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Intelligent Control Technique Based Zeta Converter Fed PMDC Motor

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ABSTRACT*:* This paper deals with the implementation of fuzzy-PI based Zeta converter fed PMDC motor with high efficiency, less total harmonic distortion and good power factor adjustment. It involves simple control circuitry with less external components. Basic procedure of this converter is explained. Fuzzy-PI controller is used to control the gate pulse and to reduce the harmonics of proposed system. The Performance of Zeta converter is shows and reduce the harmonics. This proposed system is implemented by using MATLAB Simulink. This closed loop system of zeta converter has low THD value and better power factor . The proposed approach has more feature, containing easy implementation, stable merging characteristics and very good performances efficiency.

KEYWORDS: Zeta converter, Fuzzy logic control, Total harmonics destructions, Discontinuous mode operation **.**

I.INTRODUCTION

Now a DC-DC converter is widely used in modern electronic equipment and Drives. The single phase supply is passing through the universal bridge and providing constant input voltage to the converter, then the converter adapts it wide range of values depending on the conversion level. At less input voltage level, the converter voltage may drop below the supply voltage for continuously giving the load with constant voltages . Past year there are various research works trade with the direct voltage converters performances and their control. In a DC-DC converters several operations are required likes Buck, Boost, Cuk, Sepic and zeta converters[1, 4]. This research Zeta converter is discussed because of least attention. This converter is fourth order DC-DC converters that can be step-down or step-up the supply voltage. This converter made up of two capacitors and two inductors. He studied cuk converter circuit the performance of fuzzy Logic Controller based genetic algorithm to develop its performance . The input inductor can operates either Discontinuous conduction mode(DCM) or Continuous Conduction mode(CCM)[2]. In a discontinuous mode operation the input inductor is no longer a state variables in a given switching pulse is independent of previous switching pulses. This property of discontinuous mode supply circuit is known as Self correction of power factor values. This is a main advantage of continuous conduction mode, which multi loop control method is necessary. Two capacitors are used to balance the instantaneous power between the input and output supply[3,6]. This research ZETA converter circuit, the proposed work is trade with the design of the Fuzzy-PI Controller and to control the converter circuit output voltage and improve its output performance.

II. MODEL OF ZETA CONVERTER

In this section Zeta converter is assumed to operate in discontinuous mode operation. The switching period is divided into three sub-intervals and third interval of operation pulse is non-zero, not that either inductor current is discontinuous operation[7]. The three different time intervals are namely D_1 Ts, D_2Ts and D_3Ts with constant switching frequency. The input voltage, V_i applied to the power factor correction converter as given by equation (1).

$$V_i(t) = V_m \sin(\omega t) \quad (1)$$

Where V_m is maximum supply voltage, ω is the angular frequency. The output voltage V_{dc} of zeta converter which is buck-boost converter alignment in equation (2).

$$V_{dc} = \frac{D}{1-D} V_{in} \quad (2)$$

Where D means duty ratio of zeta converter. The duty ratio is given by

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$$D=\frac{V_{dc}}{V_{dc}+V_{in}} \quad (3)$$

For a duty cycle (D) less than 50%, the ZETA operates as a buck converter condition, and for duty cycle more than 50%, means to operates boost converter condition. As this converter involves high and low side switches, it can be applied for drivers developed for the synchronous buck converter[8,7]. Te below fig(1) represented zeta converter model.

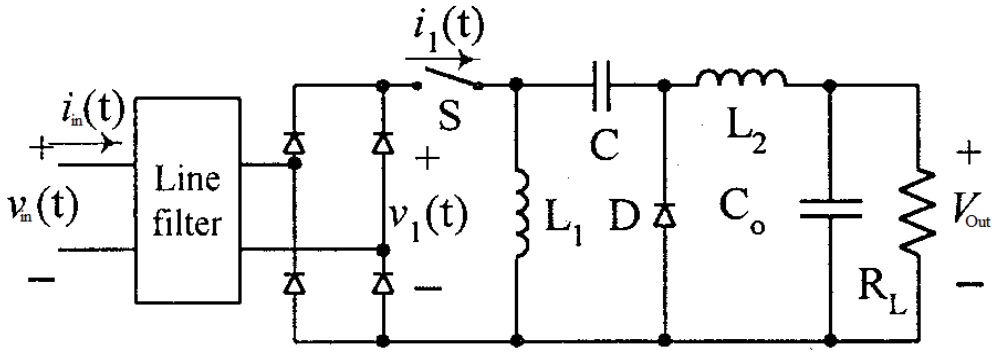

Fig 1 Zeta converter model

The ZETA converter is alternative option for regulating an unregulated input-power supply, like a low-cost barrier growth. To minimize board space, a coupled inductor can be used. The below figure(2) represented the input output voltage and current of Zeta converter.

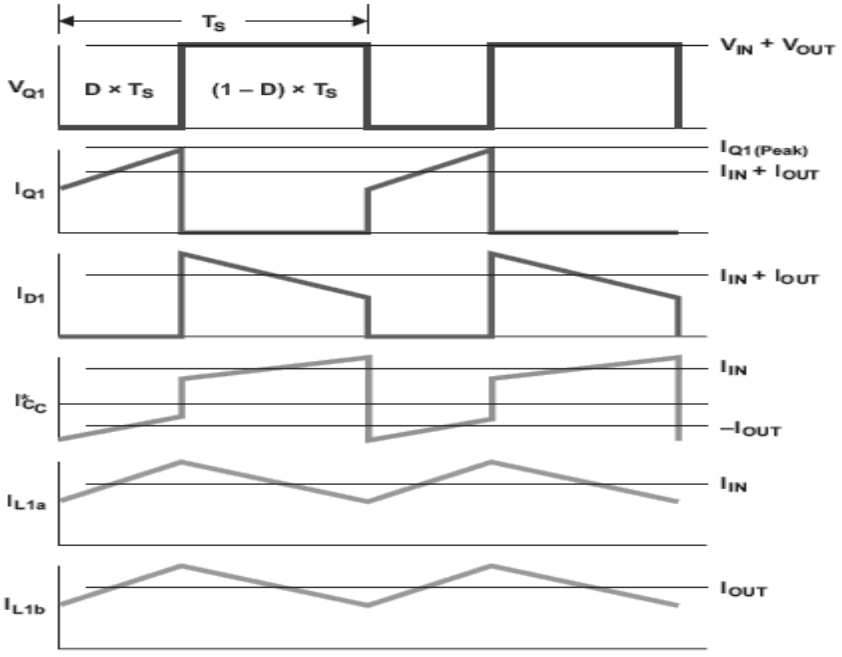

Fig 2 Wave form of Zeta converter

This type of converter is a fourth-order converter with many real and intricate poles and zeroes. Disparate the SEPIC converter, the ZETA converter does not have a right-half-plane zero and can be more easily compensated to accomplish a wider loop bandwidth and better load transient result with less output-capacitance values.

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III. DESIGN OF FUZZY LOGIC CONTROLLER

This controller is easy to understand, very simple, more stable without complexity, flexible and tolerant to inexact data. Fuzzy logic can be used to non-linear function of arbitrary complex function. It is based on natural system language. The output of fuzzy logic control(FLC) is a smooth control function despite a wide range of input variations. Since the FLC processes is user-defined rules leading the target control system, it can be altered easily to improve the system performance[5] . It does not limited to few feedback inputs and one or two control outputs, nor it is necessary to measure or compute rate-of-change parameters to be implemented. The rule-based operation, becomes complex if two inputs and one output is chosen for a single implementation since rules defining their interrelations must also be defined as : Error e(t) and change in error Δe(t) of the output voltage. The linguistic variables are defined as (NB,NM, NS, Z, PS, PM, PB)where NB means negative big, NM means negative medium, NS negative small, Z zero, PS positive small, PM positive medium, PB positive big. This model triangular membership functions of the fuzzy logic controller are considered. The fuzzy rules are shortened in Table 1. The sugino type of fuzzy inference engine is considered . The error range are taken between (-1 and 1) as shown in Figure 3, and also similar to range of error change are taken between(-1 and 1) as shown in Figure 4. The output member function is shown in fig 5.

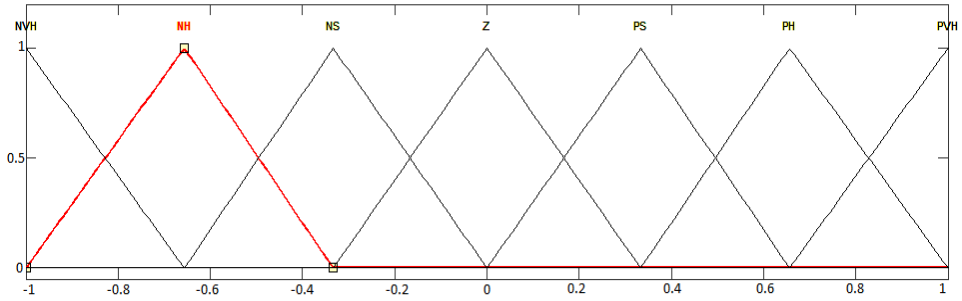

Fig 3. Input Error Membership function

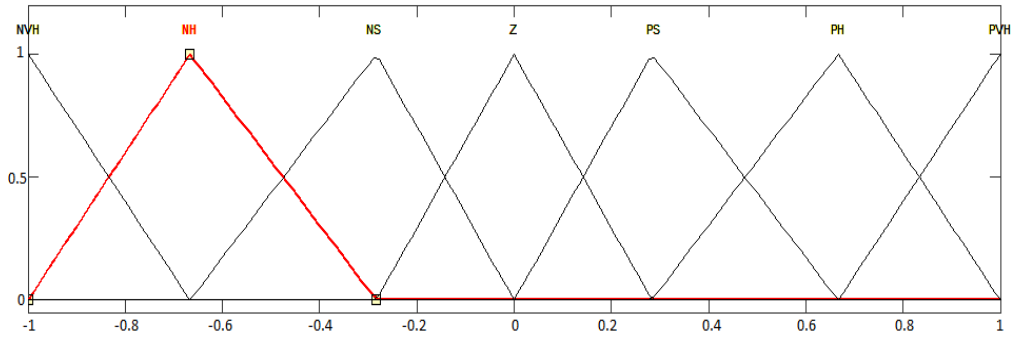

Fig 4. Change in Error Membership function

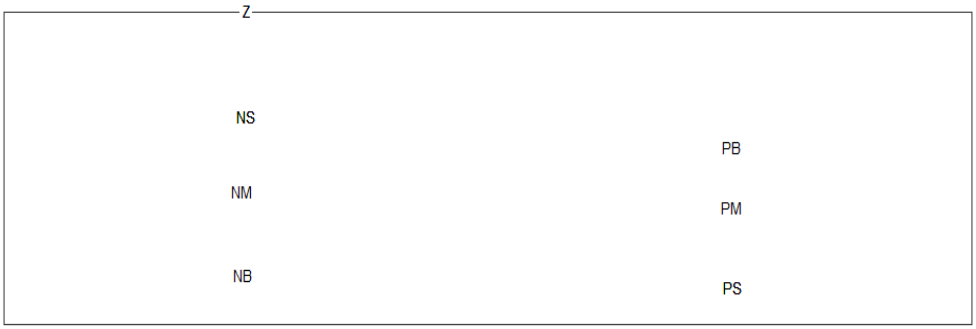

Fig 5. Output variable Membership function

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These variables are processed by an inference engine which executes 49(7x7) rules . There are two inputs which are used in FLC error *(E)* and change in error *(CE)* for linguistic variables and produce the control rules. Control variable (C) is applied to produce angular value (α) of the system, which determines output cycle. Finally, defuzzified output is obtained from the fuzzy inputs with the help of Waver method of de-fuzzification.

Table 1. If-Then Rule Base for FLC

U(T)		E(t)						
		NB	**NM**	**NS**	**Z**	**PS**	**PM**	**PB**
ΔE(t)	**NB**	NB	NB	NB	NB	NM	NS	Z
	NM	NB	NB	NB	NM	NS	Z	PS
	NS	NB	NB	NM	NS	Z	PS	PM
	Z	NB	NM	NS	Z	PS	PM	PB
	PS	NM	NS	Z	PS	PM	PB	PB
	PM	NS	Z	PS	PM	PB	PB	PB
	PB	Z	PS	PM	PB	PB	PB	PB

IV.SIMULATION MODEL AND RESULTS

The analysis of the simulations and testing of output using Fuzzy-PI controller yields a good result and reduce the total harmonics destructions(THD) finally the graph is plotted. The below figure(6) is represented the proposed model of Zeta converter.

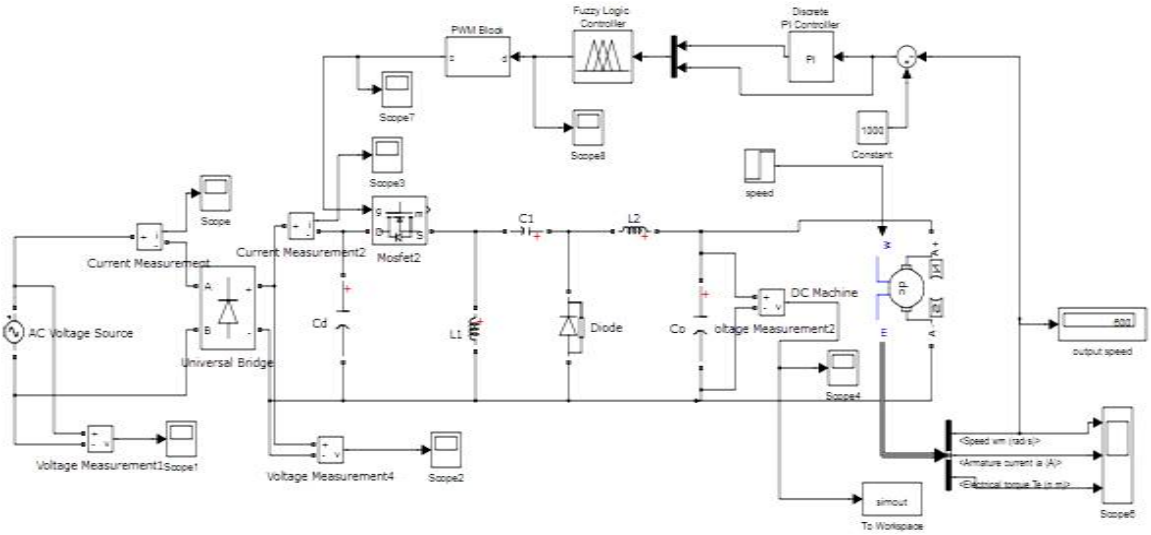

Fig 6. Simulink representation of Fuzzy-PI controller

Fuzzy-PI controller is the novel controller compared to other controllers like PI, PD and PID. The specialty of Fuzzy-PI controller with occurring time and system error is minimum, while in this research paper there is less operating time to control the speed on the PMDC motor by using Discontinuous mode of Zeta converter operations.

The below graph Fig 7 shows the calculation of input voltage with time plotted in sec in x axis and Input voltage in volt in y axis. In this graph the input voltage is 220 volt and maintained constant

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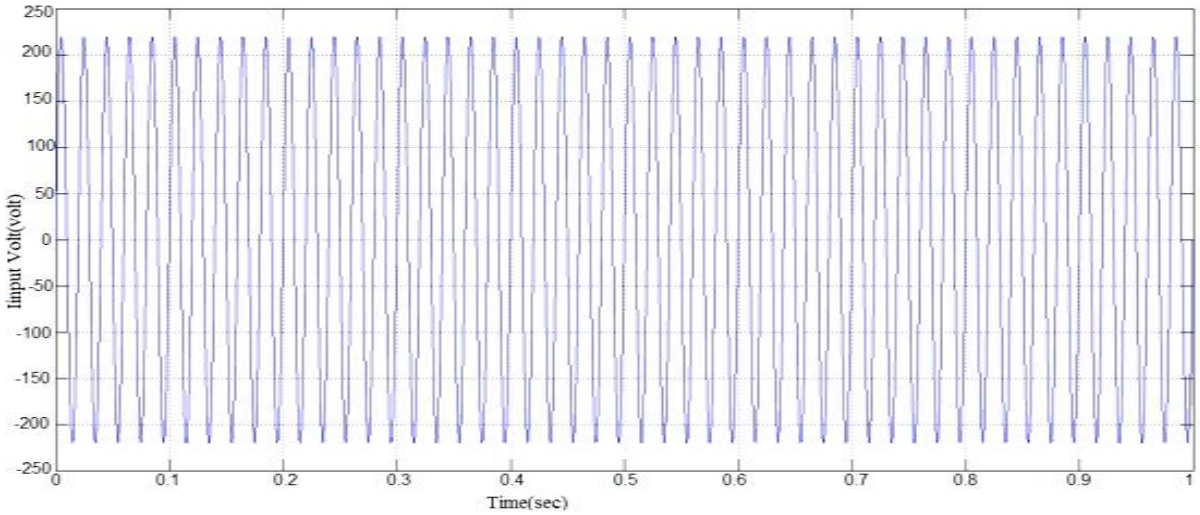

Fig 7. Input Voltage of Proposed System

The below graph Fig 8 shows the calculation of output voltage with time plotted in sec in x axis and output voltage in volt in y axis. In this graph the output voltage is initially high for 0 to 0.2 sec , after 0.2 sec the voltage is maintained constant 230 V.

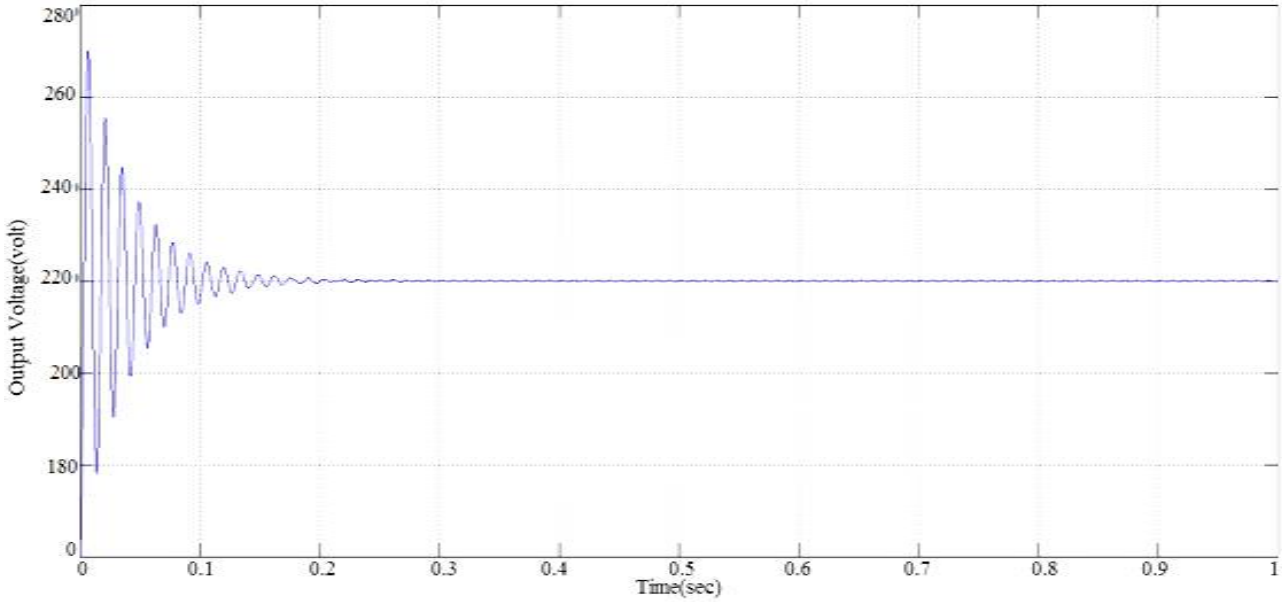

Fig 8. Output Voltage of Fuzzy-PI System

In a graph Fig 9 shows the performance of Fuzzy-PI based PMDC motor drive by calculating the Speed(ω_m), Armature current(I_a) and Electric torque(N-m) with time plotted in sec in x axis for all the parameters. In a y axis Speed(rpm), Armature current(A) and Electric torque(N-m). this graph the motor speed is constant 600 rpm and other two parameter is also constant.

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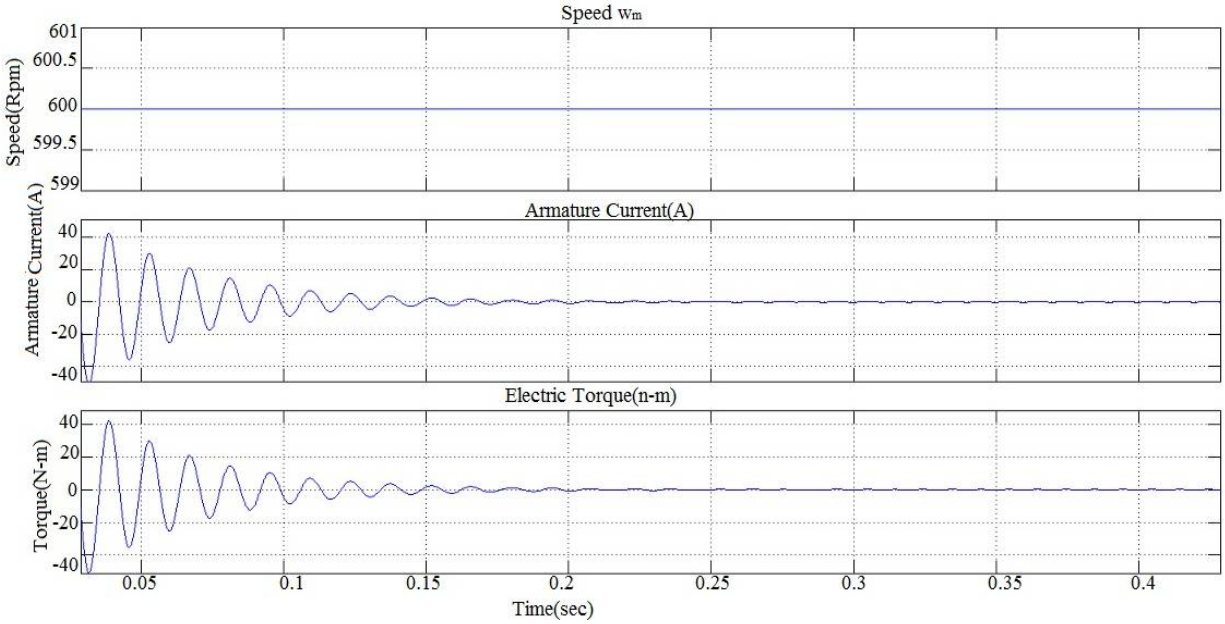

Fig 9. Output Parameters of PMDC motor using Fuzzy-PI technique

In a figure 10 represented the THD(Total harmonics distraction) value for Zeta converter output voltage by using FFT analysis method to find the THD of discontinuous mode of proposed system, this proposed system the voltage harmonics is 23.45% . The system is linear and nonlinear load condition the value of THD is reduced.

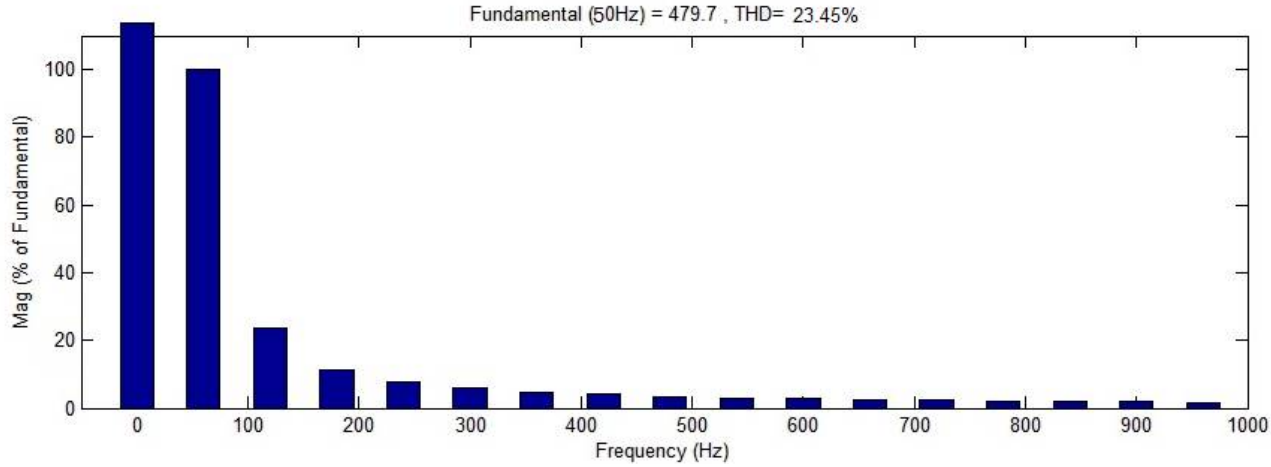

Fig 10. Total Harmonics of Zeta Converter

V.CONCLUSION

In this research paper discussion on Intelligent control technique based Zeta converter fed PMDC motor drive. The motor speed is controlled and reduced the harmonics by using intelligent techniques which were discussed. Initially the Zeta converter based PMDC motor is developed by using electrical drive systems, with which implement of F-PI technique. By using some other technique the total harmonics destructions is high in a artificial intelligent techniques based on fuzzy-PI was found to be better also by using simulink. For this reason the implemented of the artificial intelligence technique in the controller performance was used. So the proposed Fuzzy-PI controllers are the best controller compared to other controllers.

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