Study and Modeling of DC/DC Converter for DC Nano-Grid Hybrid with solar collector Power Generation System

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Abstract— **Now-a-days, the electrical energy becomes one of the basic needs in our daily life, which makes increasing demand for it. The main objective of this paper is to investigate in details of extracting constant maximum DC power from solar collector module and this DC power works as a fuel deliver to the DC loads or DC Nano grids through DC/DC converter with fuzzy based MPPT technique.. The efficiency and the maximum output of the system can be improved by using Fuzzy controller. In Modern era, most of the domestic, commercial and industrial appliances are DC operative like E- rickshaw, ceiling fan, cell phones charger, flashlights battery etc. are increasing very rapidly. Therefore a DC-DC converter is an economical and productive way to fulfil the requirement of electricity from the local Distributed Energy Resource and helps in improving the system efficiency. Solar Photovoltaic (PV) power generation system includes several elements like solar panel, DC-DC converter, MPPT circuit, Battery charge controller and load.**

The simulations are performed by using MATLAB/Simulink software.

Index Terms—**Distributed energy resources (DERs), Photo voltaic (PV), Maximum power point tracking (MPPT) and Perturb & observe (P&O).**

I. Introduction

In Modern era, Electricity plays an important role in homes, commercial and industrial field because all the devices, businesses and industries are running because of electricity. There are various methods of generation of electricity like thermal power plant, nuclear power plant, hydro power plant, wind power plant etc. Among all, solar energy power generation is the cheap and clean method for generating electricity. Solar energy is a non-polluting renewable energy resource which helps in decreasing the greenhouse effect [1].

Now-a-days most of the electrical and electronics equipment's are operated on DC voltage supply. AC power is generated in generating station which is transmitted to the distribution station through transmission lines. This AC power is further distributed to homes, offices, industries etc. from distribution station. This AC supply is converted into DC supply to make useful for the equipment's which works on DC supply The cost of power transmission is little bit high in this case. To overcome this problem, we start using solar cells for the generation of electrical power in an efficient and economical way [1]. The efficiency of the solar cell depends upon various factors such as intensity of solar radiation, temperature, climatic condition, impurity present in the environment and so on. The efficiency of the solar PV cells can be improved by using various methods like quantum technique, solar tracker, concentrator, MPPT and so on [2]. The implementation of a new method called maximum power point tracking (MPPT). A MPPT is the method of extracting maximum power from the solar PV module and transfer this power to the DC load or DC Nano grids. There are various types of MPPT technique like P & O method, incremental conductance (Incon) method, Fuzzy logic method etc. [3]. The DC-DC converter is responsible for transferring maximum power from the solar PV module to the load.

The output power of the PV cells can be constant by using fuzzy based MPPT technique. The intensity of the solar radiation varies throughout the day, hence the operating points of module also change. In recent times, implementation of the array of DC/DC converter has become popular. A DC-DC converter is an economical and productive way to fulfill the requirement of electricity from the local Distributed Energy Resource and helps in improving the system efficiency This present paper has addressed the review of MPPT algorithm (P &O method), fuzzy logic method and Simulink of DC/DC converter for DC Nano-Grid Integrated with Solar PV using MPPT with Fuzzy controller [3].

II. DC Nano Grid

A native power network with energy sources, loads and battery storage forms a Nano-grid. Recently, the method of using DC/DC converter integrated with DC Nano grid for power generation is widely accepted. A DC Nano grid can be used to supply sensitive electronic loads compare to micro grid. The balance between the demand and generation is very challenging in micro grid because of the difficulty in keeping the system variables within the limits. The control of micro-grid also becomes very difficult. On the contrary, installation of DC Nano-grid in every household or consumer site is very easier. Nano-grids have the advantage of simple control and the power operation is also simple. Nano grid is self-controlled device which interconnect with neighborhood DERs. Nano grid refer to a small scale of the power network, with voltage levels used on the distribution network (≤20 kV) and power ratings ranging up to 1 MW

Nano grid is self-controlled elements and worked in either grid-associated or island mode, which interconnect neighborhood DERs and burdens with nearby dissemination frameworks [4]. The primary favorable position of a DC Nano grid is that it gives superior consistence DC sorts of DERs and burdens [5]. For instance, solar PV and battery stockpiling would just use a DC/DC transformation in DC.

III. Buck-Boost Converter

A DC-to-DC converter is an electronic device that converts a source of direct current (DC) from one voltage level to another. It is a type of electric power converter. It converts the power from low level to high level and vice versa. Basically DC/DC converter is of two types. The first one is Buck converter which is step down buck converter by using switch mode power supply. The DC output voltage of Buck converter is less than the DC input voltage. The second one is boost converter which is step up boost converter by using switch mode power supply. The DC output voltage of Boost converter is higher than the DC input voltage. This output voltage mainly depends on the duty cycle. The following diagram shows the basic buck boost converter.

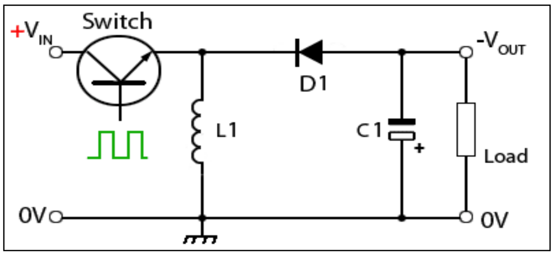


Figure 1: Buck converter

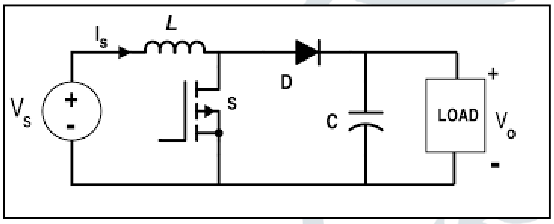


Figure 2: Boost Converter

IV. System Description

The Simulink model of poly crystalline model is shown in figure 3. A PV cell is manufactured by various semiconductor materials. Hence the output power is also different for each PV module. A fussy based MPPT method is used to extract the maximum power from the various types solar modules (mono crystalline, poly crystalline and Thin film) which is delivered to the DC/DC converter for result orientation of output voltage in order to operate DC connected loads like mobile charger, laptop chargers and battery energy storage system. Power delivered by a module depends on the load connected to the module. After using Fuzzy based MPPT technique, the output power for each PV module becomes constant. Recently, the use of DC appliances is increasing very rapidly in all sectors like, industrial, commercial and domestic. The solar PV modules produce DC power which is directly fed to DC load from DC/DC converter to minimize the conversion losses and improve power quality and efficiency.

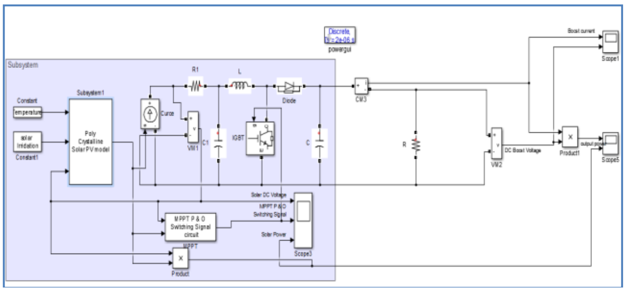


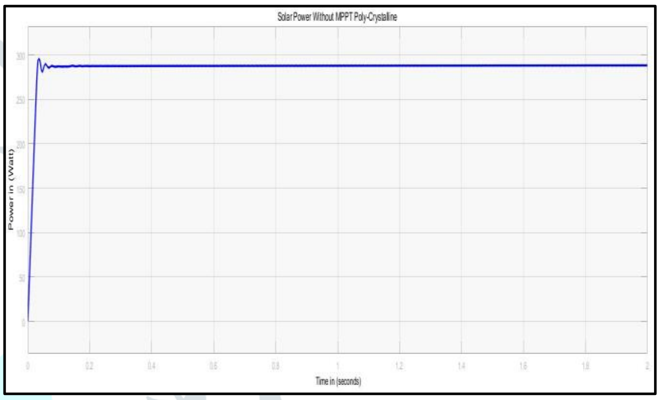
Figure 3: Poly Crystalline block diagram

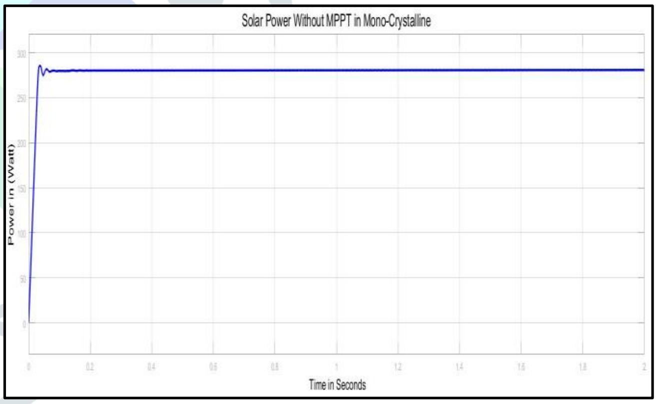
V. MPPT Algorithm

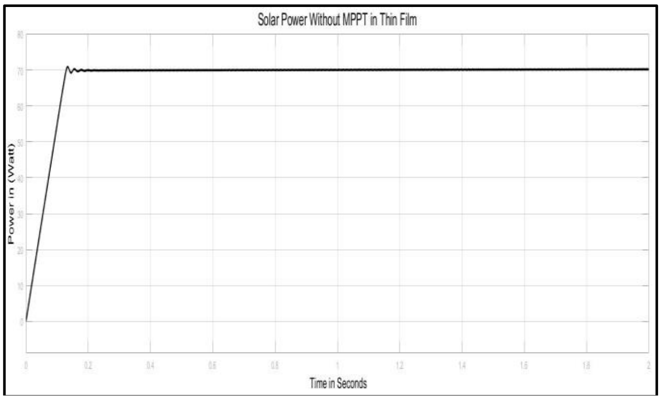
The output power of the solar cell is very. Hence the efficiency of the solar cell is also low. The efficiency of a solar cell can be improved by using such a method called Maximum Power Point Tracking (MPPT). This method is used to extract the maximum power from a varying source. The MPPT method can be used in all-weather condition without disturbing the output power. There are various types of MPPT technique like P & O method, incremental conductance (Incon) method, Fuzzy logic method etc. In this paper we are using Fuzzy based MPPT technique.

VI. Result and Analysis

The Simulink model of a closed loop buck boost converter for DC Nano grid integrated with poly crystalline, mono crystalline and thin film solar PV module is shown in results. These solar PV module is modeled using electrical characteristics for provide the output current and voltage of the PV module. PWM signals are generate using combination of output of MPPT duty cycle and output of Fuzzy controller.







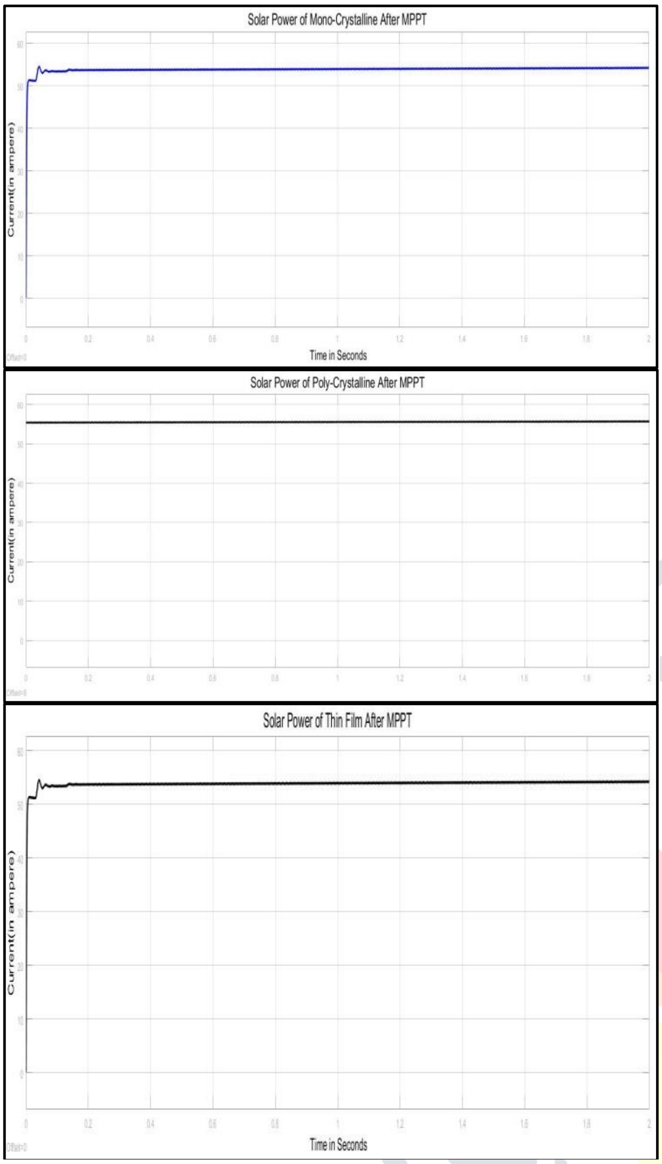


Figure 5: The result of Simulink for polycrystalline, mono crystalline, and thin film solar cells before and after using fuzzy based MPPT technique

VII. CONCLUSION

This work simulates the DC-DC converter for application of DC Nano grid, a constant output power is obtained after using MPPT technique. Mathematical modeling of PV solar, MPPT Algorithm, and DC buck Boost converter for solar PV module are done with fuzzy controller. The simulation results demonstrate the solar PV modules (like Poly crystalline, Mono crystalline, Thin film) using MPPT Techniques. It improves the system efficiency by reducing no. of conversions.

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