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Characterization of Solar Panels for Powering Sensor Applications

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Abstract. Devices installed in remote places require continuously energy supply for their functionality or communication requirements. For these applications, conventional energy supply is very expensive, or unreliable, and batteries dependence is not a good solution for long-term installations. Energy harvesting can be a good solution, to increase the availability of energy. Regenerative energy sources like thermoelectric, magnetic, piezoelectric, and/or renewable sources such as photovoltaic, wind, among others, allowed the development of different powering solutions for sensor units. The purpose of this work is to characterize three photovoltaic solar panels for different power consumption sensor applications. The study is carried out taking into account the intensity of light and angle of incidence over the photovoltaic panels *versus* voltage generated. The energy is stored in an association of supercapacitors. This association together with the solar panel itself forms the two possible sources to supply the sensor application.

Key words

Regenerative energy sources, energy harvesting, solar energy, photovoltaic cells, sensor applications.

1. Introduction

Nowadays, the increases in efficiency of sources that capture the energy of the surrounding environment, like solar, wind, vibration and temperature gradients, it becomes possible the development of energy autonomous systems or a great increase of autonomy supplied by the batteries.

The problem of autonomous devices self-powered over a full lifetime by harvesting the energy of the environment is the storage of that energy when it isn't completely consumed by the system or when the source can't always delivery the same amount of energy that guarantees the consumption needs.

Solar energy is one of the most used sources of renewable energy. The photovoltaic cells convert to electricity the captured light. Recent developments promise conversion efficiency above 40 % [1] for photovoltaic cells. On the other hand, the use of new and different materials allows reducing drastically the dimension and weight of solar panels for several applications, where small sizes and/or thickness are required.

The goal of this paper is to characterize different size solar panels, in a way of optimizing the efficiency and costs in function of the power systems requirements.

Many energy harvesting systems are oversized, either because there is no controller to manage and optimize the energy flow or because they are designed for worst-case scenarios [2].

The characterization is done by the capability to generate power for instantaneous consumption, or energy storage *versus* intensity of light and angle of incidence over solar panels.

The experimental results allow determining the point of maximum power generation in each solar panel, thus improving the performances in function of the requirements of each application supply.

For systems installed in the field (open air), the light intensity varies strongly during the day and does not exist during the night. With the daylight, the solar panel must be able to supply sufficient power that allows to support the power requirement of the application and to store the excessive energy. This stored energy is used to support the power of the load, during eventual working hours under less daylight intensity or during the night, when there are no more regenerative/renewable sources able to supply energy to the application.