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Fuzzy-PID Control Method of Hybrid Derived Boost Converter (HDBC) Using Wind Energy

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Abstract

The hybrid converters are provides the energy to the load with better efficiency. The method of supplying the energy to the both loads such as AC load and DC load are done by using multi converters. More than one converter is used for AC and DC outputs in applications of micro grid as well as nano grid. Therefore the components are increased due to the utilization of more converters. This paper proposes HDBC which is supply the simultaneous DC and AC loads and the input power is obtained from the wind energy system. The system circuit consists of a power switch of the boost converter with single switch and the single phase inverter. The proposed HDBC gives a high reliability outputs for DC and AC loads using PID-fuzzy logic controller. For the system which has DC loads as well as AC loads simultaneously, Such a HDBC is well suited. The output of this proposed system provides high gain with the better efficiency. The output results of the proposed system are verified using in MATLAB/ Simulink.

Keywords: HDBC, Wind source, Micro Grid, Fuzzy-PID controller.

1. Introduction

In the electric power systems the nano-grid systems are increasing in the modern smart residential applications. In future, the development of the distribution network reliability of DC would be high (1). In this the power system models are circuit breaker, DC-DC transformer and the voltage source inverters are analyzed and for the both distribution networks reliability such as AC and DC the method of minimum cut set is improved. The hybrid micro grids for the various distributed generation to provide the power for grid is implemented and they requires a converter to maintain the constant power management and for the control strategy (2). The Ac and DC loads are our daily used loads and the DC system is essential distribution system. For the LVDC system the converter and inverters are needed to supply the power along with the AC power to loads (3). In (4) for the power supplies to small farms the power system is designed and the energy storage is providing the power during the low wind speed.

The solar produces the DC power before the grid connection and the generated power is converted into AC voltage. At the same time the converted AC need to be the conversion of DC at the load that directs to losses in system (5-6). To control the energy losses in the modern system due to the conversion stage, the renewable energy usage is increased for the DC loads. The power system is to provide energy to the AC machine according to the AC power provision (7-8). But also the different kind of devices and components are used in the ongoing revolution. The supply from the AC source to be rectified for DC loads (9). In this case the rectification process leads to more losses so that the micro grids are implemented for that area. The infrastructure of this micro grid can be implemented and designed to supply the power from the renewable energy system directly (10-11). The PV system is used at where the numbers of converter are used for the conversion of DC-DC as well as inverter that converts DC-AC. The conversion stage converters are regulating the output voltage and current that from the PV source. The power efficiency is improved in power transmission at DC voltages with higher. In the inversion stage of DC-AC the converter output of the converter is act as a supply (12).

This paper proposed the different home appliances compatibility based on the DC power grid. The appliances used in home such as LED lightning, SMPS adapters, mixer-grinder are minded to the distribution network of 220V (13). For the benefits of distribution system it uses the currents of both AC and DC. This kind of system has the isolate DC or AC links to interface between the distributed generators in renewable sources, DC loads and AC loads, and converters. This paper (14) covered the redundancy, higher reliability and the less cost of PV generation for the micro grid is designed and developed by the Bosch organization while compare with other equivalent systems (15). The separated micro grid of AC-DC hybrid operation and the power management control method is implemented and the hybrid comprises the both DC micro grid and Ac micro grid. Here the generators of wind and diesel are connected for the AC micro grids with the AC loads while DC micro grid connected with the PV system.

2. Methods and Materials

In this proposed system, the hybrid boost converters are used to provide the energy to the both loads such as ac and dc. The presence of the boost converter is eliminated in this system the switch count is also reduced. The four switches are used and they act as a inverter to provide the energy or power to the Ac load. The both of the AC and DC loads are powered simultaneously from the single source. The given input is boosted up and increased the gain voltage at the both loads. The block diagram of the proposed system is shown in figure. 1. The hybrid boost converter performs the improvement of the given input voltage. The converters are connected in parallel to boost up the system voltage to the certain level to meet the load requirement. The source is generated from the renewable wind which is produced using the PMSM generator. The produced or generated energy is fed to the hybrid boost converter such AC-DC as well as DC-AC.

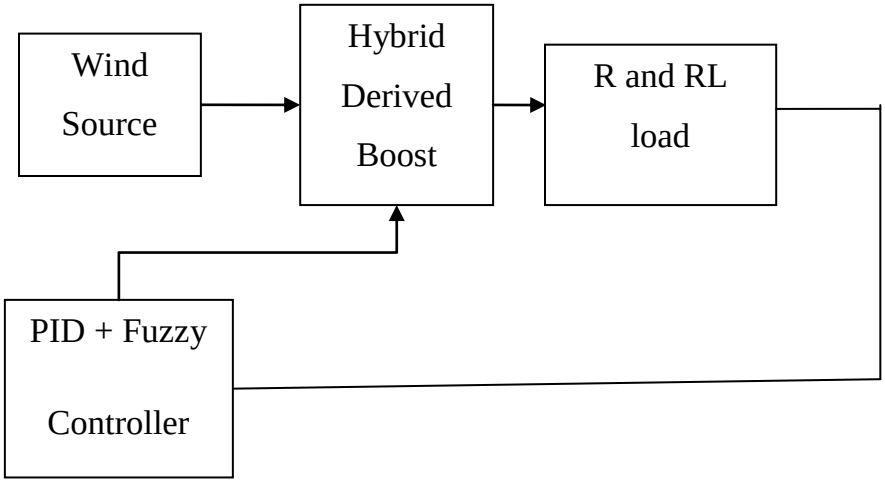

Figure. 1Block diagram of the proposed system

3. PID Control

PID controller resembles the same function of PI controller in terms of P and I terms. The adding of additional parameter D makes error during the steady state to zero. It also reduces the rise time and oscillations. The main advantage of PID controller is it diminishes the overshoot to a greater extent. The PID also increases the response speed of the system which reduces the settling time. The accuracy of the set point is increased than P, PI controllers. The general block diagram is shown in figure 2.

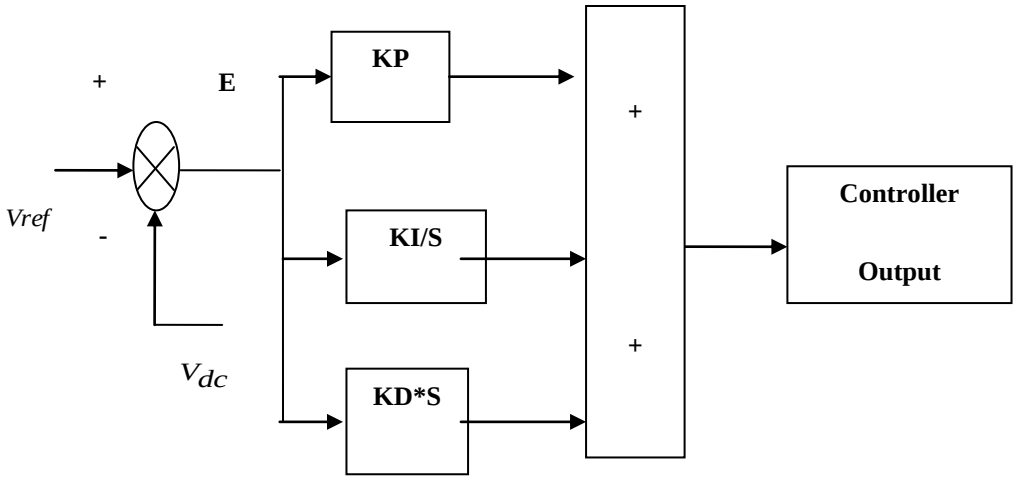

Figure. 2Block diagram of the PID controller

4. Fuzzy Controller

The fuzzy controller is used to control the system performance along with the rules defined to do the process based on the designed system. To provides the better system stability, the error from the plant to be minimized. The logic rules defined using the fuzzy sets and member functions. The fuzzy editor in the MATLAB is illustrated in figure. 3. In this control the two inputs are given to the system named as input1 and input2 and have a output called output1.

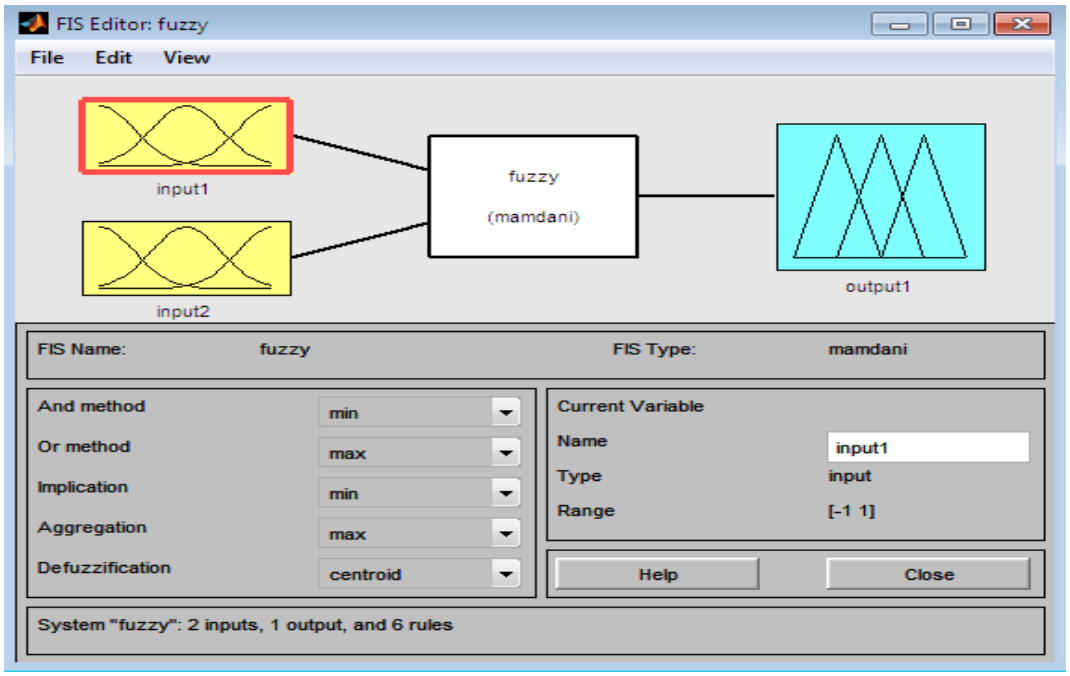

Figure. 3 Fuzzy editor in the MATLAB

The member functions are used to give the corresponding values to the variables. The input 1and input 2 member functions are shown in figure. 4 and figure.5 are respectively.

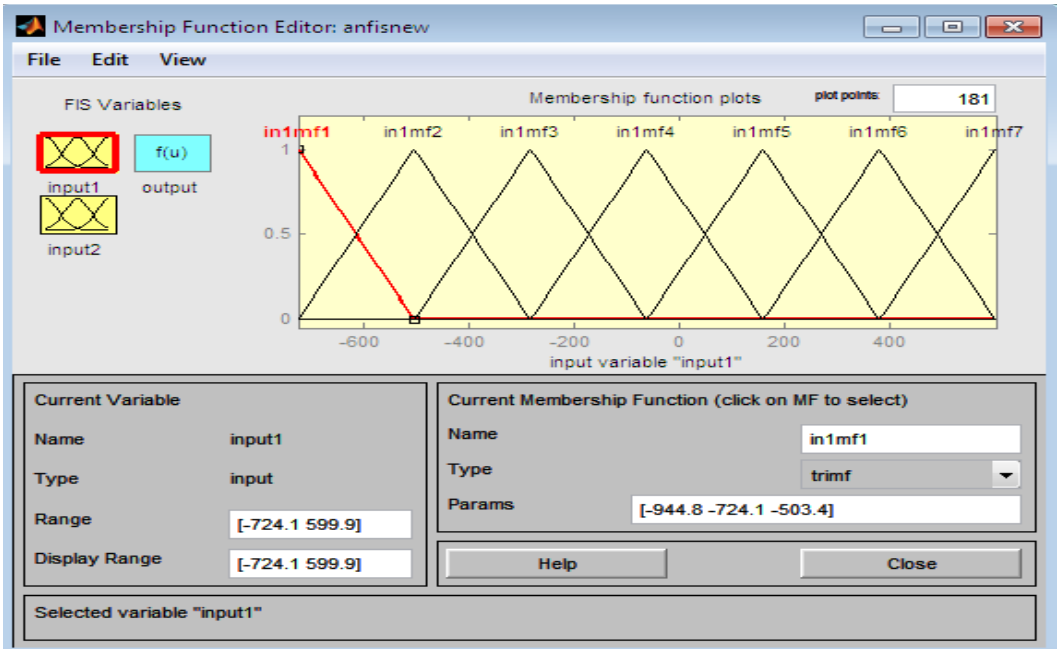

Figure. 4 Member function of input 1

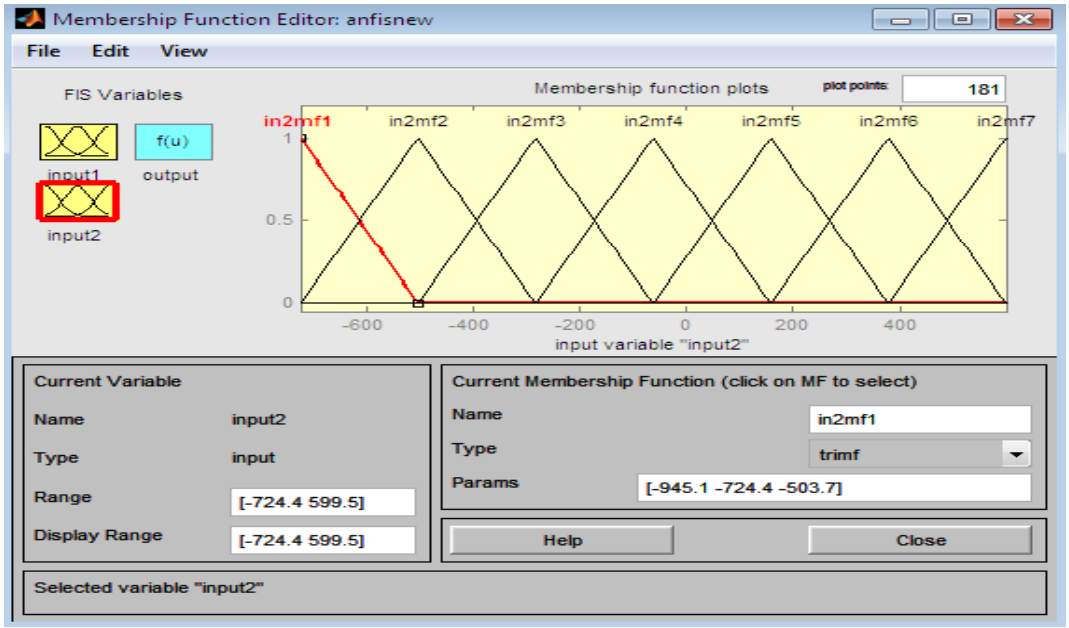

Figure. 5 Member function of input 2

5. Simulation Results

The hybrid boost converter based on the wind renewable energy source implemented to provide the DC and AC power for the micro grid and smart home appliances. Proposed Simulink model is shown in figure. 6. The converter consists the four switches for the operation of supply both currents (AC and DC) to load simultaneously. This implemented system is controlled by using the PID with Fuzzy controller rules and the system power flow is controlled.

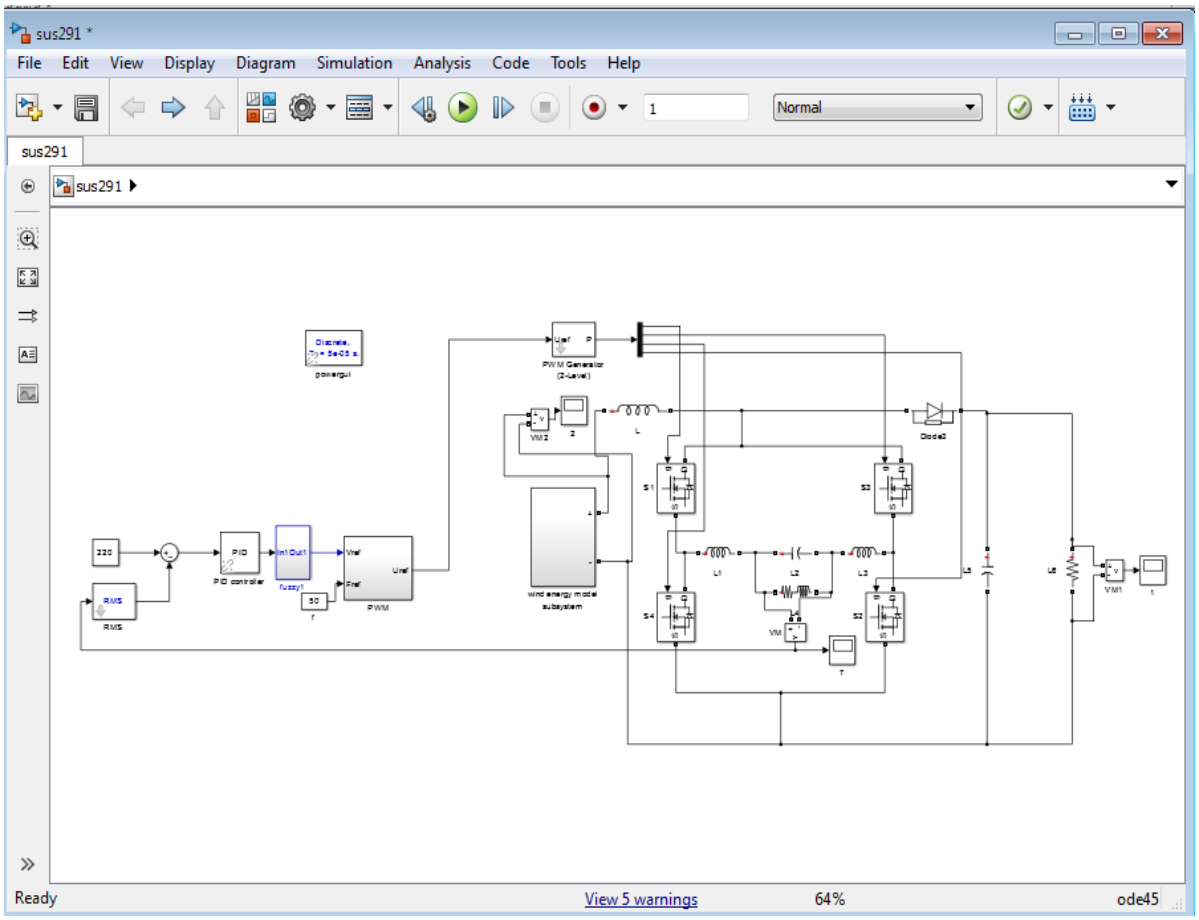

Figure. 6 Simulink model of hybrid converter

The input power to the converter is around 55v from the wind generator as shown in figure. 7. The output from the wind generator and the input to the converter is AC voltage. The power is fed to the micro grid as per the load requirements based on the AC and DC loads. The DC output and AC outputs are shown in figure .8 and figure. 9 are respectively.

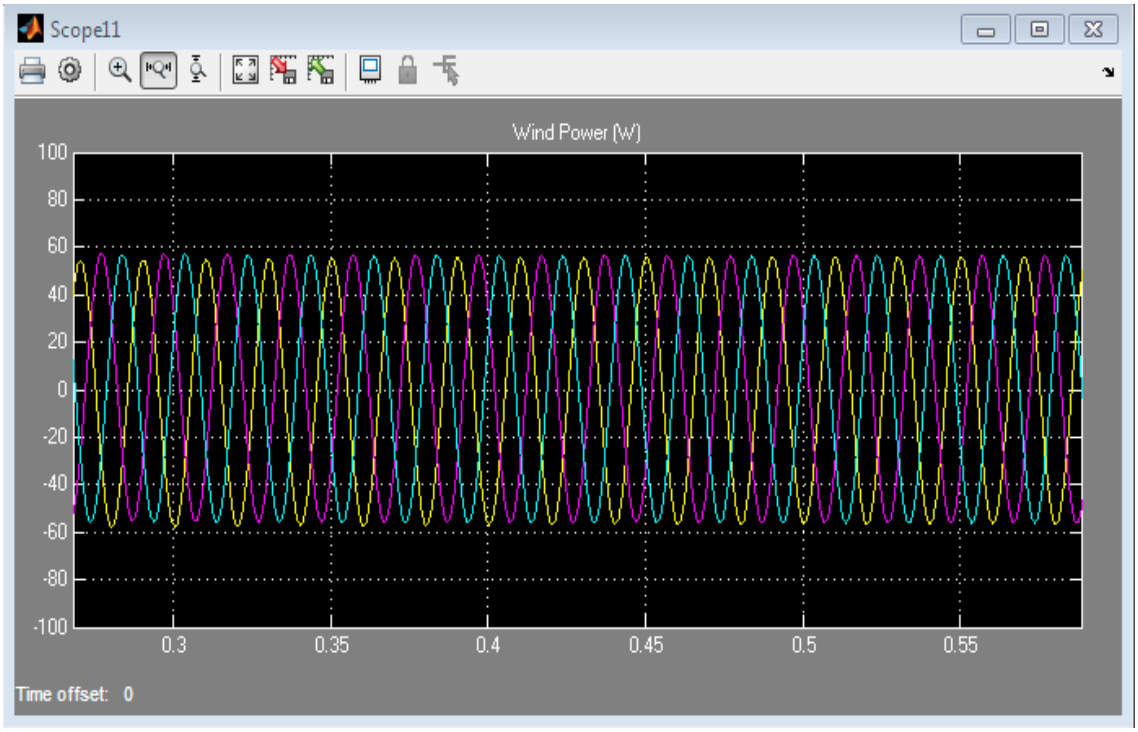

Figure. 7 Generated wind input power

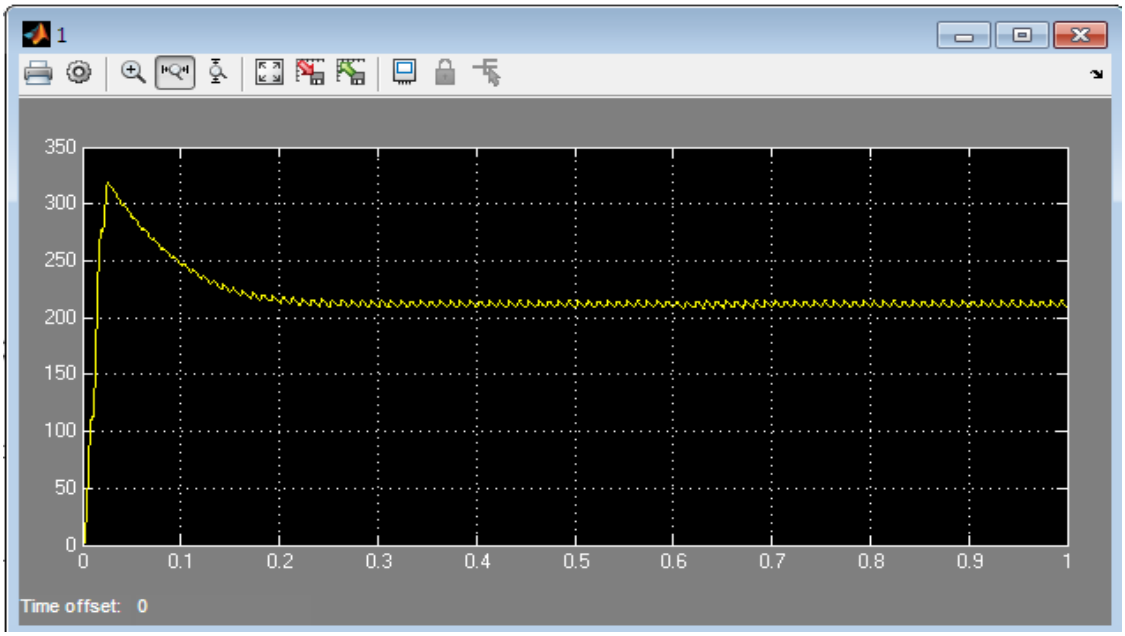

Figure. 8 DC output power

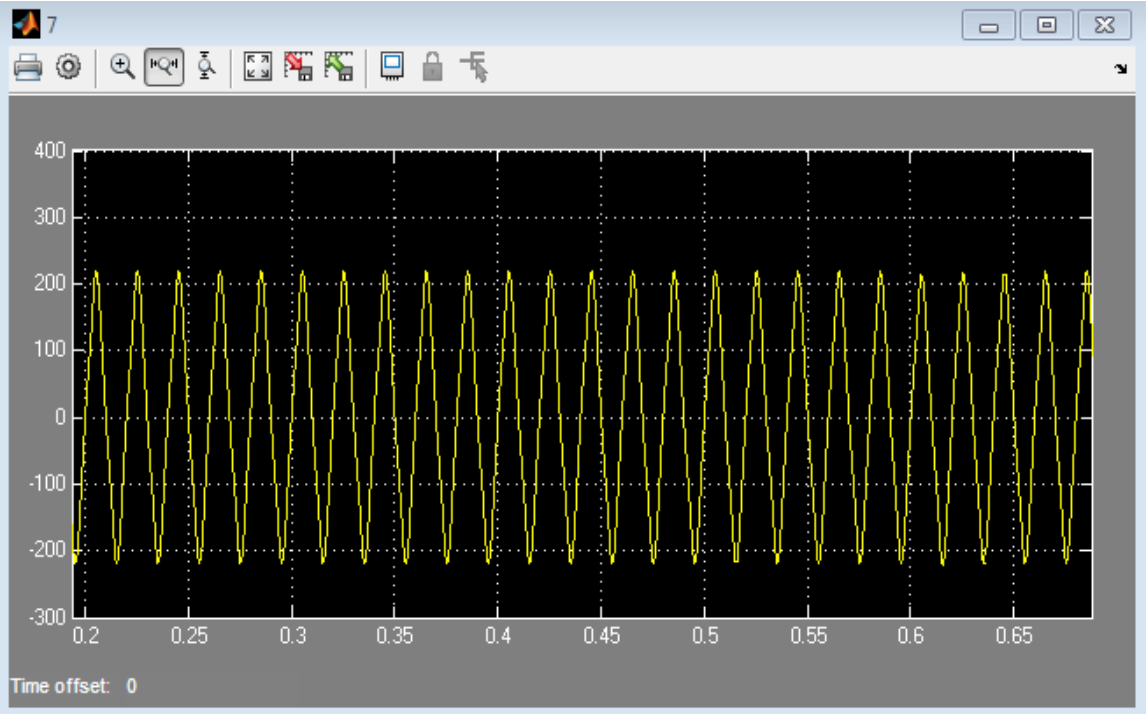

Figure. 9 AC output power

6. Conclusion

The simultaneous power flow to the both DC and AC loads are achieved by using the hybrid boost derived converter. The control method of this system has the fuzzy with PID controller to establish the steady state of the system performance. The generated energy from the wind renewable source is rectified and fed to the converter. The DC and AC loads are powered simultaneously from the renewable wind source. The input power is 55V which is produced or generated from the wind generator. Finally, the obtained DC power is 220V for the load such as battery. The achieved AC voltage is 220 V for the load to AC applications.

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