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Comparative Study Of Pv Fed Various Converter Topologies Intruding Fuzzy Logic Control Technique

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Abstract: ***The role of converters play a vital role in improving power production in renewable energy resource. As per the above aspects, the processing of various converters withappropriate control topology will help to convert low magnitude into higher voltage voltage range us mandatory. In accordance with gaining of higher magnitude, differential converter topologies are handled in this proposed work.There are numerous converters avaliable in nature. But depending upon the voltage requirement the converters are chosen. So that the topologies handling in proposed topology are cuk, SEPIC, zeta, and landsman converter. To resolve switching stress a proper gate triggering portion is essential. Thus FUZZY logic control system is preferred due to its advantages like robust in nature, able to handle non-linearities,and able to work witofvague input voltage to attain finite output. To concern high voltage and satisfies load requirement the fuzzy controller is interfaced with above mentioned converter to examine which one is perfect with low switching stress and deducing harmonics is essential one in this analysis. The experimental analysis is carried out with low voltage range to determine the performance of individual converters are examined.***

Keywords:; Photo-Voltaic(PV); CUK Converter; Singe Ended Primary Inductor converter (SEPIC); Zeta converter; Landsman Converter;FUZZY Logic Controller.

1. INTRODUCTION

Few decades ago, the steam power production plays a major role in electricity generation. The steam power plant needs coal as raw material. To extract raw materials lots of cultivate lands are converted into coal mines. Finally, the coal from mines is fine powdered and settled in boilers. The ash may spread everywhere through air and pollute it. It causes breathing disorders who around steam power plant. Due to incremental population and industrial sector will tend to increase requirement of electricity. To fulfil requirements, other renewable energy resource becoming more popular. The renewable resources are solar, wind, hydro, tidal, geo-thermal, etc. Except solar energy, other resources are available in plenty. But there are some uncertainties in it. Since water is huge, but the construction of power plant needs more space to build a dam and it requires high capital cost. Further it promotes deforestation.

Wind power generation is avail to install in hill station. It is possible when the air flown is said to be high or else it does not produce electricity. Similarly, other resources also have some disadvantages like predecessor. But solar power generation needs less space and the cost for installation is low. Depending upon the load requirement, the solar cells are arranged. The solar cells are available to install in some place like home's roof top, vehicles and uncultivable lands. It won't affect farming. So that solar power generation becoming more popular. In some cases, the power production is said to be low due to shading and severe changes in climatic condition. To resolve these difficulties, a lossless power generating converter is essential. It assists to increase/decrease the voltage. In relation with necessity of load, the converter can perform either buck/boost mode. But the converter cannot perform those actions by self. The functioning of switches oriented with the gate pulse given to it. In general duty ratio ranges from 0 to 1. The switches need specified control logic to gain higher efficiency. Among differential control topology with variation in voltage section, FUZZY logic control is chosen. It having more number of fuzzy sets to a generate gate pulse by combining reference signal with the output obtained from converter output section. Through selective process alone the role of converter is chosen. In orientation with need the converter topology is selected. In proposed topology, the selective process is done with cuk, SEPIC, zeta, landsman converter topologies.

The overall power production in modern civilization depending moreover with solar energy. It is eco-friendly and available in plenty. By intruding control topology in every converter to examine its efficiency under constant input voltage range is performed by designing a Simulink blocks using MATLAB software is presented in proposed method.

In section II, overview of PV fed cuk, SEPIC, zeta, and landsman converter performance and its operation are clarified. Also, this examines the efficiency of converters individually by comparative study. The section III defines circuit configuration and its modes of operation with the help of waveform. The fuzzy logic controller is explained with functions involved in it and it is denoted in IV. The experimental results are oriented with the load in V. Further the efficiency and the following regards to identify which one is efficient in VI.

2. LITERATURE SURVEY

Rajan Kumar et.al, in [1] proposed PV fed cuk converter to improve efficiency of BLDC motor. By using incremental conductance method the maximum power has been attained from solar energy. Apart from maximum power point tracking (MPPT) mechanism, the requirement in output port to perform water pumping is compensated by the converter topology. The main advantage of proposed converter is to set low starting torque to attain high speed without any interruption. At bad weather condition, the system cannot have higher capability to bring more power to the load terminal. Depending upon that the size of motor and solar panel is designed.

Syam et.al, designed a combination of solar panel fed cuk converter with grid to ensure the quality of power in distribution system [2]. The problems such as irradiance, temperature, shading, etc are moreover eliminated by tuning the converter to operate with higher voltage

range. To maintain low ripple between source and load, a capacitor is attached with the circuit topology. The capacitor can store the voltage and it serves the load during switch on/off condition. Further the overall circuit performance is compared with boost converter topology to determine how much it responds well under severe climatic condition.

Rajan Kumar et.al, in paper [3] defined about water pumping of Brushless DC (BLDC) drive by intruding solar power generation as input power to the SEPIC converter. As same as in paper [1], the control topology would be incremental conductance method. The availability of converter to perform either buck/boost mode will make the circuit enrolled with PV can make it flexible to operate under any voltage condition.

Sowmya Sitha Raj et.al, suggested a fourth order dc-dc converter (i.e. zeta converter) for renewable energy resource in [4]. A simpler MPPT control logic known as hill climbing method is introduced in this to bring high rated power from the panel. After that the converter section will make more voltage and operates the load at affordable rate.

Rinu Alice Koshy et.al, in [5] selected P & O method to bring more power from solar panel in relation with zeta converter fed BLDC to satisfy the load requirement. By intruding low duty ratio, the high voltage gain is attained in converter output. This will reduce low switching stress and deduce ripple in input voltage supplied by solar panel.

Yamini Venkatesh et.al, design a PV fed three phase induction motor in [6] to satisfies the load requirement of 415V at voltage source inverter. In this, differential control topologies are handled; they are: SEPIC, zeta and landsman converter. Among these three converters an input of lower magnitude is driven towards it. Through that, how much amount of power is generated from converter section is noted and without any difference in input voltage and gate pulse at three different circuit combination.

Nandiwardhana et.al, in [7] concentrating power factor correction by giving a solution to problems in conventional method like harmonics and large ripple current. By combing ac source voltage, diode bridge rectifier with inverter won't correct uncertainties in power flow path. Due to this, selective converter is necessary. Then variety of converters namely cuk, SEPIC, zeta converters are chosen to improve power quality in addition with power factor correction. By adding capacitor at converter section, the voltage is purified. Through this study, which converter is suited for the need? has been studied in this.

C.H. Hussaian Basha et.al compared SEPIC, zeta and landsman converter's performance for PV dealt with P & O method to regulate the power flow at induction motor is presented in [8]. To attain soft starting torque, one among those three converters is selected though its output voltage.

3. OPERATION OF CONVERTER

This section describes about circuit configuration and operation of cuk, SEPIC, zeta, landsman converter in a simpler manner. The converter described in this paper, should have ability to do buck and boost functioning as depending upon the necessity.

Cuk converter:

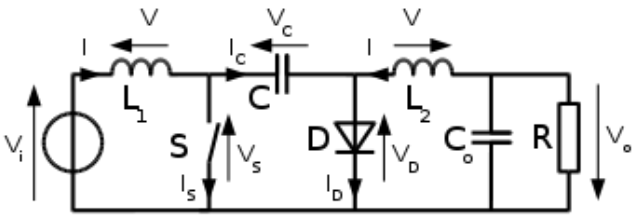


Fig.1.cuk converter

Mode1: In this mode S switched on; so that L_1, C_1 saves energy for a short duration. D do not conduct in this mode.

Mode 2: The converter cannot have supply voltage due to switch off condition. The stored energy is diverted to load terminal by diode in it. The resultant capacitor holds charge to keep power flow at load terminal during next mode.

Sepic converter:

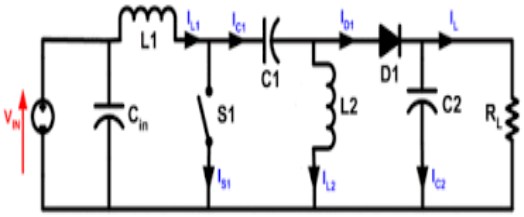


Fig.2.sepic converter

Mode 1: Likewise, cuk converter, the following converters also keeps same switching action. The voltage in keeps changing at L_1, C_1. Thus L_2 charges C_2.

Mode 2: The stored energy in L_2 by previous cycle is transferred towards C_2 and load.

Zeta converter:

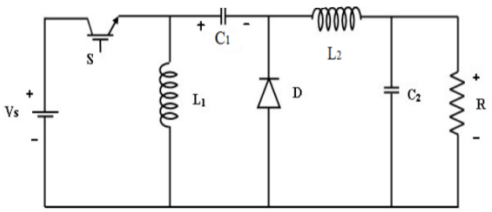


Fig.3.zeta converter

Mode 1: The input voltage is directed towards L_1, C_1 with low duty ratio. Regarding with load requirement the gate pulse is supplied by feedback the output from converter to controller algorithm. To stabilize the voltage, the converter is turned on and off.

Mode 2: Diode starts conducting and it helps to move charge from L_2 to C_2. Even supply voltage is off, it makes constant voltage.

Landsman converter:

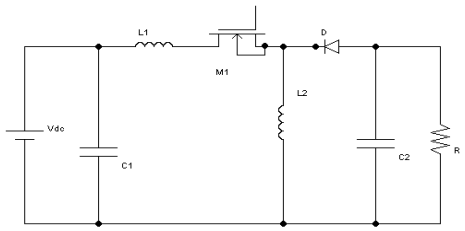


Fig.4.landsman converter

Mode1: V_{dc} is stored in C_1, L_1 and L_2 alone.

Mode2: C_2 possess desirable energy to maintain voltage at load side continuously. It is possible only when diode will conduct.

The following graph regards energy storage at inductor and capacitor, current flow through unidirectional device and bidirectional switches is demonstrated.

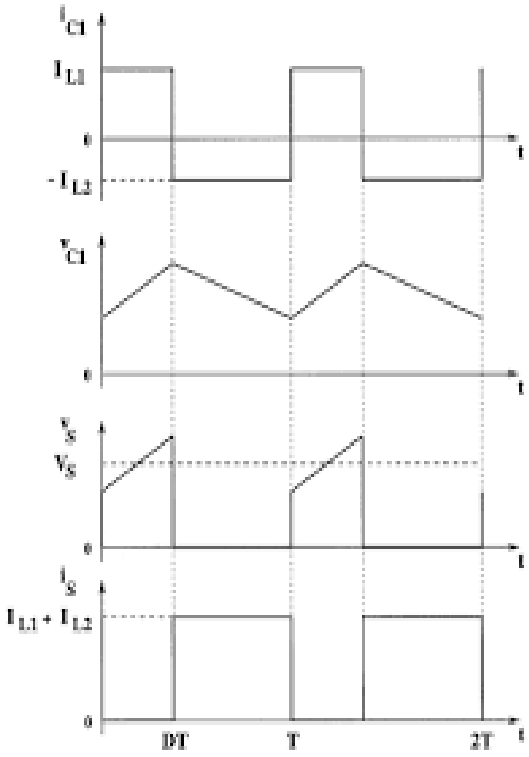


Fig.5. graph showing current flow in cuk converter

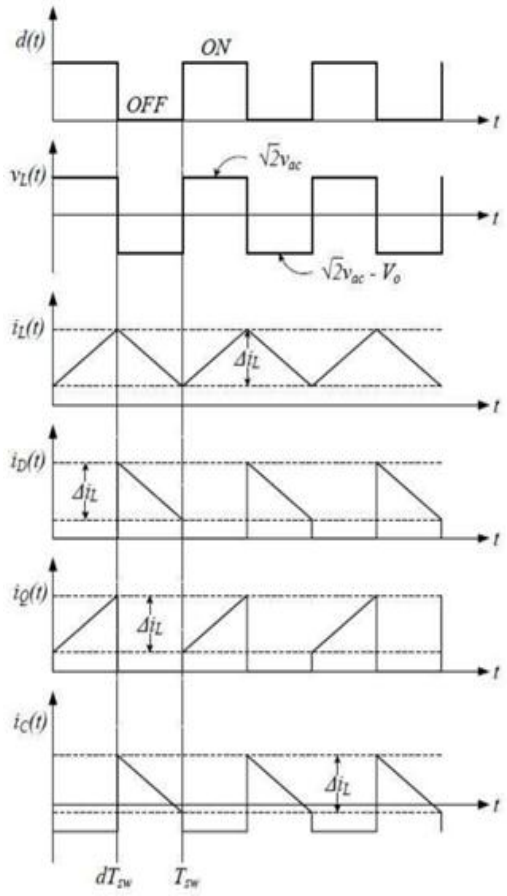


Fig.6. graph showing current flow in SEPIC converter

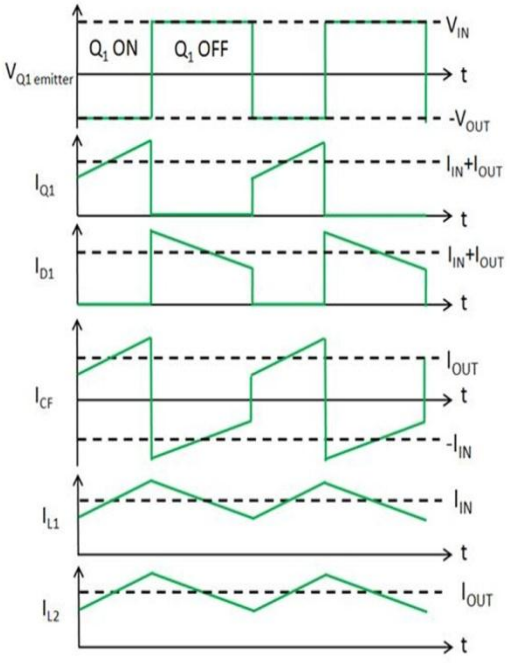


Fig.7. graph showing current flow in zeta converter

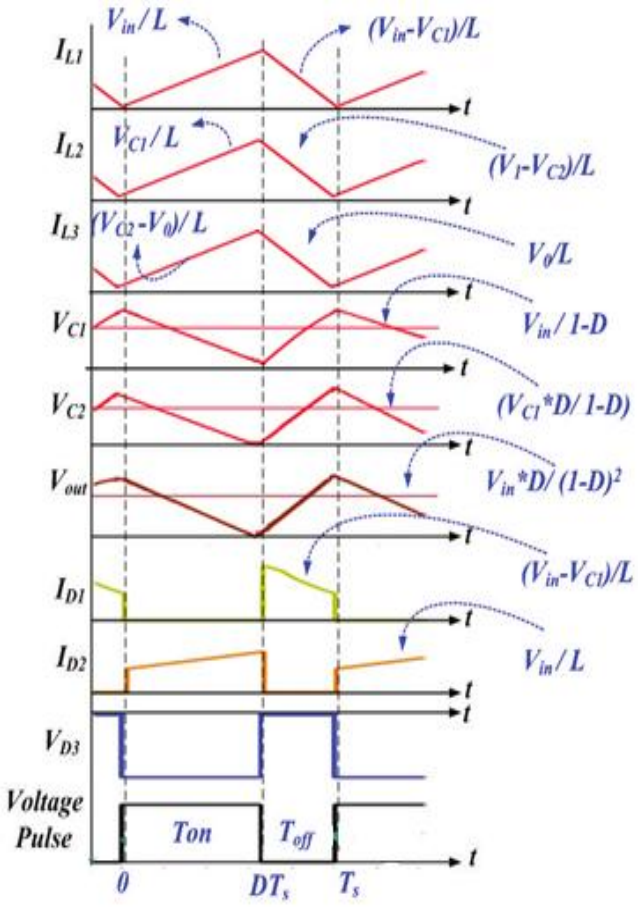
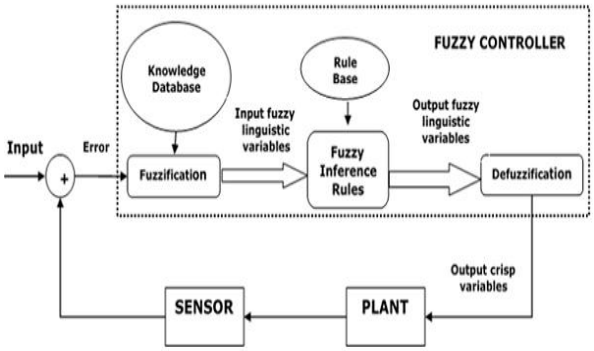


Fig.8. graph showing current flow in landsman converter

4. CONTROL LOGIC

The fuzzy logic controller follows if-else condition to controlling the gate pulse.



The fuzzifier generates fuzzy value by changing the input into fuzzy values. Fuzzy knowledge base keeps data of input-fuzzy values. It possesses membership function to get input as fuzzy rule base and output variable to plant under control. The operating elements are stored in fuzzy rule base. The inference engine analyse human decisions and perform functions as denoted by human. Finally, defuzzifier transmits fuzzy value as input value.

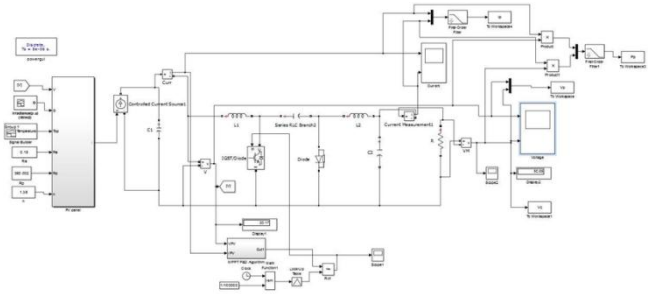
5. RESULT AND DISCUSSION

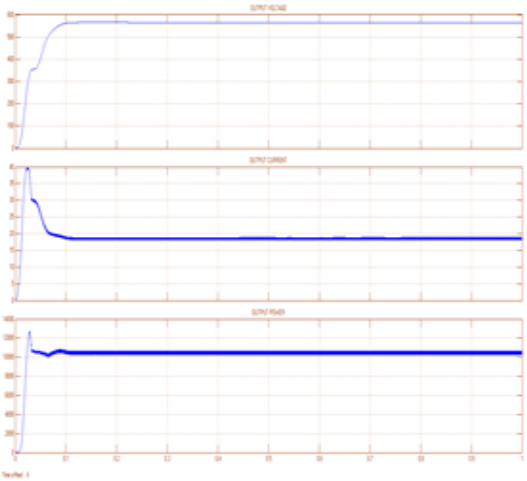
The experimental verification of different converters is analysed through MATLAB software in this section. The solar power generation could be possible only when sunlight will be more or else it could not respond well. The fuzzy logic algorithm enrolled within it should take care upon entire cycle. But output may vary within it regarding to converter action.

A constant input voltage is fed to the converter. The low duty ratio is given to individual converter and it won't affect the need. Because, various converter can create variable output voltage. Through analysis using MATLAB software the resultant waveform should evaluate difference in performance effectively. Thus 275 volt, 40 amps is supplied through solar power generating system.

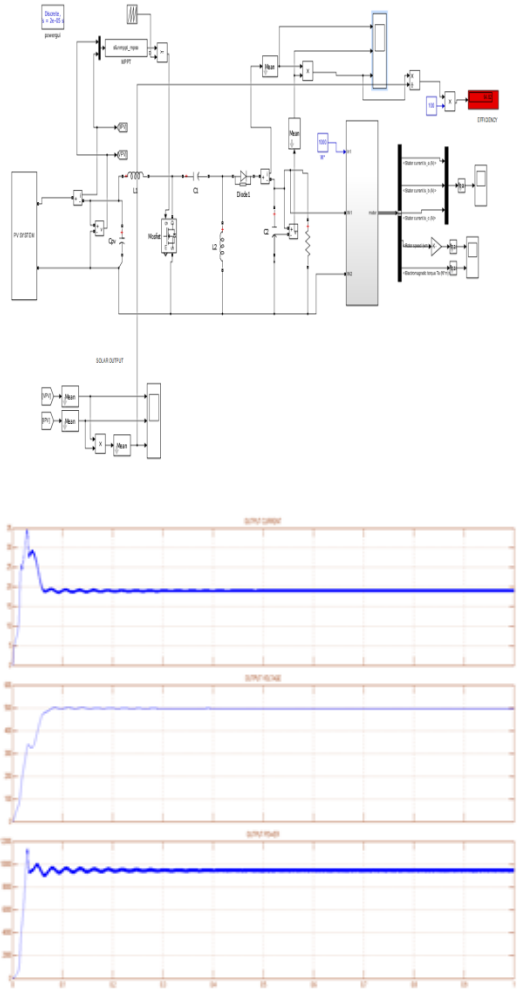
The following shows resultant waveform in the form of output voltage from the converter.

Cuk converter:

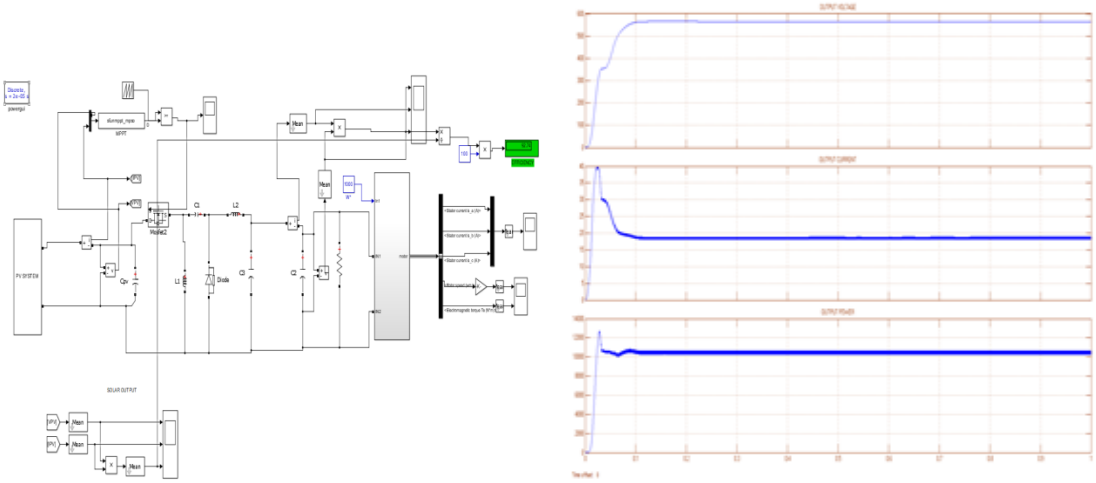




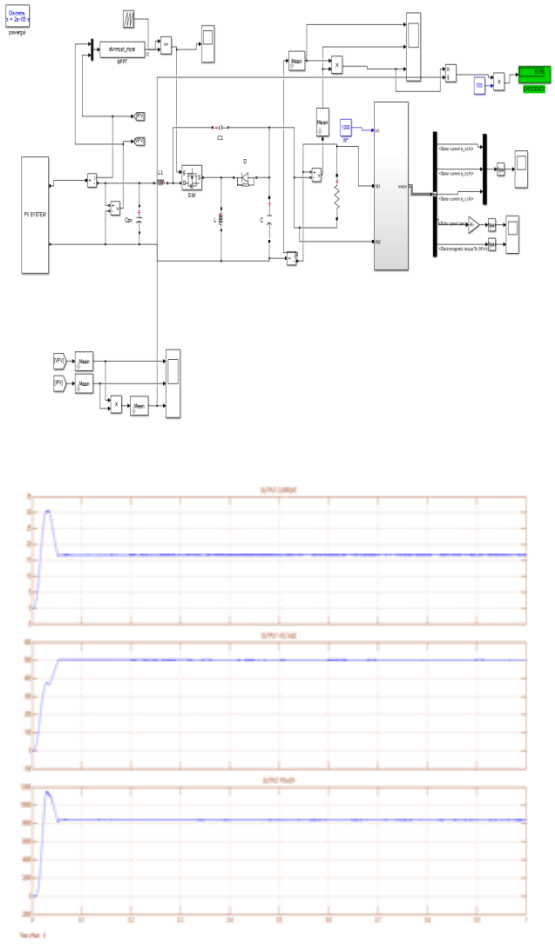
Sepic converter



Zeta converter



Landsman converter



A voltage of 550 volt, 19 amps is the higher magnitude noted in SEPIC converter. This will be the maximum efficiency attained with fuzzy logic algorithm.

6. CONCLUSION

From previous section, the efficiency of several converters are clearly defined through waveform and it describes input voltage to the motor and its efficiency. Through low input voltage, the converter can attain high voltage gain. As per the above aspects the SEPIC will be chosen as better choice because the output is said to be high and load needs low starting torque. By using if-else condition the switching action is also justified.

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