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Orientation system of solar panels based on a robot manipulator

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Abstract. Solar energy is one of the most interesting renewable energies, as it is an inexhaustible natural accumulation. The electrical energy generated depends on the performance of photovoltaic panels that is based on the direction of sunlight.

The position of the sun changes during the day, even during the year, which imposes a system of automatic orientation of solar panels for this purpose, several devices have been proposed and marketed.

In our article, we focus on the adaptation of a robot manipulator for orientation and positioning of solar panels, applying for the control system, the model of the robot controller.

First, we present the robotic system, which is a well-mastered, and his order was the subject of several studies and applications, and the model of the robot used for controlling the system.

Finally, we give the simulation results in two modes: Mode fixed facing south with an inclination of 45° and the robot tracking mode following the elevation and azimuth movements with two decoupled movement. The results found show a gain in terms of solar energy collected measured about 51%.

Key words

solar panel, solar radiation, Tracking System, Robot manipulator control model.

1. Introduction

The electric power produced by a solar photovoltaic system depends on the intensity of light output depending on the position of the sun varies throughout the day.
To collect the maximum energy, we use tracking devices. The solar tracking system must be adjusted so that the photovoltaic panels are always perpendicular to solar radiation. The solar tracking systems to a single axis are less expensive and their control is easy to implement, but, their efficiency is lower than that of tracking systems Biaxial [1].

The latter requires an appropriate control of the two movements are decoupled and used in thermal concentrating heliostats for guiding [2] and for photovoltaics to increase their efficiency which can reach values of 30% compared to systems stationary [3].

2. Solar Potential in ALGERIA [5]

According to its geographical situation, Algeria holds one of the highest solar reservoirs in the world. The illumination time over the quasi-totality of the national territory exceeds 2000 hours annually and may reach 3900 hours (high plains and Sahara). The daily obtained energy on a horizontal surface of 1m² is of 5 kWh over the major part of the national territory, or about 1700 kWh/ m² / year for the North and 2650 kWh / m² / year for the South of the country. The solar deposit exceeds the 5 billion GWh and the solar potential is summarized in Table 1 [5]:

Table 1: Solar Potential in Algeria [5]

Areas	Coastal Area (North)	High Plateau (Centre)	The Sahara (South)
Surface %	4	10	86
Average duration of Sunshine (hours / annum)	2650	3000	3500
Received Average Energy (kWh / m²/ annum)	1700	1900	2650