Renewable Energy and Power Quality Journal (RE&PQJ), ISSN 2172-038 X, No.9, 12th May 2011, Reference Paper: 696

Mono-axis vs Bi-axis Tracking for a String of Photovoltaic Modules

N. I. Tatu[1] and C. Alexandru[1]

[1] Department of Renewable Energy Systems and Recycling
Transilvania University of Braşov
B-dul Eroilor, 29, 500036 Braşov (România)
Phone/Fax number: +0040 268 412921, e-mail: nicoleta-irina.tatu@unitbv.ro, calex@unitbv.ro

Abstract. This paper presents a comparative study of motion laws applied to a mono-axis string of photovoltaic modules and to a bi-axis system. This study will reveal which system is more efficient (inclusive economically) in the geographical area of Braşov and under which conditions. There are two types of tracking systems: mono-axis and bi-axis, the last being split into other three types of tracking systems according to their rotation axis. First the solar angles and direct solar radiation are computed and graphically modeled. Further the optimum elevation and daily angles are determined. For each interval both tracking efficiencies are calculated and then compared. Also, the yearly tracking efficiencies of mono-axis and bi-axis systems are compared. Taking into account the technical and economical aspects, beside the energy gain of the dual-axis tracking system, it was concluded that a mono-axis system is preferred for the studied geographical area.

Key words

Photovoltaic, tracking, energetic efficiency, pseudo-equatorial, string.

1. Introduction

The photovoltaic systems occupy an important role in the domain of renewable energies by converting solar energy into electric energy. Tracking mechanisms used to follow the movement of the Sun on the sky dome are added to the photovoltaic (PV) systems in order to capture a maximum amount of solar radiation, thus increasing the energetic efficiency [1], [2].

The tracking mechanisms are actuated by motor sources (linear or rotative) controlled on the basis of various control strategies. Some of these strategies involve the use of photo-sensors to track the Sun or mathematical algorithms to determine the Sun position on the sky dome relative to Earth rotations (daily - around its own axis, seasonal - around the Sun) [3]-[5].

According to these two rotations, PV tracking systems can be mono-axis and bi-axis. In the first only the daily rotation is performed, the last involves both rotations. For comparison, the bi-axis system was chosen to be a pseudo-equatorial system where the daily rotation axis varies by changing the elevation angle (around which the seasonal rotation is performed) [6]-[8].

The motion laws were developed for a string of PV modules designed to supply the load for small house [9], [10]. The number of modules was determined in accordance with the specific climatic parameters of the geographical area Braşov. The resulted tracking system consists of five PV modules with an active surface of 1.26 m^2 and 15% conversion efficiency each.

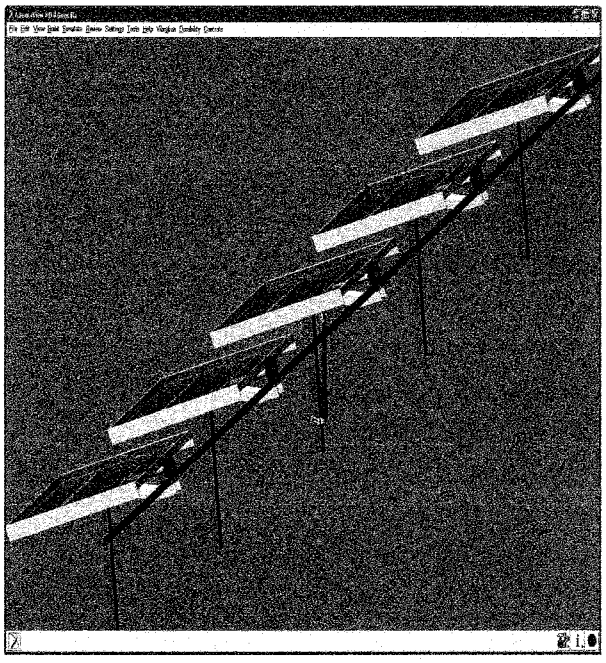

Fig. 1. The five PV modules bi-axis string

The bi-axis tracking system is represented by a five modules string actuated simultaneously with one motor source for each rotation axis. The daily motion is