Comparison of PI and PID Controlled Current Fed QZSI based Induction Motor Drive Systems

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Abstract

Objectives: To improve response of QZSIIMD system. This work aims to reduce settling time and steady state error. Method used: The computations the simulation is done using state space method. Findings: The present work has proposed QZSI for the control of induction motor. The speed response of QZSIIMD system is studied with a positive step change in input. Settling in found to be reduced by 71% and steady state error is reduced by 80% by using PIDC. Applications: The proposed QZSIIMD and system is suitable for textile and paper mills.

Keywords: FL Control, Induction Motor, QZS Inverter

1. Introduction

Current-Source quasi-Z-source inverter with voltage step up / step down and regeneration capability is suggested by Shuitao1. Steady-state performance of current-fed PWMI drives is given by Bullough2. Comparison of PI and PID Controlled Wind turbine Fed Γ- Z Source based PMSM Drives is suggested by Jaffar3. Coordination of PSS and PID Controller for Power System Stability improvement is presented by Kasilingam4. Improvement in the Synchronization method of the VSC Connected to the Grid by PLL is given by Mahdian5. Fuzzy Logic and Firefly Algorithm based mixed System for Efficient Operation of Three Phase Induction Motor Drives is presented by Sundaram6. Carrier-based PWMVSI over modulation strategies: are given by Hava7. Dead-band PWM switching patterns is given by Agelidis8. Minimum-loss vector PWM strategy for three-phase inverters is suggested by Trzynadlowski9. Power losses for SVM techniques is presented by Pinewski10. New SVM-based harmonic elimination inverter control is given by Singh Grewal11. The relationship between space-vector modulation and regular-sampled PWM is suggested by YenShin12. Space-vector PWM voltage control with optimized switch in strategy is presented by Yukosavic13. SVMS applied to interphase transformers-based five-level is suggested by Dupczak14. PWM modulation for CSC is given by Vanaparthy15. Z-source current-type inverters: digital modulation and logic implementation is presented by Vilathgamuwa16. A critical evaluation of PWM methods is given by Boost17. An active modulation technique for single-phase grid-connected CSIs suggested by Chung18. An SVPWM-Based switching pattern for isolated and grid-connected three-phase SBI suggested by Mirafzal14. Use of hybrid PWM and passive resonant Snubber for a grid-connected CSI is presented by Chung19. DC-Link Current Minimization for High-Power CSI fed Motor Drives is presented by Zargari20.

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Application of discontinuous PWM modulation in active power filters is presented by Asiminoaei. 

The literature does not deal with the comparison of PI and PID controlled QZSIMD systems. This work proposes QZSI for the control of the induction motor. The circuit configuration of CF-QZSI is shown in Figure 1. The Q-Z network uses a coupled inductor and two capacitors.

![Circuit configuration of CF-QZSI.](image)

**Figure 1.** Circuit configuration of the CF-QZSI.

### 2. Simulation Results

The open loop and closed loop drive systems are represented using MATLAB package. The open loop controlled QZSIMD system is shown in Figure 2. A step change in wind speed is considered. Output voltage of wind generator is shown in Figure 3. The output of QZSI is shown in Figures 2, 3. The voltage increases from 380 to 490 volts, due to the increase in the wind speed. The speed and torque responses are shown in Figures 4 and 5 respectively. It can be seen that the steady state error in output of QZN is very high.

![Open loop circuit.](image)

**Figure 2.** Open loop circuit.

![Output voltage of the wind generator.](image)

**Figure 3.** Output voltage of the wind generator.

The simulink model of closed loop QZSIMD system with PI controller is shown in Figure 6. The output voltage of QZ network is sensed and it is compared with the needed voltage. The error is applied to a PI controller. The output of PI controller is compared with the triangular signal to generate the pulses required by the MOSFETs of the semi converter. The output voltage of wind generator and QZ network are shown in Figures 7 and 8 respectively. From the Figure 8 the output voltage is regulated. The speed and torque responses are shown in Figure 9 and Figure 10 respectively.

![Output voltage of Quasi-Z source.](image)

**Figure 4.** Output voltage of Quasi -Z source.

![Motor speed.](image)

**Figure 5.** Motor speed.

![Torque.](image)

**Figure 6.** Torque.
The closed loop PID controlled QZSI fed induction motor drive is shown in Figure 11. The PI controller in the above system is replaced by a PID controller. Output voltage of wind generator and QZ network are shown in Figures 12 and 13 respectively. The speed response and torque response of the QZSIMD are shown in Figures 14 and 15 respectively. The comparison of the response of PI and PID controlled systems are given in Table 1. The comparison indicates that the response of PID controlled system is better than that of the PICS.
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3. Findings

The CF-QZSI is suitable for low voltage application. The settling time is reduced from 1.4 to 1 second using PID controller and the steady state.

4. Conclusion

The PI and PID controlled QZSI fed induction motor drive systems are compared in terms of torque, settling time and error in speed from the comparison, it was concluded that the dynamic response of PID controlled system is superior to PI controlled system. The numbers of passive elements are reduced, since the coupled inductor is used. The disadvantage of QZSI network is that it needs two big capacitors.

The present work deals with modeling and simulation of PI and PID controlled QZSI drive systems. The comparison of PID and Fuzzy logic controlled drive systems will be done in future.

5. References

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