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## Hysteresis controlled Quasi Z-Source inverter Fed Induction Motor drive system with Enhanced Response

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**ABSTRACT**: In this project, This effort deals with enhancement in dynamic response of QZSI fed induction motor framework". The objective of this effort is to develop a closed loop controlled QZSI fed induction motor framework that provides a steady rotor speed. - This has been realized using closed loop controlled QZSIIMD framework. The 'QZSI' is exploited to switch it to 'three phase-AC'. The yield of-3phase-inverter is sorted before it is applied to a '3phase-Induction-motor using a OTT filter'. The methodology involves simulation of open-loop QZSI IMD system and closed loop PR and HC controlled QZSI-IMD systems. The result obtained using Proportional-Resonant (PR) controlled QZSI-IMD system is compared with Hysteresis controlled QZSI-IMD system. The proposed Hysteresis controlled QZSI-IMD system has advantages like low settling time and fewer peaks over shoot.

**KEYWORDS**: Switched inductor quasi z source inverter, Boost inversion ability, Shoot through duty ratio, Total Harmonic Distortion.

#### I. INTRODUCTION

Future interest contemplations, lead diverse nations to utilize sustainable power sources as a brilliant option for petroleum derivatives. With the development of use of the sustainable power sources, PE converters have been progressively appropriate in this field. Contingent upon the application, the power converter requires explicit highlights, for example, voltage increase, measure, productivity, cost, and so forth. "A control procedure for parallel activity of single-phase VSI: investigation, structure and test outcomes" was created by Telles. The control framework for every inverter comprises of two fundamental circles, which both utilize immediate qualities [1]. "Enhanced ZSI with diminished Z-source capacitor voltage stress and delicate begin ability" was introduced by Tang. This work proposes an enhanced ZSI topology. Contrasted with the conventional ZSI, it can diminish the ZSI- voltage stress essentially to play out a similar voltage help, and has innate restriction to inrush current at start up. The-control technique of the recommended ZSI is actually equivalent to the conventional one, so all the current control system can be utilized legitimately. A delicate begin system is additionally recommended to smother the-inrush surge and the reverberation of Z-source capacitors and inductors [2].

"Based on the traditional-ZSI, this exhibits a created impedance-type power-inverter that is named the exchanged inductor (SL)ZSI". To extend voltage-movability, the recommended-inverter utilizes an interesting SL-impedance system to -couple the-principle-circuit and the power source[3]. Two exchanged inductor semi ZSI was created by Lim. In this investigation, two topologies are displayed for exchanged inductor-qZSI, to be specific a ripple information current exchanged inductor -QZSI and a ceaseless info current exchanged inductor QZSI. The recommended inverters have high—lift-voltage reversal capacity &a lower-voltage-stress over the dynamic exchanging gadgets. Contrasted and a customary exchanged-inductor ZSI, the recommended SLQZSI's for a similar information and yield voltage give a constant information-current& a diminished voltage-weight on the capacitors [4]. Examination and PWM control of exchanged boost-inverter was recommended by Joshi [5]. These permits shoot through exchanging condition of inverter legs to support the information voltage. The altered-PWM techniques utilized to consolidate the shoot through interim in each exchanging cycle. The harmonic- range of the inverters yield voltage likewise plotted. Current-Fed Switched Inverter[6]. Expanded boost-dynamic exchanged capacitor/exchanged inductor QZSI was introduced by Ho. In the event that a-higher-boosting-rate is entailed, extra-cells can without much of a stretch be fell at the impedance arrange by including 1inductor and 3 diodes [7]. A class of quasi-switched boost inverters was given by Ho [8].



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Created installed exchanged ZSI was displayed by Laali [9]. In this investigation, another topology for exchanged ZSi was proposed. Decrease of weight, size and cost are the primary favourable circumstances of the proposed topology. Likewise, this inverter can take care of the issue of short out over the inverter leg and comprises of higher estimation of voltage gain when contrasted and the regular exchanged boost-inverter. Additionally, the created topology of the proposed inverter dependent on exchanged inductor cells is introduced [10]. "Upgraded boost-ZSI with exchanged Z impedance" was introduced by Fathi [11]. This proposed another topology for an upgraded boost-ZSI with joined two Z-impedance systems. In customary ZSIs for elevated boosting-voltage, a diminish adjustment record is entailed; subsequently, under these circumstances, the yield voltage will have diminished-quality. Contrasted and the traditional elevated-boost ZSI topologies, the recommended-inverter utilizes shorter shoot-through term and a bigger regulation record to improve the yield waveform quality.

#### **II. EXISTING METHOD**

The block diagram of PR controlled QZSI system is exposed in Fig. 1. DC is converted to three-phase AC using QZSI. The yield of QZSI is transmitted to TPIM. The speed is regulated using a PR controller.



Fig. 1 Block Diagram of PRC controlled QZSI System'

Utilizing the PR controllers, the converter reference following execution can be upgraded and recently realized inadequacies related with traditional PI controllers can be reduced. These inadequacies incorporate unfaltering state mistakes in single-phase-frameworks and the requirement for synchronous d-q change in 3phase frameworks. Another preferred position - related with the PR controllers &filters is the likelihood of actualizing particular harmonic-remuneration without requiring inordinate computational assets. A portion of the benefit of PR controller is-that-it is broadly utilized in the grid interfaced converters.



Fig. 2. Schematic Diagram of PR-controller



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#### III. PROPOSED METHOD

The 'block diagram of proposed HC-QZSI system' is delineated in Fig. 2. The speed is evaluated with the reference speed and the error is directed to a HC controller. The 'yield of HC' controls the pulse width of the rectifier.



Fig. 3. Block diagram of Proposed-Hysteresis controlled QZSI IMD System

The hysteresis band is estimated as follows: "I u = I + r/2" "I l = I - r/2" The advantage of HC is that lower and upper current-limits are fixed.

#### Hysteresis controller:

Basic self oscillating controllers based on hysteresis are well described .The hysteresis controller can be made with either a current or a voltage loop. The benefits of hysteresis controllers are primarily the linear modulation caused by the sawtooth-shaped carrier with ideally straight slopes, and by the infinite power supply rejection ratio, PSRR, if the supply variation can be considered very slow compared to the switching frequency. Power supply variations at higher frequencies are not suppressed totally, and will result in sum and difference products of the reference signal and the power supply variation, but these still meets high suppression. For use in audio amplifier applications, the hysteresis controller is very desirable due to the high linearity and simple design. However, hysteresis controllers suffers from a switching frequency dependent on the modulation index, M, of the amplifier. All other basic types of self oscillating modulators suffer from this phenomenon too.

The basic operation of the current mode hysteresis controller is: The output inductor integrates the differential voltage between the output voltage of the power stage and the output voltage of the amplifier. If the output voltage of the amplifier can be considered constant within one switching period, the integration results in a sawtooth shaped inductor current, which is subtracted from the reference current programming voltage, and fed into a hysteresis window to control the switching frequency by controlling the time-delay trough the controller loop. The voltage mode hysteresis controller differs from the current mode controller by integrating the difference between the output voltage of the power stage and the input reference voltage with an active integrator, which again results in a saw tooth shaped carrier that is fed to a hysteresis window. The major functional difference between the two is that the current mode controller is a voltage controlled current source with an integrated output filter. The voltage mode controller is a voltage controlled voltage source without output filter. Both controllers have a first order closed loop function. In switch mode audio amplifier applications some additional control feedback loops are often desired to reduce distortion caused by non-linearity in the circuit. Furthermore if a current mode controller is used, a voltage feedback control loop is required since an audio amplifier as often is a voltage amplifier. To reduce distortion as much as possible, it is desired to apply the voltage feedback after the output filter, so errors from both power stage and output filter will be reduced. The biggest drawback with basic hysteresis controllers used in audio and a lot of other applications are the non-constant switching frequency. In the ideal model for a hysteresis controller, the switching frequency is dependent on the modulation index, M, by:

The variation in switching frequency basically causes two main functional problems: Increased high frequency ripple voltage on the output at high modulation index caused by less attenuation of the lower switching frequency's harmonics, and reduced open loop bandwidth and -loop gain, causing increased distortion as well. A variable hysteresis window that follows M, or the absolute value of the input signal, has been proposed in prior art [3]. If the variable hysteresis



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window is made such that it follows the square of the absolute value as well as the derivative of the input signal, the switching frequency can be made constant, but at a much higher system complexity than the basic design. In this paper a second integrator block inserted before the hysteresis window in either a current or a voltage mode controller is proposed to obtain a close to constant switching frequency, regardless of M.



Fig. 4. Proposed current and voltage mode controller

The proposed modulator is shown in Figure 4 for both current and voltage mode operation. The extra integrator integrates the sign of the first saw tooth shaped carrier signal that results in a pure triangular shaped second carrier overlapped by the reference signal.



Fig. 5. Circuit diagram of hysteresis controller

In this closed loop hysteresis controlled Qzsi system proportional resonant controller is substituted by a hysteresis controller actual speed is compared with reference speed to obtain the speed error. Then the error is applied to the hysteresis controller. the output of the hysteresis controller is used to update the pulse-width of semi-conductor. Fig. 5 shows the circuit diagram of hysteresis controller.



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IV. SIMULATION RESULTS

CASE 1: SIMULATION RESULTS BY USING PR CONTROLLER



Fig. 6. Input voltage



Fig. 7. Output voltage



Fig. 8. Load current

Fig. 9. Rotor speed

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Fig. 10. Rotor Torque

CASE 2. SIMULATION RESULTS BY USING HC CONTROLLER



Fig. 11.  $V_G$ 



Fig. 12. Vout







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Fig. 14. Rotor speed

The PWM signal to the power stage is made from the second carrier signal fed into a hysteresis window. The modulator loop has maintained a 1st order behaviour at high frequencies, since the first comparator effectively differentiates the high frequencies, and followed by the second integrator, the -90° phase shift at high frequencies is maintained. The variable modulator forward gain is made by the second carrier signal, which will be a triangular shaped signal overlapped by the reference signal. For a DC reference signal, the second integrator will simply increase the forward gain by shift the second carrier signal with respect to ground, and ideally obtaining exactly the same forward gain and thereby the same switching frequency at all modulation indexes, M. The ability of keeping the switching frequency constant depends on the slopes of the reference signal, since the correction of the falling switching frequency will have larger deviations from a constant value with high frequency reference signals at high levels, but if the time constant of the second integrator is high compared to the corresponding time constant for the reference signal, only small variations will occur at the switching frequency. Because of the constant switching frequency, the open loop gain and -bandwidth is maintained, and performance of the controller is not reduced at high M.

#### V. CONCLUSION

Matlab based qzsi-imd system is successfully designed formed and simulated utilizing pi, pr and hysteresis controllers. the speed is successfully regulated using hc controller. Closed-loop-simulation results are analysed and they are summarized here. The 'steady-state-error' is 2.3 rpm and the 'settling-time' is 4.0 sec. the simulation results indicate that the response of of hc-qzsi is better than that pi, pr-qzsi systems. the contribution of this effort is to enhance-the-dynamic response-of qzsi-imd utilizing HC. the benefits of hc-qzsi are high gain and low thd. the disadvantage is that the circuit requires eight switches. the closed loop system needs two additional controlled switches. The present effort pacts with evaluation of pi, pr and hysteresis controlled qzsi. The comparison between HC and slide mode controlled-qzsi-imds will be done in future. the hc-qzsi-imds can be extended to handle high power. The control circuit may be implemented using fpga to increase the switching frequency.

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