

Accepted Manuscript

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PII: S0263-2241(18)30792-9
DOI: <https://doi.org/10.1016/j.measurement.2018.08.056>
Reference: MEASUR 5835

To appear in: *Measurement*

Received Date: 25 July 2016
Revised Date: 7 July 2018
Accepted Date: 23 August 2018



Please cite this article as: N. Afiqah Zainal, A. Razlan Yusoff, Ajisman, Integrated Cooling Systems and Maximum Power Point Tracking of Fuzzy Logic Controller for Improving Photovoltaic Performances, *Measurement* (2018), doi: <https://doi.org/10.1016/j.measurement.2018.08.056>

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Integrated Cooling Systems and Maximum Power Point Tracking of Fuzzy Logic Controller for Improving Photovoltaic Performances

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Abstract

The nonlinearity of solar irradiation and temperature leads to unstable photovoltaic (PV) outputs and decrease in efficiency. A method based on experimental study is developed to maximize the output of the PV panels using the combination of PV cooling system and fuzzy logic, fuzzy logic (FL)-based constant voltage(CV) maximum power point tracking(MPPT) algorithm. The PV cooling system reduces the PV panel temperature to the optimum temperature, while the FL-based CV MPPT algorithm tracks the maximum power of the PV panel. Experimental results showed that the combination of the two methods in a PV system results in improving the photovoltaic performances. Thus, the PV panel outputs increase when the PV panel works at its optimum temperature. This integrated FL-based CV MPPT controller proves the effectiveness in improving PV performances for any weather condition.

Keywords: photovoltaic panel, maximum power point tracking, constant voltage, fuzzy logic

1. Introduction

Recent studies have focused on the usage of renewable energy as a prime source of electricity. The reason for such focus is the increase in demand for electricity, as well as the growth of world population and various sectors, such as the industrial, transport, agriculture, residential, and commercial industries. The rapid depletion of fossil fuels, coal, and natural gas as sources of electricity has enhanced the usage of renewable energy, which is abundant, clean, and environment-friendly [1]. Furthermore, the International Energy Agency has estimated that global energy consumption will increase by 53% by 2030, with 70% of the increase in demand coming from developing countries [2].

Malaysia receives abundant solar energy throughout the year. Solar radiation in Malaysia is excellent because of the country's location in the equatorial region [3] with an average of 4.96 kWh/m² of solar radiation per year [4]. The strength of solar radiation is the

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