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Comparison of PI and Fuzzy Based Vector Control and Soft Start Capability by Adding SL-ZSI with Photovoltaic for Induction Motor Drive

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ABSTRACT

A soft start motor is a novel form of control to temporarily reduce the current and torque during startup. Additionally, it is used to compensate the load increase and voltage of the electrical system decrease. In this paper proposes the switched inductor Z source inverter based photovoltaic power generation for soft start capability of induction motor. Moreover, the PV system is interfaced with one kind of Z source inverter to the AC drive by the power electronic inverter. The Switched inductor Z source inverter (SL-ZSI) is used to able of improving dynamic response for the photovoltaic system over other classical Z source inverter. Hence, suitable models of the proposed inverter are needed to analyze the PV systems for AC applications. The vector control based PWM technique which is used as to given the triggering pulse for inverter switches. This paper describes the comparison of PI controller and design of a rule based fuzzy logic controller (FLC) for proposed Z source inverter. The direct vector control of induction motor has been developed for providing soft start capacity. The obtained result of AC voltage contains the harmonics of both odd and even harmonics of lower and higher order. Here, the higher order harmonics can be eliminated with help of LC filter and also lower order harmonics eliminated by using impedance network. In order to verify the results can be obtained using FFT analysis of proposed topology. The performance of soft starting induction motor has been analyzed and verified with comparison results of proportional integral controller (PI) and fuzzy logic controller (FLC) under load torque variation. It can be evaluated using simulation results in MATLAB/ Simulink environment.

Keywords: Photovoltaic (PV) System, Pulse Width Modulation (PWM), Switched Inductor Z Source Inverter (SL-ZSI), PI, Fuzzy Logic, Soft Starter, Induction Motor, Vector Control

1. INTRODUCTION

Recently, an important factor in induction motor during the past five decades has been increasing edification of factory automation which has improved productivity manifold. The performance of induction motor can be adjusted with help of soft starter and control of torque, speed, inrush current of the system comprising it. The impedance source network concept has been opened up a new research area in power electronics. The various renewable energy generations such as PV, wind power and motor drives are potential applications of Z-source converters because of the unique voltage buck boost ability with minimum component count and possible low cost. An improve Z source inverter can be reduce the Z source capacitor voltage stress significantly. In order to perform the same voltage boost and has been inherent limitation to inrush current at startup condition [1]. A proper soft start strategy can be used to suppress the inrush current, resonance of Z-source capacitors and inductors in traditional topology.

A review of Z Source inverter topology considers as for power electronics DC-AC Convertor with important properties such as single stage conversion and buck-boost characteristics. The detailed explanation of Z source

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topology is discussed and also it can be helps power electronics researchers and engineers [2]. In order to understand and identify the pros and cons of each topology and choose of the most suitable one for their applications. The PV system based Modified Z Source inverter has been implemented for V/f control of induction motor drive. It can be achieved the better performance with reduced switching losses compared to the traditional inverters at low speed applications. Also, in order to reduce the common mode leakage current and common mode voltage in a three phase Z Source inverter with photovoltaic (PV) system by using modulation techniques. The simulation results are carried out under for different load power factors and switching frequencies with regarding real time application [3]-[4]. The development of solar power generation and improving the performance of Z Source inverter can be used by the conventional voltage source inverter and also used to realize the boost range of DC-AC conversion.

The additional transformer does not meet the supply requirement at Z source inverter while compared to traditional voltage source inverter. Because it can provides any desired output ac voltage even greater than line voltage, reduces harmonic currents, improved reliability, strong EMI immunity and low EMI. To enhance the voltage adjustability and increases the voltage boost inversion ability can employ the SL impedance network [5]-[6]. By eliminating the supply frequency torque pulsations and keeping the line current preset constant value obtained at the performance optimization of medium/high-power induction motors during soft starting capability. Here, the elimination of starting current pulsation is achieved under by activating back to back connected switch at proper points on the first supply of voltage cycle. In order to improve the service life of AC motor drive using soft start multi-slope and current limiting fuzzy logic control algorithm [7]-[8]. It can be applied effectively for voltage and current mode control for induction motor.

A improve the soft starter operated motor has been developed under the introduction of diagnosis methodology relying on the startup current analysis. Similarly, to fulfill the requirements of induction motor can be achieved and compared with the senserless vector control scheme for wind energy application based on MRAS method and ASO method. The dynamic model of experimental setup has been developed to formalize a model of six terminals motor for delta and star connection performance analysis. The constant current control performance of soft starter has been analyzed with experiment and simulation studies. Here, the elimination of torque pulsation is produced at big power application of high voltage induction motor. Also, the harmonics of stator current can be eliminated using soft starter controlled by thyristor [9]-[13]. In order to choosing the optimal switching point of the applied voltage has been verified with practicable of novel soft starter. The high power applications in most non linear system as well as motor drives have been achieved by Artificial intelligence. Here, it can be control the amplitude of starting current and be save the energy and also the new intelligent control structure is insensitive used to disturbance generated outside or inside the system [14]-[16].

To implement the effect of simplified flux estimator on steady state behavior of the motor has been investigation under normal conditions, load fluctuation condition and frequent start/stops in both directions. This system configuration can be applicable for both low cost and good dynamic performance of the drive system. The water pumping system has been verified with the effect of temperatures and intensity of solar radiation. The fuzzy logic based intelligent controller has been analyzed with different operating conditions such as sudden change in reference speed and load torque [17]-[18]. The speed regulation of induction motor carried out using classical fuzzy logic controller at different operating dynamic condition such as step change in load, sudden change in speed and some parameter variation. The improvement of system performance and eliminate the error due to the change in stator resistance obtained by using the fuzzy resistance estimator. Fuzzy based field oriented control used to maintain the decoupling and overcome the problem of robustness with respect to the corresponding parametric variations [19]-[21].

In this paper, proposes the modified vector control of photovoltaic based switched inductor Z Source inverter for induction motor. The comparison results of PI and Fuzzy based soft start capability of induction drive is verified with result of FFT analysis. A mathematical modeling of photovoltaic array can be designed under variation of temperature and solar irradiation. Among the different Z source inverter topologies, the choice of switched inductor

Z source inverter (SL-ZSI) is used to increases the inversion of voltage boost ability significantly. The soft starting system provides the step less motor control and an excellent alternative at low cost with simple structure though the normal operating speed. The vector control based speed regulation of induction motor can be provides the improvement of power factor and reliability, to extends the output voltage range and also reduced cost of the proposed topology. A comparison study of PI and FLC for solar power generation using vector control of soft start induction drive and switched inductor Z source inverter have been performed.

2. RELATED WORKS

A mended Z source topology can be compared with conventional type of impedance source network gives results and verified with real time implementation. It can be applicable for both solar power generation and three phase speed control of induction motor. The PV based various Z source inverter has been developed at linear and non linear load conditions and also it can be suppressing the output current harmonics [1]-[6]. The superior control of fuzzy logic is designed at Matlab/Simulink platform using fuzzy toolbox under various operating condition. The comparison results are obtained with confirmed the very good dynamic performance and robustness of the fuzzy logic control during the sudden changes applied on loads and transient period [18].

The simulation results are carried out under various conditions of increasing and decreasing of the induction drive key parameters. The response of overshoot speed can be obtained against large deviations of rotor self inductance, rotor resistance and inertia. Similarly, the fuzzy based resistance estimator is used to estimate the change in stator resistance. Also, in order to maintains the decoupling and provides a high statistic and dynamic performance [19]-[21]. The induction motor performance at during voltage controlled soft starting has been modified by eliminating the supply frequency torque pulsations and also by keeping the line current constant at the present value over the entire soft starting capability period. The current limiting fuzzy logic control used to achieve the final purpose of starting with celerity, smoothness and steady [7]-[9]. Some kind of conditions applied at induction motor operating with soft starters is formalized for advanced time-frequency decomposition tools.

The elimination of torque pulsation under soft starter can be used to eliminate the low order harmonics of the stator current and the lowest order is concerned with the ratio of the switching frequency to the system. The developed method of optimal soft starting without a speed sensor with sensing of thyristors voltages is required very much. The improvement of system performance has been verified with comparison results of PI and fuzzy based solar power generation [14]-[17]. The senserless MRAS based speed estimation can be employed in induction motor drive for wind power applications. The microcontroller based soft start capability techniques have been analyzed for three phase induction motors in star-delta with series inductor starter. In order to achieve the good starting performance of motor drive and novel soft starter about the energy saving methods are discussed [10]-[13].

3. PROPOSED CIRCUIT CONFIGURATION

This proposed methodology consists of solar single diode power generation, switched inductor Z source inverter and soft start capability of induction motor. In order to evaluate the system performance and suppress the current harmonics by using total harmonic distortion results. In this proposed system configuration can be proved the good dynamic performance of the induction motor drive while compare to the conventional speed control with a faster response time. The performance of system can be improved by using PI and fuzzy controller and which is implemented by MATLAB/SIMULINK software for better control of motor.

3.1. Single Diode Photovoltaic Model

The dynamic model of Photovoltaic module with moderate complexity includes the temperature independence of the saturation current of the diode, photocurrent source and also a series resistance is conceived based on the Shockley diode equation. The output characteristic of both I-V and P-V can be lighted with radiation of sunlight.

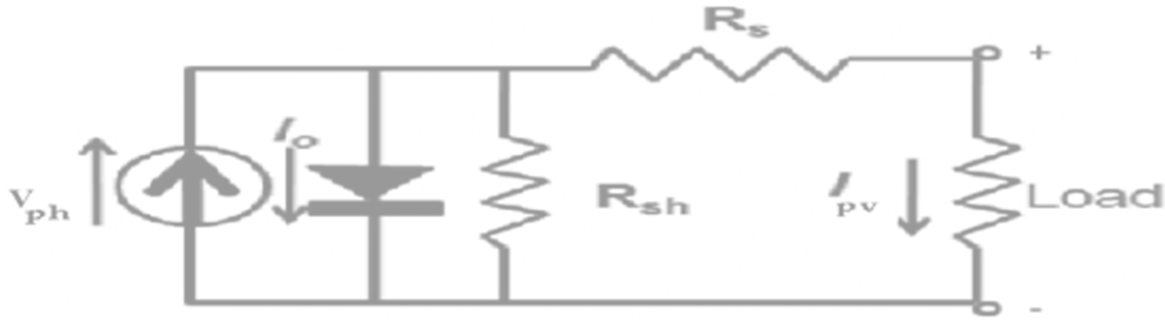

Figure 1: Equivalent Circuit of Single Diode PV cell

This PV panel cell is used to converts part of the photovoltaic potential directly into electricity. The equivalent circuit configuration of single diode PV panel is shown in figure 1.

The mathematical modeled of PV cell can be written as given below,

$$I_{PhotoCurrent} = \left[I_{SCref} + K_i\left(Temp - 298\right)\right] * \lambda/1000 \tag{1}$$

$$I_{ReverseSaturation} = \left[I_{SCref} \Big/ \left[\exp\left(qV_{OC}/N_s KAT\right) - 1\right]\right] \tag{2}$$

The output saturation current I_0 varies with the single diode PV temperature which is written by,

$$I_0 = I_{ReverseSaturation}\left[\left(T/T_{ref}\right)^3 e^{\left(qC_g/AK\right)} * \left(1/T_{ref} - 1/T\right)\right] \tag{3}$$

$$I = I_{PV,Cell} N_p - I_{0,Cell} N_p \left[\exp\left(\frac{V + R_s I}{V_t a}\right) - 1\right] - \frac{V + R_s I}{R_p} \tag{4}$$

According to real condition of temperatures and irradiance of PV modules are evaluated to their initial values. The specification of single diode PV cell and corresponding simulink model are shown in table 1 and figure 2.

Moreover, the operating temperature increases while the output current increases marginally. But the output voltage decreases drastically, which result in net reduction in power output increase with in temperature. The variation of irradiation and temperature would be producing by the output P-V characteristics is indicated in figure 3.

Table 1
Parameters of Single diode PV Cell at Operating Condition

S. No	Specification	Values
1	Electron charge (q)	1.6 × 10-19 C
2	Open Circuit Voltage (Vocn)	70V
3	Total no of Cells in series (Ns)	6
4	Short Circuit Current (Isc)	17A
5	Total no of Cells in parallel (Np)	1
6	Boltzman constant (K)	1.3805 × 10-23 J/K
7	Output Current of PV (Ipv)	120A

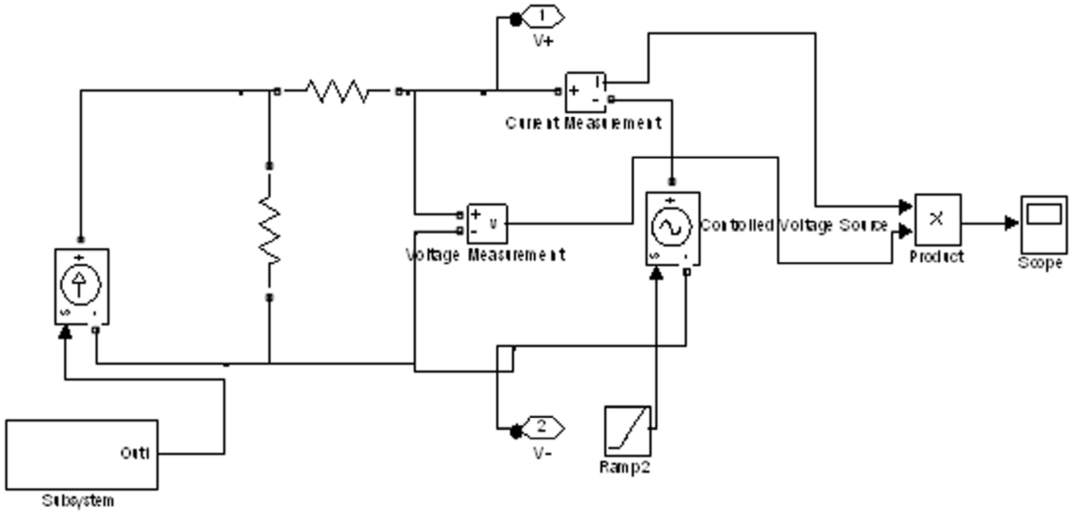

Figure 2: Single Diode PV Cell Simulink Model

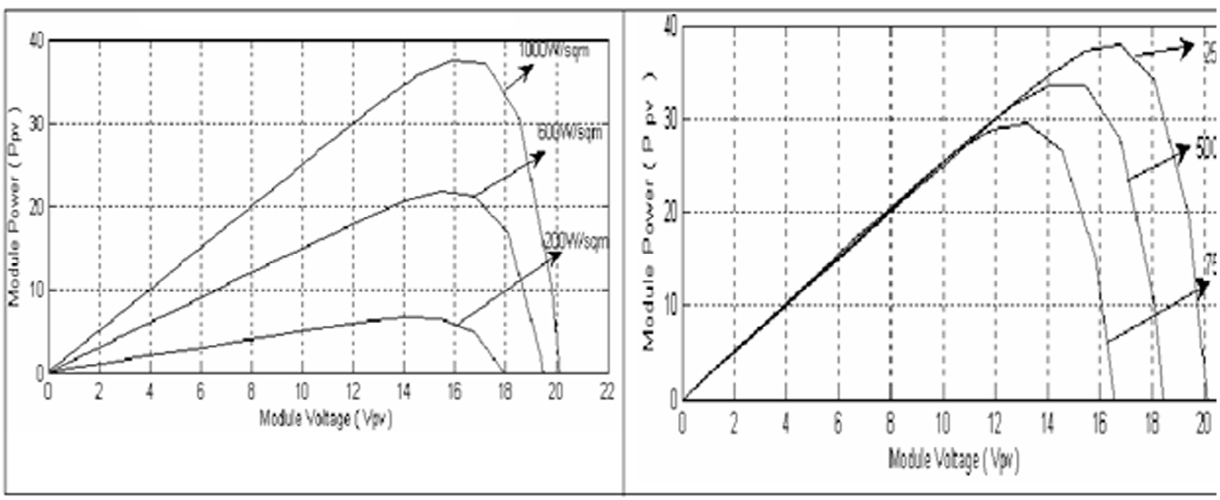

Figure 3: Output P-V Characteristics Varying under irradiation and temperature

From the above figure represent the increase of irradiance, while the output current and voltage also increases. This simulation results are referred as the net increase in output power with an increase in irradiance at the constant temperatures. Here, also the peak power point changes unendingly due to environmental variations, sometime signification drop in power especially during partial blending conditions.

3.2. Switched Inductor Z Source Inverter (SL-ZSI)

The traditional concept of Z Source inverter consists of an impedance network, causing two inductors and two capacitors. For low voltage energy sources consider as Photovoltaic Cell and fuel cell can be used in DC-DC power converters for improving power levels. Additionally, the Switched-Capacitor (SC), Switched-Inductor (SL) or the combination of both (SC/SL). In this paper described about the switched inductor Z Source inverter and tested with different modulation indexes using simple boost pulse width modulation control techniques. The conventional Z Source inverter has been performed under various conditions of the severe state as shoot through zero state. The schematic circuit diagram of Z Source inverter topology is shown in figure 4.

$$Boost\ Factor_{ZSI} = V_{dc}/V_{in} = 1\Big/\left(1-2\left(\frac{T_0}{T}\right)\right) = 1/(1-2D) \qquad (5)$$

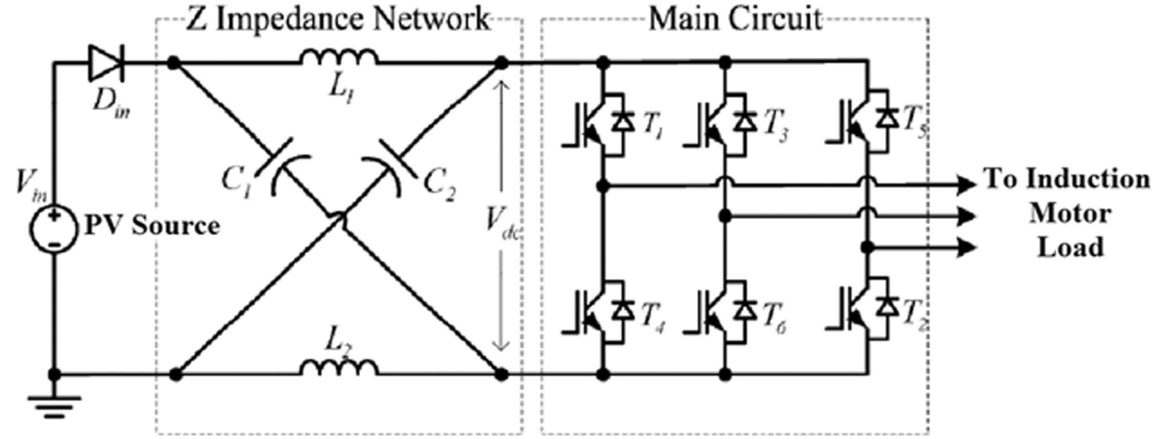

Figure 4: Schematic Diagram of Z Source Inverter

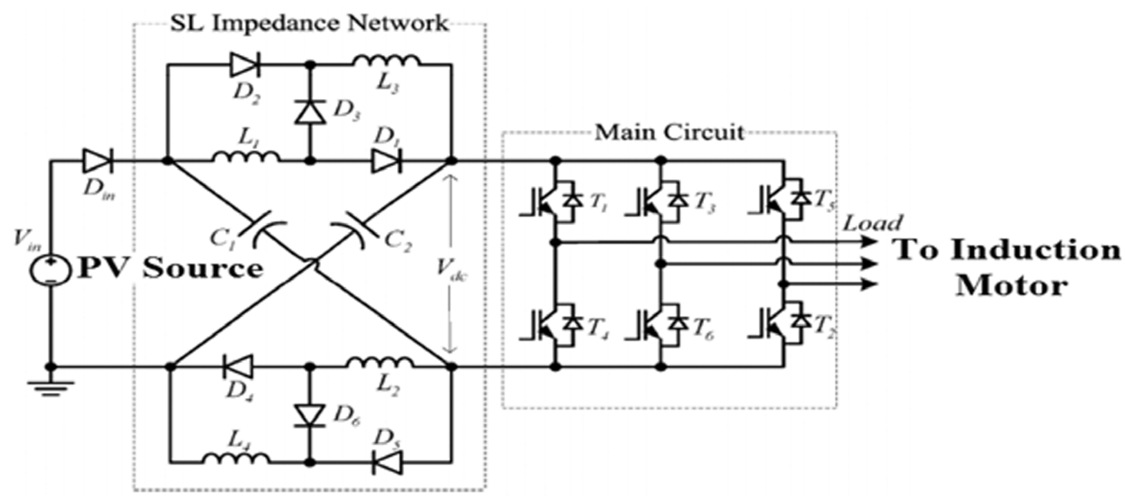

Figure 5: Switched Inductor Z Source Inverter Topology

In order to allow for very high boost factor with low DC voltage energy source is required higher value of duty cycle (D) for practical applications. Similarly, the design of switched inductor Z source inverter (SL-ZSI) is followed of six diodes (D1, D2, D3, D4, D5 and D6), four inductors (L1, L2, L3 and L4) and two capacitors (C1 and C2). Moreover, the function of lower Switched Inductor cell is performed under by combining L2-L4-D2-D4-D6 and also the upper Switched inductor cell is performed as combining L1-L3-D1-D3-D5. The configuration of switched inductor Z Source inverter is presented in figure 5.

The main intention of switched cell (SL) is used to store and transfer the energy from the capacitors bank to DC link when the circuit activation of power switching operation. These kinds of impedance network are divided into two parts such as the non shoot through state and shoot through state respectively. The representation of equivalent circuit is indicated in figure 6.

$$Boost\ Factor_{SL-ZSI} = \frac{1+D}{1-3D} = \frac{1+\left({T_0}/{T} \right)}{1-3\left({T_0}/{T} \right)} \tag{6}$$

$$V_{dcLink} = \left(\frac{1+D}{1-3D} \right) V_{in} = Boost\ Factor_{SL-ZSI}\ V_{in} \tag{7}$$

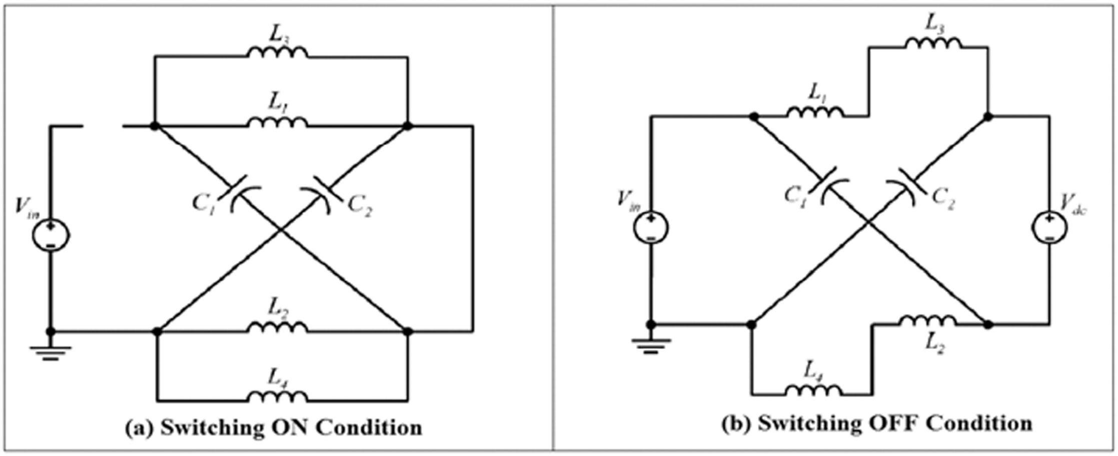

Figure 6: Shoot and Non Shoot States of Equivalent Circuits

The proposed switched inductor impedance network is used to increase the boost ability as compared with the classical type of Z source inverter topology. Here, the increment of modulation index is providing the decrement of output load voltage while the decreased shoot through interval same as conventional Z source impedance network.

3.3. Soft Start Capability of Induction Motor

Generally, the mechanical damage is associated with high starting current attracted by ramping of induction motor. There are various starting methods can be applied to electrical for reducing the starting issues. A solid state electronics circuit based used manipulates the supply voltage prior to connecting the soft starter motor terminals. Here, the reduced voltage of soft starter used to protect the motor and connected equipment from damage by controlling the terminal voltage. In conventionally, the star-delta method of reducing start-up voltage electromechanically has been proved at popular. The induction motor per phase equivalent circuit is shown in figure 7.

The capacity to calculate motor starting time for large induction motor is important in order to measure the relative strength of the power system. At the time of starting, an induction motor depicts the high values of current while in very close to the motor meshed rotor value and stay this value for the time required starting the motor. The representation of speed – torque characteristics and phasor diagram for induction motor drive is shown in figure 8.

The determination of starting current, need to calculate starting power required by the induction drive expressed as,

$$S_{Starting} = Code\ Letter\ Factor \times Rated\ Horsepower \quad (8)$$

$$I_L = \left(\frac{S_{Starting}}{\sqrt{3} V_T} \right) \quad (9)$$

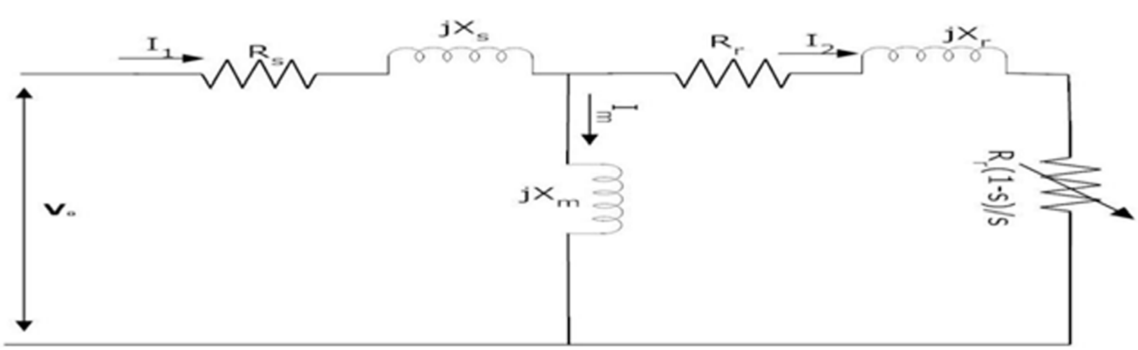

Figure 7: Induction Motor per Phase Equivalent Circuit

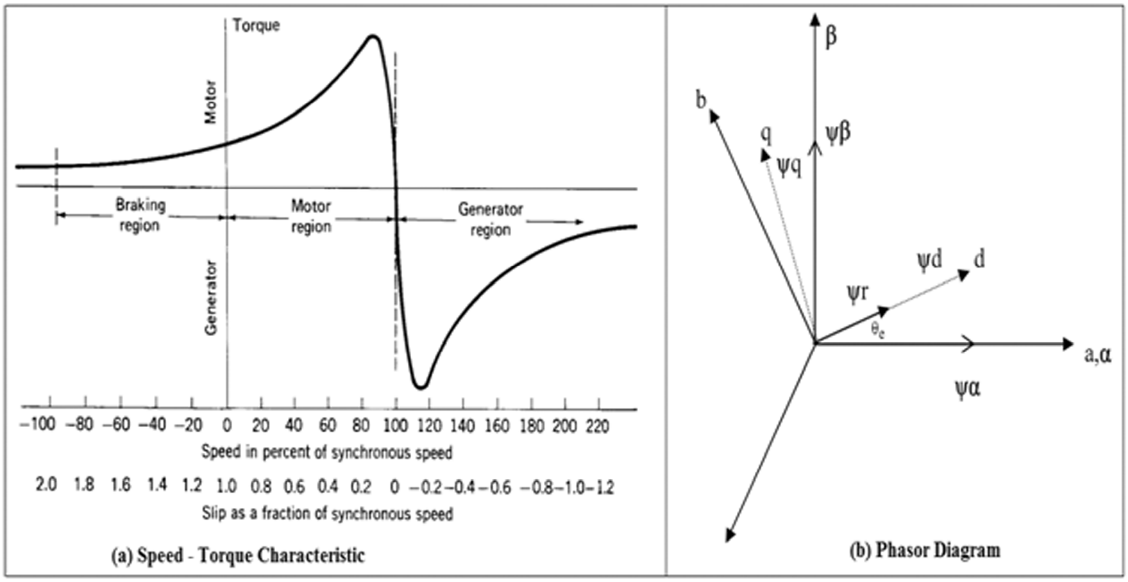

Figure 8: Graphical Representation of induction motor performance

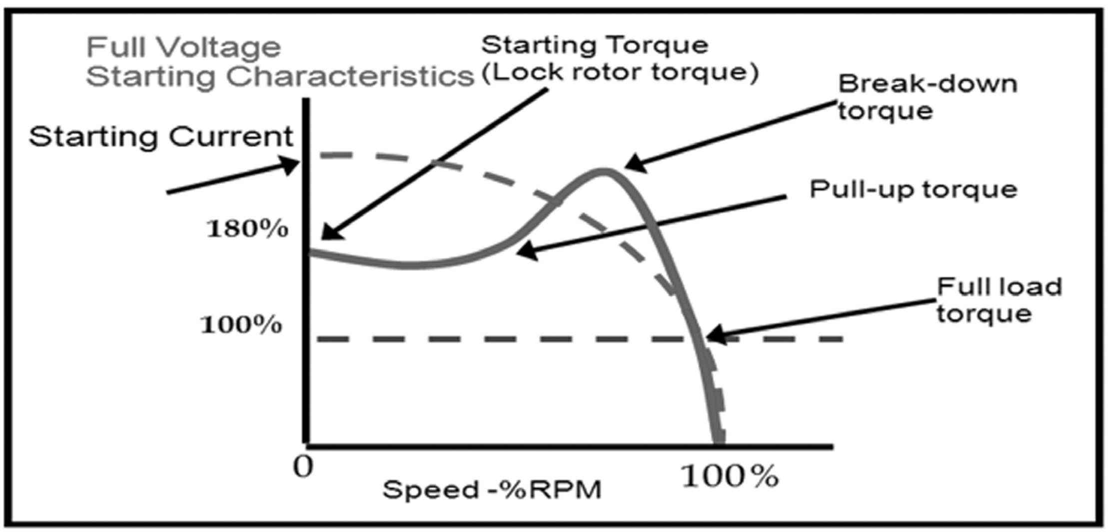

Figure 9: Typical Curve for Electrical Motor Drive Staring Condition

Here, the speed of the motor increases and rotor frequency decreases, hence the impedance of self inductor significantly decreases and but in effect shorts the resistor. The above condition represents the capacitor acts an open circuit which leads to improved operating condition. The typical motor starting drive curve is depicted in figure 9.

The starting of torque and current issues can be cause to the damage of the electrical and mechanical system. In this paper presents the modified vector control of induction motor inherent advance for soft start capability has been achieved. Also, in order to achieve and limit the amount of inrush current for high vibration applications.

4. COMPARATIVE STUDY OF CONTROL STRATEGY

In this paper discuss about the vector control based induction motor for analysis the PI and Fuzzy Logic Controller (FLC) performance. The tuning and design of conventional controller increases the execution cost and adds to complexity in the control system. Thus, it may be reduce the reliability of the control system. Therefore, the PI and Fuzzy based techniques are used to overcome this kind of issues. The field orientation or vector control leads used to independent control of flux and torque. Here, the major disadvantages are sensitive to motor parameter variations,

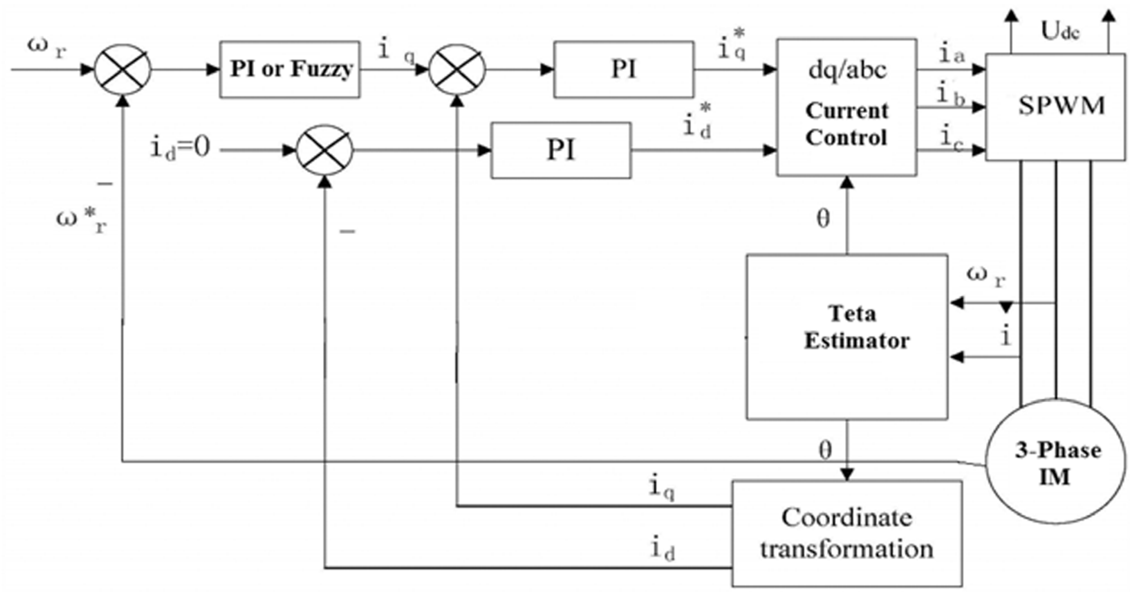

Figure 10: Block Diagram of Vector Control Based Induction Motor Configuration

in turn the performance of conventional controller. The control of motor is designed at close loop with the Field Oriented Control block shown in figure 10 which generates inverter switching commands to achieve the wanted electromagnetic torque at the motor shaft. The estimation of flux can be expressed by,

$$\psi_{rotor} = \frac{L_m}{1+T_r S}(I_{ds}) \tag{10}$$

The vector control of induction machine measures appear as DC signals in the rotating dq frame. The stator (i_{sd}) d-axis current is used to control the stator q-axis current and rotor flux, (i_{sq}) used to control the torque. This assures independent control of flux and torque in the machine which are normally orthogonal to each other with steady state. Because these signals are DC in the rotating dq frame it causes for easy control using proportional integral (PI) controllers. An exact vector control used to involves good control of the stator q and d axis currents and accurate approximation of rotor flux position. It allows the transformation of amounts from the rotating reference frame to the stationary reference frame.

The output voltage of voltage source inverter is used in a feed forward scheme where it depends upon the DC link value and state of the switches. It is also potential to expend the several approaches exist and VSI as a current controlled source. At the end of feedback based phase currents can be regulated by using controllable VSI. Moreover, the measured current is compared with a reference current signal and also one leg of the inverter is changed in such way that error of the current remains inside the hysteresis band.

The large majority of variable speed applications demand only at speed control in which the torque reaction is secondary interest. It is more ambitious applications such servomotors, traction applications and also depends critically upon the ability of the drive system. It is used to provide a dictated torque where upon the speed turns the variable of secondary interest. The torque control method in AC machines is called as either field orientation or vector control. It is refers to the handling of flux linkages, terminal currents and voltages to affect the motor torque.

4.1. Design of PI Controller (PI)

This paper presents the both control methods such as conventional and artificial intelligent are inserted and applied to direct field oriented induction motor. In this first type of approach, conventional PI controller is used to achieve the speed control and a problem of starting situation is also detected. The schematic block diagram of PI controller is shown in Figure 11 (a) which is used for the regular type of parallel PI controller.

The Proportional integral (PI) controller has property of making the steady state error zero for step change, while PI controller builds the steady state error zero. It may take a substantial amount of time to accordance. The error of the speed is defined as input to PI controller and also represent the ratio of equated reference speed and actual speed. Based on the value of proportional gain and the value of integral gain, the PI controller determines an output which is contributed to the inverter activating switch counting on the load variation.

4.2. Design of Fuzzy Logic Controller (FLC)

The second control is based on the artificial intelligence controller like fuzzy logic controller. Moreover, the linguistic If-Then rules are introduced as set of controller rule base. The Simulink block of fuzzy logic controller used is indicated in Figure 11 (b). This Fuzzy logic controller (FLC) based on the control strategy shows the better result because fuzzy logic defeats the mathematical troubles of modeling at highly non linear systems. It is responds in a more stable fashion to imprecise readings of feedback control parameters such as dc link current and voltage and also the modification is very easy and flexible.

The Sugeno type systems used to build up the model any inference system in which output membership functions are either constant or linear function. Even though, the Mamdani type used to produces the either linear

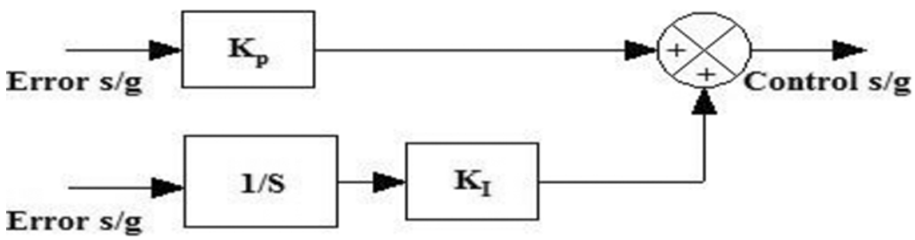

Figure 11: (a) Typical Proportional Integral Control

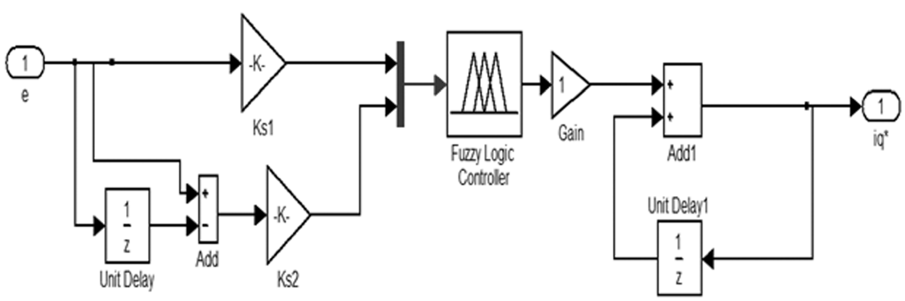

Figure 11: (b) Schematic Diagram of Fuzzy Logic Control

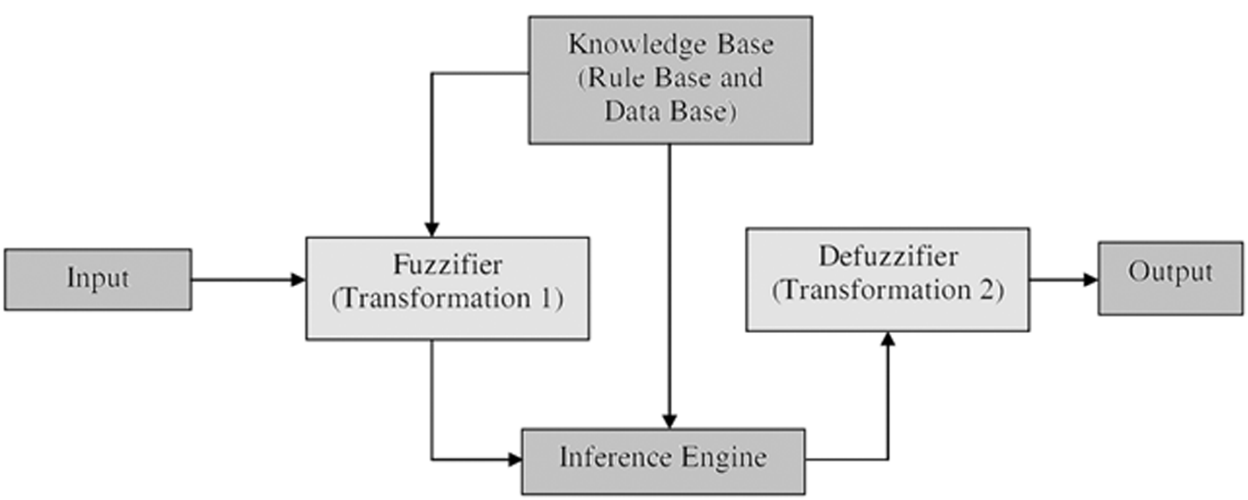

Figure 12: Fuzzy Logic Control Block Diagram

or non-linear output. The fuzzy logic controller contains of four stages including the input fuzzification, rules derivation, inference mechanism and de-fuzzification. These kinds of Fuzzy logic systems are represent the general function estimates. Generally, the main goal of fuzzy logic system is used to yield a set of outputs for given inputs at non-linear system and without using any dynamic model while using linguistic rules. A basic block diagram of Fuzzy logic is established in Fig.12.

The Graphical User Interface Fuzzy Logic (GUI) tools are used to create a Fuzzy Inference System (FIS). The adopting GUI tools are used to build, edit and view fuzzy inference systems. It is used to deal with the high level problems for the system. The software Fuzzy Logic Toolbox does not limit the number of inputs. Even so, the number of inputs may be limited by the available memory of motor drive. Here, if the more number of the lengthier membership functions, then it may also be hard to analyze the FIS using the other GUI tools. The Editor of membership function is used to define the shapes of all the membership functions related with each variable. This rule editor is used to edit the rules which listed by defines the behavior of the system. Also, to view the fuzzy inference diagram by using rule viewer. The corresponding membership's function of input and output variable graphical representation is shown in figure 13.

According to rule based table can be created as If Error is Zero (ZE) and Change in Error is Negative Medium (NM), then the output is Negative Small (NS). The creations of rules are mentioned in table 2. This kind of graphical representation of Rule view and surface view of fuzzy logic control is shown in figures 14 (a&b).

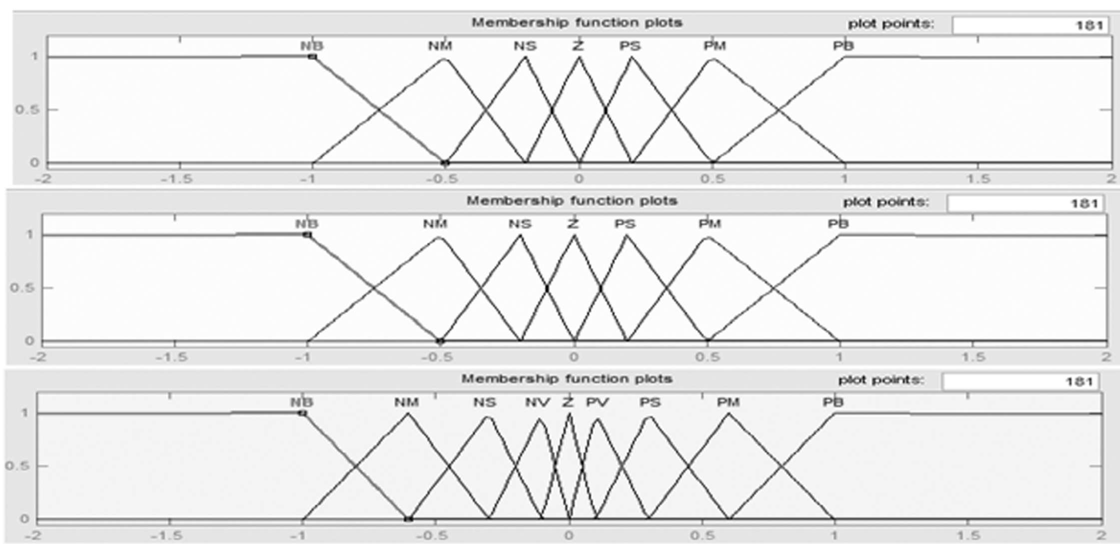

Figure 13: Input and Output variable Membership Function

Table 2
Creation of Rules for Input Variables

Change In Error \ Error	NB	NM	NS	ZE	PS	PM	PB
NB	NB	NB	NB	NM	NS	NVS	ZE
NM	NB	NB	NM	NS	NVS	ZE	PVS
NS	NB	NM	NS	NVS	ZE	PVS	PS
ZE	NM	NS	NVS	ZE	PVS	PS	PM
PS	NS	NVS	ZE	PVS	PS	PM	PB
PM	NVS	ZE	PVS	PS	PM	PB	PB
PB	ZE	PVS	PS	PM	PB	PB	PB

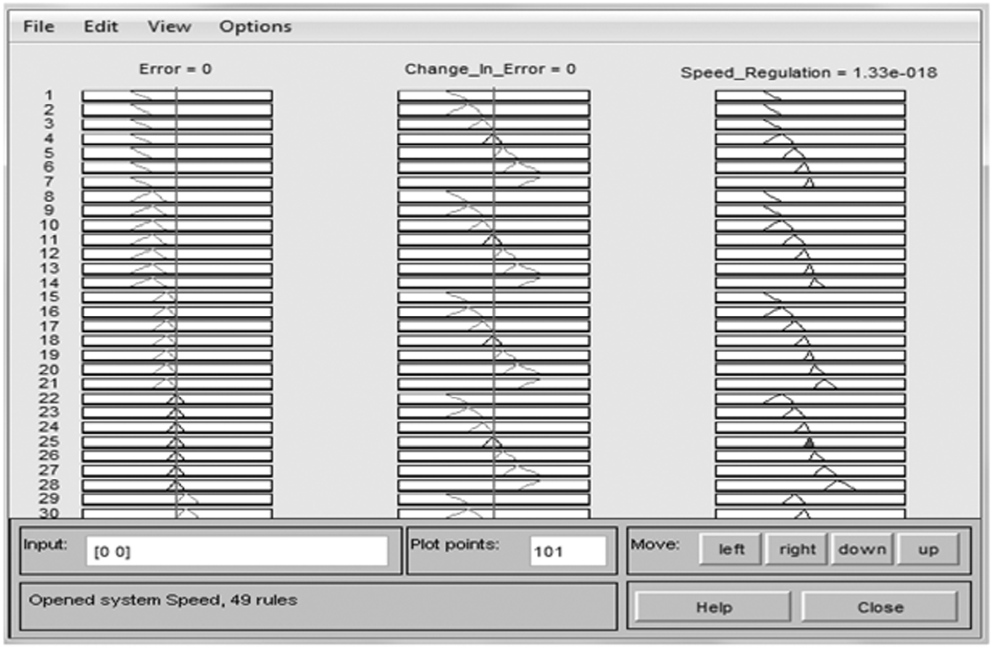

Figure 14: (a) Rule view of Fuzzy controller output

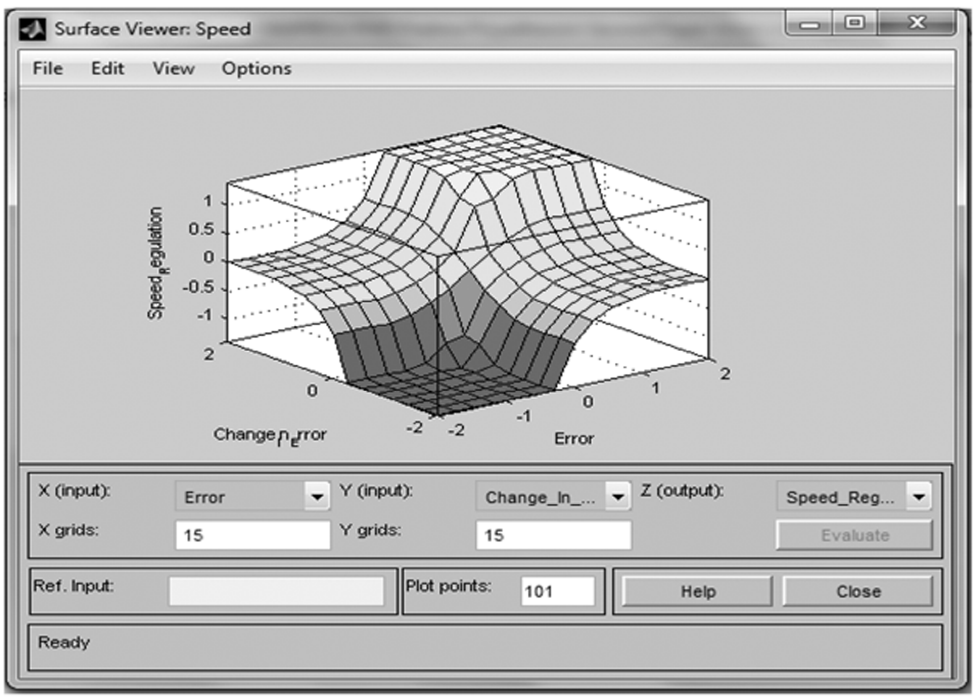

Figure 14: (b) Surface View of Fuzzy Controller Output

The perturbation of voltage controller is based on varies in stator voltage and input power. This Fuzzy logic control has been underlined for voltage perturbation. Here, the fuzzy logic membership functions for both outputs and the inputs are zoned using nine MF for output and seven MF for inputs fuzzy sets and are shown in figure 12. The derivation of input variables and output variables are expressed by,

$$Error = \omega_r^* - \omega \tag{11}$$

$$\frac{dError}{dt} = \frac{\Delta Error}{\Delta t} = \frac{CError}{T_S} \tag{12}$$

$$DU = \Delta T_e^* = K_1 Error + K_2 CError \tag{13}$$

In this triangular fuzzy sets are used for both inputs and outputs, with a limitation that the output fuzzy sets must be symmetric to modify defuzzification. Here, the input and output values are presented linguistically such as PM = positive medium, NM = negative medium, NS = negative small, PS = positive small and ZE = zero. This corresponding waveform is shown in figure 13 for both inputs and outputs are annealed between -1 and 1. It is required to define the proper gains for all parameters to change in per unit. To selecting these gains is one of ambitious part of fuzzy logic controller and suppose if it is selected improper means, it may be not get in optimum result leads to instability.

5. SIMULATION STUDY

The modified vector control based induction motor performance is explained with simulation results. This paper proposed switched inductor Z source inverter with current regulates PWM based speed control strategy of induction motor drive for solar power generation. The proposed configuration consists of PI and FLC based induction motor circuit topology is shown in figure 15. The comparative study of controller PI and FLC based steady state and time response errors were analyzed and verified for soft start capability of induction motor. The voltage and current waveform of photovoltaic cell is indicated in figure 16. The simulation results are compared with FFT analysis based on the reduction of Total Harmonics Distortion (THD) for proposed control techniques. The corresponding proposed topologies are carried out by using various controller tool boxes in MATLAB/Simulink software. The DC link capacitor across the voltage waveform is depicted in figure 17. The three phase inverter output voltage and current waveform for PI and FLC based vector control with before/after filter arrangement is presented in figure 18 (a&b).

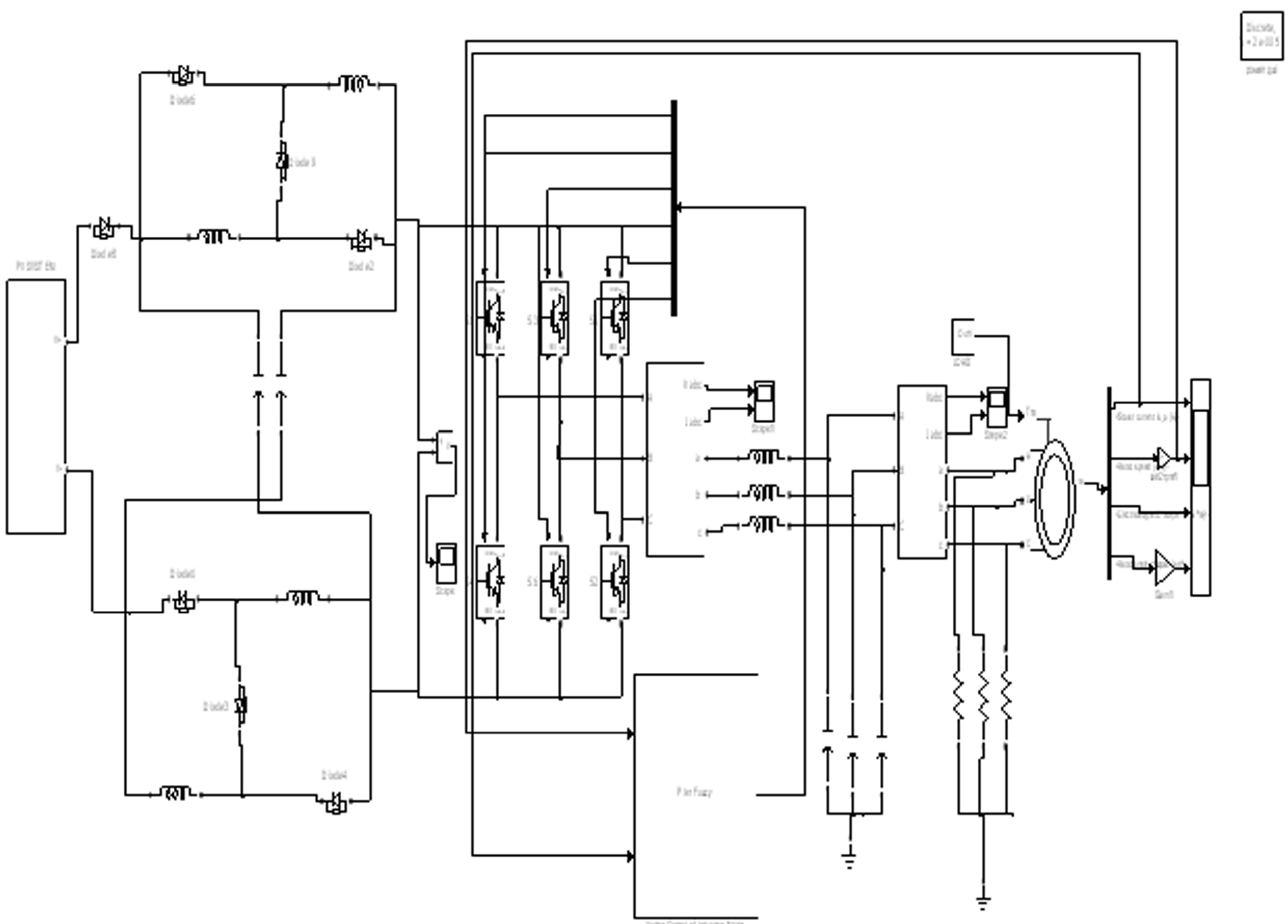

Figure 15: Simulink Proposed Configuration of induction motor

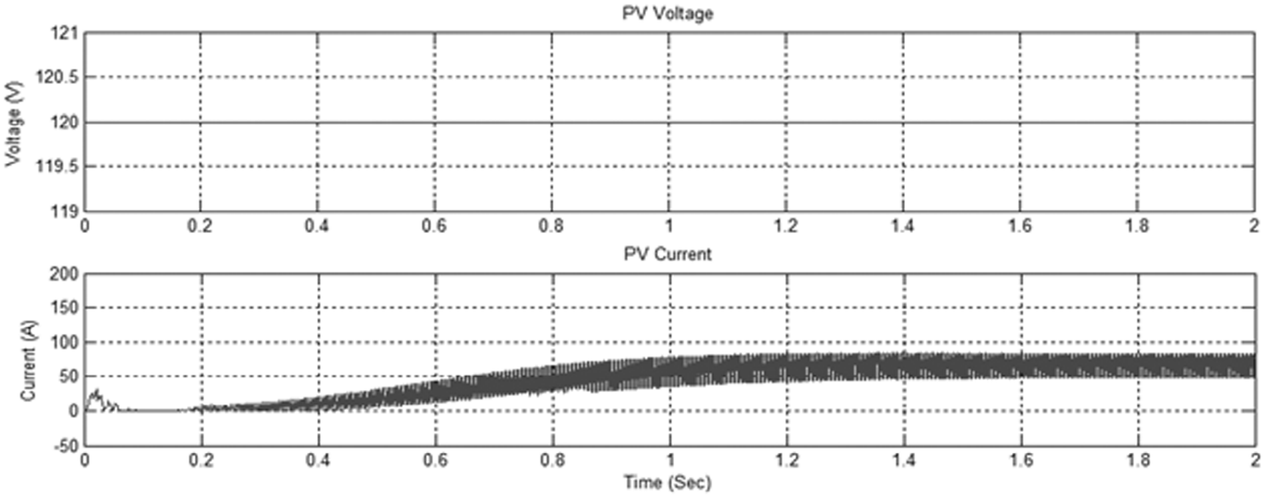

Figure 16: Voltage and Current Waveform of PV

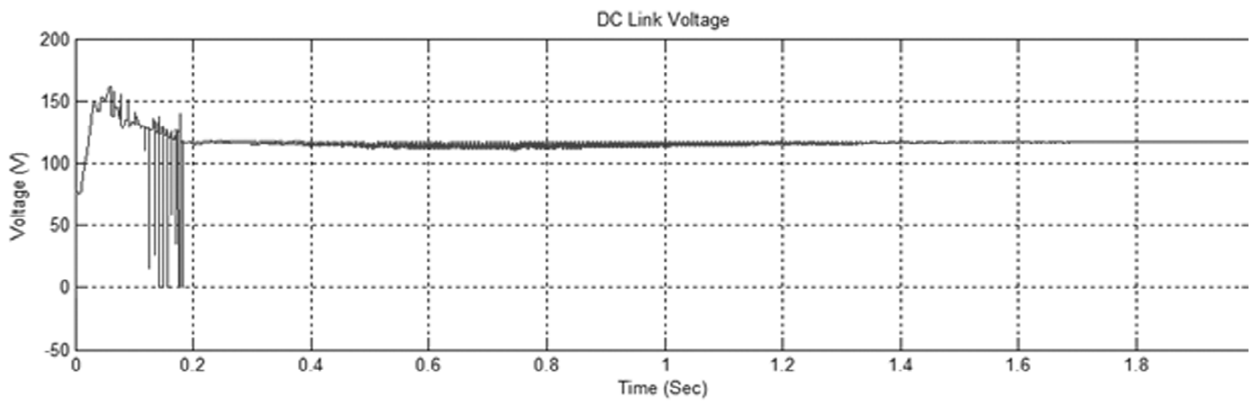

Figure 17: DC Link Capacitor across Voltage

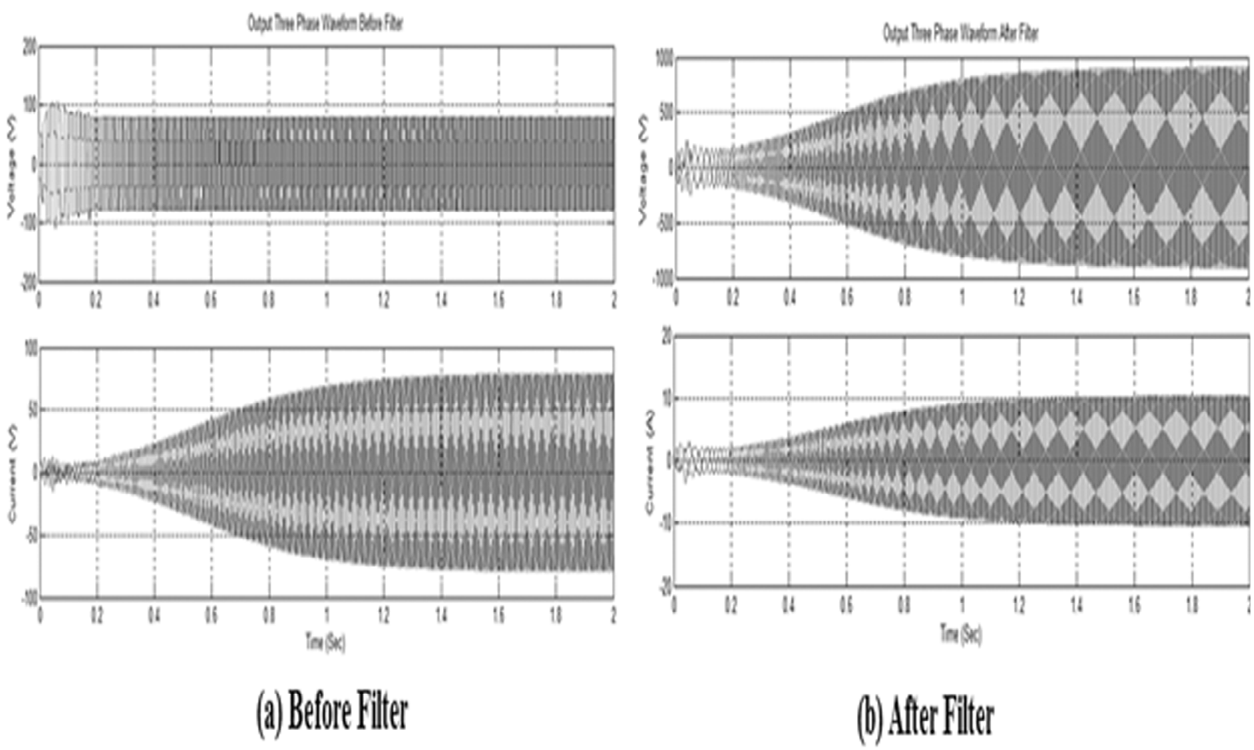

Figure 18: (a) PI controller based Three Phase Output Voltage and current waveform

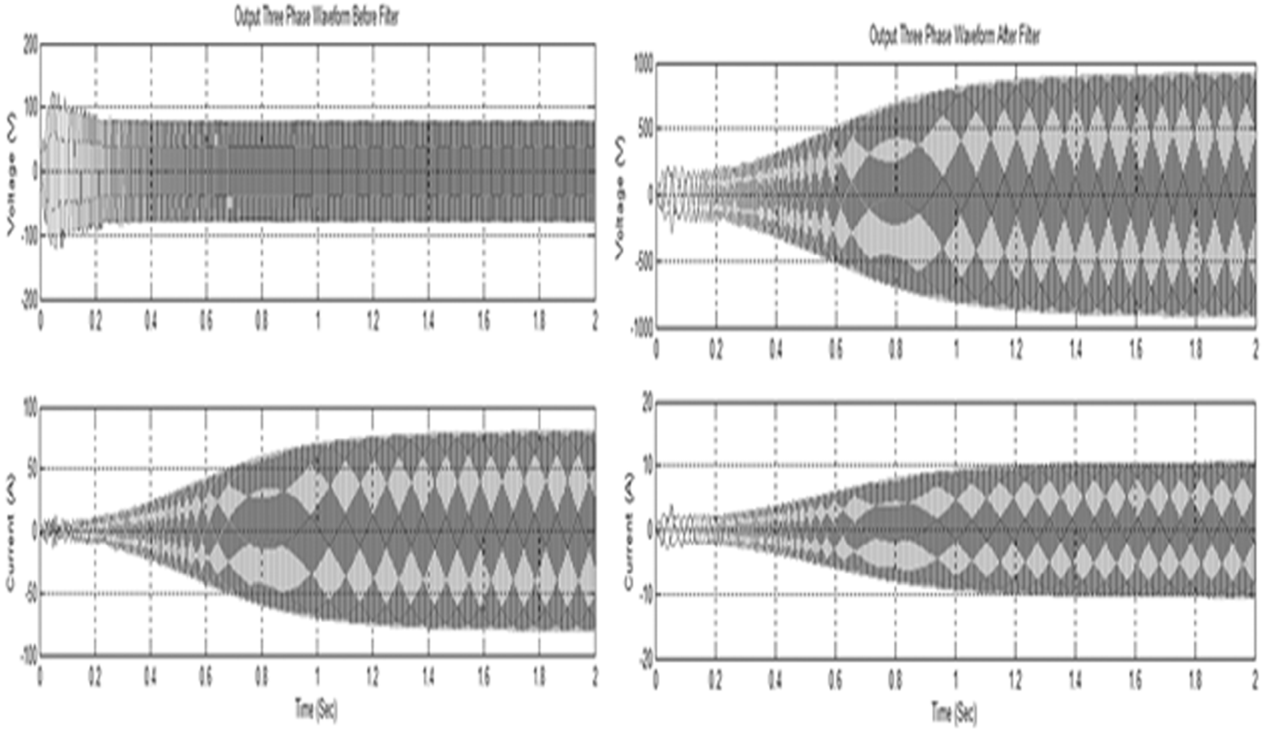

Figure 18: (b) FLC Controller based Three Phase Output Voltage and current waveform

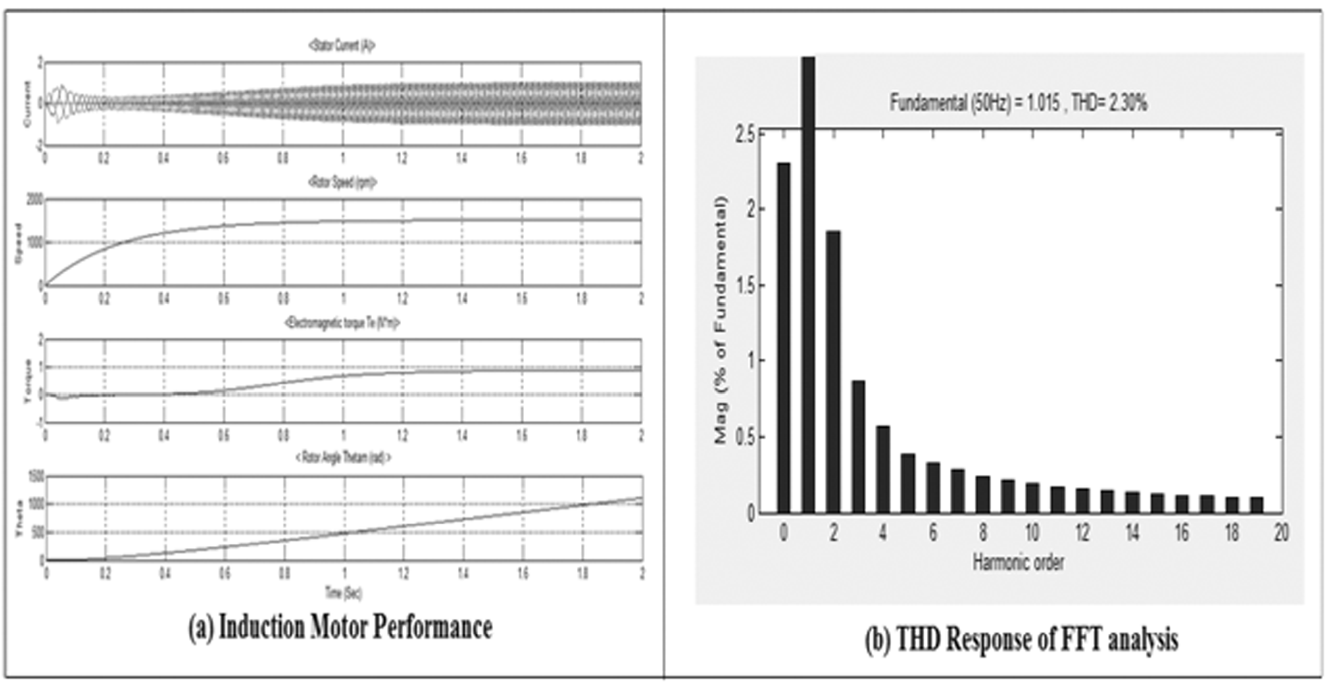

Figure 19: (a) PI based Vector Control of Induction Motor

The induction motor performance curve of stator current, rotor speed, electromagnetic torque and rotor angel thetam versus time of PI controller are shown in figure 19 (a) respectively. The corresponding response of THD is shown in figure 19 (b) and also the stator current of harmonics is much observed. Similary, the response curve of stator current, speed, torque and angle v/s time of Fuzzy Logic Controller (FLC) are shown in figure 20 (a) and FFT analysis of THD is shown in figure 20 (b). Here, it is mentioned that stator current does not display any undershoots and overshoots response of the speed wave takes less time to reach with settle the desired value.

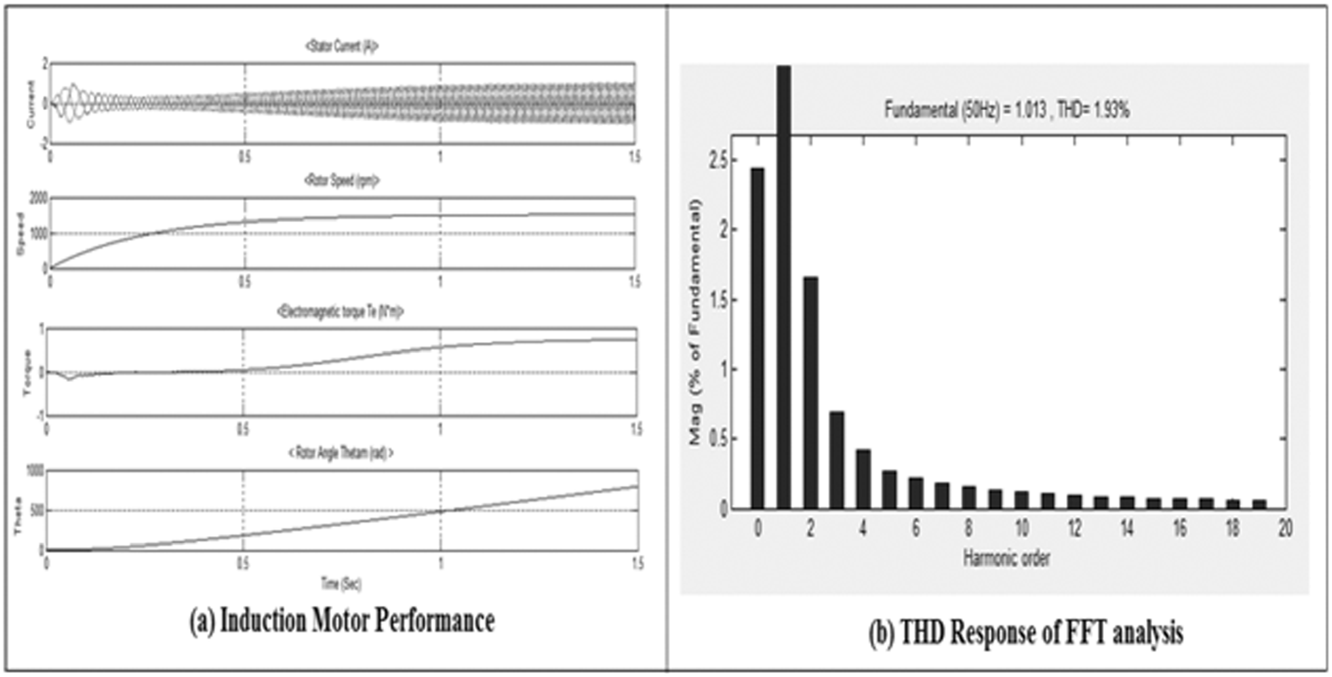

Figure 19: (b) FLC based Vector Control of Induction Motor

6. CONCLUSION

This paper proposes the dynamic model of solar array based switched inductor Z source inverter (SL-ZSI) for variable speed drive system. The vector control based speed regulation has been designed and verified with capable of soft start induction motor. The reference current generation based PWM method is used to analysis with proporational integral (PI) and Fuzzy Logic Controllter (FLC) for achieving soft start capability. Here, the stator current response of FL controller is performed better than PI controller performance with respect to steady state error and rise time. The obtained simulation results have supported the very good robustness and dynamic performance the fuzzy logic controller during sudden change in load and transient period. In order to achieve better efficiency and reliability of drive system are more in the case of Fuzzy Logic Control instead than that of PI Control. From the above simulation results is mentioned the settling time taken by the FLC is less equated to that of PI controller and also from the FFT analysis carried out for different start time. Here, it is detected the percentage THD related with range of Fuzzy logic controller is around 1.93% less compared to 2.30% of PI controller. In future, an advanced impedance source network based system configuration will be analysed with both combination of aritificial neural network (ANN) and Fuzzy Logic Inference System for attaining better soft start capability of variable speed drive application.

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