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Solar based Random PWM DC-DC Converter using Closed Loop Fuzzy Logic Control for Shunt Motor

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Abstract

This paper presents an solar based random PWM DC-DC Converter using Closed loop Fuzzy Logic Control for shunt motor. Solar panel is connected input side then full bridge converter, step up transformer, full wave converter; LC filter and shunt motor are connected. Fuzzy Logic Control is control the load side converter based on controlling signal motor runs at constant speed. The circuit with all the component parameters operates at zero-voltage switching which retains the high circuit efficiency. Speed, Torque of motor, Rise time, Peak time, Settling time and Steady state error are measured by experimental. Analysis of solar based Random PWM closed loop DC-DC Converter using PID and Fuzzy Logic Control for shunt motor are also done. A circuit operation and simulation designed for a 220v dc output and speed of the motor is 1000 RPM are arrived and tested.

Keywords— Solar, Random PWM,Converter, Fuzzy logic control, Shunt motor.

I. Introduction

Single – stage power factor correction (SSPFC) converter is applicable for only a low power application because of ripples present in voltage, less value of capacitor, hard circuits, more voltage variation and voltage stresses. Main disadvantage of (SSPFC) converter is more circulating currents are flowing due to that getting less efficiency as well as not suitable for high power applications. Single-stage three-level DC/DC converters and resonant converter is use but more voltage stress is present getting low efficiency only. Three-level resonant converter is use, less no of switches only there as phase-shift control technique in that variable frequency control method is use. Advantage of converter is more power density and input power factor less amount of voltage stresses, more efficiency no need extra like resonant capacitor and less conduction losses is present. The additional circuit is control the output voltage [1].Converter circuit at zero voltage switching time using phase-shift control technique and control the leakage inductance. In this circuit capacitor connected with IGBT they limited ZVS and control the leakage inductance, duty cycle loss and conduction loss, converter primary current is reset due to the capacitor and reactor circuit elements otherwise inter winding capacitance that time only getting high output voltage. Using clamp circuit and snubber circuit maintain ZCS but they present hard switching and voltage stress present. But in ZVZCS full bridge PWM converter giving high efficiency with low voltage stress also used for high voltage applications. This converter used in less components and simple auxiliary circuit, circulating current based on load and auxiliary circuit is smoothly commutated [2]. Current fed step-up converter employs high voltage applications like servo-drive systems and photovoltaic systems has more power capability and conversion ratio some time voltage surges is present across the switches. So snubber circuit is used this circuit is increased the inductor current, dissipative snubber is decreased to the efficiency of the converter circuit so no dissipative snubber circuit is used but this circuit is complicated and ZVS is not allowed. Dual inverter-fed boost converter is implemented but more voltage stored in capacitor. New active clamping ZVS PWM current-fed half bridge converter is implemented in this circuit giving more efficiency and worked large operating frequency, use small size reactive components, not used PWM IC, simple circuit and low cost [3]. High frequency, low-voltage PWM technique used in medium voltage dc-to-dc converters is analyzed. Advantage of this converters, is simple design and using available components and fault time, over voltage and current time this converter circuit act as circuit breaker at dc power distribution system [4]. The ZVZCS full bridge phase shifted converter circuit consist soft switching technique but more voltage stress is present so occur more power dissipation also high power application reverse recovery problem and more conduction loss will present. At present of diode using MOSFET devices, more ripple and conduction losses are there in capacitor. At load side soft switching technique is implemented in the diodes reduced voltage stress as well as getting high efficiency [5]. At critical conduction mode (CRM) time when the switches is triggering freewheeling current meet a minimum value the reverse recovery is removed from the freewheeling diode. Normally critical conduction mode set between the continuous and discontinuous mode with some switching frequency. CRM is limit the power stress of switches and switching frequency value is increased. But more ripple is present and tapped-inductor is used in the circuit there is controlled the duty cycle of the converter (tapped winding ratio is varied). Advantage of this converter is removed maximum-peak current so getting less switching and conduction losses [6]. Resonant converter works on below or above the resonant frequency. At above the resonant frequency the switches triggered they produce switching losses is less compared to the PWM converters but conduction losses is more because of the RMS device current and peak current is high. Low switching stresses and EMI is the advantages of high-frequency resonant-converter [7]. Power moving to both the direction as well as without more resonant and switching components, so producing high efficiency and power density with low cost. This converter operates the continuous current, constant and soft switching with less switching stresses of the switches. These types of converters are implemented in drives application and battery charging [8]. In three phase diode rectifier circuit input current power factor and voltage regulation are improved. Single-switch diode bridge boost type rectifier and pwm circuit of three phase unidirectional boost rectifier are connected in parallel with input supply and load. Low harmonic distortion and voltage regulation are obtained and this type of circuit operated in a high switching frequency with a small power rating [9].At limited dynamic properties only linear controllers archive constant switching frequency nonlinear controller work at hysteresis level period archive faster dynamic response based on changing of load. In current controllers switching frequency is variable they produce maximum side band harmonics within the switching frequency and adopt adaptive bandwidth. The fixe-frequency mode hybrid current controller produce reduces the dynamic properties of controller. Delta modulated carrier-based current controller and predictive current controller produce the minimum current error are implemented. Hybrid current controller is implemented because of nil static error and low cost [10]. One angle modulation, two, three and multi-angle modulation is used reduces the losses. Set constant values based on efficiency, the phase-shift between the input and an output bridge is called one angle control. Analysis of steady-state bidirectional duel-bridge series resonant converter with three angle phase shift modulation circuit at minimum current light load operation is explained [11]. Random PWM Technique for a Full-Bridge DC/DC Converter [12] Hardware Implementation of Single-Stage Solar Based DC-DC Converter [13] and Performance enhancement of high voltage Gain two phase interleaved boost converter [14] are discussed. The proposed converter’s circuit diagram, operation of the circuit and output wave forms are discussed in this paper.

II BLOCK DIAGRAM OF DC-DC CONVERTER USING FUZZY LOGIC CONTROL FOR SHUNT MOTOR

Figure 1 shows block diagram of proposed Converter using fuzzy logic control for shunt motor. In this diagram input voltage getting from solar panel output side connected D.C. shunt motor. Fuzzy Logic control circuit is control the full wave converter after secondary winding of a transformer and source side converter random PWM is use to producing the gate pulses.

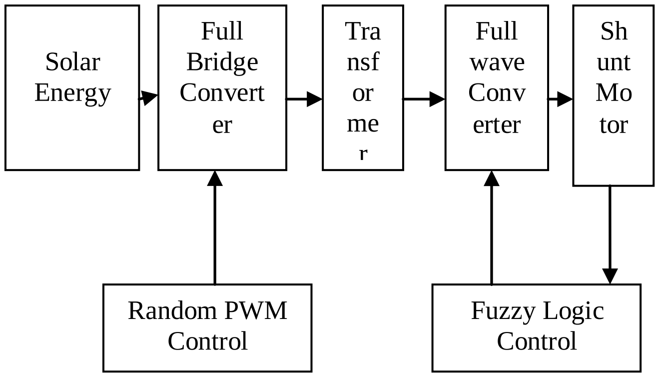

FIG.1 BLOCK DIAGRAM OF PROPOSED CONVERTER

III PROPOSED DC-DC CONVERTER USING FUZZY LOGIC CONTROL FOR SHUNT MOTOR

Figure 1 shown in Random PWM DC-DC converter using closed loop Fuzzy logic control circuit for shunt motor. From solar panel producing some DC voltage that voltage passed to the source side converter, Random PWM circuit is controlled to the source side converter. Full wave converter is connected to the load side then formed fuzzy logic closed circuit.

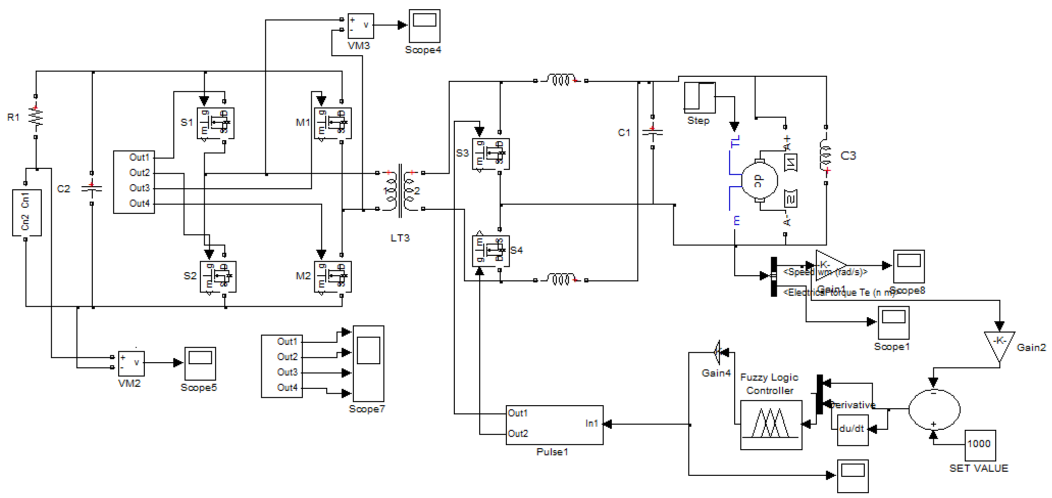

Fig.2.DC-DC Converter using Fuzzy logic Control circuit for Shunt Motor

In Figure 2 from a solar panel getting some voltage that is input voltage that passed to the source side converter. Source side converter pair of switch’s like S1 and

M2 is triggered after that switches S2 and M1 are triggered getting alternating voltage this voltage is applied to the step-up transformer. Step-up voltage is moved to the load side converter in this full wave converter S3 and S4 is triggered simultaneously based on output voltage motor running. In between LC filter is filtered some ripples. Fuzzy logic control circuit is connected the load side of converter. This will control the converter as well as motor so that motor runs at constant speed. Figure 3 shown in the DC motor specification details. In this diagram armature resistance, armature inductance and torque value is intimated.

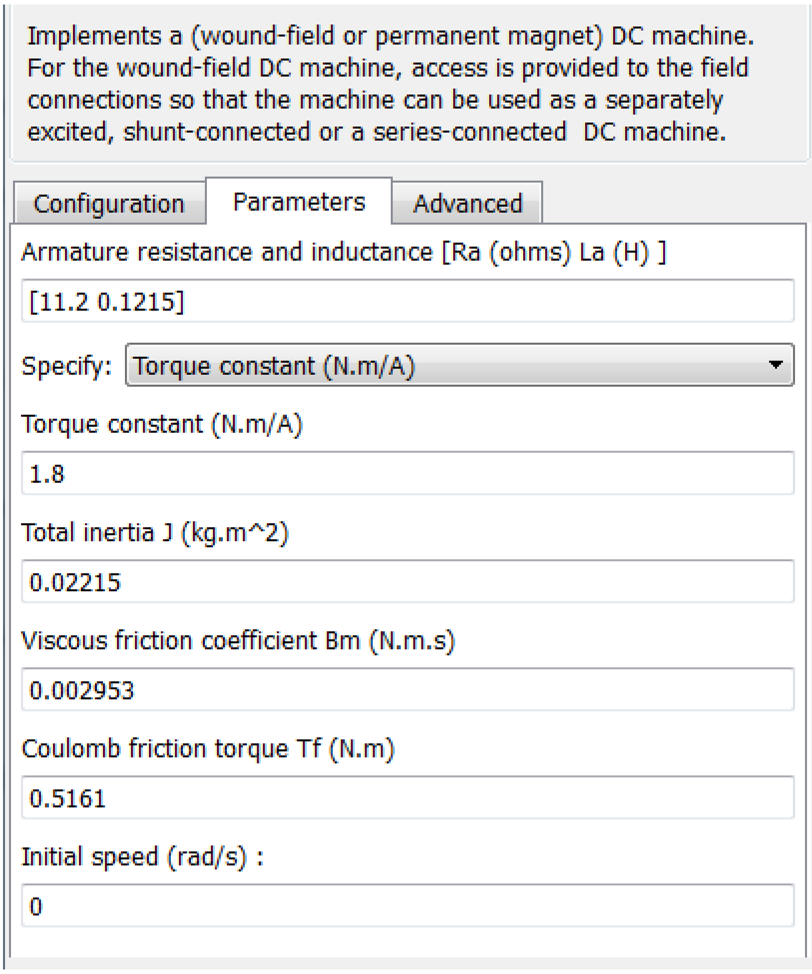

Fig.3 Motor specification details

Figure 4,figure 5, figure 6,figure 7,figure 8 and figure 9 indicates Input membership function -1, Input membership function -2,Output membership function, Single comparison details, Surface plot and Rule viewer simultaneously.

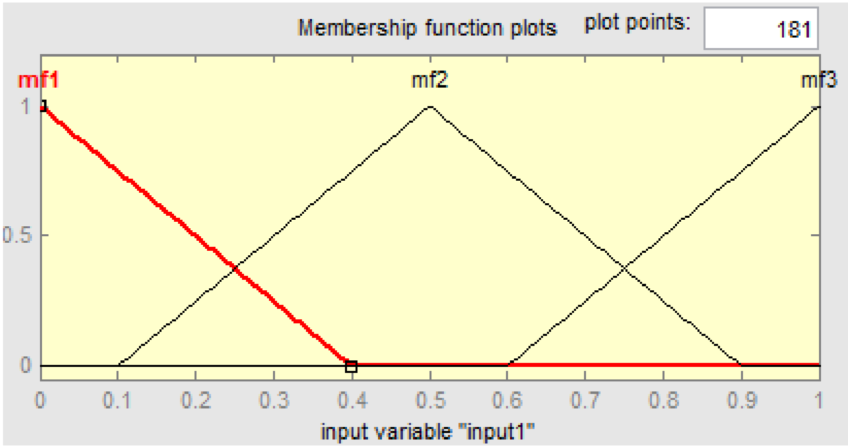

Fig.4 Input membership function -1

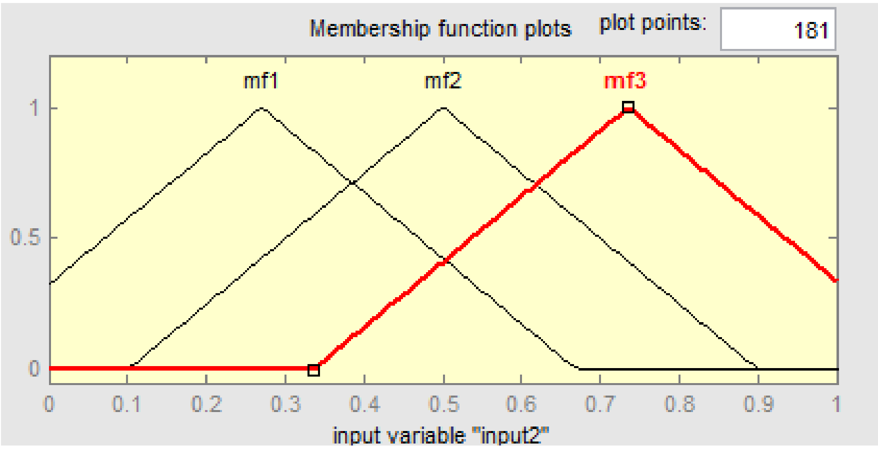

Fig.5 Input membership function -2

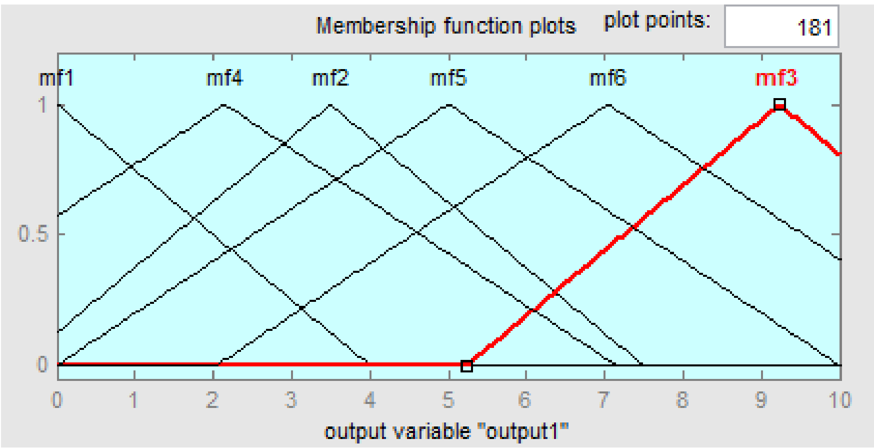

Fig.6 Output membership function

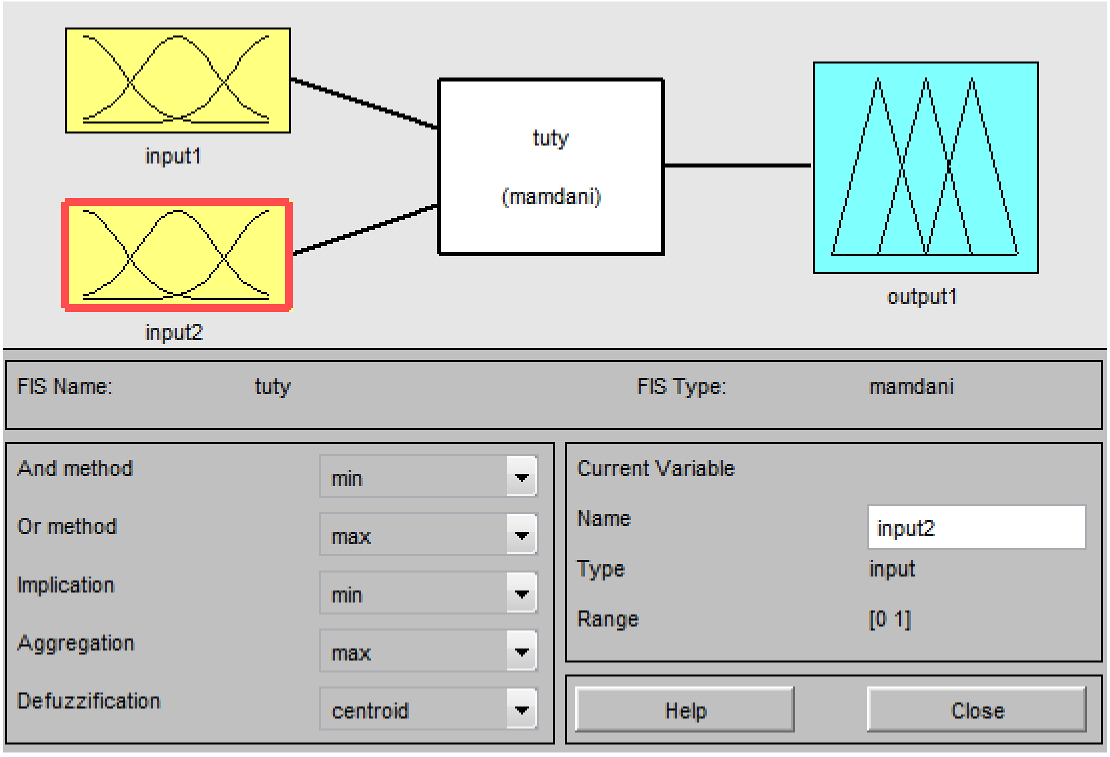

Fig.7 Single comparison details

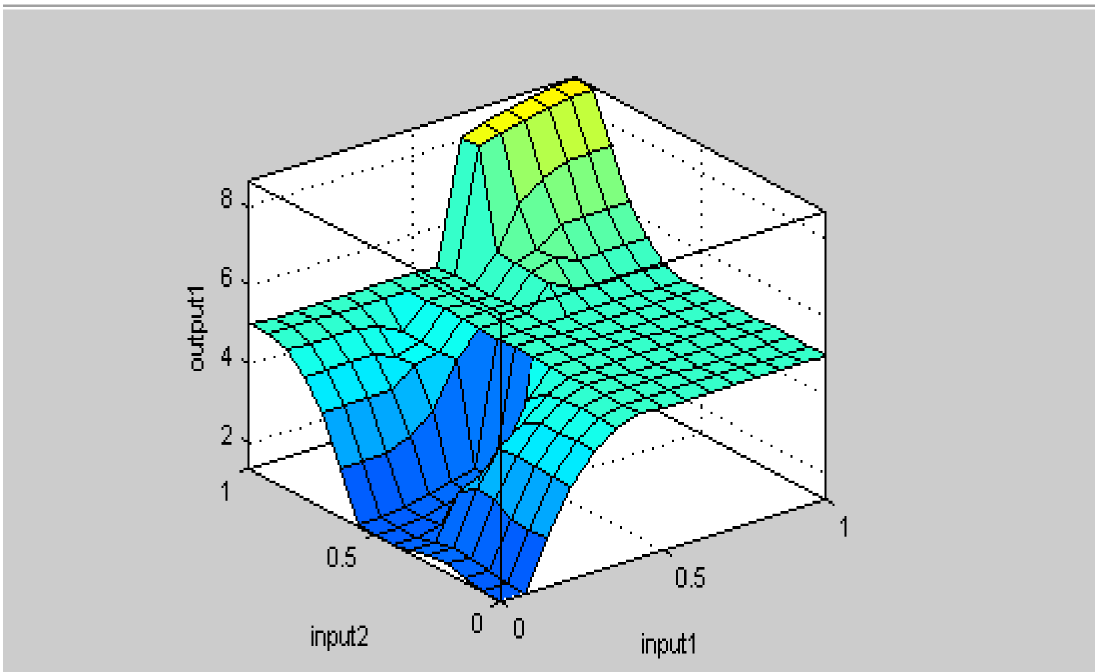

Fig.8 Surface plot

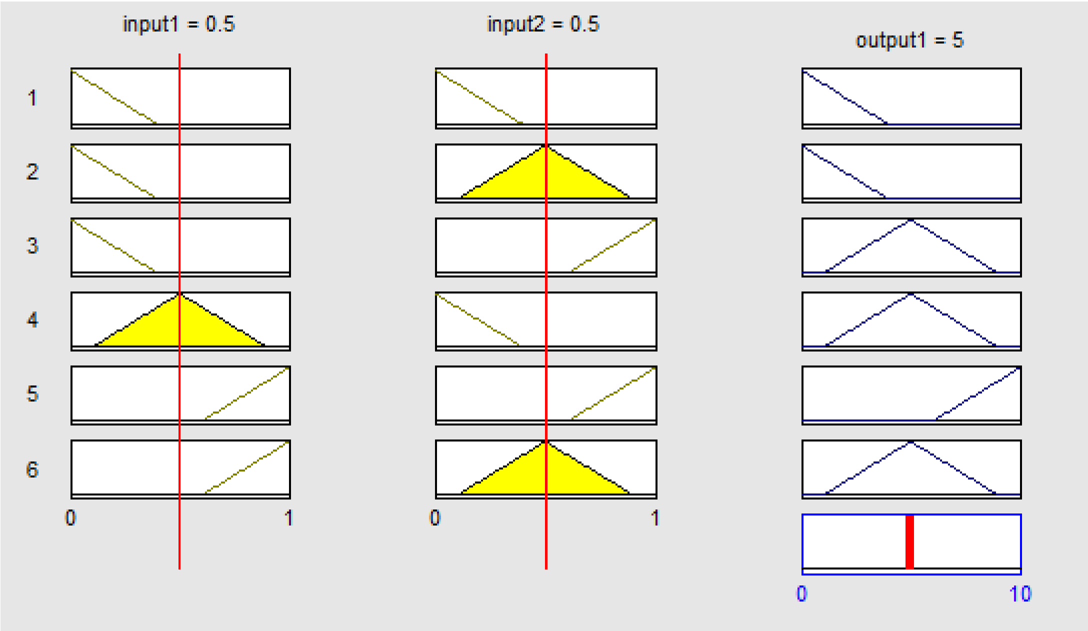

Fig.9 Rule viewer

Fuzzy logic control is producing the control signal based on converter produce the output voltage motor runs at constant speed like 1000 RPM. The speed and torque of shunt motor is indicating in Figure10 and figure 11.

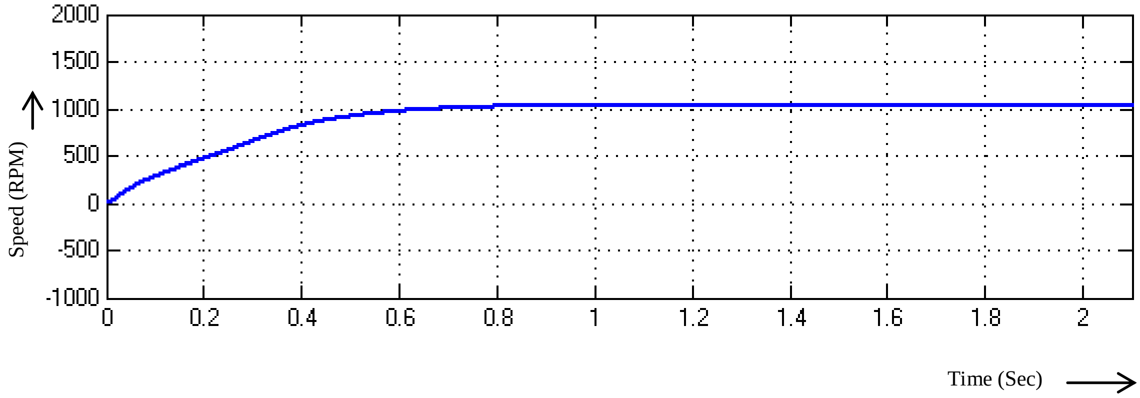

Fig.10 Motor Speed

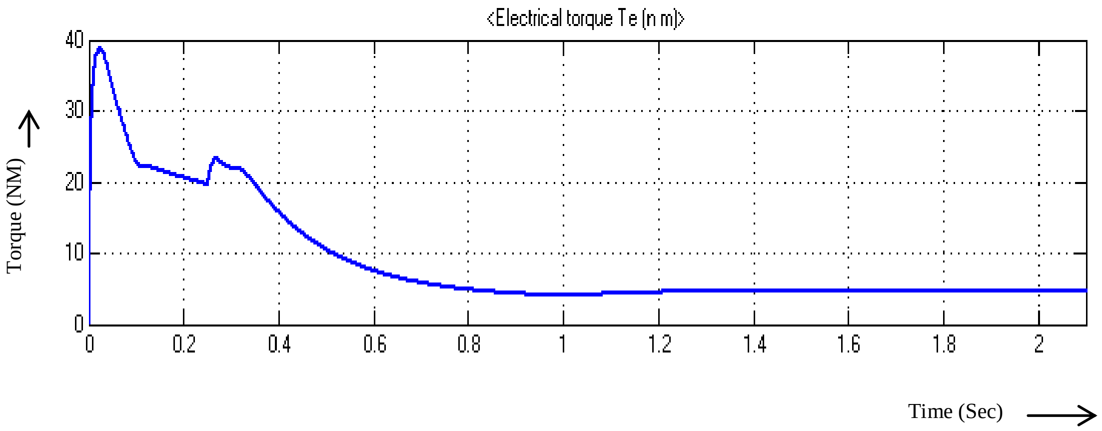

Fig.11 Motor Torque

Analysis of solar based Random PWM DC-DC Converter using closed loop PID and Fuzzy Logic Control for shunt motor is done. Those analysis results are tabulated in table.1.

Table.1 Analysis Result

Controllers	**Rise time (Sec)**	**Peak time (Sec)**	**Settling time (Sec)**	**Steady state Error (RPM)**
PID controller	0.52	0.68	1.14	0.15
FuzzyLogicController	0.38	-	0.73	0.0002

In table.1 rise time, peak time, settling time and steady state error at using PID and Fuzzy logic Controller are tabulated.

IV CONCULSION

Solar based random PWM DC-DC Converter using closed loop Fuzzy Logic Control for shunt motor is implemented. Fuzzy Logic Control is control the load side converter based on controlling signal motor runs at constant speed. The circuit with all the component parameters operates at zero-voltage switching which retains the high circuit efficiency. Speed, Torque of motor, Rise time, Peak time, Settling time and Steady state error are measured by experimental. Analysis of solar based Random PWM closed loop DC-DC Converter using PID and Fuzzy Logic Control for shunt motor is also done. Settling time of Fuzzy Logic Controller circuit is less as compare to PID controller circuit. A circuit operation and simulation designed for a 220v dc output and speed of the motor is 1000 RPM are arrived and tested.

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