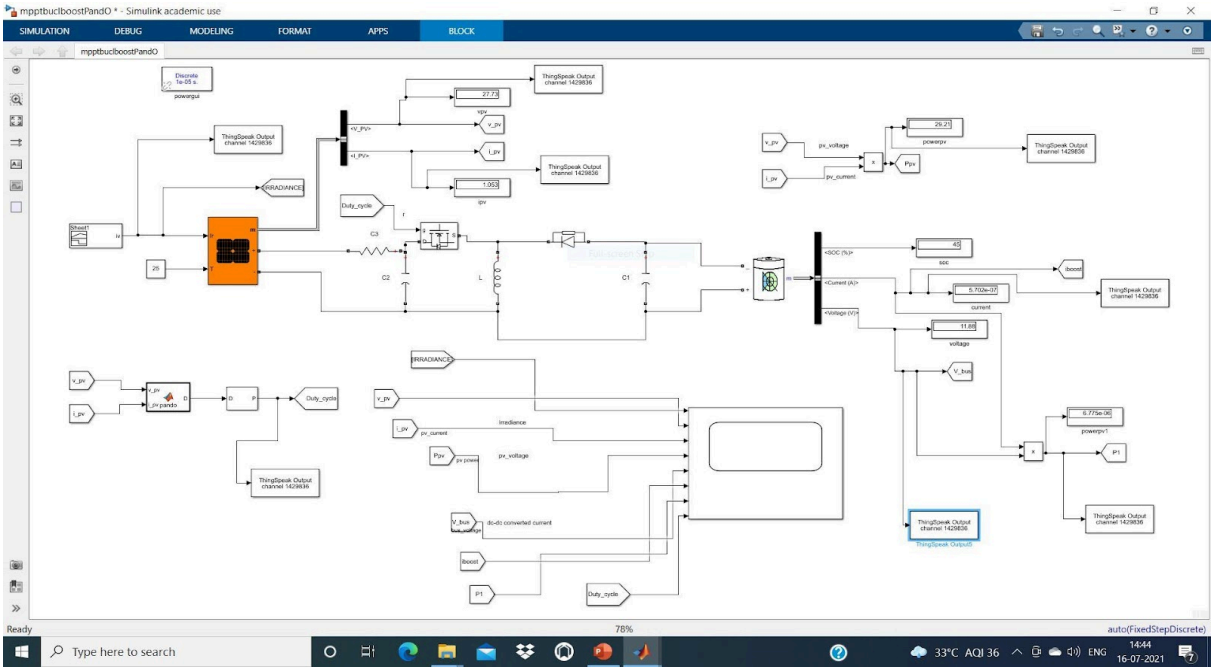

Figure 3: Perturb and Observe MPPT Simulink Model

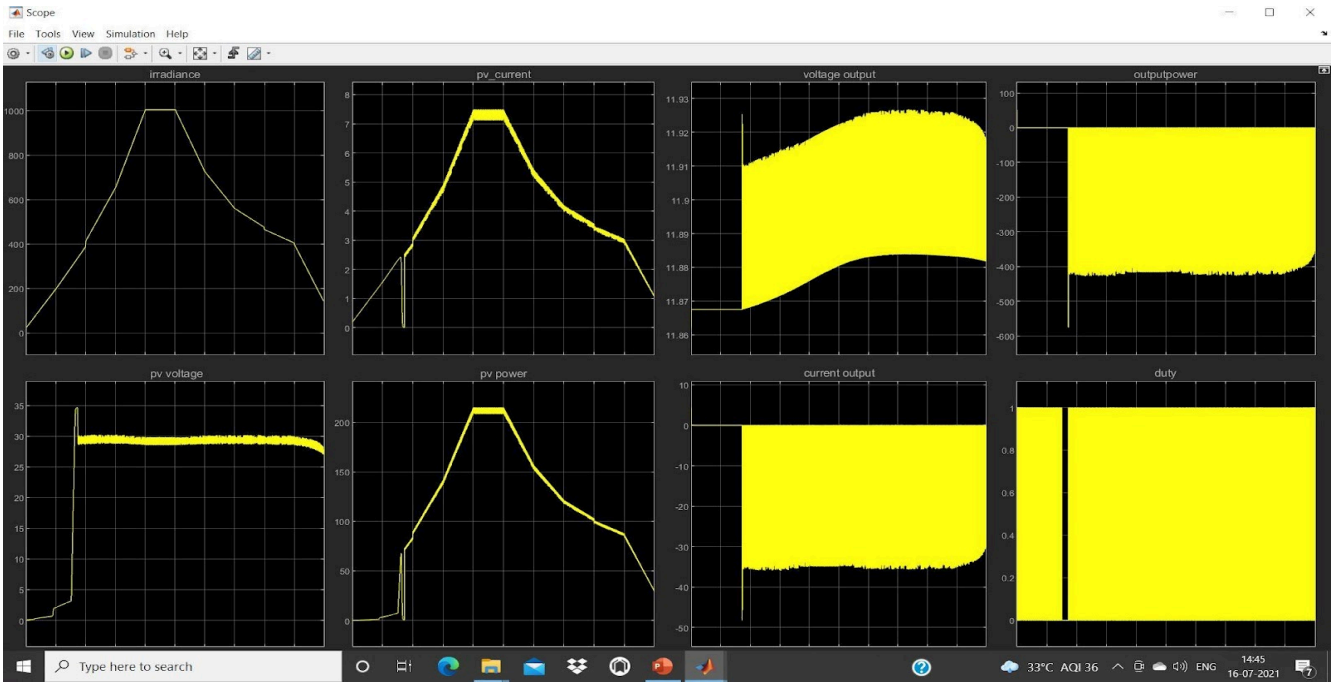

Figure 4: Simulation Results for P&O MPPT

4. Comparison of Methods

Criteria	Incremental Conductance (INC)	Perturb & Observe (P&O)
Accuracy	High (accurate at MPP)	Moderate (oscillates around MPP)
Complexity	Higher (requires more computation)	Lower (simpler implementation)
Response to changes	Better for fast-changing conditions	Slower response
Implementation	Slightly more difficult	Easy to implement

5. Conclusion

This project successfully demonstrates the implementation and comparison of Incremental Conductance and Perturb & Observe MPPT techniques using MATLAB/Simulink. The results indicate that while INC offers better accuracy and faster response, it is more complex than P&O, which is simpler but less accurate near the MPP. The choice of technique depends on the application's precision and processing capability requirements.