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Enhanced the Performance of sepic converter using Fuzzy logic controller fed PMDC motor

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Abstract

This paper presents the performance analysis of output voltage stability using a SEPIC converter. The SEPIC converters adjusted the variation of voltage in the closed loop system using a fuzzy logic to maintain a constant output voltage aid the non-mathematical modeling. This converter is used to produce high output voltage than the conventional. To reduce the switching losses, conduction losses and ripples reduction in the output voltage. MATLAB simulation is used to evaluated the Sepic DC-DC converter increasing the performance efficiency of 97.3%

Keywords: The sepic DC-DC converter; fuzzy logic controller; PM DC motor

I. INTRODUCTION

The progress of high voltage Sepic Converters are significant investigation domain, which are required in many applications to be used .mean while it has used in small and medium power converters [1-2].Sepic converters are also used in renewable

energy sources and photovoltaic systems, In Many application s like electrical hybrid vehicles ,fuel-cells, Miniature D.C Motor and hospital equipment, UPS and super capacity battery equipment. Many factors are using fuzzy logic in these in these converters, the main advantage being the adaptability offered by fuzzy logic using mamdani's technique. The strength of any FLC (Fuzzy Logic Controller) lies in a set of fuzzy rule. In conventional DC-DC converter, topologies play a vital role in the system has described design procedures for selecting step down ratio transformer which do not solve the problems like the leakage inductance and parasitic capacitance which resulted in reducing efficiency [3].In recent.Sepic converter has applied in many applications like aero space ,precision instruments,and defence equipments. [4], sepic converter has minimized the ripple content present in the output voltage to use the passive filter attain the maximum efficiency [5],[6]. The application of, the DC/DC converters has extended to utilize in the Photo voltaic system [7], [8] to control the speed and maintain the voltage using PMDC motor to get the maximum torque and reduce the losses [9]. Sepic converter has utilized in better output voltage and improve the reliable operation In [10], To review many miniature DC motor by adopting switching regulators to provide proper reduction of steady state error in the closed loop response. and improve the gain[11],.In output ripple voltage in the buck converter has decreased the acceptable level of by combining a closed loop converter in using fuzzy logic system. To implement with switch mode power supply, which was modified using the duality principle, is applied sepic converter [12-18].

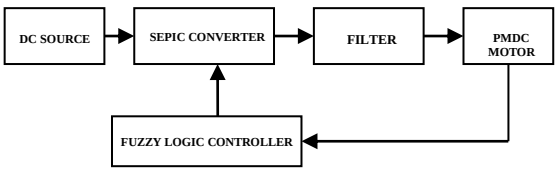

Figure.1.1 Modified Sepic converter Fed PMDC motor

Here, a fixed source voltage of 12V is connected in the input. A Sepic converter is operated in the high gain step up voltage is contain more ripple in the output voltage. To provide many passive filters to reduce the ripple content, Among the filters π filter is superior to minimize the ripple content in the output voltage. The block diagram represented a passive filter is connected to the PMDC motor as shown in Figure.1.1. Sepic converter switching frequency f, is maintained constant through out the circuit ON/OFF time among the timing one time can be varied other time can be fixed is called as PWM control. Variable frequency control is not operated in this circuit due to the more harmonics is generated in the output voltage and uncertainty of the frequency is creating the problem for designing the filters. Sepic converter offers an output voltage that can be operated in the bidirectional mode of operation aids the

circuit to enable the greater or lesser than the input voltage. hence the name "boost-buck" or inverting regulator. Transformer is implemented in the step up as well as step down depends upon the requirement in the bidirectional mode of operation To maintain the constant output voltage is available in time ratio control mode .Soft switching is preferred in n-channel enhancement MOSFET. The depletion MOSFET remains on at zero gate voltage and at the same time enhancement type MOSFET remains off at zero gate voltage. The enhancement type MOSFETs are generally used as switching devices because of high mobility of electrons. The advantages of n-channel enhancement MOSFET are low gate energy, high switching speed and low switching losses. It has calculated and operated the switching frequency could be applied for high power application. This has been observed and recognized the FB-ZVS-PWM (Full Bridge Zero Voltage Switching Pulse Width Modulation) is considered as one of the best power converters. Conventional converters using the hard switching operation to produce more losses.In the circuit as applied soft switching operation to reduce the switching losses[13].To developed the transformer which has the characteristics like high frequency, comparatively smaller size, less weight and low cost which make it affordable. It was also suggested that if the power involved becomes significant, as in high power and frequency conditions, the the performance of the converter has improved [14]

A soft-switching is applied in the sepic converter to reduce the turn-off loss of the IGBT and MOSFET in a buck converter. The snubber, provide the voltage protection to reduce the switching losses,conduction losse and reduce the electromagnetic interference Normal snubber circuit is utilized for all the non-isolated DC-DC converters.[15].Snubber circuit using capacitor is based on the circuit rating [16]. Sepic converter has limited the frequency ranges due to the switching losses To optimize the frequency to nullify the switching losses [17].The output voltage calculation is effectively designed and minimize the output ripple voltage[18]. The above literature work does not deals the closed system of fuzzy logic controller in the modified Sepic converter.

II OPERATING PRINCIPLE OF SPEIC DC-DC CONVERTER

Sepic converter with π filters is shown in Figure 2.1. This Sepic converter has two parts inclusive of main diode and main capacitor. Normally the capacitor is charged to the maximum output voltage and also . Sepic converter operated in the C_S capacitor is inverted to achieve high voltage. It is used in medium rating and high power rating converters used in high voltage operation. Zero voltage switching technique is applied in all the switches. The switch voltage is summation of the input voltage and output voltage maintaining the Integrity of the Specifications

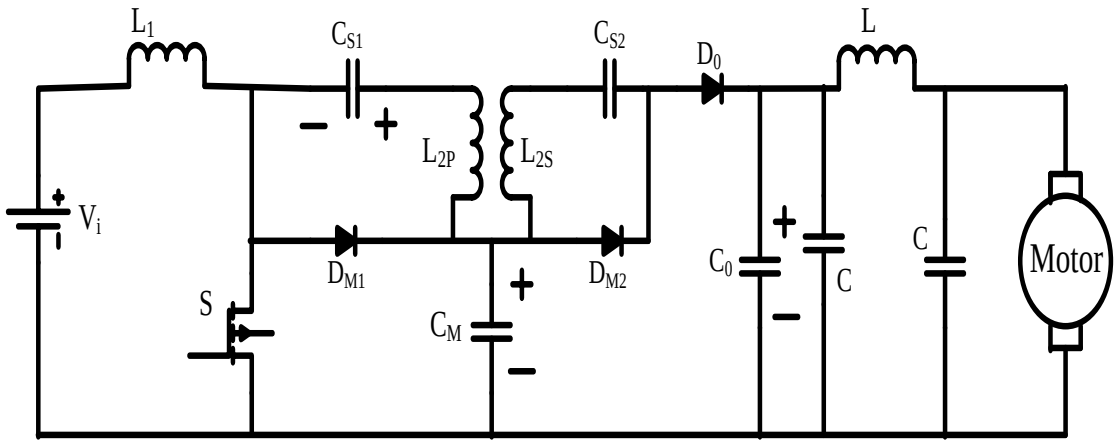

Figure 2.1 Modified Sepic converter with π filter fed DC motor

The operation based on the boost converter with magnetic coupling and the voltage multiplier cell is used in the circuit to get high voltage gain and an improved efficiency as shown in the Output. Though the magnetic coupling is achieved with the input inductor in the boost mode operation, the input current ripple increases and relies on the inductor winding turn's ratio

$$D = \frac{v_0}{V_i + V_0} \qquad \text{----------(1)}$$

$$L_{Ce} = \frac{R_L}{2f}\frac{v_o}{V_i + V_o} \qquad \text{----------(2)}$$

$$L_{ke} = \frac{R_L}{2f}\frac{V_i^2}{V_o(V_o + V_i)} \qquad \text{----------(3)}$$

D= Duty cycle

V_o=Output voltage

V_i= Input voltage

f = supply frequency

R_L=Load resistance

L_{ce} = Equivalent critical Inductance

L_{ke}= critical inductance

In different arrangement of a Sepic converter with an LC, CLC,C,RC filter are presented to decrease the Output Ripple voltage among them CLC filter produce the decreased amount of ripple voltage in the output.

which have been extended about the single-ended primary-inductor converter (SEPIC) are more constant voltage has maintained in the fuzzy control method. The duty cycle is operated normally 50% of total frequency. The entire circle operates in the constant frequency mode.

L_{ke}= critical inductance

Sepic converter is applied the passive filter in the load side. The filters are RC, LC, C and CLC. The Output Ripple voltage in the load side among them CLC filter produce the decreased amount of ripple voltage in the output. Sepic converter is maintained constant in the closed loop system using fuzzy logic controller. The duty cycle is operated normally 50% of total frequency. The entire circle operates in the constant frequency mode.

III. CLOSED LOOP CONTROLLER OF SEPIC DC-DC CONVERTER

Fuzzy system is needed for a good closed loop operation. It is operated in non-mathematical and non linear system is optimal usage of the Sepic converter system. Matlab software is used in the Sepic converter circuit. In the open loop system is not able to maintain the constant voltage due to variation of the input applied voltage. To maintain the constant voltage using some optimization technique. The steady state error signal is reduced by properly tuning the fuzzy logic controller. Mamdani's technique has been applied in the fuzzy logic controller circuit and simulated by MATLAB and the results are presented The fuzzy logic system using base rule normally operated in the 100% overlapping from the point of (0-1, 1) in this circuit are modified the overlapping of 50% from the point of (0 to 1).It has given the better and constant output voltage.The rule base functionality of an fuzzy logic controller are given in Table .1.

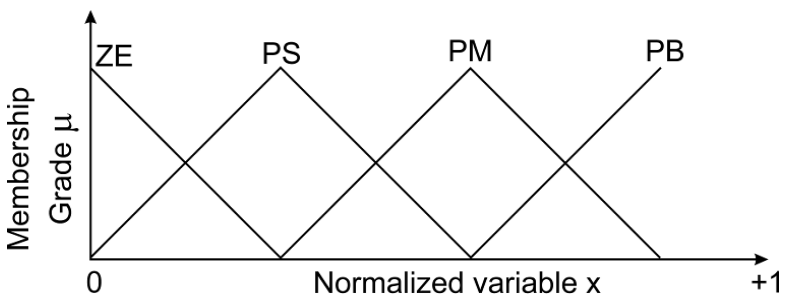

Figure 3.1 Triangular Shaped Membership Function

Table I: Fuzzy Control Using Rules Derivation

Reference Points	Rules		Output	Notation
	error	***Corrected error***		
a1, a2	P	ZE	P	(P, ZE, P)
b1, b2	ZE	P	P	(ZE, P, P)
c1, c2	N	ZE	N	(N, ZE, N)
d1, d2	ZE	N	N	(ZE, N, N)

IV. SIMULATION RESULT

Sepic converter has applied the Input voltage of 12V .Figure.4.1 shows the output voltage of 220 V to maintain constant and without fluctuations of Sepic converter. And Figure. 4.2 shows the output current of Sepic converter has produced 0.26 A to operate in the circuit, Figure. 4.3. The sepic converter is using current of 0.5 A to drive the load.when the boodst voltage is stepped up to produce the output voltage of 160Vas shown in Figure 4.4

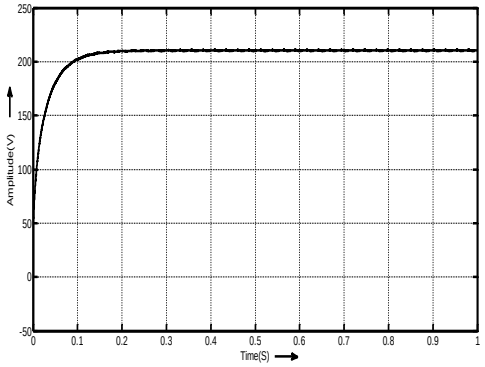

Figure.4.1 OUTPUT VOLTAGE OF SEPIC CONVERTER USING FUZZY LOGIC CONTROLLER

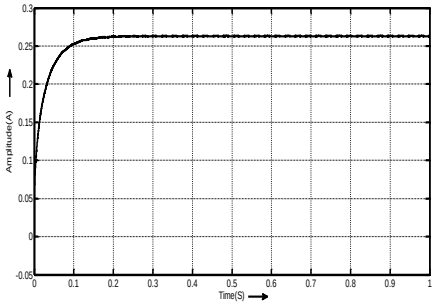

Figure.4.2 OUTPUT CURRENT OF SEPIC CONVERTER USING FUZZY LOGIC CONTROLLER

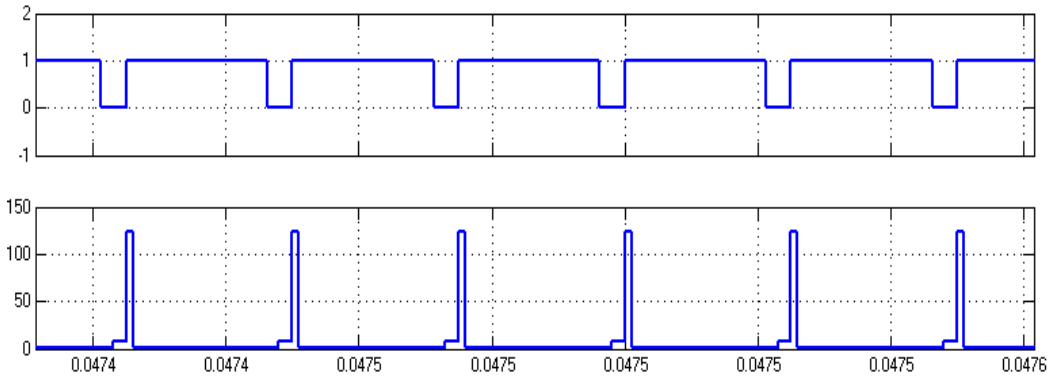

Figure 4.3 Switching pulse for M1 & Vds

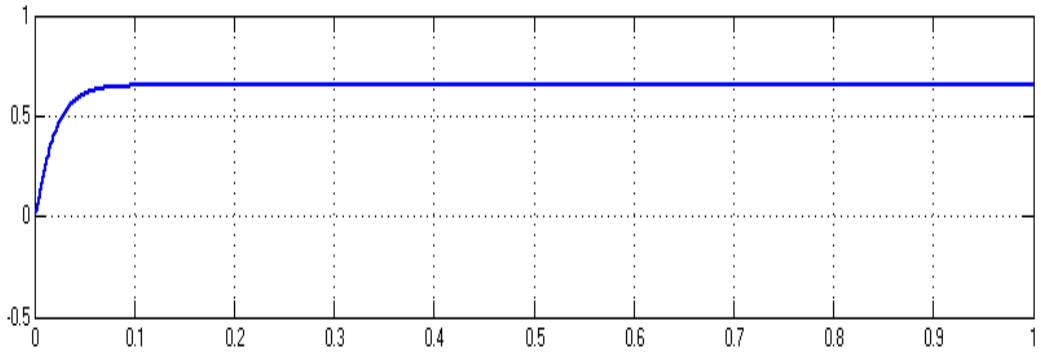

Figure 4.4 Output current of Sepic converter

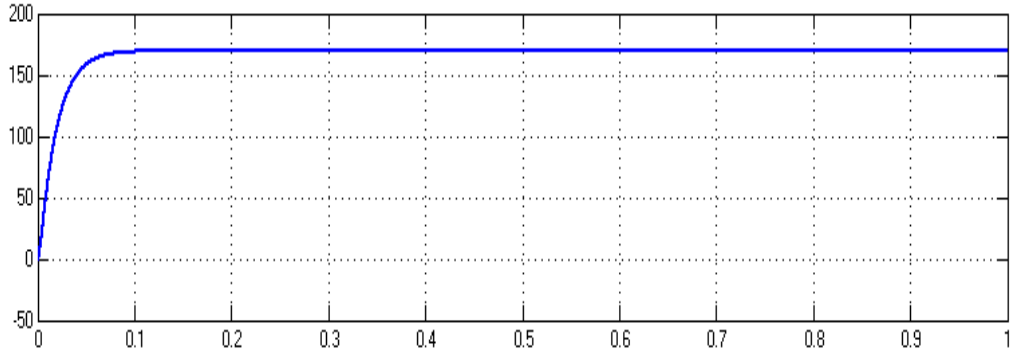

Figure 4.4 Output Voltage of Sepic converter

Table 1. variation of ripple factor with different filters (Input-12V)

Filters	Ripple factors (%)	Efficiency (%)	Input power (W)	Output power (W)	Output voltage (v)
Pie	0.000271	95.52	58.73	56.04	225
LC	0.006056	89.57	59.38	53.19	181
RC	0.006051	89.52	59.33	53.14	182
L	0.00036	94.37	58.78	56.09	224

Table 2. Simulation Parameters

S.NO	PARAMETER	VALUES
1.	Input Voltage	12 v
2.	Frequency	20 Khz
3.	Speed	1500 rpm
4.	Current	2 amps
5.	Inductance	10mH & 300 µH
6.	Capacitance	10 µF & 100 µF
7.	Resistance	10 Ω
8.	Miniature motor Model (PMDC motor)	842,V=220V, A=2A and power 96W

V. CONCLUSION

The performance of the Sepic converter is analyzed in both direction with π-filter in the output side is superior to C and LC filters. Closed loop response is operated with fuzzy controller. Fuzzy controller is simulated and analyzed. The best among the converter is Sepic DC-DC converter, since it produces high output voltage with reduced ripple content and is also very quick to reach the steady state. The performance of the Sepic converter efficiency is 97.1%

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