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A Fuzzy Optimized Multiport Buck Boost Converter

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Abstract: *An organised method for derivation of a multiport converter (MPC) with optimized fuzzy concept is proposed in this paper. The MPC is trigger by interconnecting multiple pulsating voltage cells (PVCs) through the DLIs. The PVCs can be load, yield, and bidirectional type, and bidirectional MPC topologies can be harvested if all the PVCs are bidirectional type. As a result, a family of hardback MPCs, including multi input converters, single output converters, and bidirectional MPCs, are derived. With the propound MPCs, step-up and step down voltage conversion between any two of the ports can be implemented. The operation principles, pulse width modulation, fuzzy logic and feed-back control strategies are presented and analyzed. The analysis indicates that, compared to the traditional common dc-bus-based solution, bulky dc-link capacitor is banish and single-stage conversion between any two of the three dc-buses are achieved with the proposed converter, which is beneficial for higher coherence, power density, and reliability.*

Keywords: *Multiport Converter, Pulsating Voltage Cells (PVCs), Fuzzy Logic, Pulse Width Modulation, dc-link Capacitor, Single Stage Converter.*

I. INTRODUCTION

1.1 MULTIPORT CONVERTER

A multi output topology is attractive for the applications where multiple outputs at different voltage levels need to be precipitated from a single dc input. A hybrid-port topology contains input, output and bidirectional ports, and more. Typical hybrid-port topologies are the three-port converters presented. They are good candidates for a stand-alone renewable potential system to interface a renewable source, a storage battery and an output load. A multiport bidirectional converter can be used to meet multiple storages and/or dc buses, which is usually required in electric vehicles and dc micro grid.Due to the advantages of MPCs, several near have been proposed to derive MPC topologies for various applications. In systematic approaches for deriving multi input converter topologies have been proposed by decomposing converters into basic switching cells and output filters. High-power solidity can be achieved with these topologies, but it is not easy to extend the number of ports up to three or more.

1.2 BUCK-BOOST CONVERTER

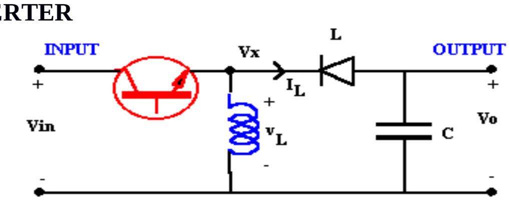

Figure 1.1: Schematic for buck-boost converter

With continuous conduction for the Buck-Boost converter Vx =Vin when the transistor is ON and Vx =Vo at what time the transistor is OFF. For zero net current change over a period the average voltage beyond the inductor is zero.

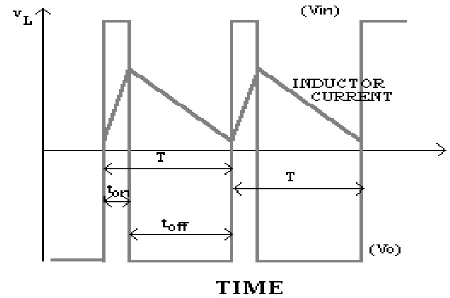

Figure 1.2: Waveforms for buck-boost converter

VintON+VotOFF = 0 (1.1)

This gives the voltage ratio

Vo/Vin = -D / (1-D) (1.2)

And the corresponding current

Io/Iin = - (1-D) / D (1.3)

Since the duty ratio "D" is between 0 and 1 the output voltage can vary between lower or higher than the input voltage in magnitude. The negative sign indicates a swerve of sense of the output voltage.

1.3 PI CONTROLLER

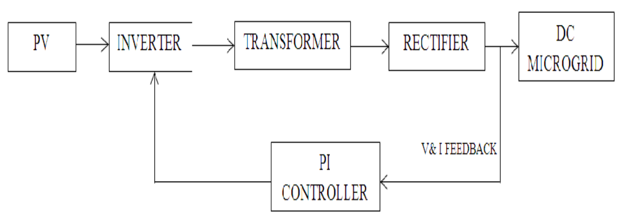

Figure 1.3: Block diagram of PI Controller

P-I controller is mainly used to eliminate the steady state error resulting from P controller. However, in terms of the speed of the response and overall stability of the system, it has a negative impact. This controller is mostly used in areas where speed of the system is not an issue. Since P-I controller has no ability to predict the future errors of the system it cannot decrease the rise time and eliminate the oscillations. If applied, any amount of I guarantees set point overshoot. P-I controller is used to insert either PV or Wind as input of dc-dc converter then convert into AC by inverter and through isolation transformer to avoid harmonics in the circuit and then rectify to dc micro grid injection type and feedback to P-I controller again inverter it.This controller is mostly used in areas where speed of the system is not an issue. Since P-I controller has no ability to predict the future errors of the system it cannot decrease the rise time and eliminate the oscillations.

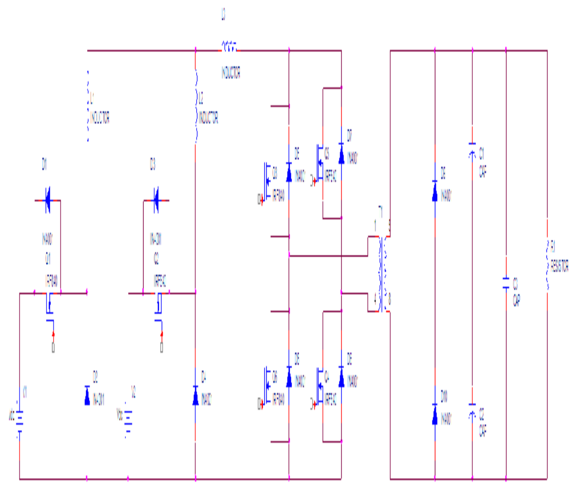

Figure1.4: Circuit for two port boost converter

State I: The upper switch S11 is ON and S12 is OFF, the inductor current iL1 flows into or out the dc bus, depending on the direction of power flow. We have

diL1 / dt = UBus – um / L11 (1.4)

State II: S11 is OFF and S12 ON, we have

diL1 / dt = um / L11 (1.5)

1.4 FUZZY CONTROLLER

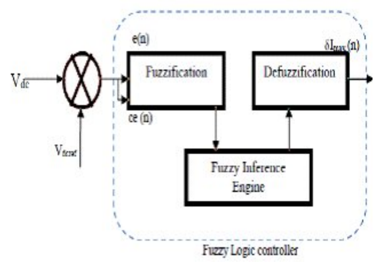

Figure 1.5: Structure of Fuzzy controller

Basically, Fuzzy Logic (FL) is a multivalve logic that allows halfway values to be defined between conventional evaluations like true/false, yes/no, high/low, etc. Here we using fuzzy logic controller as mamdani type controller they provide low error rate and change in voltage and current with respect to power if it is possible means Vref must be increased not possible means Vref become zero.

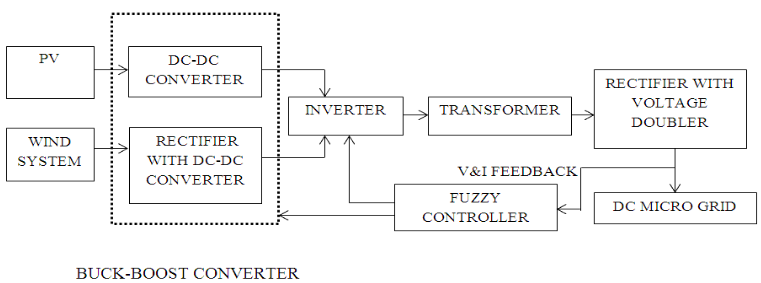

Figure 1.6: Block diagram of fuzzy optimization

Basically, Fuzzy Logic (FL) is a multivalve logic that allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, etc. Notions like rather tall or very fast can be formulated mathematically and processed by computers, in order to apply a more human−like way of thinking in the programming of computers.

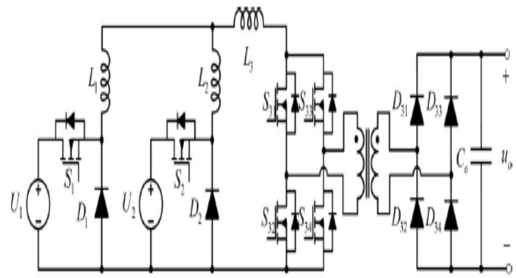

Figure1.7: Circuit diagram for multiport buck-boost converters

The fuzzy controller is characterized as follows:
(i) Seven fuzzy sets for each load and harvest.
(ii) Fuzzification using continuous universe of conferences.
(iii)Implication using Mamdani's 'min' worker.
iv)Defuzzification using the 'bisector' method.

Table 1.1: Control rule base

e \ ce	NB	NM	NS	ZE	PS	PM	PB
NB	NB	NB	NB	NB	NM	NS	ZE
NM	NB	NB	NB	NM	NS	ZE	PS
NB	NB	NB	NM	NS	ZE	PS	PM
ZE	NB	NM	NS	ZE	PS	PM	PB
PS	NM	NS	ZE	PS	PM	PB	PB
PM	NS	ZE	PS	PM	PB	PB	PB
PB	ZE	PS	PM	PB	PB	PB	PB

1.4.1 Advantages of fuzzy controller

Multiple input renewable sources can be added.
High power density
High reliability.
High efficiency system.
Isolation transformer is used, so maximum harmonics can be reduced.

1.4.2 Applications

Energy harvesting.
High voltage DC grid injection systems.

II. SIMULATION MODULE

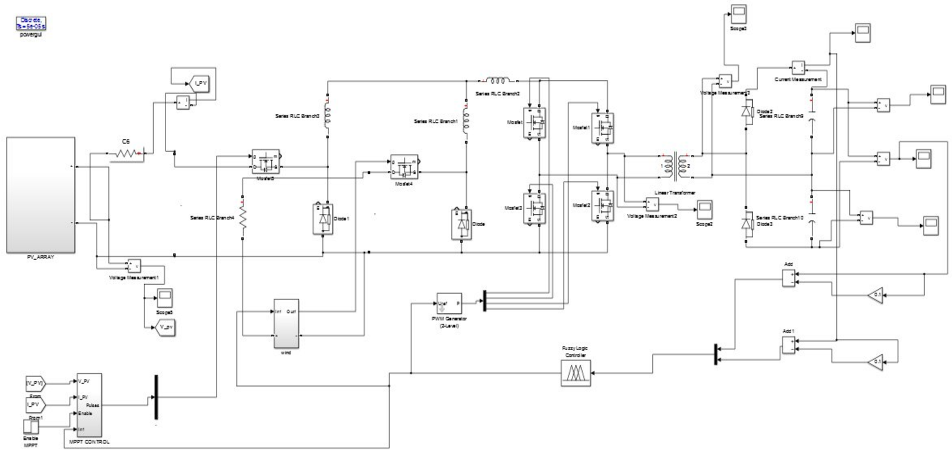

Figure 2.1: Simulink model for fuzzy optimized buck boost converter

The above figure shows the simulation module of the proposed system.

- In our system we have two sources wind and PV.
- The two sources are connected to the buck-boost converter and they are inverted to AC and using transformer they connected to secondary side. To avoid reverse voltage we used a transformer.
- Where the voltage doubler circuit is used. Here we rectify the AC input to DC output and the voltage is doubled using the capacitor.
- Here we have used MPPT technique to boost the voltage of PV.
- To maintain the stable output with quick response we have used Fuzzy logic controller at output by taking output voltage and current feedback.

The Waveform shows the inverter output voltage waveform. Where X axis=1 sec, Y axis= 200Volts.

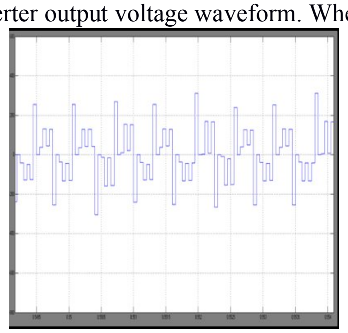

Figure 2.2: Inverter Output Voltage

The waveform shows the output voltage after transformer stage. Where X axis=0.01sec and Y axis = 100 Volts.

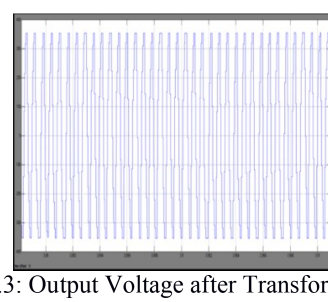

Figure 2.3: Output Voltage after Transformer Stage

The waveform shows the output voltage waveform of the voltage multiplier. Where X AXIS=1 sec and Y AXIS=100Volts.

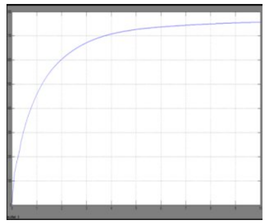

Figure 2.4: Output Voltage Waveform

III. CONCLUSION AND FUTURE SCOPE

CONCLUSION

A systematic method for derivation of a multiport converter (MPC) with optimized fuzzy concept is proposed in this paper. We have designed the proposed simulation module using MATLAB simulink. The analysis indicates that, compared to the traditional common dc-bus-based solution, bulky dc-link capacitor is abolished and single-stage conversion between any two of the three dc-buses are achieved with the proposed converter, which is beneficial for higher efficiency, power density, and reliability.

FUTURE WORK

The proposed system is expected to be work in very wide range of input voltage and load variation. So it has scope on the fields like inverter, isolation transformer and fuzzy controller.

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