Implentating Fuzzy Logic Controller for Non-Isolated DC-DC Converter

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Abstract:
The world's demand for renewable energy sources are growing rapidly, but due to their low voltage generation and high input current requirement they demand a high efficiency, high step-up dc-dc converters .

Practically, the conventional boost converter cannot provide a voltage gain greater than six times of it's applied voltage due to its parasitic Components associated with passive elements and semiconductor devices. In this project we proposed a high voltage gain dc-dc converter with improved efficiency with fewer components. In this, efficient power conversion is achieved with reduced voltage stress across semiconductor devices. The proposed converter is analyzed, simulated using mat lab/Simulink 2018a.Further; a generalized comparison is done between open loop, PIPWM & fuzzy logic controller. The results obtained by fuzzy logic controller are qualitatively good among the other controller's.
Keywords—Simulink, Matlab, fuzzy logic controller, PIPWM ,semi conductor device ,DC-DC Converter .

1.INTRODUCTION :

fabrication variation and different operating conditions The growing use of renewable energy sources (RESs) and Energy storage systems (ESS), due to global environmental concern, brings new challenges to the energy conversion technology. Because some devices that store or produce electrical energy (e.g., batteries, ultra-capacitors, fuel cells and solar photovoltaic) is often realized using multiple low voltage cells, which are usually connected in series to produce sufficient voltages for the intended application. Unfortunately, series connection of cells degrades the system performance, adds complexity to the system, and possible temperature rise due to between cells. In batteries, this may be related to the state of charge of a cell. In solar arrays, it may be due to a change in solar irradiance or partial shading of the array. Many green power supply system calls for a high efficiency, high step-up DC-DC converter in the power conversion stage.Typical applications include grid-connected inverters, motor drive, uninterruptible power supply system (UPS), tele-communication/network server power systems, electric vehicle (EV), high intensity discharge (HID) lamps and distributed power generation (DPG) system. Furthermore, high voltage step-up gains usually ten times or higher are increasingly required when the system is powered by low voltage energy sources such as Li-ion batteries, solar arrays and fuel cells. It is necessary or customary to use a relatively high and stable DC voltage in these applications. Besides, considering that the overall cost of a renewable energy system is high, the use of high-efficiency power electronic converter is necessary. The boost and buck-boost converters are the simplest non-isolation topologies that produce an output voltage that is greater in magnitude than the source voltage.

However, the conventional boost and buck-boost converters must operate at extreme duty ratio to achieve high voltage gain (in particular ten times). This is an undesirable operating point since the output diode sustains short pulse, high amplitude, current pulses which result in severe reverse recovery losses. Besides, as the output voltage increases so must the voltage rating of the semiconductor switching devices and at high duty ratio the conduction losses of the semiconductor device can make a more significant impact to the performance of the system.Furthermore, as the duty ratio approaches unity, the output voltage approaches zero, and the efficiency decreases to zero. Consequently, the converter may suffer poor dynamic response to system parameter changes and potential load variations. This behavior is typical of converters having boost or buck-boost characteristics. The challenge for any high step-up DC-DC converter is to avoid extreme duty ratio operation.

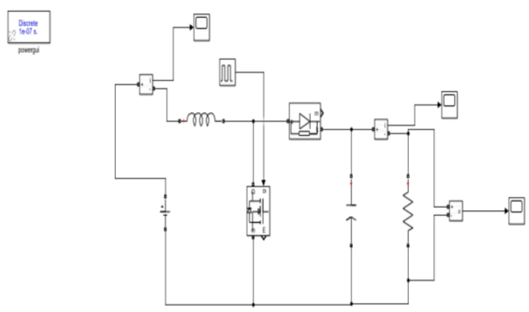
Appropriate duty ratio operation, conduction losses reduction and alleviation of diode reverse recovery problem can greatly improve the efficiency of power conversion. It is the aim of this to investigate methods of improving the performance of high step-up converters.

2.PROPOSED METHODOLOGY

However in this project study it was observed that Fuzzy controller has better performance than the other controllers proposed .It has robust voltage regulationto the change in load. Further, it has reduced the peak overshoots and rise time and settling time to a considerable extent.Hene the response of fuzzy logic controller is best as compared to other controllers. Such type of controllers will be better suited for battery charging applications and electric vehicles and hybrid power

IMPLEMENTATION

Many applications powered by RESs call for a highefficiency high step-up DC-DC converter in the power conversion stage. Typical examples include grid connected inverters, high-intensity discharge lamp (HID), electric drives and uninterruptible power supply system (UPS). Some emerging applications that require high step-up DC-DC power converters are briefly described in the following section.



A. Conventional Boost converter(Single Boost): **Simulink implementation of Conventional Boost Converter**

A Boost converter is a switch mode DC to DC converter in whichthe output voltage is greater than the input voltage. It is also called as step up converter.The name step up converter comes from the fact that analogous to step up transformerthe input voltage is stepped up to a level greater than the input voltage. By law of conservation of energy the input power has to be equal to output power (assuming nolosses in the circuit).

ISSN: 2005-4297 IJCA

Input	30V DC
Switching frequency	24 KHz
Inductance	205e-6 H
Output Capacitance	140e-6 F
Load	384.4 Ω
Output Voltage	160V DC
Duty ratio	82.35% (or) 0.8235

parameters of conventional boost converter

B.Principle of operation of Boost converter :The main working principle of boost converter is that the inductor in the input circuit resists sudden variations in input current. When switch isOFF the inductor stores energy in the form of magnetic energy and discharges it whenswitch is closed. The capacitor in the output circuit is assumed large enough that thetime constant of RC circuit in the output stage is high. The large time constantcompared to switching period ensures a constant output voltage Vo(t) = Vo(constant).

D. Open loop controller for Non-Isolated DC-DC Converter :In this the circuit is simulated without feedback from output. The circuit is directly excited by a pulse voltage source . The duty cycle is calculated manually using the relationship derived from the paper.

E. Implementation of PI Controller: For tuning boost converter with PI controller by using ZIEGLER-NICHOLAS method

In this method, we will set ki=0 and kd=0 then the value of kp is increased until it reaches a stable and constant oscillations

where,

kp= proportional gain

ku=ultimate gain

Tu =oscillation period

Now, set the kp , ki and kd as following

Control type	k_p	T_i	T_d
P	$0.54\ k_u$	-	-
PI	$0.45\ k_u$	$T_u/1.2$	-
PID	$0.6\ k_u$	$T_u/2$	$T_u/8$

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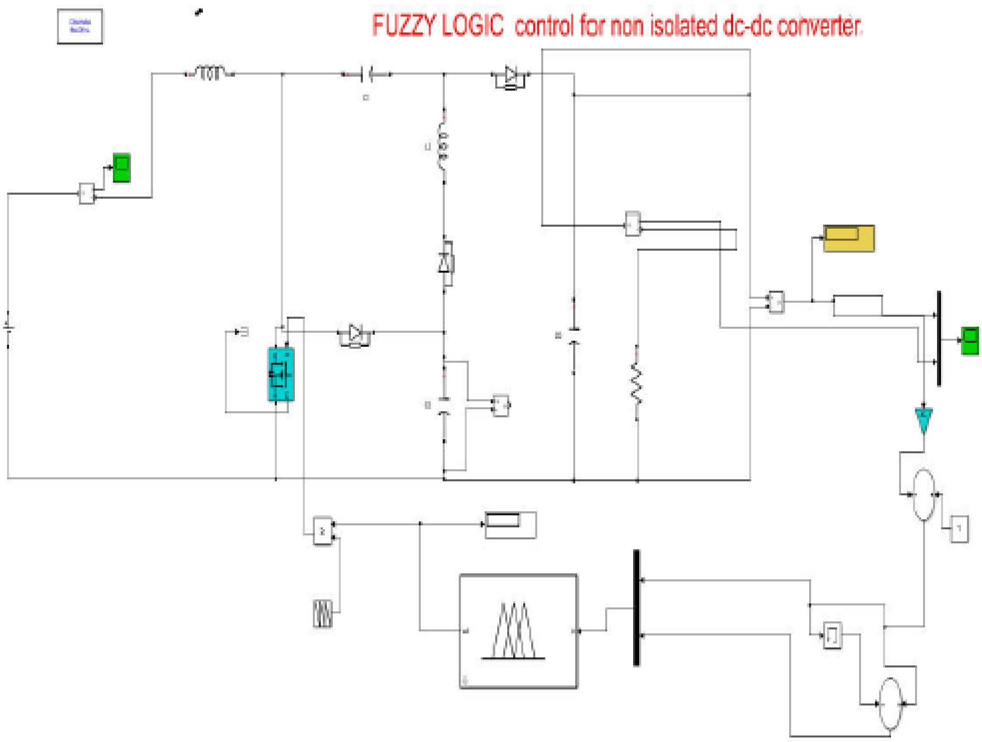


implementation of fuzzy logic controller for non-isolated converter

parameters of Fuzzy Controlled non-isolated boost converter

Input	30VDC
Switching Frequency	24 KHz
Proportional Controller Value	0.45
Integral Controller Value	270
Load Value	384.4Ω
Output Capacitance	140e-6 F
Inductance Value	205e-6 H

IV. ADVANTAGES

- They are used in regulated DC power supplies.
- They are used in regenerative braking of DC motors.
- Low power boost converters are used in portable device applications.
- As switching regulator circuit in highly efficient white LED drives.
- Boost converters are used in battery powered applications where there is space.
- constraint to stack more number of batteries in series to achieve higher.
- voltages.aware of the messages in the LCD display since they are far away from the energy meter.

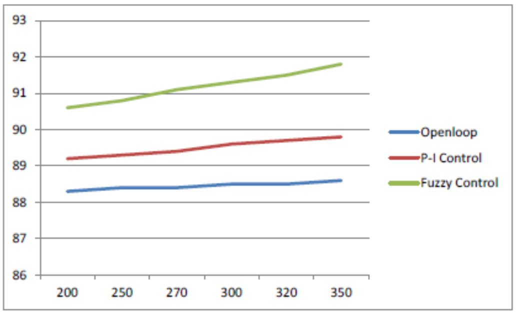
V. CONCLUSION

Non-Isolated DC-DC converter with single switch was studied during this project course. Non-Isolated DC-DC converter was simulated with different controllers (Open loop,P-I controller and Fuzzy logic controller).There performances were studied and tabulated. However in this course of project study it was observed that Fuzzy controller has better performance than the other controllers proposed .It has robust voltage regulation to the change in load. Further, it has reduced the peak overshoots and rise time and settling time to a considerable extent.Hene the response of fuzzy logic controller is best as compared to other controllers. Such type of controllers will be better suited for battery charging applications and electric vehicles and hybrid power systems.

Future Scope

The converter proposed with fuzzy logic controller can be further extended into power systems applications such as hybrid power systems. On the other hand the proposed project can be studied using other advanced controllers such as artificial neural networks, Proportional-Resonance controllers and Belbic controllers.

Result Analysis



Analytical comparison of Voltage regulation at different load conditions

s.no	Load	Open loop (%)	Pi controller (%)	Fuzzy Controller (%)
1	200	88.3	89.2	90.6
2	250	88.4	89.3	90.8
3	270	88.4	89.4	91.1
4	300	88.5	89.6	91.3
5	320	88.5	89.7	91.5
6	350	88.6	89.8	91.8

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ISSN: 2005-4297 IJCA