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Integration of Renewable Energy in Green Hydrogen Generation

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Abstract – The inclusion of renewable energies, especially photovoltaic energy in the green hydrogen production is a very promising idea in the field of energy. However, these sources are unstable and susceptible to a variety of atmospheric influences, including temperature and illumination, for this reason, we must address these issues before we can adopt renewable energy as a major source in hydrogen production. Using Matlab software, we will construct an autonomous photovoltaic system that uses a DC-DC boost converter to link the PV array to the load. To improve the efficiency of the photoelectric power, we will utilize the perturbation and observation MPPT approach.

Keywords – Photovoltaic System, MPPT Technique, Perturbation and Observation, Optimization, DC/DC Converter, Green Hydrogen.

I. Introduction

The use of renewable energies, particularly photovoltaic solar energy to produce hydrogen, can be a good solution to the growing demand of electricity. Because it's a clean resource and it's free from the nature. But since this source is volatile and unstable, as it's affected by several climatic factors such as lighting and temperature, where it have one ideal working point called maximum power point MPP. In this study, the method of perturbation and observation is used to track the MPP of the PV system. This approach has numerous benefits, such as how simple it is to use, does not depend on PV array, upright, precise, and high performance under uniform radiation.

The organization of this work is as follows: Section 2 provides a quick overview of the system. Modelling of the suggested system is the focus of section 3. The use of P&O control to monitor the maximum output of a photovoltaic system is reserved for section 4. Section 5 presents the simulation findings. Section 6 summarizes a few of this work's conclusions.

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II. DESCRIPTION OF THE PROPOSED SYSTEM

As shown in Figure 1, the modeling of the photovoltaic system is based on three components: the PV array, the boost converter, and the controller system.

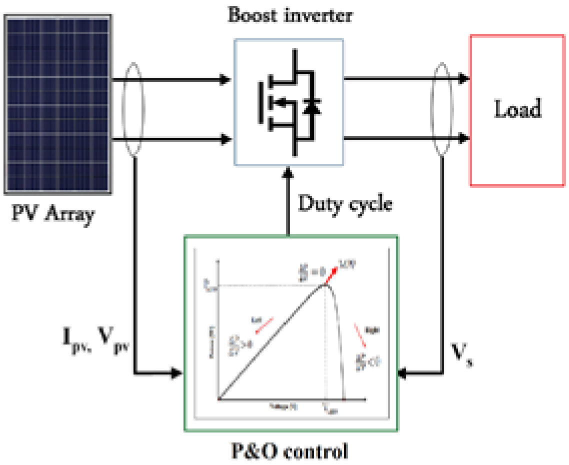

Fig. 1 Example of a figure caption

III. MODELING OF THE PROPOSED SYSTEM

A. Modeling of the photovoltaic panel

A current source connected in parallel to a diode serves as a model for an ideal solar cell. No solar cell, however, is perfect. As a result, the model now includes two resistances, one placed in series and the other in parallel, as indicated in the accompanying figure:

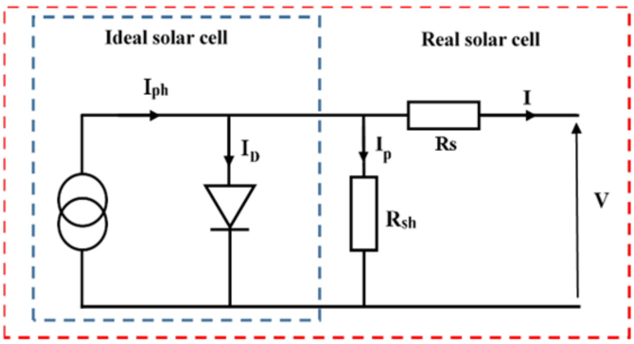

Fig. 2 Electric model of solar cell

When the surface of a solar cell is exposed to light, it demonstrates the unique ability to function as an energy generator, providing electrical current to keep going. Indeed, the electrical behaviour of the cell is identical to that of a diode when it is illuminated. Therefore, the electrical regime of a solar cell with a PN junction can be described using the following equations:

Photo-current :

$$I_{ph} = [I_{sc} + k_i \cdot (T - 298)] \cdot \frac{G}{1000} \quad (1)$$

Saturation current

$$I_0 = I_{rs} \cdot \left(\frac{T}{T_n}\right)^3 \cdot \exp\left[\frac{q \cdot E_{g0} \cdot (1/T_n - 1/T)}{n \cdot K}\right] \quad (2)$$

Reverse saturation current

$$I_{rs} = \frac{I_{sc}}{e^{\left(\frac{q \cdot V_{oc}}{n \cdot N_s \cdot K \cdot T}\right)} - 1} \quad (3)$$

Current through shunt resistor

$$I_{sh} = \left(\frac{V + I \cdot R_s}{R_{sh}}\right) \quad (4)$$

Output current

$$I = I_{ph} - I_0 \cdot \left[\exp\left(\frac{q \cdot (V + I \cdot R_s)}{n \cdot K \cdot N_s \cdot T}\right) - 1\right] - I_{sh} \quad (5)$$

B. MPPT Control strategy (Perturbation & Observation control)

The P&O algorithm is the most used in literature, particularly in the practical due to its simplicity of implementation. This method takes the input voltage **Vpv** and current **Ipv** values and produces the duty cycle value. It causes a disturbance of the voltage **Vpv** by operating on the duty cycle, then calculates and compares the power supplied by the panel with the previous one. As the power is increased, the **(MPP)** is approached and the duty cycle fluctuation remains in the same direction. On the contrary, when the power drops, we move away from the MPP. The direction of variation of the duty cycle must then be reversed.

The following figure illustrates how a solar generator's Power and Voltage characteristics vary depending on the weather.

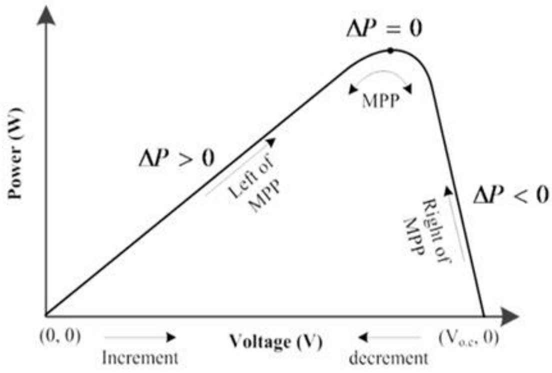

Fig. 3 Typical Power-Voltage characteristic

The algorithm for perturbation and observation control will be shown as:

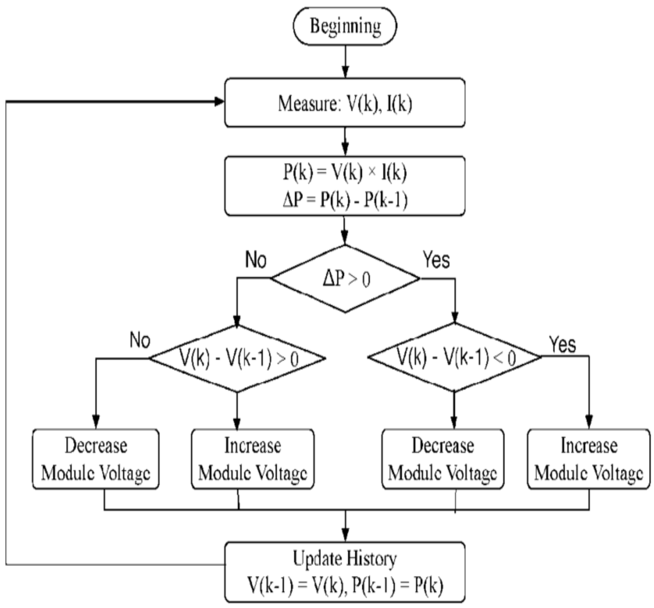

Fig. 4 Perturbation and observation control algorithm

IV. SIMULATION RESULTS

In this simulation, the irradiation value of 1000 W/m2 and a constant temperature of 25 0C are taken into consideration in order to examine the performance of the P&O strategy used to the DC/DC converter.

Table 1. TABLE TYPE STYLES

PV Model : SPR-225-BLK-U	
Maximum power	P_{mpp} = 213.15 W
Voltage of maximal power	V_{mpp} = 29 V
Current of maximal power	I_{mpp} = 7.35 A
Open-circuit Voltage	V_{oc} =36.3 V
Short-circuit current	I_{sc} = 7.84 A
Cell numbers	60
Temperature coefficient of the maximum power	- 0.360%
Reference temperature	T_r = 25ºC
Boltzmann Constant	K = 1.3805*10^{-23} J/K
Electron charge	q = 1.6 * 10^{-19} C

From the simulation results we can see that the PV system maintains its maximum power at every moment despite the change in the irradiation levels.

As for the external tension, it consistently maintains the reference value **(48 V)** despite variations in irradiation and promptly recovers to it.

As Likewise, for the battery current, it always remains constant at the reference value **(IBref)** with few oscillations.

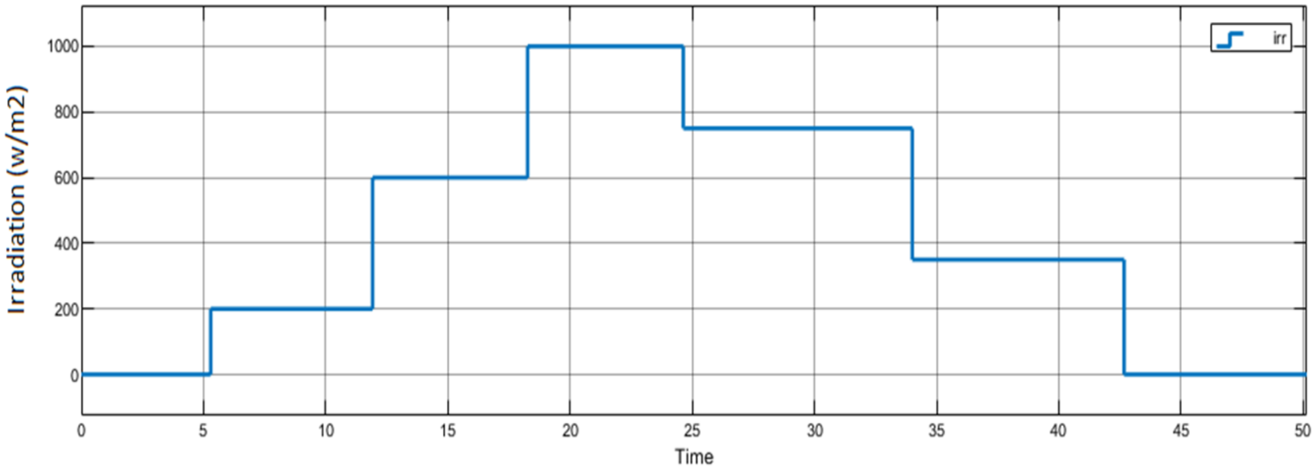

Fig. 5 The irradiation over time

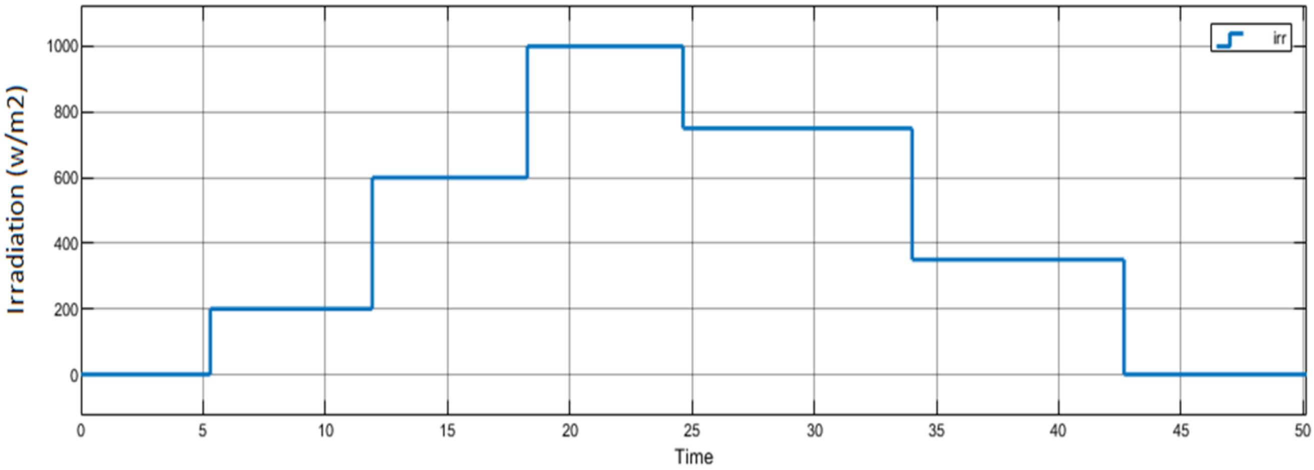

Fig. 6 The PV system output power

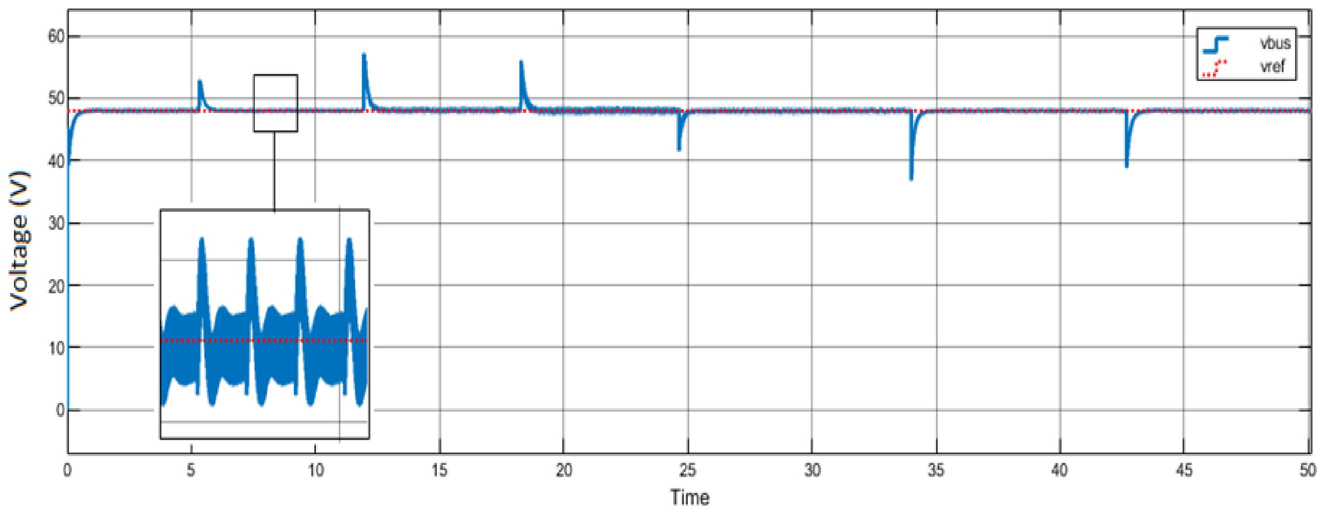

Fig. 7 The PV system Voltage output

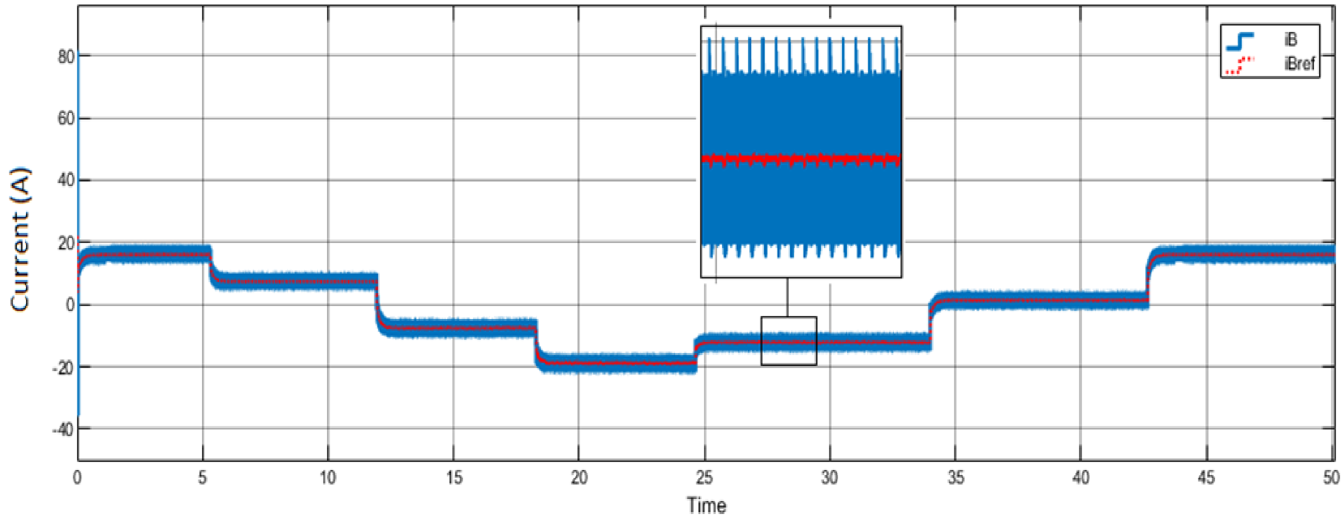

Fig. 8 Battery charging current

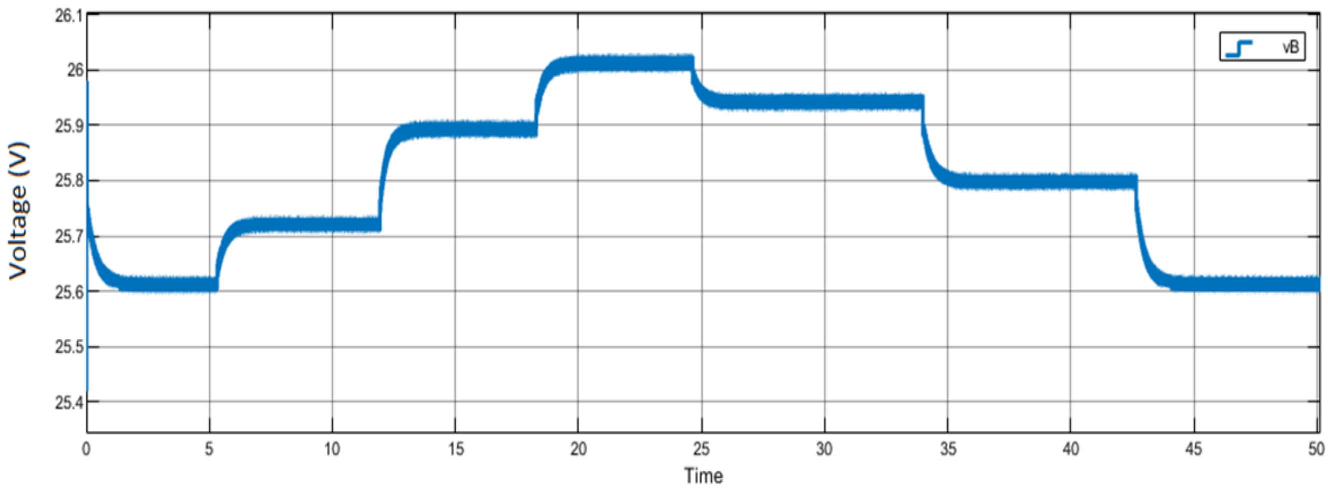

Fig. 9 Battery voltage

V. CONCLUSION

The research that is provided in this paper focuses on an autonomous PV solar system's optimization analysis. A method based on perturbation and observation has been suggested to extract the most PV power. Simulated experiments using the Simulink Matlab software are used to validate this strategy in a boost converter-based chain. The simulation results unmistakably demonstrate the effectiveness of the suggested strategy for MPP tracking and power harvesting at maximum levels, independent of solar environmental circumstances. The next work is to connect this system to an electrolyzer and find the optimal control technique to produce hydrogen gas.

REFERENCES

[1] Hossain, Md Biplob, et al. "Modeling and performance analysis of renewable hydrogen

[2] Kharef Fatima Zohra,Memoire Master Commande MPPT pour les panneaux photovoltaïques en ombrage,2020-2021.

[3] Salman Salman, Xin AI,Design of a P-&-O algorithm based MPPT charge controller for a stand-alone 200W PV system.2018.

[4] Habbati Bellia, Ramdani Youcef. A detailed modeling of photovoltaic module using MATLAB,16 May 2014.