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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Introduction

Simulation result in PSIM software

Conclusion
INTRODUCTION

Energy demand

Clean energy

Green economy

This Christmas, Santa decided to use an energy-saving light globe
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

Operating point is not at the PV array's MPP

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

Increasing the system cost and energy losses

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

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

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

![PV system with DC/DC converter](image)

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:** $R_{in} = (1-D)^2R_{load}$
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

Maximum Power Point Tracking Using Perturb and Observe Method

MPPT control system
# Simulation result in PSIM software

## Table 1. System parameter for simulation

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