WORKSHOP

Clean energy in Vietnam after COP21

SIMULATION OF MPPT CONTROL SYSTEM WITH DC/DC BIDIRECTION CONVERTER IN BOOST MODE FOR PV SYSTEM

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- Simulation result in PSIM software
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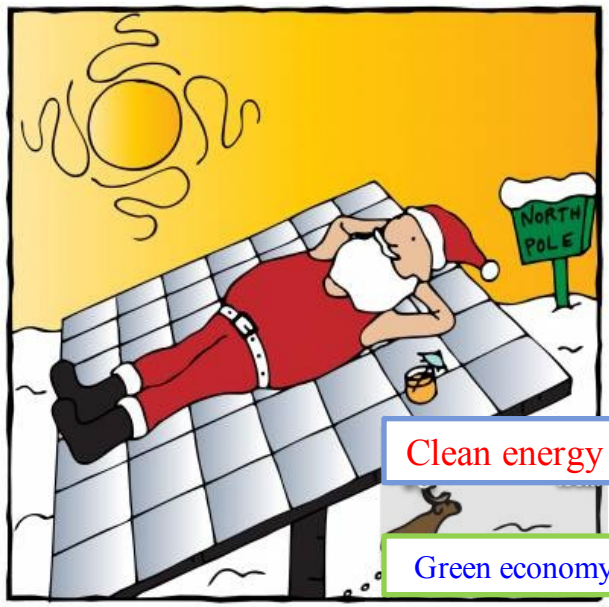
INTRODUCTION



Clean energy

Green economy

THIS CHRISTMAS, SANTA DECIDED TO USE AN ENERGY-SAVING LIGHT GLOBE

Energy demand

INTRODUCTION

- A PV array under constant uniform irradiance has a current–voltage (I–V) characteristic.
- Temperature influences the PV output voltage while solar irradiance affects PV output current.
- There is a maximum power point (MPP), at which the array operates with maximum efficiency.

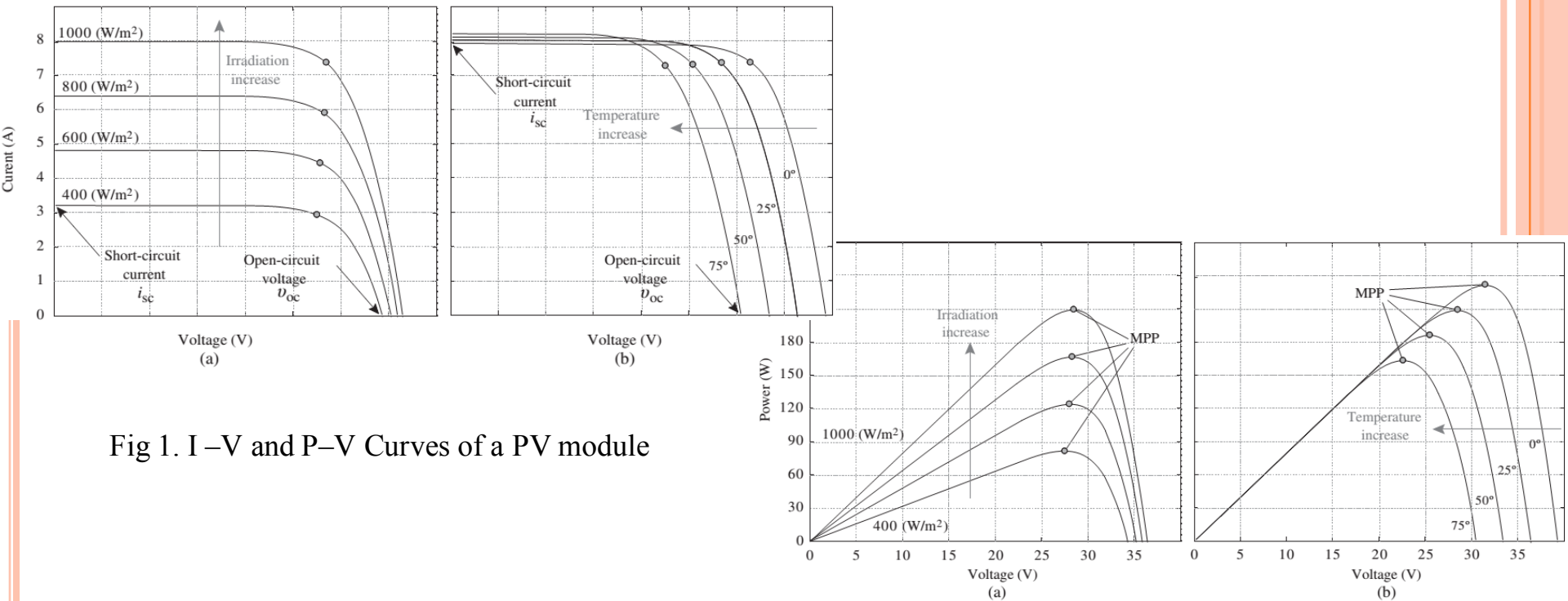


Fig 1. I –V and P–V Curves of a PV module

INTRODUCTION

PV array is directly connected to a load

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Operating point is not at the PV array's MPP

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PV array must usually be oversized to ensure that the load's power requirements can be supplied

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Increasing the system cost and energy losses

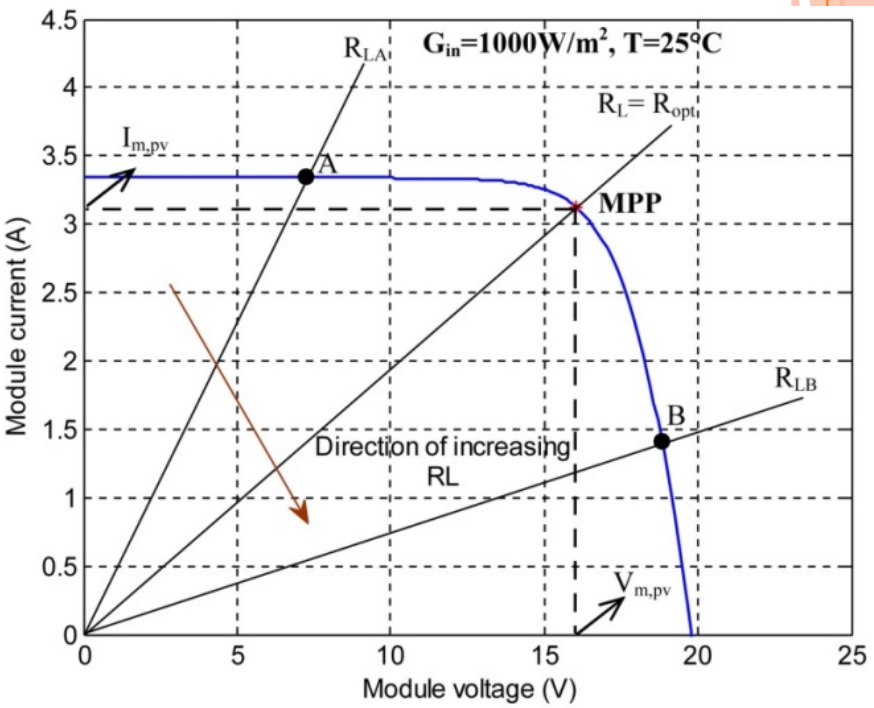


Fig 2. I –V Curve of PV array connected to a load

Controlled power converter + maximum power point tracking (MPPT) methods

INTRODUCTION

Impedance matching principle: the power output of a circuit is maximum when the source impedance matches with the load impedance.

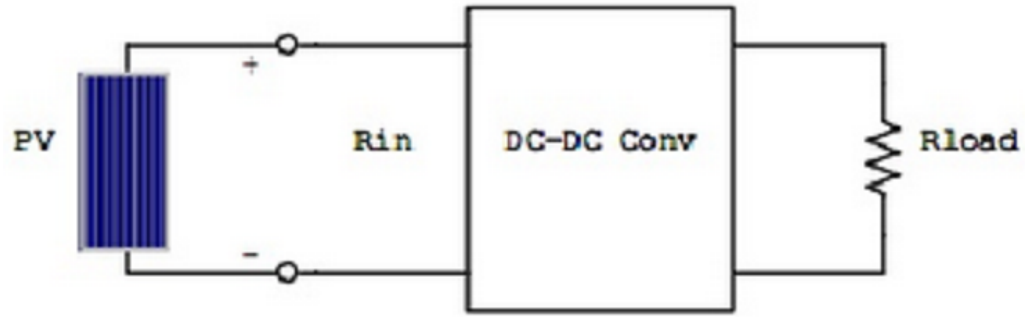


Fig 3. PV system with DC/DC converter

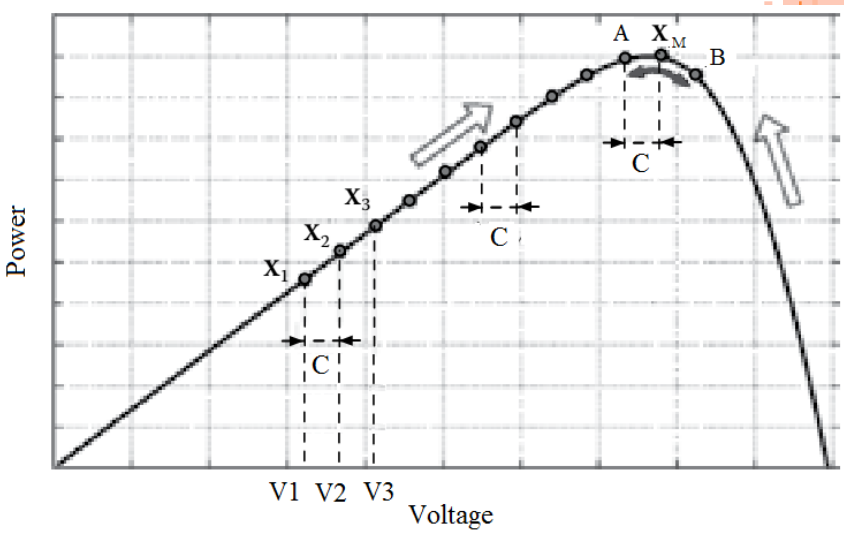
MPPT match the impedance of load with the largest load impedance of PV by adjusting the duty factor D of DC-DC converter

Boost DC/DC converter: $R_{in} = (1\text{-}D)^2 R_{load}$

INTRODUCTION

Perturb and Observe (P&O) algorithm of MPPT method

- Perturbing the reference voltage.
- Measuring the system response (observing) to determine the direction of the next perturbation.
- The reference voltage perturbations are performed in the direction in which the power should increase.



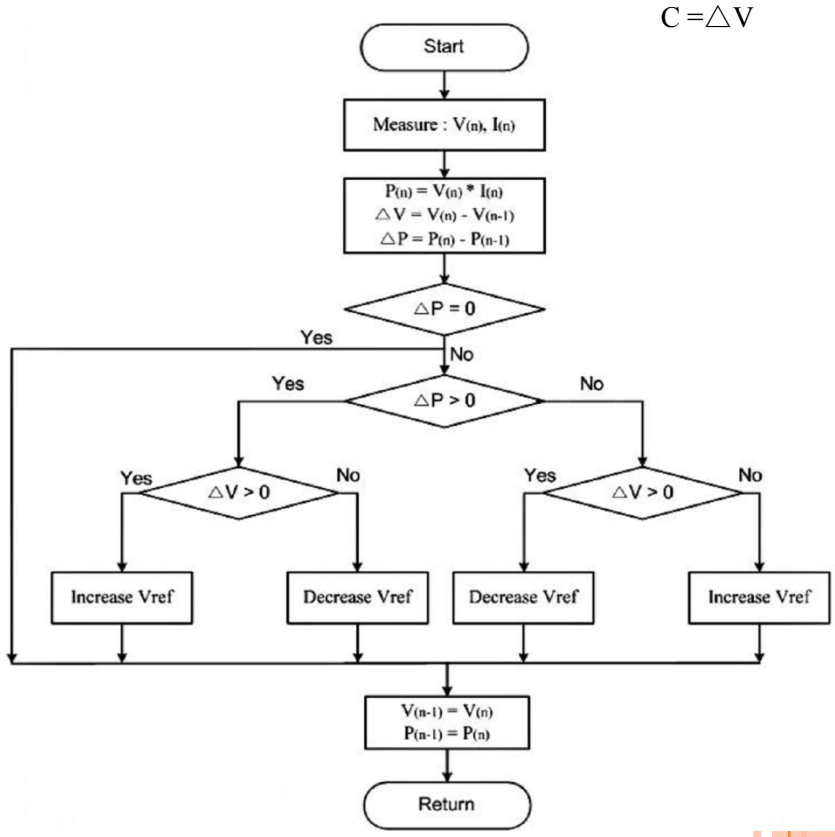


Fig 4. Mechanism of P&O algorithm

INTRODUCTION

MPPT control structure with DC/DC converter in boost mode

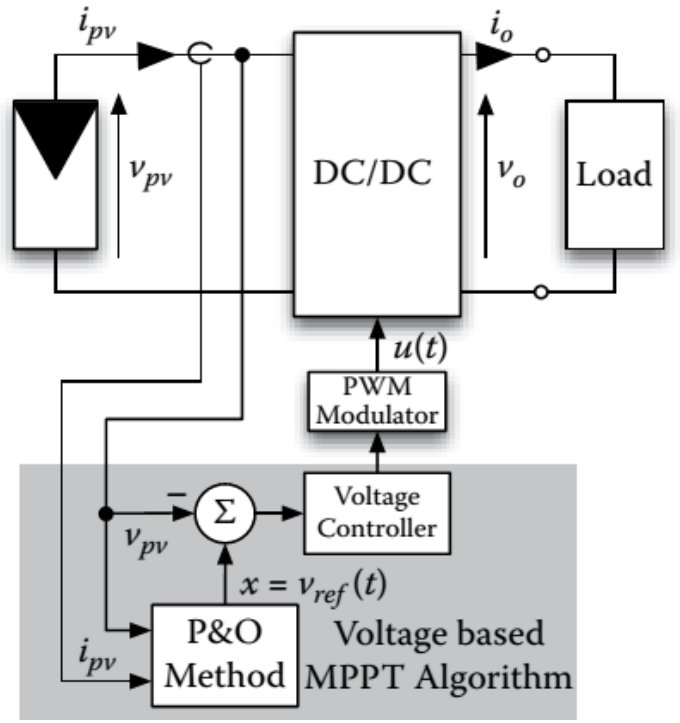


Fig 5. Diagram of MPPT control system

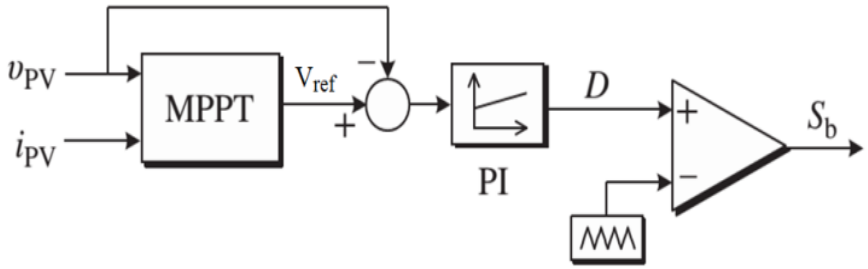
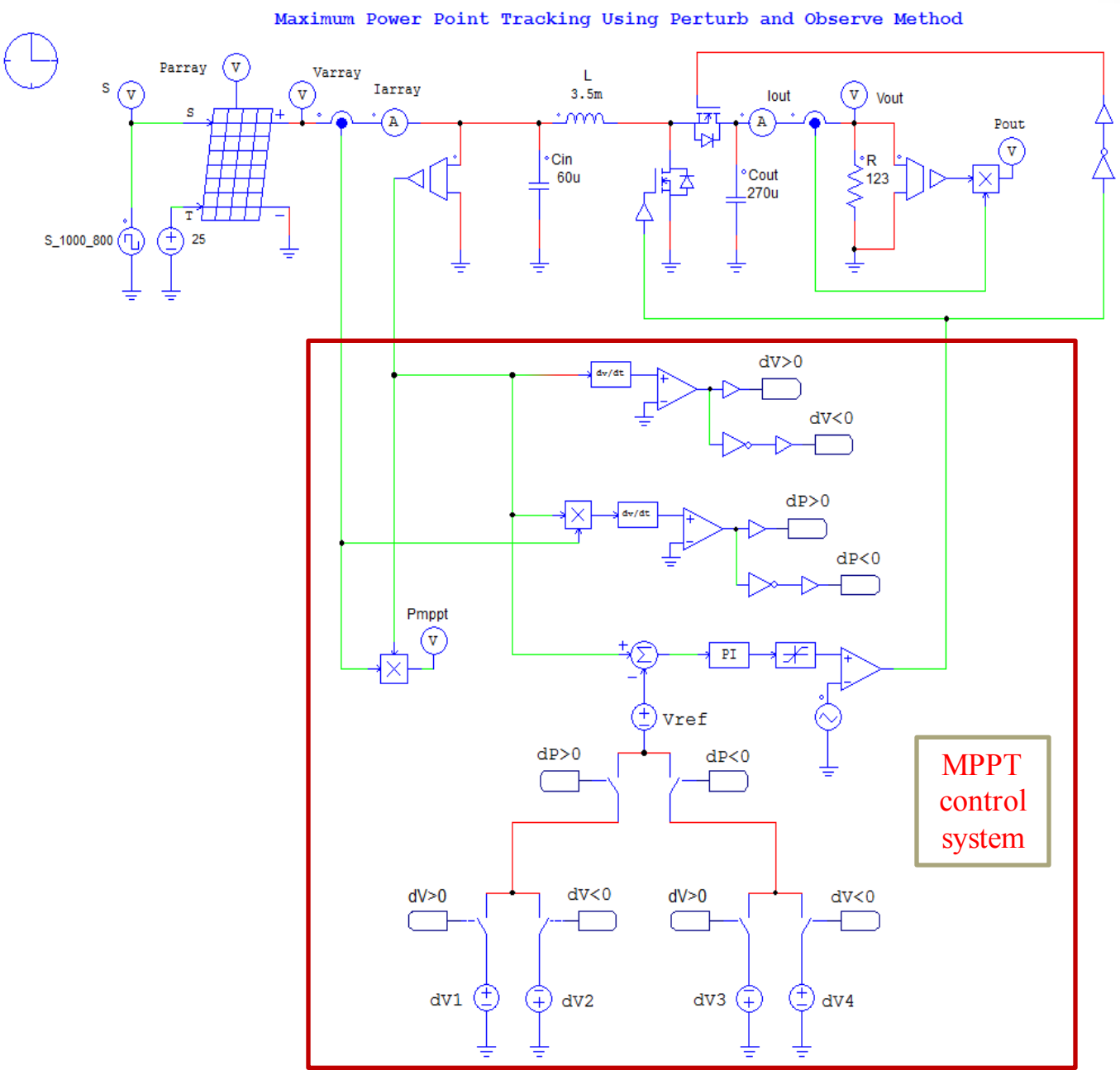


Fig 6. Voltage control loop block diagram

Simulation result in PSIM software



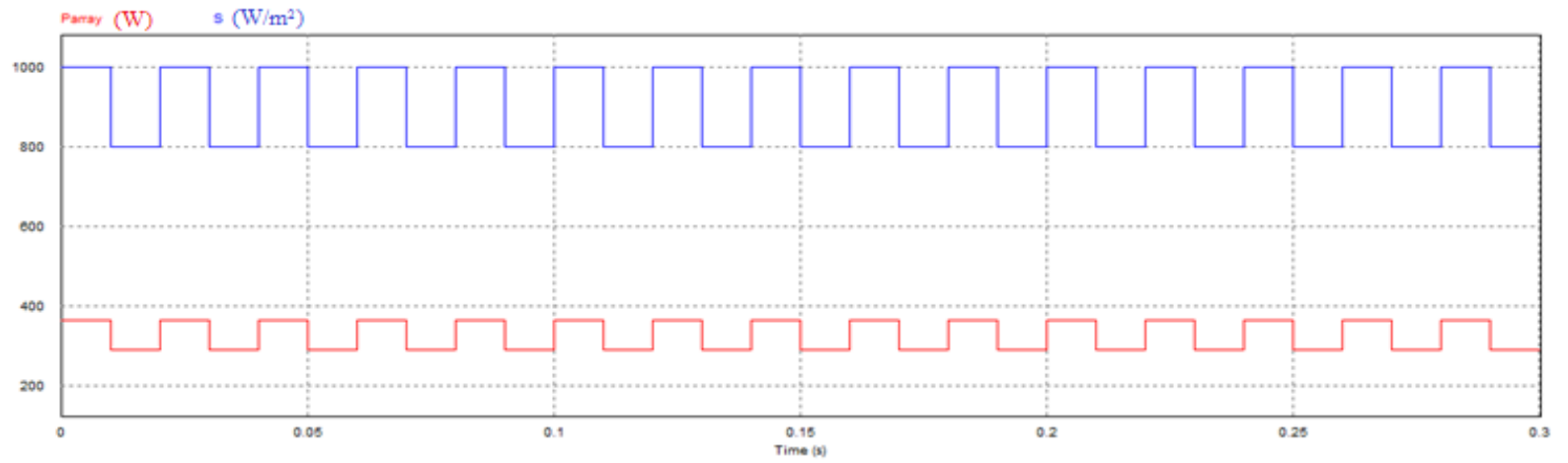
Simulation result in PSIM software

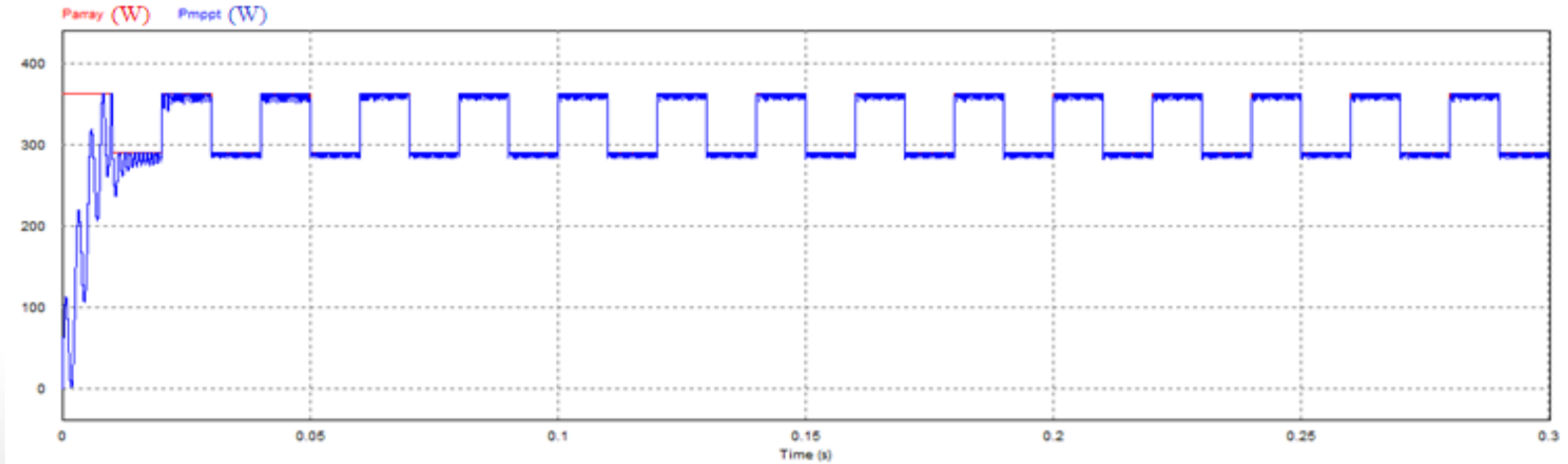
Table 1. System parameter for simulation

No	Parameter	Value
1	Power of PV system P_{array} (including 6 solar panels 60Wp)	360 Wp
2	Output power of converter P_{out} (assuming efficiency of DC/DC converter is 90%, so P_{out} =90% P_{in})	324 W
3	Voltage of solar panel system V_{array}	100 VDC
4	Output voltage of converter V_{out}	200 VDC
5	Output current of converter I_{out}	1.62 A
6	Duty cycle D	0.5
7	Switching frequency of the converter f_s	30000 Hz
8	Input capacitor C_{in}	60µF
9	Output capacitor C	270µF
10	Inductor L	3.5 mH
11	Load Resistor R	123 Ohm

Simulation result in PSIM software

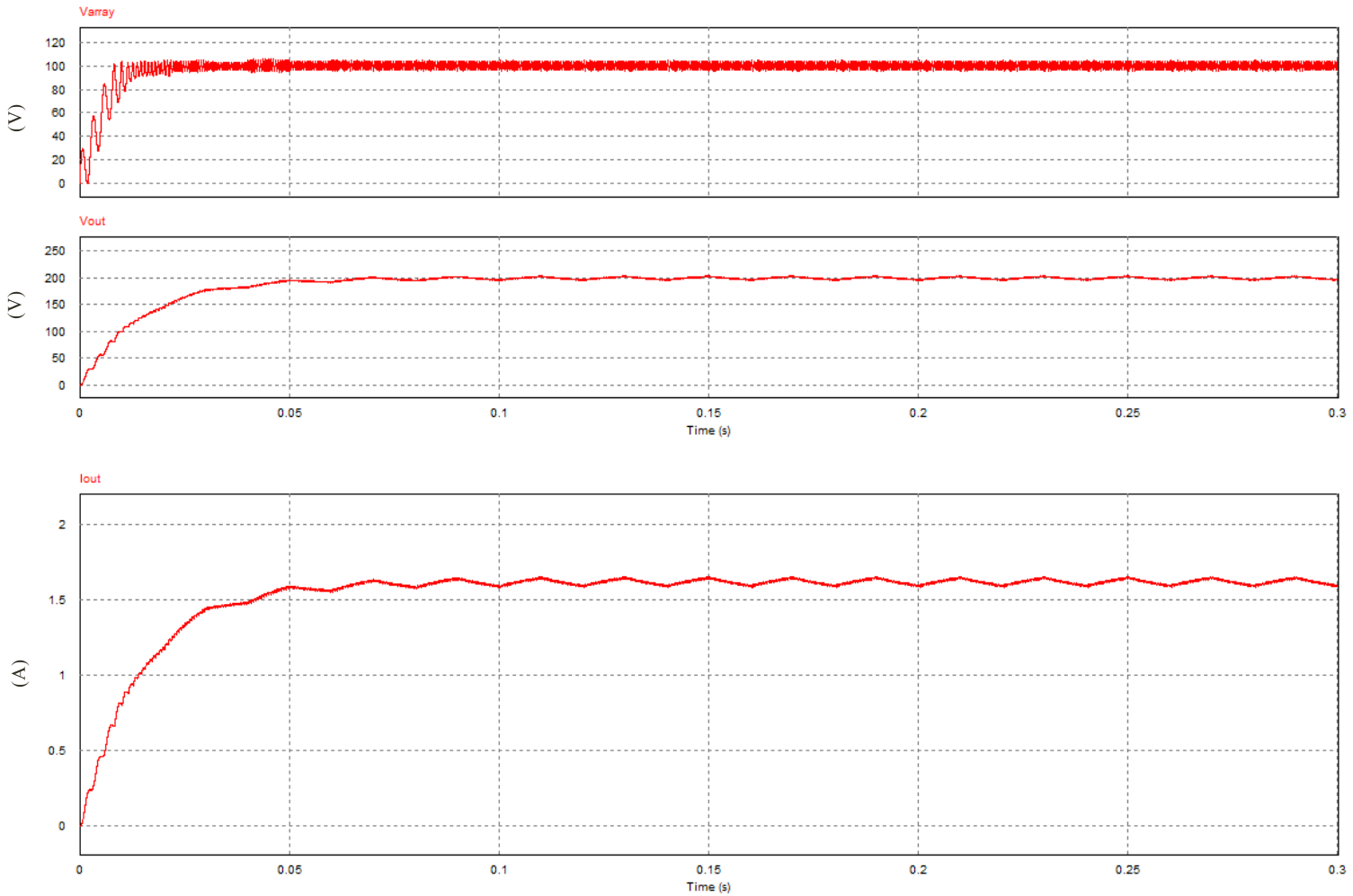
- Power output of solar panel array almost reached the maximum power.
- MPPT system could produce a maximum power output of solar panel even though under different (high/low) irradiation conditions.





Simulation result in PSIM software

When the solar irradiance changes, the variation in the output power, output voltage, output current of converter is very less



CONCLUSION

- The design and simulation of Maximum Power Point Tracking (MPPT) using Perturb and Observation method are executed by voltage control loop for photovoltaic system.
- By using MPPT algorithm and DC/DC bi-direction converter, solar array is operated at maximum power point irrespective of variations of solar irradiance.

FUTURE WORK

Research on hybrid power system (PV+wind turbine) connected to the power grid with the help of a single phase grid tie DC/AC inverter

Thank
for your attention!