Modeling of Incremental Inductance Based PV System with Power Grid

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ABSTRACT

Generally, PV systems are need of the hour from electrical energy system point of view. This paper also proposes the concept of hybrid grid energy system which consists of photovoltaic system. And also an Incremental Conductance MPPT technique is proposed in order to improve the photovoltaic power. The performance of this hybrid system is observed by simulation case study demonstrate the usefulness of the proposed system.

I.INTRODUCTION

At present, most of energy demand in the world relies on fossil fuels such as petroleum, coal, and natural gas that are being exhausted very fast. One of the major severe problems of global warming is one of these fuels combustion products, carbon dioxide; these are resulting in great danger for life on our planet [1].
Fossil fuels can have as an alternative some renewable energy sources like solar, wind, biomass, and so; among them on the wind energy system which converts the wind energy into electricity, largely used in low power applications. The wind generator is chosen for its positive points including being carbon free and inexhaustible; moreover, it does not cause noise for it is without moving parts and with size-independent electric conversion efficiency [2].

Nevertheless, the power generated by a wind energy system is influenced by weather conditions; for example, at rainy or in cloudy periods, it would not generate any power or application. In addition, it is difficult to store the power generated by a wind system for future use. The best method to overcome this problem is to integrate the wind generator with other power sources such as PV, Electrolyzer, hydrogen storage tank, FC system, or battery due to their good features such as high efficiency response, modular production, and fuel flexibility [3, 4]. Its coordination with a wind system could be successful for both grid-connected and stand-alone power applications. Thanks to the rapid response capability of the fuel cell power system, the wind based photovoltaic fuel cell hybrid system can be able to overcome the inconvenience of the intermittent power generation. Hence, the coordination between the FC power system and the photovoltaic generator with wind turbine system becomes necessary in order to smooth out the wind power fluctuations.

This paper focuses on developing a simulation model to design and size the hybrid system for a variety of loading and meteorological conditions. This simulation model is performed using Matlab and SimPower Systems and results are presented to verify the effectiveness of the proposed system. The proposed grid connected hybrid energy generation system is shown in figure 1.

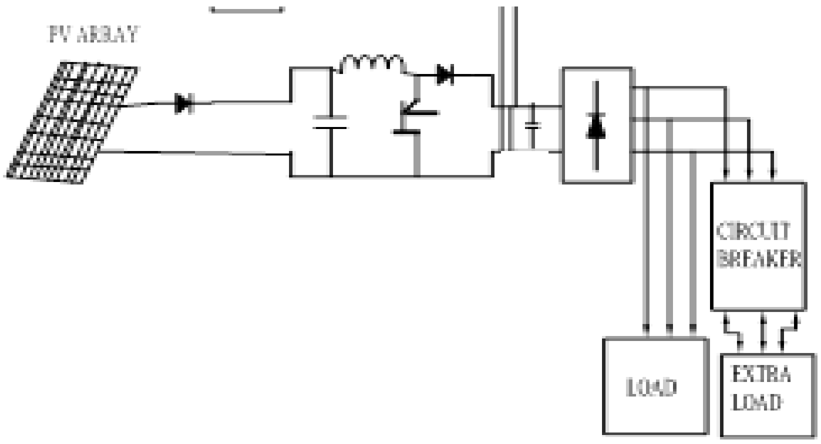

Figure 1: Configuration of proposed grid connected hybrid system

II.SOLAR SYSTEM

In photovoltaic (PV) system, solar cell is the basic component. PV array is nothing but solar cells are connected in series or parallel for gaining required current, voltage and high power. Each Solar cell is similar to a diode with a p-n junction formed by semiconductor material [5]. It produces the currents when light absorbed at the junction, by the photovoltaic effect. Figure 8 shows at an insulation output power characteristic curves for the PV array. It can be seen that a maximum power point exists on each output power characteristic curve. The Figure 8 shows the (I-V) and (P-V) characteristics of the PV array at different solar intensities. The equivalent circuit of a solar cell is the current source in parallel with a diode of a forward bias. Load is connected at the output terminals. The current equation of the solar cell is given by:

$$I = I_{ph} - I_D - I_{sh}$$

$$I = Iph - I_o [\exp (q V_D / nKT)] - (v_D / R_S)$$

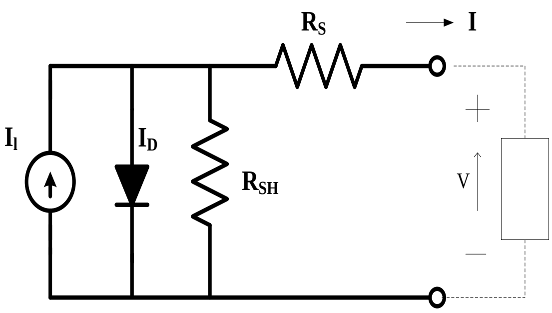

Figure 4: Equivalent circuit of PV Module

Power output of solar cell is P = V * I

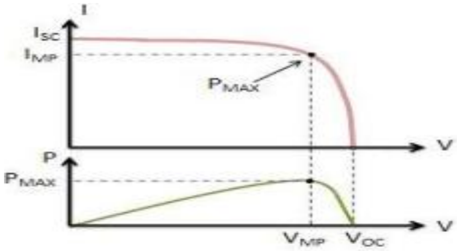

Figure 5: Output characteristics of PV Array

III.INCREMENTAL CONDUCTANCE METHOD

This method consists in using the slope of the derivative of the current with respect to the voltage in order to reach the maximum power point [2].

What advantage does MPPT give in the real world that depends on the array, their climate, and their seasonal load pattern. It gives us an effective current boost only when the Vpp is more than about 1V higher than the battery voltage. In hot weather, this may not be the case unless the batteries are low in charge. In cold weather however, the Vpp can rise to 18V. If ther energy use is greatest in the winter (typical in most homes) and the have cold winter weather, then the can gain a substantial boost in energy when the need it the most.

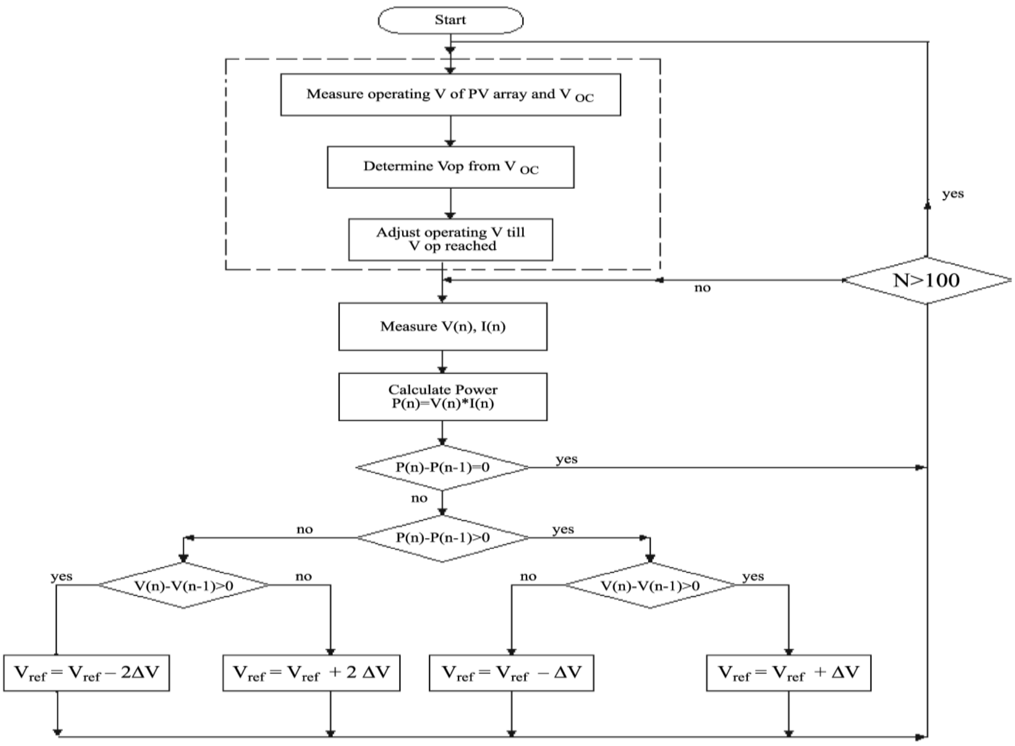

Figure 6: Incremental Conductance Method Algorithm

Under these conditions, a theoretically perfect MPPT (with no voltage drop in the array circuit) would deliver a 50% increase in charge current. In reality, there are losses in the conversion just as there is friction in a car's transmission. Reports from the field indicate that increases of 20 to 30% are typically observed.

IV.RESULTS AND DISCUSSION

The complete grid connected hybrid system is given in figure 1. The PV system consists of PV module in series mode and boost converter.

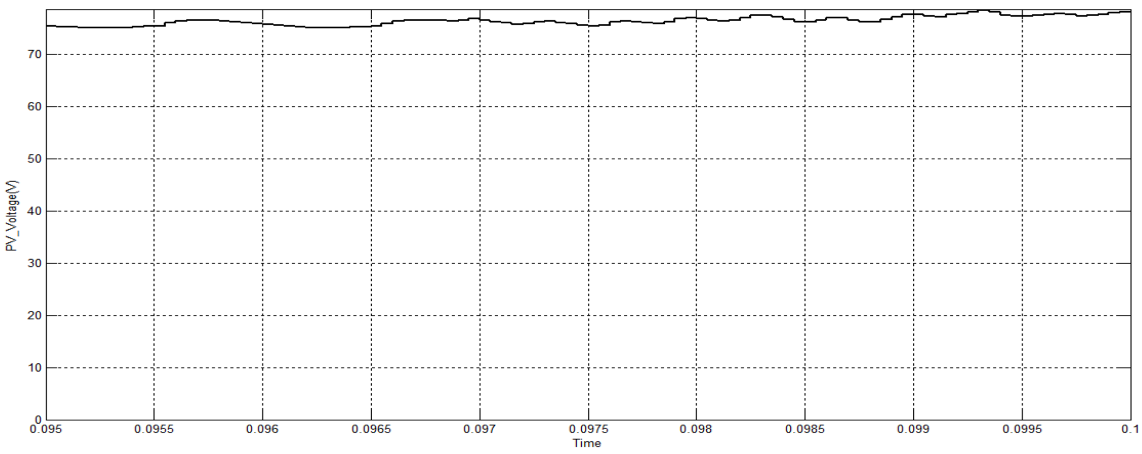

Figure 7: Photovoltaic Voltage after Boost Converter

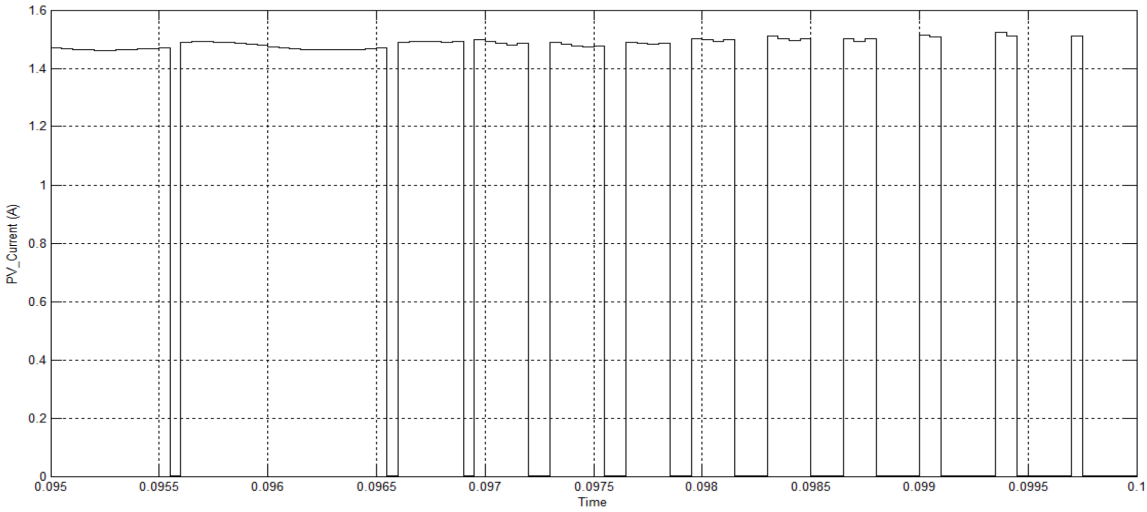

Figure 8: Photovoltaic Current after Boost Converter

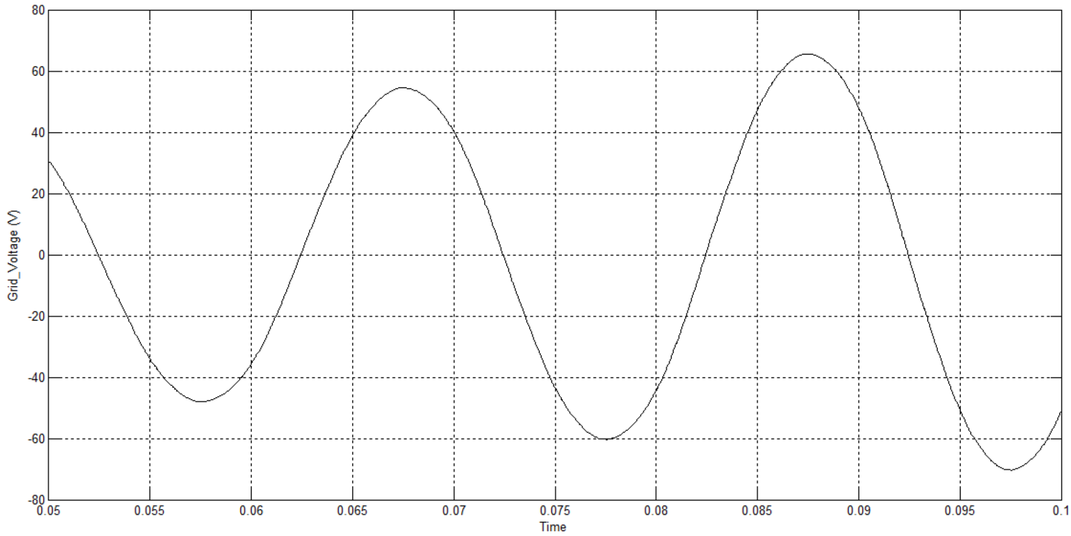

Figure 9: Grid Output Voltage

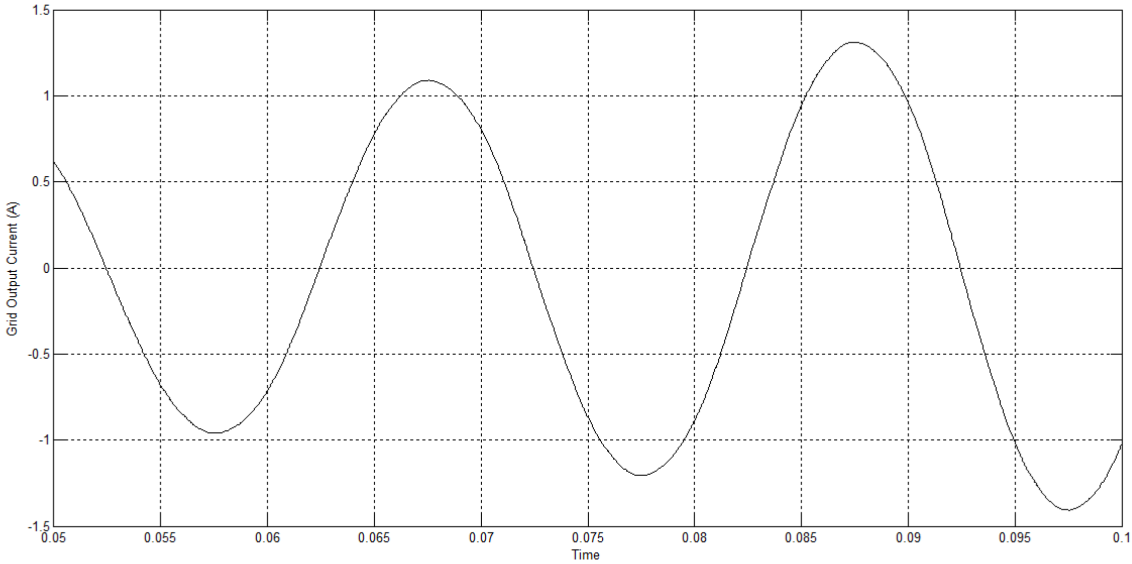

Figure 10: Grid Output Current

V.CONCLUSION

The effectiveness of isolated power systems are evaluated in MATLAB PC environment. The system considered is photovoltaic panels to meet the load which is highly advantageous for remote and inaccessible loads. It is observed that the proposed configuration is low cost and having less complexity. The gird is utilized to supply to the unmet power demand by the isolated power systems if they are connected to the gird. On the whole, the performance of isolated system is better and economically beneficial to the customers at large and is very effective for rural areas to meet remote loads.

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