

HYBRID MODEL OF POWER GENERATION USING MPPT

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Abstract - This paper describes the simulation and analysis of hybrid energy system consisting of wind and solar PV system. The wind and solar PV system are connected to the common load through DC-DC boost converter. In the stand-alone mode the converter needs to maintain constant voltage and frequency regardless of load imbalance or the quality of the current, which can highly distorted, if the load is nonlinear. The modelling and simulation of hybrid system along with the PI controllers are done using MATLAB. Simulation results show that the proposed hybrid system has the potential; to meet the electricity demand of an isolated system. When the power demand increases power failure also increases so the renewable energy can be used to provide constant loads. To convert the basic circuit equation of solar cell into simplified form a model is developed including the effects of changing solar irradiation and temperature. Maximum power point tracking control strategy is used to extract the maximum power output of photovoltaic power generation system. This paper reports the development of a computer simulation approach for evaluating the general performance of stand-alone wind/photovoltaic generating systems.

In the present scenario, renewable energy sources are incorporated along with the battery energy storage systems, which are mostly used for maintain the reliability of power. The number of renewable energy sources is increased as distribution sources; generally, to improve the power supply stability, and hence the power quality new strategies of operations are required. The common disadvantage of both wind and solar power plants are as these generate unreliable power. In order to overcome this problem a new technique is implemented i.e maximum power point tracking algorithm which is applicable to both wind and solar plants. Dynamic performance of a wind and solar system is analyzed. There are some previous works on hybrid systems comprising of wind energy, photovoltaic and fuel cell have been discussed. All the energy sources are modeled using MATLAB software tool to analyze their behavior. A simple control method tracks the maximum power from the wind/solar energy source.

Key Words: renewable energy, PV system, Wind system, MATLAB, modelling, MPPT.

2. Body of Paper

1. INTRODUCTION

In near future, the best alternative to overcome the shortage of exhausting fuel resources and their price rise is, to take a turn to produce electricity from Non-Conventional Energy sources. However, burning of fuel material causes harmful effect of carbon emissions, acid rains and global warming on environment by spreading pollutants like carbon dioxide, sulphur dioxide, and their chemicals into atmosphere. Clean and sustainable energy sources like PV, WECS, Geothermal energy has been deeply studied for rapid development.

2.1 BUCK-BOOST CONVERTER

Fig.1 shows the dialog box and subsystem of a buck boost converter. For each converter to verify it's working in open loop configuration trigger pulses have been derived using a repeating sequence generator and duty cycle block. Function block compares the duty cycle and saw tooth from repeating sequence-derived trigger pulses are connected as an input to the switch control. Hence inputs for the masked subsystem are duty ratio and input voltage, and the outputs are chosen to be inductor current, capacitor voltage, and output voltage. When double-clicking the pointer on the masked subsystem of first Fig. of dialog box, then it enters parameter values of the switching converter circuit in a subsystem of buck-boost converter in second figure. In this simulation SimPowerSystems library is used and created a buck-boost converter. The input of the subsystem is connected to the solar panel block and output to a battery. IGBT used for switching operations.

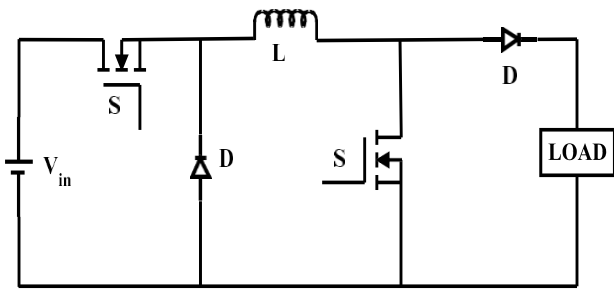


Fig -1: Buck-boost converter

2.2 PV MODULE

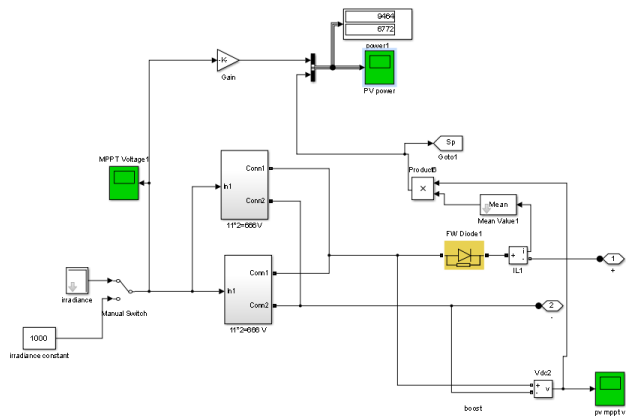


Fig -2: Simulink model of PV module

Figure 2 represents the algorithm of PV panel in MATLAB. In this algorithm we use various equations. If we go deeper inside the model we can find equations connected to it. By this figure we can observe it is starting to give output power of PV system (PV power scope). With the help of MPPT we can reach to the maximum power. Also by scope PV MPPT voltage we can see the output after respective boosting.

A solar cell performs three functions. First, the solar cell absorbs light. Secondly, it will separate the electric vectors generated in it. Thirdly, transport the charging carriers separately to external loads without damage to the switchboard. A photometric installation requires several components other than photoethral panels. These components are battery charger controllers, DC-DC converters, DC-AC converters for AC loads, and structurally supported networking systems for mounting photoethral panels, protective relays, etc. Dc-DC converters are used to convert dc voltages to adjusted DC voltages with the help of different components. They are energy storage devices such as capacitors and inductors and electrical devices such as balloons and diodes. The DC-DC converter is controlled by the MPPT controller. Basically MPPT controllers will receive voltage and photoethral current as inputs and processors.

2.3 WIND ENERGY SYSTEM

Figure 3 shows the Simulink model of the wind energy system. Here we use a generator called permanent magnetic generator (PMSG). As the figures shows there are various input models which are connected to the permanent magnetic generator. These input models are predefined calibrated. By giving inputs the generator starts to move and starts generating

power. Also the output of generator is always AC so we have to add a rectifier so we can change the output into DC.

Totally it is controlled by the PMSG, we can also adjust with the different parameters like current, peak-peak voltage, frequency, rpm etc. The respective figure shows the exact way of how to control and change the parameters so we can get different outputs.

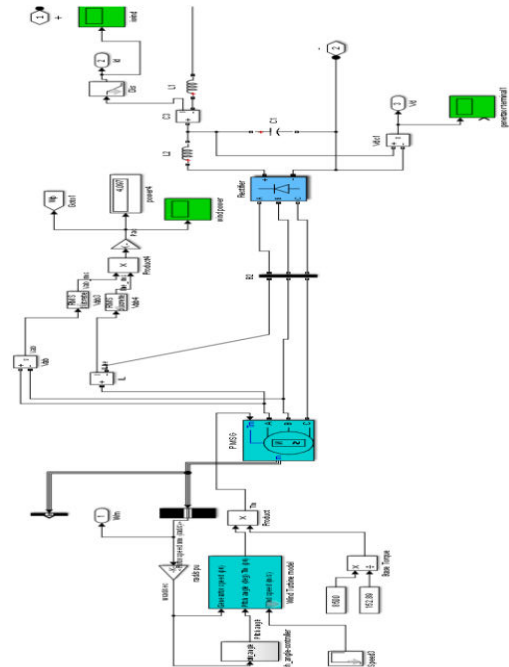


Fig -3: Simulink model of Wind module

2.4 MPPT ALGORITHM

Apart from all this is the most commonly used methods with the hybrid model of solar and wind energy system. It is the doneby the altering the value of duty cycleof boost type DCDC convertor. In case of solar PV system the PV output voltage and current are measured two consecutive intervals [9]. The power is calculated for two successive intervals. The change of power to change voltage is calculated dP/dV . Based on the positive and negative values of the slope dP/dV the duty cycle is incremented or decremented. Accordingly the voltage and power are adjusted to the maximum power point. If the slope $dP/dV=0$, then the maximum power point is reached for the present environmental conditions. This is a continuous process. The measurements are to be continuously taken and change power and change of voltage are calculated to take control actions. Basically the MPPT is achieved by making the impedance of the solar PV with the impedance of the load side. The duty cycle is adjusted to match the impedance.

Algorithmic steps:

- **Step 1:** Measure the two consecutive values of voltages and currents of solace PV.
- **Step 2:** Calculate the powers $P(n)$ and $P(n-1)$.
- **Step 3:** If the powers are increasing, then decrease the duty cycle.
- **Step 4:** If the powers are decreasing, then increase

the duty cycle.

- **Step 5:** Go to step 1.

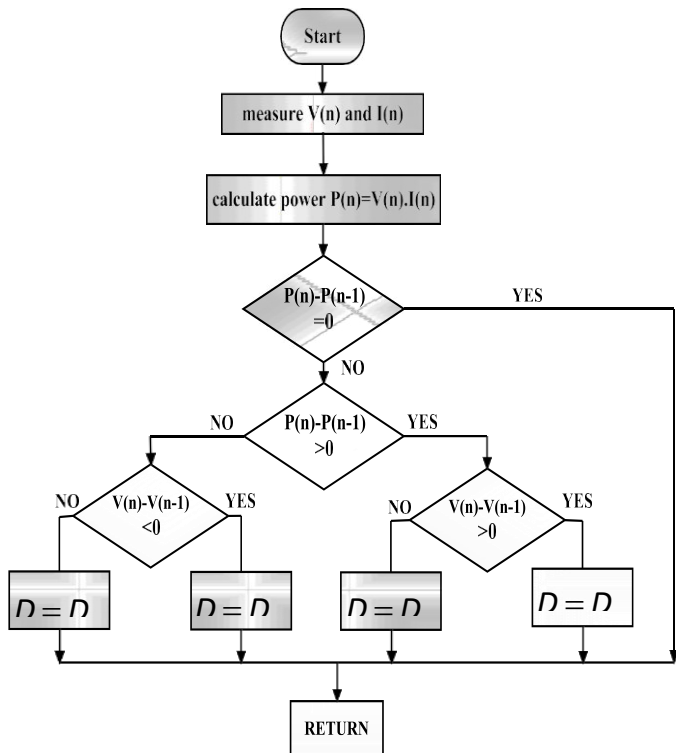


Fig -4: Flow chart of P&O method

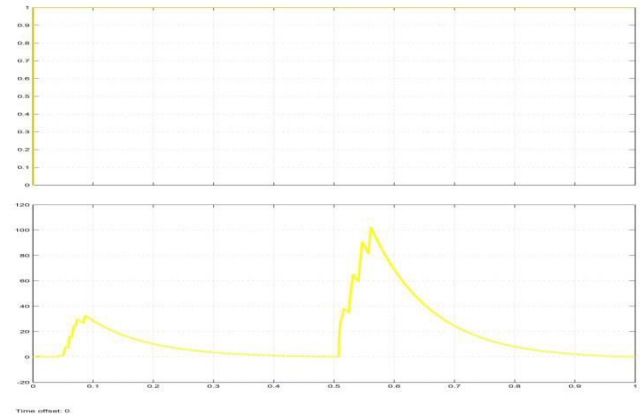


Fig -6: MPPT OUTPUT OF WIND ENERGY

3. CONCLUSIONS

The proposed system designed by MATLAB/SIMULINK can prove that the system can provide energy demand. It shows the real-time situation of the operating system because of this system set by the dynamic situation. The proposed system can show the power control techniques that are applied on solar and wind power generation systems. A perturb and observe control method is implemented on boost converter switch, that works on controlling the maximum power operating point. In wind energy conversion system, the obtained AC power is rectified into DC using a uncontrolled rectifier, where the DC is gained control using hysteresis band current control on boost converter switch. To meet the requirements of ac loads it is then converted to AC by using a three phase inverter.

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SIMULATION RESULTS

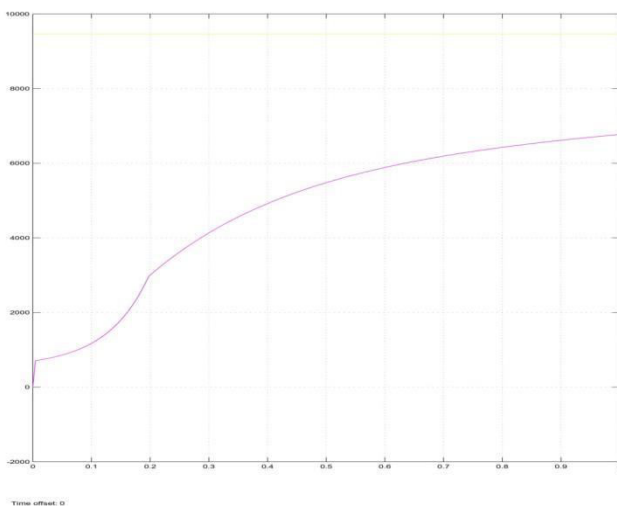


Fig -5: MPPT OUTPUT OF SOLAR PV MODULE