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The application of Trust Region Method to estimate the parameters of photovoltaic modules through the use of single and double exponential models.

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Abstract. ***This paper presents a methodology for the extraction of parameters of photovoltaic (PV) modules through the use of electric models with single and double exponentials. The aim of the proposed method was extract the parameters directly from measured curves applying the Trust Region Method to solve a system of equations $f(x_i)$. The variables x_i are the photocurrent (I_{ph}), the reverse saturation current (I_o), the ideality factor (A_i), series resistance (R_s) and the shunt resistance (R_{sh}). The validation method is made by approximating the IV curves using the calculated parameters. So, is provided a statistical analysis of errors from the curves obtained in a way to assess the feasibility of the method. A comparison between the results obtained through the two circuit models is also provided.***

Key words

Photovoltaic modules, Parameters extraction, Trust region method.

1. Introduction

The determination of an efficient method able to estimate the parameters of a photovoltaic panel is essential for the development and performance analysis of such equipments. In this context several methodologies have been proposed in order to obtain these parameters from measurements performed on these devices.

The search for methods to estimate these parameters based on experimental data is justified by the difficulty in determining the values of some variables that describe the analytical equations, when focusing on an analysis of the chemistry and physics of materials. This analysis based on physics of materials can be seen in [1].

Some methods have been proposed using measurements taken at different light levels [1] - [7], while others use light and dark conditions [8] - [13]. There are also methods that differ by the proposed analysis model, in other words, the equivalent electric circuit used for analysis. In short, there are two models used frequently in this area of study: the model with one exponential [14], [15] and the model with two exponentials [16] - [18].

Figs. 1 and 2 show the model of a cell with one and two exponentials, respectively.

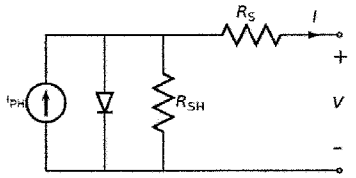

Fig.1. Electric model of photovoltaic cells with one (exponential) diode.

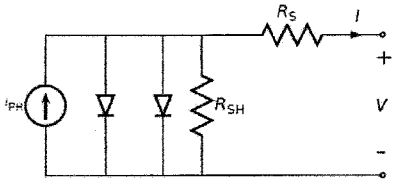

Fig.2. Electric model of photovoltaic cells with two (exponentials) diodes.

The main advantage of using the model with single diode is to simplify the electric circuit and consequently the equation that describes the device operation. The model with two diodes may represent more closely the observable effects on the device under consideration in various lighting conditions.