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Comparison of Boost Converter and SEPIC Converter for Speed Variation of Bldc Motor

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***Abstract:** In the recent days, the utilization of brushless dc motor is increasing for variable speed applications. Controlling the parameters of motor is crucial. In this paper speed of brushless dc motor is controlling through output voltage of converter connected to the motor. By the variation of the duty cycle of converter the variation in the speed is obtained. For this operation non isolated BOOST and SEPIC converter are chosen. Comparison between the two converters is represented based on output voltage and speed of bldc motor obtained for the same and constant input. Due to absence of brushes to commutate bldc motor electronically voltage source inverter(VSI) is used. Simulation of the both BOOST controlled bldc motor and SEPIC controlled motor is presented separately. The tool used for simulation is PSIM software.*
***Keywords:** Brushless dc motor, Boost Converter, SEPIC Converter, PSIM Software, VSI*

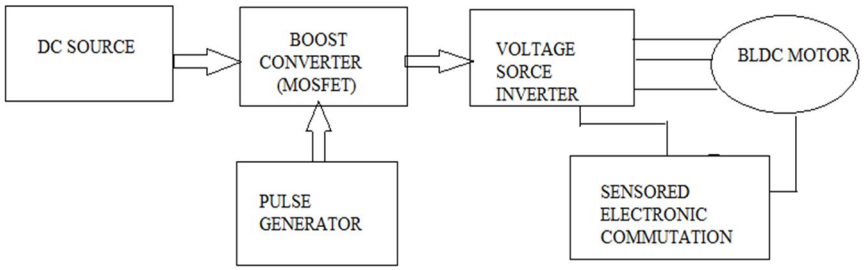
I. INTRODUCTION

Motor is an electromechanical machine which converts electrical energy to mechanical energy. The brushless motor usage is increasing now days in variable speed applications, position controlling applications, constant speed etc..Bldc motor are found more advantageous over conventional brushed dc motors, dc motor due to absence of brushes ,wide and higher speed range, longer operating life ,less noise production, improved speed-torque characteristics, high reliability ,improved efficiency. BLDC motor consists of stator and rotor. Stator consists of coil windings and rotor is made of permanent magnets . To vary the speed it is necessary to know the position of rotor. The rotor position can be determined by sensor method and sensorless method. Sensored method involves hall sensors to detect rotor position. Sensorless method is based on the back emf generated by motor .The speed of motor is propotional to back emf. The electrical energy which is given as an input produces torque due to interaction of current carrying coils with the magnetic field. In the process of conversion, the electro-magnetic field (EMF) inside the conductors will be an alternating quantity. For a DC motor, supply will be DC type but the EMF should be AC type. This is done by solid electronic swithes. Fot this pupose three phase voltage source inverter is used.

The dc-dc converters are mainly classified into isolated and non-isolated type. Isolated converters require transformer which makes circuit more complex for implementation. Non-isolated converters are more a advantageous compared to the isolated converters due to less cost, less size, higher power density ,more efficient for higher rating and controlling is easier. Hence in this paper non-isolated Boost and SEPIC converter is proposed for speed control of brushless dc motor.

II. BLOCK DAIGRAM OF PROPOSED SYSTEM

The block diagram as shown in Fig 1 consists of dc source, boost converter ,voltage source inverter and three phase bldc motor. DC Source is used to supply voltage to the boost converter. Boost converter is used for step operationand by varying the duty cycle of MOSFET switch the variation in the speed of bldc motor is obtained.



Figur. **Error! Use the Home tab to apply 0 to the text that you want to appear here.**.1 boost converter bldc motor

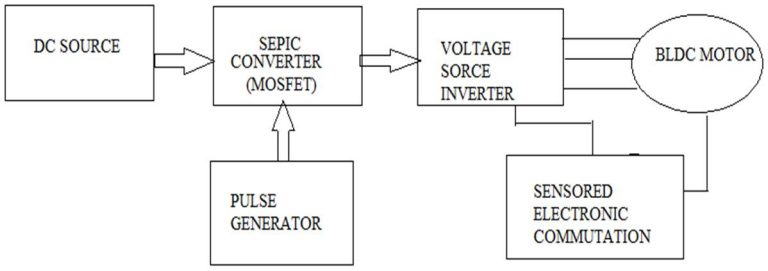


Figure **Error! Use the Home tab to apply 0 to the text that you want to appear here.**.2 SEPIC converter bldc motor

III. BOOST CONVERTER

Boost converter is switching converter that operates by periodically opening and closing an electronic switch. It is called a boost converter because the output voltage is larger than the input. The circuit diagram is shown in Fig 3.It consists of inductor (L), capacitor(C), switch, diode(D) and load.

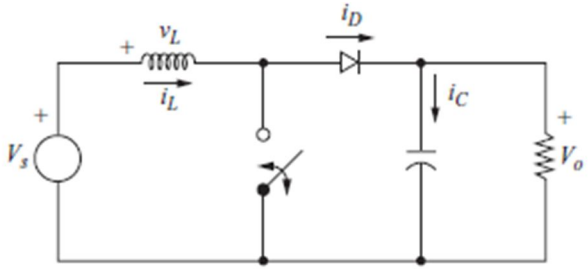
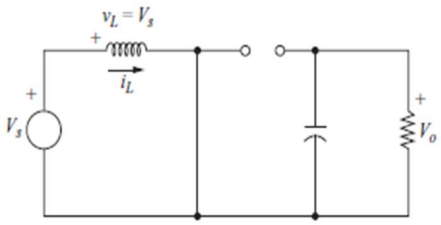


Fig 3.Circuit Diagram

When the switch is closed, the diode is reverse biased, The rate of change of current is a constant, so the current increases linearly and circuit diagram is shown in Fig 3.1. When the switch is opened, the inductor current
cannot change instantaneously, so the diode becomes forward-biased to provide a path for inductor current as shown in Fig 3.2



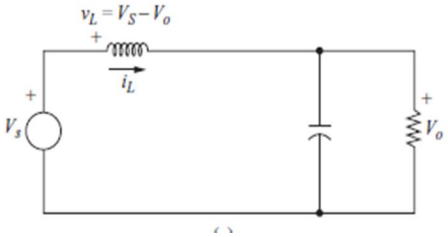


Figure 3.1 when switch is closed

Fig 3.2 when switch is open

IV. SEPIC CONVERTER

A converter similar to the Cuk is the single-ended primary inductance converter (SEPIC), as shown in Fig 4.. The SEPIC can produce an output voltage that is either greater or less than the input but with no polarity reversal.

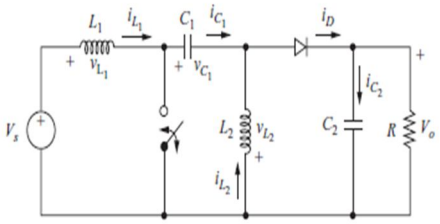


Fig 4.Circuit Diagram

When the switch is closed, the diode is off, and the circuit is as shown in Fig.4.1.The voltage across inductor L_1 is equal to supply voltage. . Capacitor C1 charges inductor L2 through switch S1 and thus it discharges. The current through the switch is iL1 + iC1 and capacitor C2 discharges through load R. With switch S1 in open position, the diode D1 is forward biased the circuit is as shown in Fig4.2. Source Vs and inductor L1 charges capacitors C1 and C2 and supplies the load. Inductor L2 charges capacitor C2 and supplies the load

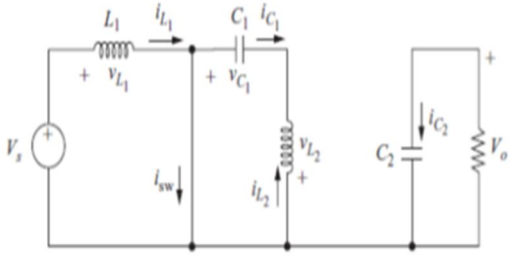


Fig 4.1 when switch is closed

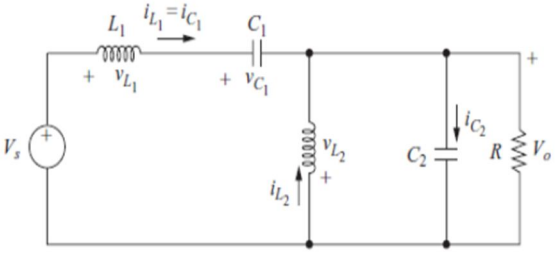


Figure 4.2 when switch is open

V. SIMULATION OF PROPSED SYSTEM

The specification of designed system are represented in table 1.

SL.NO	Parameter	Specification
1	Input voltage	12V
2	Output voltage	30V
3	Output current	06A
5	Frequency	25Khz

The simulation circuit diagram of boost converter bldc motor is shown in Fig 4.And circuit diagram of SEPIC converter bldc motor is shown in Fig 5..

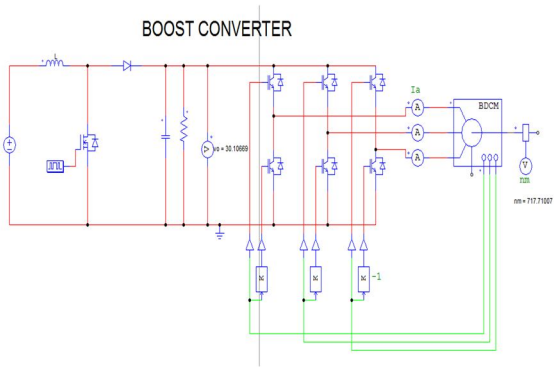


Fig 4. Boost Converter controlled bldc motor circuit

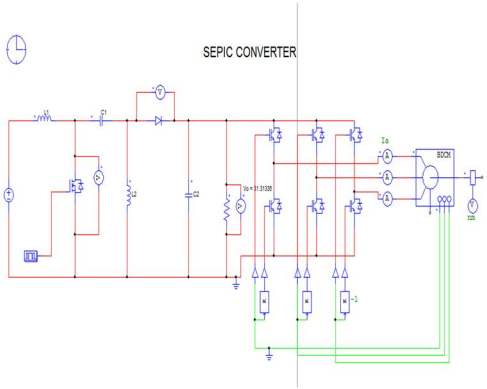


Fig 5.SEPIC Converter controlled bldc motor circut

VI. SIMULATION RESULTS

By the variation of duty cycle of the switch corresponding output voltage and speed of bldc moor is varied keeping the input voltage constant. By this method of the bldc motor can be varied . The obtained results are tabulated in Table 2 and Table 3.

Table 2. Performance Of Boost Converter Bldc Motor

Duty Cycle(%)	Output Voltage (V)	Speed (RPM)
60	30	718
62	31	738
64	31.7	760
66	32.6	783
68	33.7	810

Table 3. Performance of SEPIC Converter Bldc Motor

Duty Cycle(%)	Output Voltage (V)	Speed (RPM)
60	22.8	556
62	23.9	579
64	24.8	590
66	26	624
68	28	659

The output speed waveform of boost converter are shown in Fig 6.

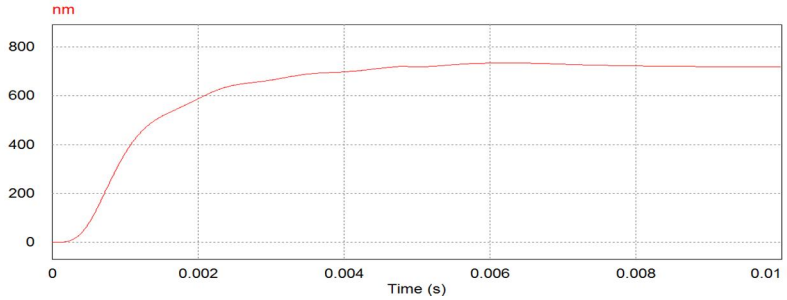


Fig 6.Speed waveform of Boost Converter based Bldc motor

The output speed waveform of boost converter are shown in Fig 7.

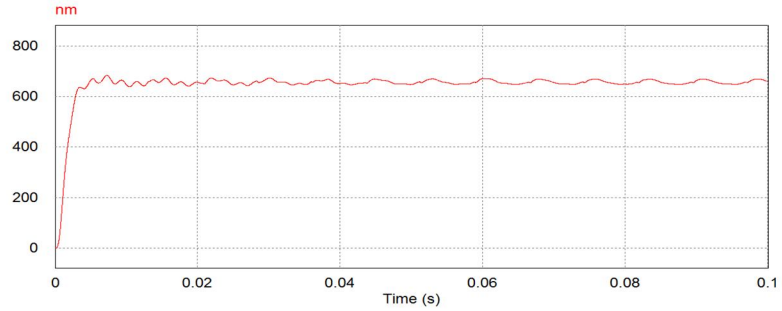


Fig 7.Speed waveform of Boost Converter based Bldc motor

Hence for the same input voltage and same duty cycle the BOOST converter produce higher voltage and higher speed range than SEPIC converter bldc motor.

VII. CONCLUSION

In this paper comparison between boost converter fed bldc motor and SPIC converter fed bldc motor is explained in terms of their output voltage and speed of motor. The circuit analysis of boost and sepic converters is discussed .Simulation of both converters are presented with their parameters and speed characteristics is represented.From simulation study it is clear that for the same input voltage and same duty cycle the BOOST converter produce higher voltage and higher speed range than SEPIC converter bldc motor

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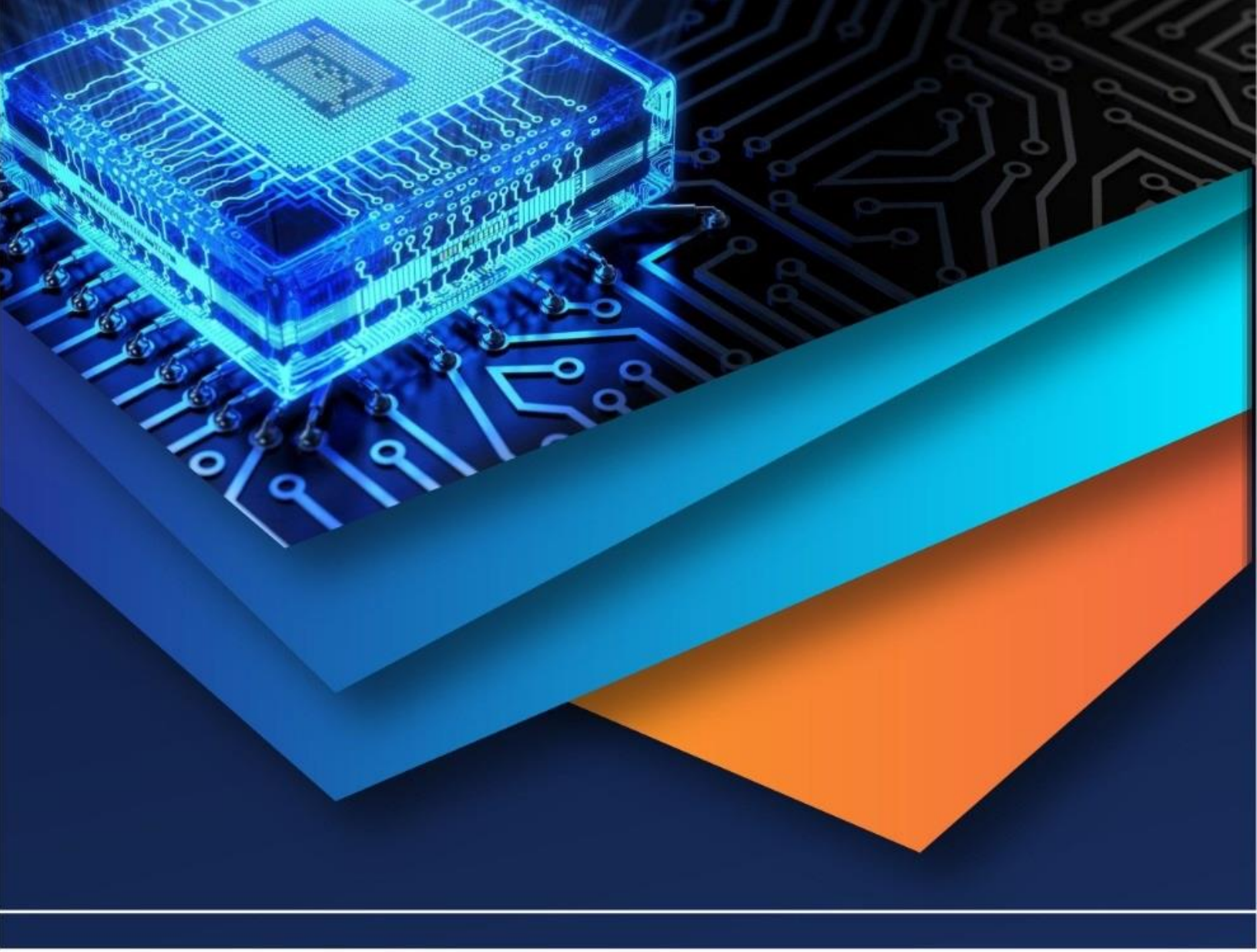

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