Implementation of ANN Controller Based Interleaved Hybrid Converter

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ABSTRACT

In existing method separate DC-DC and DC-AC converter topologies are required to supply DC and AC loads in which efficiency is poor. In the proposed work single converter topology of interleaved hybrid converter is used to provide simultaneous AC and DC output. Battery is used to supply load in absence of solar power. Artificial Neural Network control strategy is used to provide gating signals for the converter which improves the overall performance and stability of the system.AC and DC output from the interleaved hybrid converter are obtained using MATLAB/Simulink.

KEYWORDS: *Battery, Interleaved hybrid converter, Artificial neural network.*

I. INTRODUCTION

Solar power is a renewable source of energy and has several advantages such as no fuel cost, a little maintenance requirement and environmental friendly.The requirements of PV systems should operate with high efficiency level, small size and low cost. The maximum power from solar panel is obtained by varying the temperature and irradiation.With varied weather conditions, the PV system should continuously operate with greater efficiency level near or at the maximum power point of the solar panel. PV alone cannot serve as standalone system and hence battery is employed with the bidirectional converter which can be charged and discharged which enables bidirectional power flow.The DC bus feeds the interleaved hybrid converter which supplies both AC and DC loads.

II. OBJECTIVE

➢ To provide simultaneous AC and DC Output.
➢ To increase efficiency
➢ To improve the overall performance
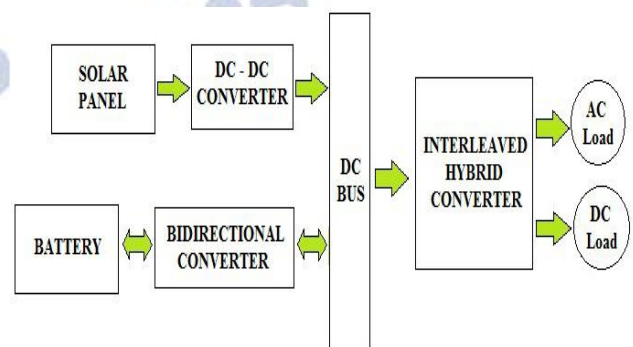
III.BLOCK DIAGRAM

Fig.1 Block Diagram

IV.DESCRIPTION

The light energy from the sun is converted into electrical energy by the PV panel.An incremental conductance MPPT method is used to extract maximum power from the panel.The output of the panel is provided to DC-DC converter which boost the voltage and feeds the DC bus.Battery stores the charge supplied by an bidirectional converter.Artificial neural network controls the hybrid converter and boost its performance.The interleaved hybrid converter feeds AC load and DC load efficiently**.**The importance of the ANN controller is the rapid detection of the disturbance signal with high accuracy and high dynamic performance. The conventional controller does not perform accurately by varying the parameters.ANN based controller provides better response and maintain stability under different conditions.

V.ANN TRAINING DATA SET

The data collected is stored in the Matlab workspace. This data is used for offline training of the neural network controller. The activation function chosen in this investigation are tan sigmoid for the input layer, hidden layer and pure linear is for output layer.Levenberg Marquardt back propagation algorithm is used to train the data set.

ANN is trained by using the input variable as error voltage and output variable as duty cycle.The training data set are as follows:

Input = Error voltage
Target=Duty cycle

Table1 Training data set for DC-DC converter

INPUT	TARGET
-200	0
-160	0.1
-120	0.2
-80	0.3
-40	0.4
0	0.5
40	0.6
80	0.7
120	0.8
160	0.9
200	1

Table 2 Training data set for interleaved hybrid converter

INPUT	TARGET
-100	0
-80	0.1
-60	0.2
-40	0.3
-20	0.4
0	0.5
20	0.6
40	0.7
60	0.8
80	0.9
100	1

The table 1 and 2 shows the training data set of DC-DC converter and interleaved hybrid converter in which the input variable is error voltage and output variable is duty cycle.These datas are trained in ANN to provide fast dynamic response while maintaining stability over wide operating range.

VI.INTERLEAVED HYBRID CONVERTER

The proposed IHC is by interleaving two boost converters and replacing the control switch of one of the boost converter with H-bridge inverter network. The IHC gives DC and AC output simultaneously from a single DC input.Thus, the proposed IHC is capable of giving high DC and AC voltage gain and has inherent shoot through protection capability. A modified unipolar sinusoidal pulse width modulation (SPWM) technique is used and a feedback loop is designed to regulate the DC output voltage with ANN controller.
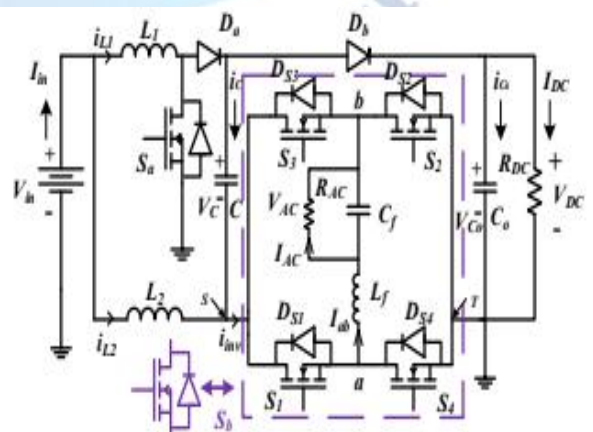

Fig.2 Proposed Interleaved Converter

6.1 Shoot-through interval (S$_b$ on):

This interval occurs due to turn ON of either S$_1$ and S$_4$ or S$_2$ and S$_3$ at the same time, which is restricted in conventional VSI. The shoot-through interval is inserted in the zero intervals of the inverter switches without disturbing the active states. In this interval, no power is transferred to AC load.

6.2 Power interval (S$_b$ off):

This inteval occurs due to turn ON of S$_1$ and S$_2$ in the positive half cycle and S$_3$ and S$_4$ in the negative half cycle of AC output voltage. In this interval, power is transferred to AC load from the input source.

6.3 Zero interval (S$_b$ off):

In this interval, antiparallel diodes (DS$_1$- DS$_4$) start conducting with the inverter switches to freewheel the AC filter inductor current through the AC load and no power is transferred to AC load from the input source.
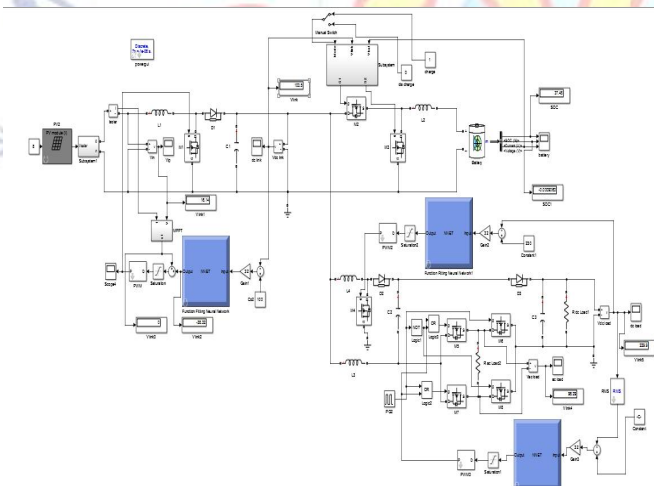
VII.RESULTS AND DISCUSSION

Fig.3 Matlab Simulink Circuits

The proposed system is simulated in the MATLAB SIMULINK and the corresponding output waveforms are obtained.The output voltage from the PV panel is 16 V and MPPT with Incremental conductance algorithm is used to track maximum power.The DC - DC converter boost the voltage from 16 V to 104 V DC and the controller based on ANN is used to provide fast dynamic response while maintaining stability over wide operating range.Battery is charged and discharged by using bidirectional converter.The output from DC - DC converter and bidirectional converter feeds the DC bus. The DC bus is fed to Interleaved hybrid converter which provides simultaneous DC and AC load.
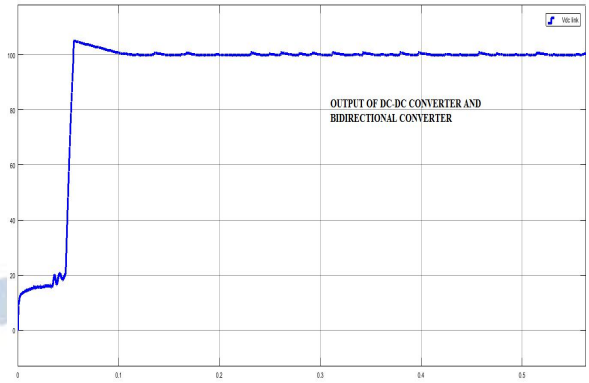
7.1 Simulation Waveforms

Fig.4 Output of DC-DC converter and Bidirectional converter
X-axis=Time in sec
Y-axis=voltage (V)

The figure 4 shows the output voltage of both DC-DC converter and Bidirectional converter.The input voltage of 16 V from the PV panel which is tracked by MPPT is boosted to 100 V which feeds the DC bus.
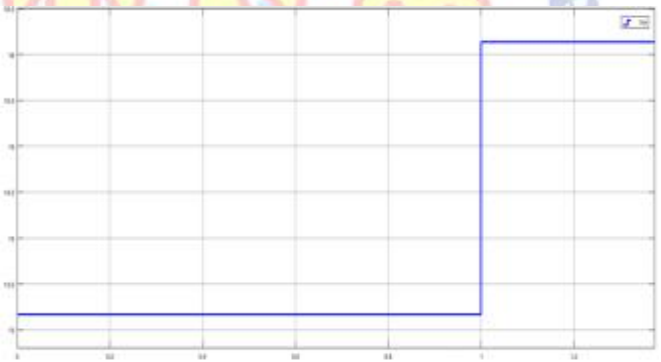

Fig.5 Step input waveform
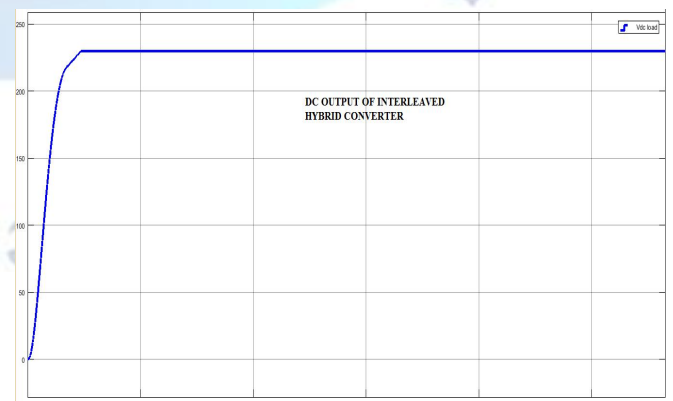This figure 5 graph shows the voltage of 16 V input from the PV panel at step time = 1 second.

Fig.6 DC Output of Interleaved hybrid converter

X-axis=Time in sec
Y-axis=Voltage(V)

Figure 6 shows the DC output voltage of 230 V from interleaved hybrid converter in which the input from DC bus is fed to the interleaved converter.The output voltage is controlled with ANN controller to provide fast dynamic response to maintain stability over wide operating range.
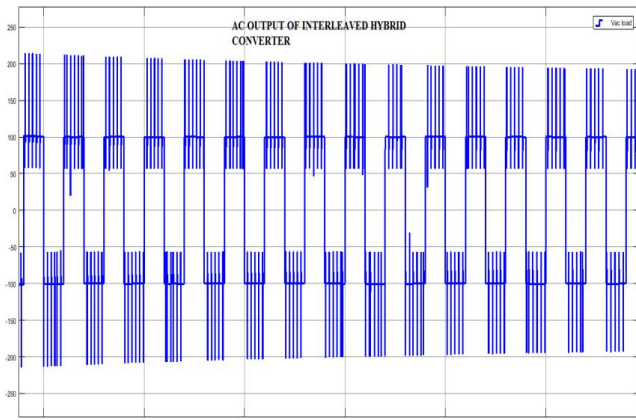

Fig.7 AC output of interleaved hybrid converter

X-axis=Time in sec

Y-axis=Voltage(V)

This figure 7 shows the AC output voltage of 100 V from the interleaved hybrid converter of H-bridge network with the duty cycle of 0.5.

VIII.CONCLUSION

In this proposed work,interleaved hybrid converter with simultaneous DC and AC outputs are obtained.To provide a stable response,ANN based control strategy is employed for regulation of converter output voltage due to any changes in load, reference voltage and input voltage. Time taken for computation is less since there is no mathematical model in Artificial Neural Network. Maximum power is tracked by MPPT using Incremental conductance algorithm which provides fast tracking even when there occurs rapid changes in solar irradiance. Interleaved hybrid converter is implemented to increase the efficiency. Battery is also provided in absence of solar radiation to supply the load. Bidirectional converters are employed when the DC bus voltage regulation has to be achieved along with the power flow capability in both the direction. The separate converter topologies of DC - DC and DC - AC is replaced by single converter topology of interleaved hybrid converter.

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