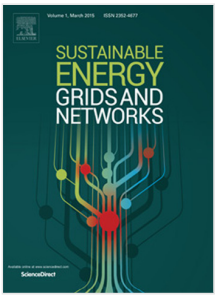
Accepted Manuscript



A new approach to locate and track the maximum power point of a photovoltaic generator by means of a new centered differentiation method

Carlos Francisco González Toraya, Rafael Jiménez Castañeda, Juan Andrés Martín García, Juan Antonio López Ramírez

PII: S2352-4677(16)30086-8
DOI: http://dx.doi.org/10.1016/j.segan.2016.09.004
Reference: SEGAN 77

To appear in: *Sustainable Energy, Grids and Networks*

Received date: 1 October 2015
Revised date: 27 May 2016
Accepted date: 21 September 2016

Please cite this article as: C.F. González Toraya, R. Jiménez Castañeda, J.A. Martín García, J.A. López Ramírez, A new approach to locate and track the maximum power point of a photovoltaic generator by means of a new centered differentiation method, *Sustainable Energy, Grids and Networks* (2016), http://dx.doi.org/10.1016/j.segan.2016.09.004

A new approach to locate and track the maximum power point of a photovoltaic generator by means of a new centered differentiation method.

González Toraya, Carlos Francisco. (1)
Jiménez Castañeda, Rafael. (2)
Martín García, Juan Andrés. (3)
López Ramírez, Juan Antonio. (4)

(1) Electrical Engineering Department, Escuela Superior de Ingeniería UCA. Avenida Universidad de Cádiz, 10. 11519 Puerto Real (Cádiz) Spain. Teléfono: 956483200. Email: carlos.toraya@telefonica.net.
(2) Electrical Engineering Department, Escuela Superior de Ingeniería UCA. Avenida Universidad de Cádiz, 10. 11519 Puerto Real (Cádiz) Spain. Teléfono: 956483200. Email: Rafael.castaneda@uca.es.
(3) Electrical Engineering Department, Escuela Politécnica Superior de Ingeniería UCA. Avenida Ramón Puyol S/N. 11202 Algeciras (Cádiz) Spain. Teléfono: 956028000. Email: juanandres.martin@uca.es
(4) Environmental Department, CASEM UCA. Polígono Río San Pedro S/N. 11510 Puerto Real (Cádiz) Spain. Teléfono: 956016041. Email: juanantonio.lopez@uca.es

Abstract
This paper presents a new experimental method that allows estimating on real time, the slope at a generic point of the P-V curve of a photovoltaic generator. The slop is obtained by means of centered differentiation method, but it's taken into account that the solar irradiation could change along readings process, for that reason the method is improved. The novelty consist in get readings at three consecutive times, in two different places (two on the left side and one on the right side of the point where the slope should be calculated), instead of get readings at two consecutive times in two different places as standard centered differentiation method do. An analysis is carried on with the proposed method to delimit the accomplished error. A mathematical calculation is carried on a standard photovoltaic generator to evaluate the error of the new method. At the case of constant solar irradiance, the results are the same as the standard centered differentiation method. The proposed method is applicable to real photovoltaic system and can be used to locate and track the position of the maximum power point.

Keyword
Photovoltaic, Maximum power point tracking (MPPT), centered differentiation method.

1. Introduction.

The reason that drive the definition of a new method of estimating the slope at a generic point of the Power-Voltage (P-V) curve of a photovoltaic (PV) generator, is none other to achieve the goal of locating the Maximum Power Point in a reliable and fast way.

One of the problems encountered is to be able of calculating the dP / dV in a reliable way and that this calculation is not affected by irradiance changes.

All methods used for getting the maximum power from a photovoltaic generator, are named as Maximum Power Point Tracking (MPPT) algorithms and can be grouped as a function of the used strategy as either direct or indirect methods.

The indirect methods are based on parameters, details of information, specific math equations, etc., for the photovoltaic generator is going to be used. The more important are: “Curve-fitting method” [1], “Look-up table” [2], “Open-circuit voltage photovoltaic generator method” [3], “Short-circuit photovoltaic generator method” [4], “Open-circuit voltage photovoltaic test cell method” [5], [6] and “β method” [7]. All this method aren't the objective of this paper.

The direct methods are those algorithms that usually get voltage and current readings from the input or the output of the impedance adapter (DC converter) and taken into account the photovoltaic generator behavior seek the optimum working point. Those methods have the advantage of remain independents of photovoltaic generator characteristics.

The more important are: