MAXIMUM POWER POINT TRACKING OF PHOTOVOLTAIC PANEL

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Abstract

The main objective of this project is to design a DC-DC converter which plays a key role in the MPPT of Photovoltaic panels. The design is based on one topology: the Buck-Boost converter. Being said, the project studies two main components: building the DC-DC converter and tracking the maximum power point of PV array in top of building 59. We will see the change of power curves over time to be maximum at noon. The results of the MPPT will be provided at the end.

Figure 1: Perturb and Observe Algorithm

Background

Maximum Power Point Tracking (MPPT) technique is simply a procedure in which the maximum power is absorbed out of the solar cell. This is done by tracking the point which provides to us the maximum power. Although the procedure may seem straightforward, it is not. There are several challenges; one is locating this Maximum Power Point (MPP). Second, varying the load voltage meet the MPP. This MPP changes throughout the day mainly due to the temperature and irradiation. **Figure 2** shows the effect of irradiation and temperature on the *IV curve*. Also, the change of the MPP is clear.

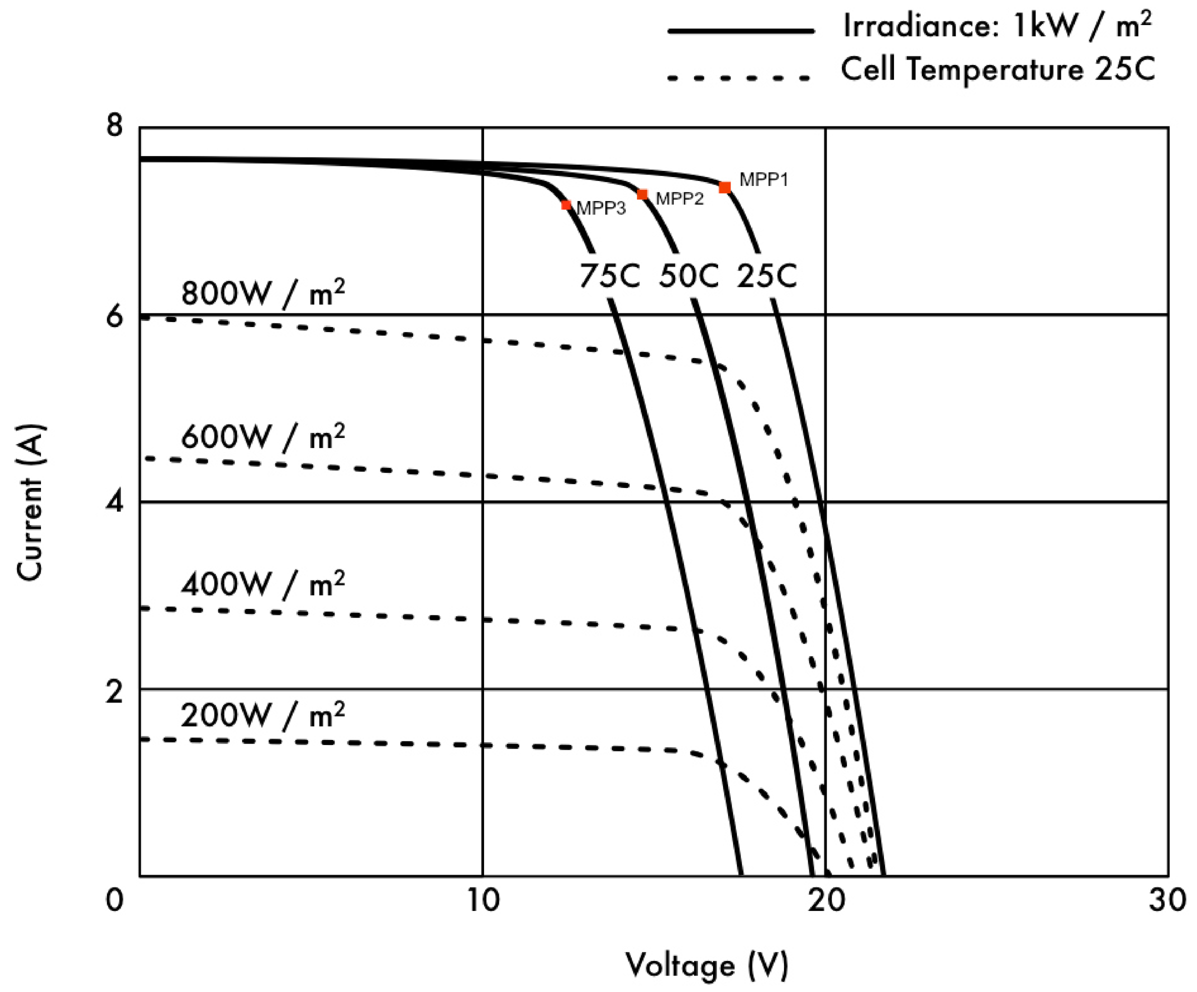

Figure 2: Perturb and Observe Algorithm

Buck Boost DC/DC Converter

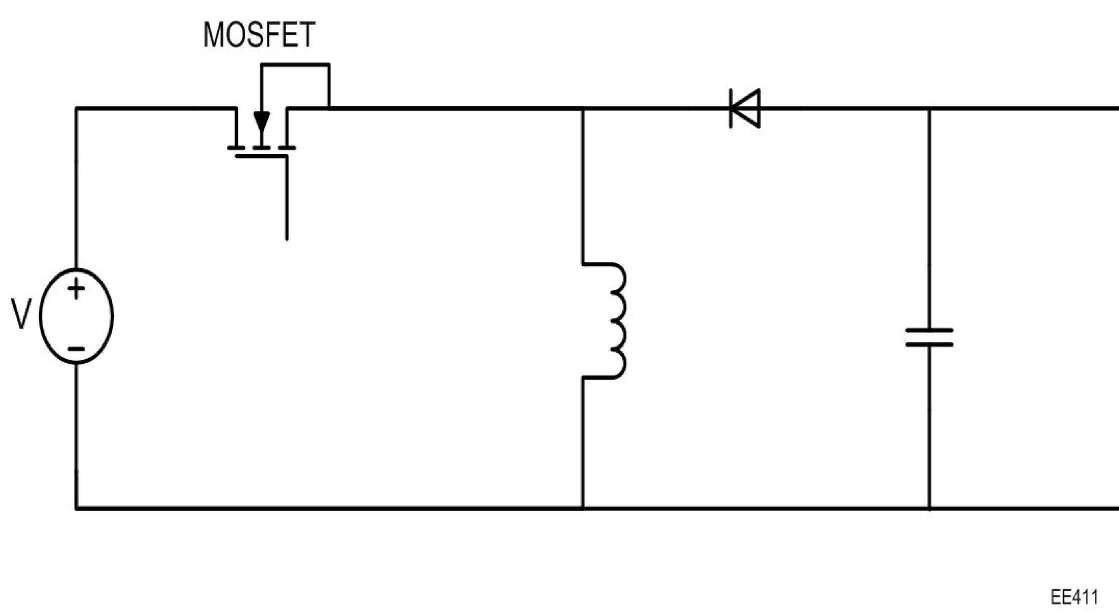

Figure 3: Buck-Boost converter

Tracking the MPP requires DC/DC converters to vary the load voltage. Buck-Boost converter is a combination of two DC-DC circuit topologies, Buck and Boost. The basic Buck-Boost converter is composed of a transistor (MOSFET), diode, capacitor and an inductor. Theoretically, this equation describes the relation between the input and output:

$$\frac{V_o}{V_i} = \frac{-D}{1-D}$$

D : Duty cycle fed to the switch

Results

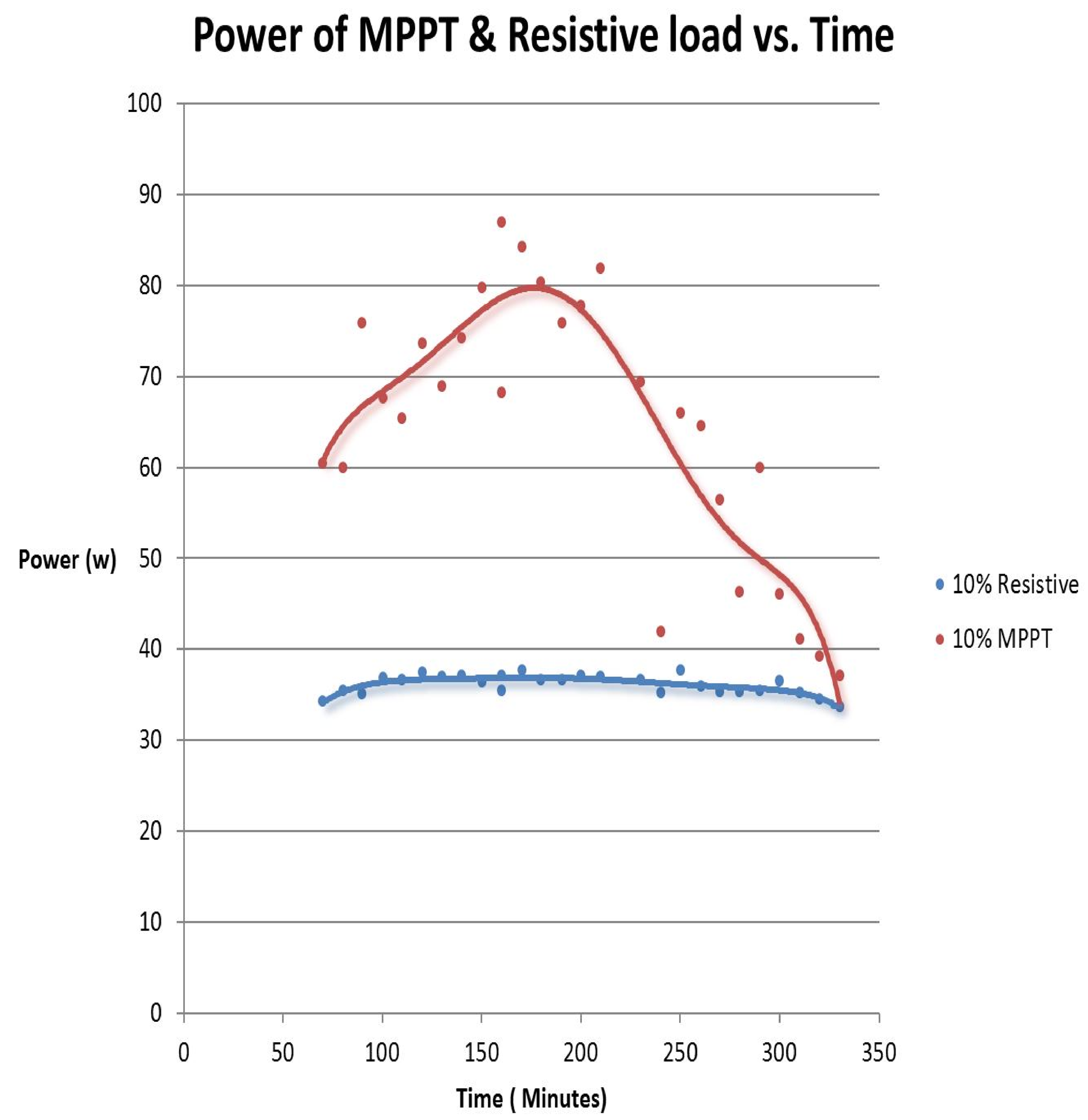

Figure 4: Comparison between MPPT and resistive load

Figure 5 shows that for different duty cycles the load absorbs different power. Therefore, the output power can be controlled by varying the duty cycle delivered to the switches. This option provides a full control of the power transferred to the load. This is crucial especially when the load is sensitive and has power dissipation limits. As a result, another use of the MPPT system is to operate it as a power controller.

Figure 4 shows a comparison in terms of the power extracted between a resistive load and an MPPT system. The power of MPPT is always superior to that in a resistive load.

Defining the efficiency as:

$E = \frac{P_{mppt}}{P_{resistive}} * 100$, we get the following table:

Table 1: MPPT Efficiency

Potentiometer Knob	Efficiency %
10%	179.39
40%	299.16
80%	928.38

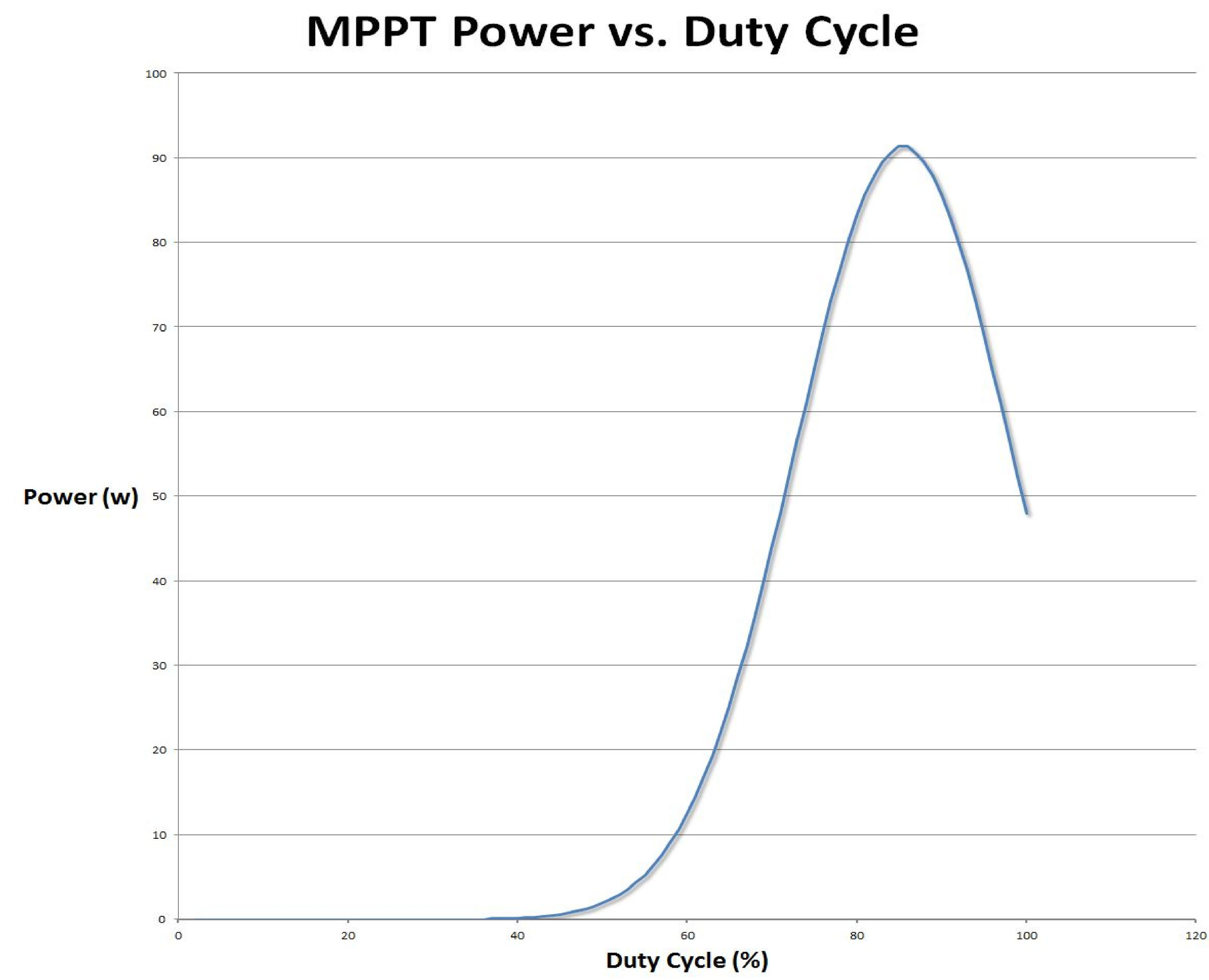

Figure 5: MPPT Power vs. Duty cycle

Conclusion

There are many methods to track the maximum power point from the PV cells. In this project, Perturb and Observe method was used. The MPPT importance relies in delivering the maximum power independently of the load by modifying the width of the pulses fed to the switches. Another use of the MPPT system is controlling the power delivered to the load by changing the duty cycle delivered to the switches. This application can be used as a safeguard protection to the load.