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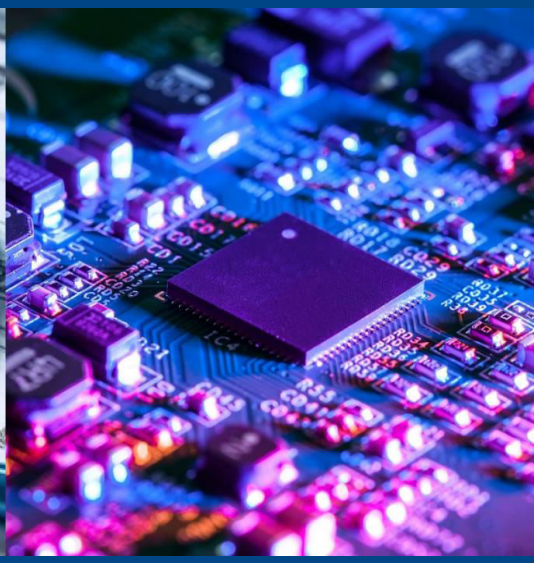

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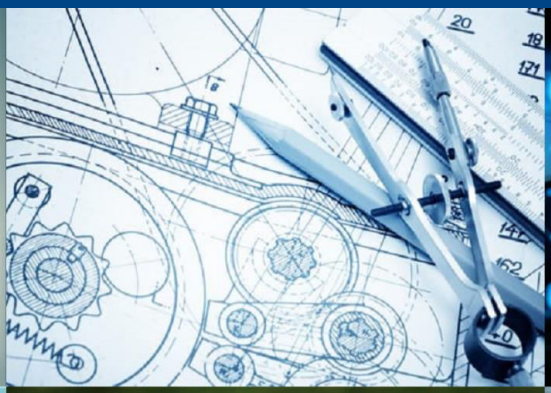

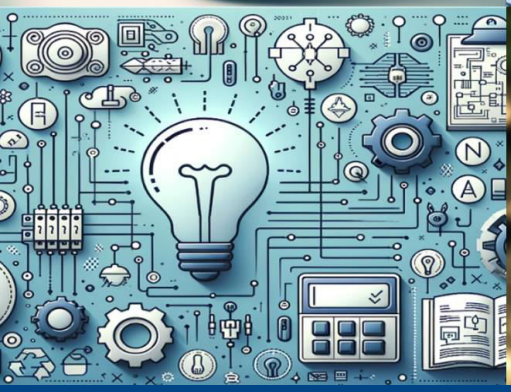

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Solar Fed Brushless DC Motor for Water Pump Applications using MATLAB –A Review

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ABSTRACT: This project present review on BLDC motor driven solar water pumping system which cost effective & economical for propose drive.Various DC DC Topology of convertor explain tis Paper .A zeta convertor is employed in order to extract the maximum power from the SPV array. The proposed MPPT algorithm reduces the starting current of BLDC motor in order to achieve soft starting of BLDC motor. The switching of invertor is achieve by commutation of BLDC motor, thereby eliminating switching losses in invertor .The proposed system is design and modelled such that the performance isn't affect under dynamic condition. The performance under various operating condition is analysed & suitability of proposed system is demonstrated using MATLAB/Simulink software

KEYWORDS: DC-DC Converter, Photo-voltaic , Brushless DC motor, MATLAB

I. INTRODUCTION

Severe problem related to environmental protection regulations, shortage of fossil fuels and eternal energy from the sun have motivated the researchers towards the solar photovoltaic (SPV) array generated electrical power for various applications . Although the several researches have been carried out in the area of SPV array fed BLDC Motor drives, combining various DC-DC converters and motor drives, the zeta converter in conjunction with the brushless DC (BLDC) motor is still useful to develop such kind of system. However, the zeta converter has been used in some other SPV based applications . The merits both the BLDC motor and DC-DC convertor essential to make such a kind of system satisfactory .The BLDC motor has high reliability ,high efficiency, high torque/inertia ratio, improved cooling, low radio frequency interference and noise and require practically no maintenance . On the other hand, a zeta converter exhibits following advantages over the conventional buck, boost, buck-boost converter and Cuk converter when employed in SPV based applications.by using zeta convertor we can eliminate following problem:

The zeta converter can be operated either to increase or to decrease the output voltage. so it can be used as a MPPT. the zeta convertor provide soft starting of BLDC motor as compare to buck boost convertor it cannot provide soft starting.in short zeta convertor reduce the starting current of motor. Unlike a simple buck-boost converter, the zeta converter has a continuous output current. The output inductor makes the current continuous and ripple free. However, a small ripple filter may be required at the input to smoothen the input current. The advantages of the zeta converter mentioned above are suitable for the proposed SPV array smooth torque and speed controlling of BLDC Motor. An incremental conductance (INC) MPPT algorithm is used to operate the zeta converter such that the SPV array always operates at its MPP and the BLDC motor experience a reduced current at the starting. The SPV array is designed such that the proposed system always exhibits satisfactory performance regardless of the solar irradiance level or its variation. This electronically commutated BLDC motor is supplied by a voltage source inverter (VSI) which is operated by fundamental frequency switching resulting in low switching losses. Suitability of the proposed system subjected to various operating and environmental conditions is demonstrated by satisfactory simulated results using MATLAB/Simulink environment.

II. LITERATURE SURVEY

[1]**_Rajan kumar, Bhim sing-** In this paper, the SPV array zeta converter fed VSI-BLDC motor pump for water pumping has been given. The zeta converter is operating in a continuous conduction mode for n order to achieve soft starting of BLDC motor, also it extract max power from SPV arry, reduce switching losses, reduce stresses etc. Also, it gives that, BLDC motor is best choice for solar water pump application.

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[2]_**Huiying Zheng, Shuhui Li-** This paper investigate and compares maximum power tracking techniques and typical algorithm and mainly focus on how the sampling rate, digital filter, time delay affect the maximum power point tracking approaches in a digital control environment and how different MPPT techniques are used for tracking maximum power under variable atmospheric condition.

[3]_**B Devi Arthi-** This paper shows the solar SPV array fed BLDC motor driven water pumping system in which Luo converter s used in order to extract the maximum power available from the SPV array and for safe starting of BLDC motor. Here SPV array is design such that the power at rated DC voltage is supplied to the BLDC motor-pump and maximum utilization of luo converter is achieve which result in improving efficiency of converter

.

[4]_**Bhim Sing, Fellow IEEE and Vashist Bist- using** In this paper the zeta converter is fed BLDC motor for fan application in which, the zeta converter operated in PFC mode in order to maintain power factor at AC mains and controlling the speed of BLDC motor. The speed controlling is achieve by controlling the voltage of DC link capacitor which is laying between VSI and zeta converter. So by single sensor here, zeta converter is best choice for PFC and speed controlling of BLDC motor for fan application.

Objectives

Main objective of project to design Solar PV Stand-Alone Water Pumping System Employing BLDC Motor Drive

1. Design photovoltaic system
2. Design MPPT using zeta converter.
3. To reduce starting current and soft starting of BLDC motor.

To compare the performance of zeta converter with other type of DC-DC convertor

WORKING

The SPV array generates the electrical power demanded by BLDC motor drive . This electrical power is fed to the motor system via the zeta converter and the VSI. SPV array appears as the power source for the zeta converter as shown in Fig. Ideally, the same amount of power is transferred at the output of zeta converter which appears as the input source for the VSI. In practice, due to the various losses associated with a DC-DC converter [11], slightly less amount of the power is transferred to feed the VSI. The pulse generator generates, through INC-MPPT algorithm, the switching pulse for the IGBT (Insulated Gate Bipolar Transistor) switch of the zeta converter. The INC-MPPT algorithm takes the voltage and current variables as feedback from SPV array and returns an optimum value of duty cycle. Further, the pulse generator generates actual switching pulse by comparing the duty cycle with the high frequency carrier wave. In this way, the maximum power extraction and hence the efficiency optimization of the SPV array is accomplished. On the other hand, VSI converting the DC power output from the zeta converter into the AC power feeds the BLDC motor to drive. The VSI is operated by the fundamental frequency switching availed by the so called electronic commutation of BLDC motor assisted by its built-in encoder. The high frequency switching losses are thereby eliminated, contributing in the effective and increased efficiency operation of the proposed water pumping system.

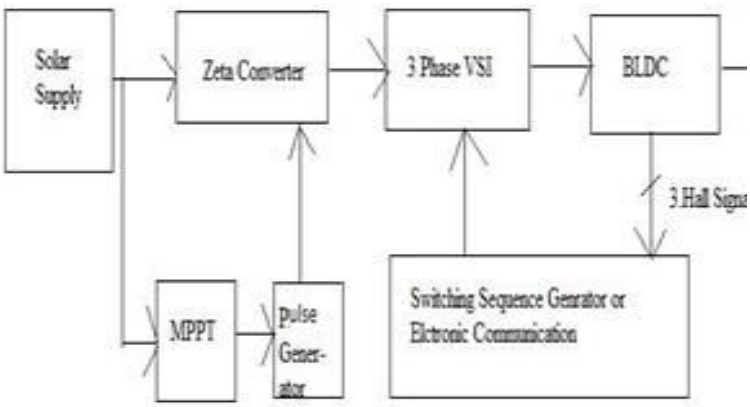

Fig- 1 Block diagram of proposed system

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1. Study of solar PV array system
2. Selecting converter for increasing proper power level as per requirement.
3. Selecting proper MPPT algorithm for operating it in maximum power.
4. Reduce the starting current of motor.
5. Simulation is done in MATLAB Simulink software
6. Completion and study of result.

III. DEFFERENT TYPES DC-DC CONVERTER

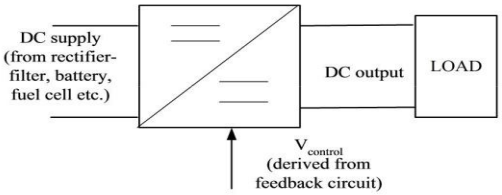

Fig. 2 Block Diagram of DC-DC Converter

A DC-DC converter is static device (switch) used to obtain variable dc voltage from a source of a constant dc voltage. DC-DC converters for switch-mode dc power supplies and dc-Motor drives. Average output dc voltage must be controlled to equal a desired level. Utilizes one or more switches to transform dc from one level to another. The average output voltage is controlled by controlling the switch on and off durations. There are three basic types of dc-dc converter circuits, termed as buck, boost and buck-boost, cuk, zeta. In all of these circuits, a power device is used as a switch. This device earlier used was a MOSFET, which is turned on by a pulse fed at its gate. The basic convertors needed single inductor. CUK,SEPIC,ZETA convertor needed two inductor for designing. The gain of different convertor is given in table 1

Table 1 DC-DC Convertor With Their Respective Gain

Sr. No	Name of Convertor	Gain
1	Buck	D
2	Boost	1/(1-D)
3	Buck-Boost	D/(1-D)
4	Cuk	-D/(1-D)
5	Zeta	D/(1-D)

1. Buck Converter

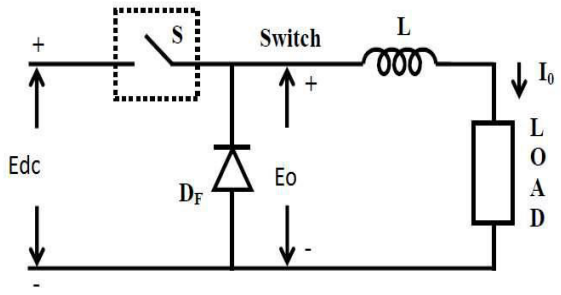

Fig.3. Buck Converter

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In which buck converter during on period when switch is ON, the supply terminals are connected to the load terminals. During the period 'Toff'', when the switch is OFF, load current flows through the freewheeling diode DF. So load terminals are short circuited by DF and load voltage therefore zero during Toff. In this way a chopped DC voltage is produced the load terminal.

The average load voltage Eo is given by,

b. Boost Converter

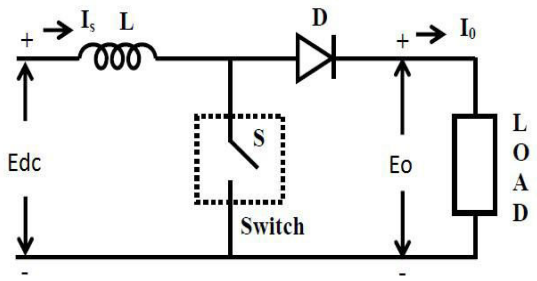

Fig.4 Boost Converter

In which boost converter when the switch is ON , the inductor L is connected to the supply Edc, and inductor stores energy during on period, Ton. When the switch is Off ,the inductor current is forced to flow through the diode and load for a period Toff. As the current tends to decreases, polarity of the emf induced L is reversed to that shown in fig. The result voltage across the load Eo becomes,

c. Buck-Boost Converter

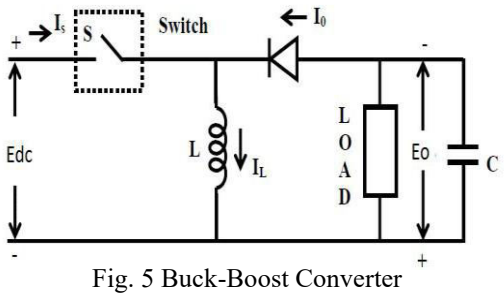

Fig. 5 Buck-Boost Converter

A buck-boost converter (dc-dc) is shown in fig.5 Only a switch is shown, for which a device belonging to transistor family is generally used. Also, a diode is used in series with the load. The connection of the diode may be noted, as compared with its connection in a boost converter. The inductor, L is connected in parallel after the switch and before the diode. The load is of the same type as given earlier. A capacitor, C is connected in parallel with the load. The polarity of the output voltage is opposite to that of input voltage here. When the switch, S is put ON, supply current flows through the path Edc+S-L-Edc.

Hence inductor L stores energy during the Ton period. When the switch is off the inductor current tends to decrease and as a result the polarity of the emf induced in L is reversed. as shown in fig.Thus the inductance energy discharges in the load through the pathL+-load –D-L.

d. Zeta Converter

The zeta converter is a fourth order DC-DC converter operating in both continuous and discontinuous current conduction mode performs a non-inverting buck-boost function. The circuit diagram for the zeta converter is shown is figure 6

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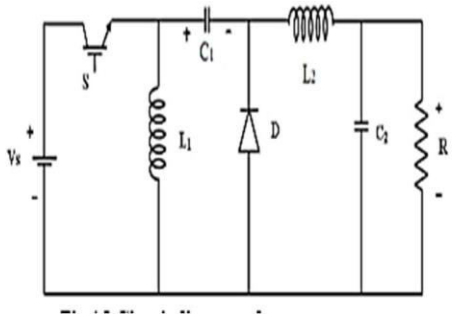

Fig 6.Circuit diagram of zeta converter

The zeta converter is suitable to be employed as a PFC stage and output voltage regulator in the proposed topology. This converter is attractive because it operates as a voltage step-down or step-up stage, depending on the imposed duty cycle. Another advantage is that the output voltage has the same polarity as the input voltage, thus simplifying control and protection circuitries. The fly back PFC topology may also be considered as an alternative to feed the half-bridge inverter. One of the features of this topology is the insulation between input and output. However, when applied to the integration technique, the fly back topology intrinsic insulation no longer takes place. In this way, the fly back topology resembles to the buck–boost topology where leakage inductances and core size are reduced.

The non inversion of the output voltage and the possibility of input filter elimination are some features that lead to the use of zeta converter in PFC instead of buck–boost PFC topology. In addition, if the input inductance used in the zeta (L1) is high, the line current will present inherently low ripple, thus requiring small EMI filter components that, in some cases, may be eliminated. This reduces the number of stages, increases efficiency, and decreases cost. The zeta can be operated in Continuous Conduction Mode (CCM) and/or Discontinuous Conduction Mode (DCM). In this way, the zeta operating in the CCM with constant duty cycle and switching frequency behaves as a resistance to the ac line, thus assuring high-input PF.Zeta converter exhibits two different modes as follows

Mode 1: When the switch is ON (closed)
Mode 2: When is the switch is OFF (open)

Mode 1: The first mode is obtained when the switch is ON (closed) and instantaneously, the diode D is OFF. A equivalent circuit shown in figure 3.11.(a). During this period, the current through the inductor L1 and L2 are drawn from the voltage source Vs. This mode is the charging mode.

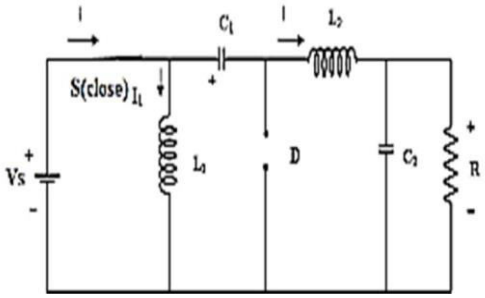

Fig.6 zeta convertor (mode 1)

Mode 2: The second mode of operation starts when the switch is OFF and the diode D is ON position, the equivalent circuit shown in fig.3.13(b). This stage or mode of operation is known as the discharging mode since all the energy stored in L2is now transferred to the load R.

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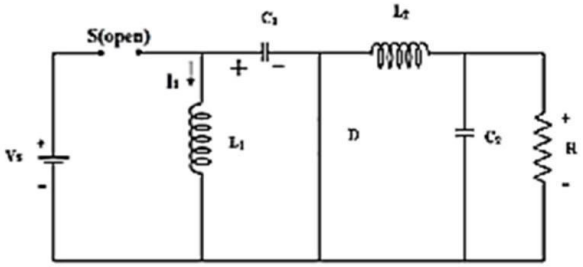

Fig 7. zeta convertor (mode 2)

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