Standalone Photovoltaic Water Pumping System Using Induction Motor Drive with Reduced Sensors

ABSTRACT:
A simple and efficient solar photovoltaic (PV) water pumping system utilizing an induction motor drive (IMD) is presented in this paper. This solar PV water pumping system comprises of two stages of power conversion. The first stage extracts the maximum power from a solar PV array by controlling the duty ratio of a DC-DC boost converter. The DC bus voltage is maintained by controlling the motor speed. This regulation helps in reduction of motor losses because of reduction in motor currents at higher voltage for same power injection. To control the duty ratio, an incremental conductance (INC) based maximum power point tracking (MPPT) control technique is utilized. A scalar controlled voltage source inverter (VSI) serves the purpose of operating an IMD. The stator frequency reference of IMD is generated by the proposed control scheme. The proposed system is modeled and its performance is simulated in detail. The scalar control eliminates the requirement of speed sensor/encoder. Precisely, the need of motor current sensor is also eliminated. Moreover, the dynamics are improved by an additional speed feed forward term in the control scheme. The proposed control scheme makes the system inherently immune to the pump’s constant variation. The prototype of PV powered IMD emulating the pump characteristics, is developed in the laboratory to examine the performance under different operating conditions.

KEYWORDS:
1. Photovoltaic cells
2. MPPT
3. Water pumping
4. Scalar control
5. Induction motor drives

SOFTWARE: MATLAB/SIMULINK

BLOCK DIAGRAM:

Fig. 1. System architecture for the standalone solar water pumping system

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EXPECTED SIMULATION RESULTS

Fig. 2. Starting performance of the proposed system

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CONCLUSION:
The standalone photovoltaic water pumping system with reduced sensor, has been proposed. It utilizes only three sensors. The reference speed generation for V/f control scheme has been proposed based on the available power the regulating the active power at DC bus. The PWM frequency and pump affinity law have been used to control the speed of an induction motor drive. Its feasibility of operation has been verified through simulation and experimental validation. Various performance conditions such as starting, variation in radiation and steady
state have been experimentally verified and found to be satisfactory. The main contribution of the proposed control scheme is that it is inherently, immune to the error in estimation of pump’s constant. The system tracks the MPP with acceptable tolerance even at varying radiation.

REFERENCES:


