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artificial neural networks for Modeling of partial shading in photovoltaic systems.

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ABSTRACT

In this paper, we present the modeling of the phenomenon of partial on electrical characteristics (current-voltage and power-voltage) shading sing artificial neural networks. This model, based on practical measures, will allow studying the effects of partial shading on photovoltaic systems and as result to make prevention in order to keep the system functional in an acceptable way. Moreover finding good solutions and results to facilitate future work in this area.

Keywords—Modeling, Partial shading, Photovoltaic system, Artificial neurons network

1. INTRODUCTION

Several recent studies have been conducted to explain the effects of shading on the properties and operation of the PV system, and solutions have been proposed to address this problem [1] [2]

In this work, we present the use of artificial neural networks to model the behavior of the monocrystalline silicon PV module SUNTEC-80Wc when exposed to partial shading.

The modeling method proposed here is not intended for a specific PV system model and can be applied to different types and models. However, the model obtained for one system will not be valid for other systems, but the technology used will remain the same.

2. Modeling of partial shading

PV cells use a single-valve model to model and simulate a PV module. In order to improve system efficiency and increase power output, PV cells must be connected in parallel or in series **[3]**. Figure 1 shows a simplified electrical diagram of a solar cell**. [4]**

$$I_{pv} = I_{ph} - I_0 \,[\exp (q\,(Vpv+Ipv*Rs)/A*n*K*T)-1]\; Vpv+Ipv*Rs/Rsh)$$

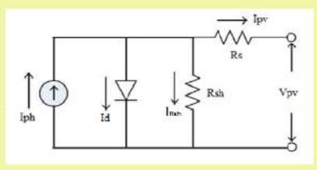

Figure.1. Solar cell diode model.

Where :

I : is the current of the PV solar module;Ipv : Photocurrent [A];V : voltage at the terminals of the PV module [V];I0 : saturation current of the diode [A];q : electron charge which is 1.602 * 10 ^ (-19) Coulomb;Rs : series resistance of PV solar module (Ω);Rp : parallel resistance of the PV module (Ω) and K : Boltzmann constant (J / K).

3. the effect of partial shading on the PV system:

Some techniques have been based on artificial intelligence techniques such as neural networks and fuzzy logic, in order to find solutions contributing to the advancement of the field of PV energy and its adoption as a source of production electricity. [5] In recent years, research in this field has developed and diversified to provide solutions to the effects of the phenomenon of shading.[6]

In this work, we used artificial neural networks to model the effect of partial shading on the operation of the PV system.

4. Artificial Neural Networks (ANN) :

A simple artificial nerve is a computational element with one or more numerical inputs and outputs. From an architectural point of view, artificial neural networks can be classified into two types; multilayer Perceptron (MLP) and radial basis function networks (RBF) [7].

In this work, we used a network of MLP neurons consisting of three layers. Input layer with two neurons: "voltage when entering the PV panel (practical order to choose the number that gives the error in smaller modeling. Measurements) and immediate error", a hidden layer with a variable number of neurons between (2 and 10) and the output layer: "the current provided by the neural model of the PV panel." For the hidden layer, we used the experimentation method, so we tested several values of neurons in smaller modeling.

5 . Results and discussions

In this work, the Kyocera KC200GT polycrystalline module was used to study its IV and PV characteristics without and in the presence of partial shading.

- Feamodule tures without shading:

Figure 2 shows the properties of i-v and p-v in the PV specified in the health condition without any shading on the cells.

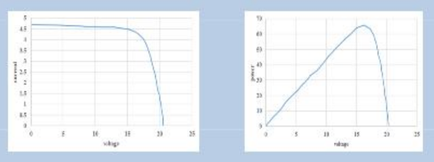

Figure.2. I-V and P-V characteristics of the used PV module without shading.

- Characteristics of shading conditions:

The following curves illustrate the I-V and P-V curves associated with different shading types and the corresponding instant modeling error for each case and table 1 illustrates the modeling errors obtained for different numbers of neurons in the hidden layer

Table 1: Number of neurons and corresponding error.

Number of neurons	Cumulative quadratic error	Number of neurons	Cumulative quadratic error
2	102.7429	7	3.6312
4	83.2985	8	0.4858
6	13.8920	11	2.9449

Figures 3 (a, b) respectively represent the characteristics, the corresponding immediate error, the PV property, the corresponding immediate error and the immediate modeling error corresponding to the neural model with 8 neurons giving a minimal modeling error Is equal to 0.4858.

5. Results and discussions

Figure.3. I-V properties in the PV module are 25% shaded and error in modeling.

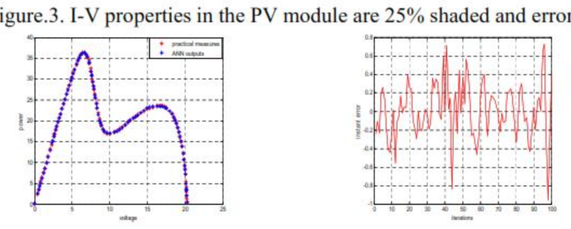

Figure.4. P-V properties in the PV module are 25% shaded and error in modeling.

6. conclusions

In this work, we presented the modeling of the effect of partial shading on a PV system in order to study its impact on the performance of PV cells shaded. For this, we have used artificial neural networks that are widely used in the modeling field and that generally offer models well adapted to the modeled systems.

Results showed that the resultant current-voltage characteristic and power-voltage curves have been strongly influenced by the partial shading conditions.

The behavior of the PV system under the partial shading has been degraded and the two electrical characteristics (current-voltage and power-voltage) are deformed.

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