



Research Article

Simulation modeling and experimental validation of solar photovoltaic PMBLDC motor water pumping system

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ARTICLE INFO

Article history

Received: 24 December 2019

Accepted: 04 August 2020

Key words:

Renewable energy; Photovoltaic panel; Simulation; Solar PMBLDC motor water pumping system; Error analysis

ABSTRACT

Solar energy is abundantly available on the earth and can be utilized in various applications by converting it in a suitable form. Water supply in remote places and rural areas is still critical due to the unavailability of the grid power. In a developing country like India, the grid construction cost is 6670 \$/km because of which some remote areas are still waiting for electricity. There is a large scope to meet this need with the help of a standalone solar water pumping system. In this context, this work presents detailed simulation in MATLAB/Simulink and experimental validation of photovoltaic (PV) permanent magnet brushless DC (PMBLDC) motor water pumping system without energy storing. Simulation is a tool to get system behavior at the various input parameters immediately reflects a change in the output parameter. The simulation results are validated with the help of field trials on the experimental setup. A 0.5 hp photovoltaic permanent magnet brushless DC (PMBLDC) motor water pumping system was used for extensive field trials experimentation. After extensive field trials, the optimum irradiation observed for full water discharge 19.9 L/min was 330 W/m² where voltage and current were 35.1 V and 3.1 A respectively. The Water flow – Irradiation characteristic curve and percentage variation in simulation and experimental results showed a good agreement with each other. The efficiency of the photovoltaic panel and the entire solar water pumping system observed was 12.76 ± 0.64 % and 9.07 ± 0.45 % respectively. The 0.5 hp PMBLDC motor water pumping system is sufficient to lift 10000 L water every day. PMBLDC motor, shown added advantage of lesser running maintenance due to the absence of carbon brushes which need frequent replacement in case of brushed DC motor.

Cite this article as: Deokar V, Bindu RS, Deokar T, Simulation modeling and experimental validation of solar photovoltaic pmbldc motor water pumping system. J Ther Eng 2021;7(6):1392–1405.

INTRODUCTION

A rapid increase in industrialization and population has almost doubled the energy demand of India. India's total installed capacity is 349.3 GW as on 31 January

2019, in which thermal energy contribution is 63.7 %, Nuclear is 1.93 %, hydro energy 12.85 %, and contribution of renewable energy is 21.14 % [1]. To meet India's huge power requirement, the sustainable solution is maximizing

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This paper was recommended for publication in revised form by Regional Editor Mustafa Kılıç

