PROPORTIONAL-INTEGRAL CONTROLLED BOOSTRAP CONVERTER SVM INVERTER BASED INDUCTION MOTOR DRIVE

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ABSTRACT

This project is based on cascaded bootstrap converter with SVM inverter for induction-motor drive. This work is planned to improve the speed-regulation of boot strapped converter-inverter fed Induction Motor drive (BSC-SVMIIM) utilizing PI controller. This work manages examination amongst open-loop and PI controlled BSC-SVMIIM systems. The BSC is suggested between rectifier and SVMI to enhance the voltage gain. PI is proposed to improve the dynamic response of BSC-SVMIIM. The objective of this work is to enhance the response of BSC-SVMIIM system using suitable controller in closed loop. Open loop BSC-SVMIIM system with disturbance and closed loop PI based BSC-SVMIIM systems are composed; displayed and recreated utilizing Simulink and their outcomes are introduced. Evaluation is done in terms of settling time and steady state error. The examinations demonstrate the unrivaled execution of controlled BSC-SVMIIM system. The proposed system has preferences like little harmonic content and fast response.

I. INTRODUCTION

There are many applications with high-voltage sources fed, such as the burn-in test plant with energy recycling, the dc–dc converter used in the car as the pre stage of the de–ac converter, etc. Hence, it is indispensable for low voltage to be boosted to high voltage. In general, the boost or Buck-boost converter is widely used in such applications. However, it is not easy for such converters to achieve high voltage ratio. In theory, the voltage ratios of these two converters can reach infinity but, in actuality, about four or five, limited by parasitic component effect and controller capability.

Predictive Control of Vienna Rectifiers for PMSG Systems is presented by Lee. The proposed predictive control takes eight feasible switching vectors of Vienna rectifiers into account; therefore, the computational burden, which is a disadvantage of the predictive control for ac/dc converters, decreases.

Time-Offset Injection Method for Neutral-Point AC Ripple Voltage Reduction in a Three-Level Inverter is suggested by Lee. These algorithms are divided into dc unbalance and ac unbalance compensation methods. The dc unbalance causes distortion of output currents; therefore, this problem has to be solved. The ac unbalance implies that there is an ac ripple in the top- and bottom-side dc-link voltages [1-2]. Comprehensive analysis of three-phase three-level LC-type resonant DC/DC converter with variable frequency control-series resonant converter is introducing by Chen [3]. A flying capacitor multilevel converter with sampled valley-current detection for multi-mode operation and capacitor voltage balancing Foo [4].

Author presented simple algorithm with fast dynamics for cascaded H-bridge multilevel inverter based on model predictive control method [6]. A new MPC algorithm is proposed in this paper for decreasing the number of calculations in multi-level CHB inverters, in which only three voltage vectors are evaluated to determine optimal vectors regardless of the level of CHB inverters.

Performance analysis of flexible multi-level converter for high voltage photovoltaic grid connected system is suggested by Lu [7]. In this paper, a flexible multilevel converter is proposed and its topology derivation process is introduced. The proposed flexible multilevel converter can adaptively work as a single-stage three-level NPC converter under high PV voltage and as a two-stage five-level converter under low PV voltage.
Author presented amplified model and control strategy of three-phase PWM current source rectifiers for dc voltage power supply applications. Common-mode voltage mitigation for back-to-back current-source converter with optimal space-vector modulation is given by Wu [8-10].

A family of zero-current-transition transformerless photovoltaic grid-connected inverter is presented by Lan. A novel CH5 inverter for single-phase transformerless photovoltaic system applications [11-13]. In this brief, a novel single-phase current source H5 (CH5) inverter is proposed. Only one extra IGBT is needed, but the leakage current can be significantly suppressed with a novel space vector modulation.

Hardware-based cascaded topology and modulation strategy with leakage current reduction for transformerless PV systems is presented by Jia. Three-Phase CH7 Inverter with a New Space Vector Modulation to Reduce Leakage Current for Transformerless Photovoltaic Systems is suggested by Guo.

According to the number of segments, the space vector modulation (SVM) can divide into conventional SVM sequence (CSVMS) and special SVM sequence (SSVMS). It is well known that SVM can be equivalently realized by carrier-based pulse width modulation (CBPWM) with a zero-component injection in both two-level and three-level inverters [14-15].

A Comprehensive Study on Equivalent Modulation Waveforms of the SVM Sequence for Three-Level Inverters. In this paper, the popular modulation sequences used for the three-level neutral point clamped converter (3L-NPC) are unified from a new and intuitive perspective. Based on the discovered correlation and pattern, a general method for modulation sequences generating is proposed, and a series of new modulation sequences are deducted according to several easily applied rules.

A space-vector modulation method for common-mode voltage reduction in current-source converters is presented by Wei. Predictive torque control scheme for three-phase four-switch inverter-fed induction motor drives with DC-link voltages offset suppression is introducing Liu [16-19].

This paper proposes a general space-vector (SV) modulation method for the optimal on-line reduction of the switching losses in any n-multilevel inverter. The proposed method consists of two steps. One is a general principle for generation of the SV map for an arbitrary n-level type to utilize redundant SV’s [20].

A general space vector PWM scheme for multilevel inverters is introducing Chen. This paper proposes a new general space vector pulse-width modulation (SVPWM) scheme for multilevel inverters with any voltage levels. The proposed SVPWM scheme calculates the duty cycles and switching states based on the modulation triangle quickly identified through a simple coordinate transformation; no pre-stored memory-consuming lookup table or time-consuming iterative calculation is required [20-22]. A five-level diode clamped rectifier with novel capacitor voltage balancing scheme is Agarwal.

Simple diagnostic technique of a single IGBT open-circuit faults for a SVM-VSI vector controlled induction motor drive is presented by Sobanski. Space-vector based hybrid pulse width modulation technique for a three-level inverter is introducing by Pandey.

Author introducing simplified space vector modulation technique for seven-level cascaded H-bridge inverter [23-25].

Research Gap

The exceeding-writing do not deal with comparison of -Boost- strap-Converter-Inverter-System in open-loop and closed loop system with PI - controller. This work proposes PI for the control of BSC-SVMIIIM. The simulation results of PI a controlled BSC-SVMIIIM are presented here. The purpose of this effort is to reduce steady state error and settling time of BSC-SVMIIIM using FOPID.

System Description

“Block-Diagram of PI controlled BSC-SVMIIIM system is shown in Figure.1. The Speed of IM is sensed and it is evaluated with the reference speed to get speed-Error (SE). This SE is directed to a PI-controller. The ‘yield of PI’ is used to obtain ref.current. The ref.current is compared with actual-current and the current-error is applied to a PI-controller. The output of current-PI is used to adjust the Pulse Width (PW) of BSC.

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Simulation Results
The designed converter was first simulated using Matlab to verify the analysis, design, and performance of the converter. Bootstrap converter with SVM inverter for load disturbance is delineated in Figure 2.

Input voltage with SVM inverter for load disturbance is appeared in Figure 3. The value of input voltage is 170V. Circuit diagram of bootstrap converter is shown in Figure 4.
Voltage across bootstrap converter with bootstrap converter is presented in Figure 5. Voltage across bootstrap converter is value is 410 Volts. Voltage across motor of BSC-SVMI system with load disturbance is shown in Figure 6 and its value is 450 Volts.

Motor speed of BSC-SVMI system with load disturbance is shown in Figure 7. The value of Motor speed is 1300 RPM.
**Figure 7: Motor speed BSC-SVMI system with load disturbance**

Motor speed- zoom out of BSC-SVMI system with load disturbance and the value of Motor speed at 1294 RPM is shown in figure 8. The Motor Torque of BSC-SVMI system with load disturbance is shown in Figure 9 and the value of Motor Torque 1 N-m.

**Figure 8: Motor speeds zoom out of BSC-SVMI system with load disturbance**

**Figure 9: Motor Torque of BSC-SVMI system with load disturbance**

Circuit diagram of BSC-SVMI system with PI controller is shown in Figure 10. The input voltage of BSC-SVMI system is appeared in figure 11 and it value is 170volts.

**Figure 10: Circuit diagram of BSC-SVMI system with PI controller**
The circuit diagram of bootstrap converter is shown in Figure 12. The value of voltage across bootstrap converter of BSC-SVMI system with PI controller is 400 Volts and it is presented in figure 13.

The voltage across motor load of BSC-SVMI system with PI controller is shown in figure 14. The motor load value is 450 volts.
Figure 14: Voltage across motor load of BSC-SVMI system with PI controller

Motor speed of BSC-SVMI system with PI controller is shown in Figure 15 and its value is 1250RPM.

Figure 15: Motor speed of BSC-SVMI system with PI controller

Zoomed Motor speed of BSC-SVMI system with PI controller is shown in Figure 16. The value of motor speed zoom out 1290 RPM.

Figure 16: Motor speed zoom out with SVM inverter of PI controller

Motor Torque with of BSC-SVMI system with PI controller is delineated in Figure 17. The motor torque value is 1N-m.

Figure 17: Motor Torque with SVM inverter of PI controller
II. CONCLUSION

Open loop and Closed loop BSC-SVMI systems with Proportional integral controllers are modeled and simulated using MATLAB Simulink. The simulation outcomes of closed loop system with PI are presented. The settling time for speed is 2.46 Sec and steady state error is 0.8 RPM by using PI controller. Thus, the response of PI controlled system is superior to open-loop controlled BSC-SVMI system. The benefits of proposed system are little harmonic content and fast response. The drawback of Quadratic boost converter is that it is appropriate for low power.

The present work deals with investigations on PI controlled BSC-SVMIIM. The investigations on Hysteresis controlled BSC-SVMIIM will be done in future and the results QBC SVMI with PR controller will be compared with SBC- SVMI with HC controller.

REFERENCES


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