

Analysis of Vector Control of AC Motor Drive based Closed-loop System

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Abstract - The Z-source converter overcomes the traditional voltage-source and current-source converter's conceptual and theoretical barriers and limitations and provides an advanced power conversion concept. The Z-source inverter system can produce an output voltage greater than the dc input voltage by controlling the shoot-through duty ratio, which is impossible for the traditional ASD systems. This work described the operating principle, analyzed the circuit characteristics, and demonstrated its concept and superiority. Different PWM techniques and their comparison are presented. The maximum constant boost control method is more advantageous than the other PWM control methods. Maximum constant boost with third harmonic injection PWM control method increases output voltage boost while minimizing voltage stresses across switching devices. It allows over-modulation where the modulation index can be varied from 0.57 to 1.154. Z-Source inverter fed IM drive system is simulated using Simulink software using the above described PWM method. Results of simulation are compared with traditional PWM inverter.

Keywords:- AC Motor, PWM, ASD, Z- Source, CSI.

1. INTRODUCTION

In some applications, such as battery, photovoltaic, or fuel cell systems, the load requires a greater DC voltage than the source voltage. In this case, the use of the DC-DC converter is essential for efficiency reasons. Traditionally, a pressure transducer can be used to increase the input voltage too high voltage levels. For example, the other topology is used to increase the input voltage. The flyback converter and current transformer derive from the boost converter. In addition, galvanic isolation between input and output grounds is the main requirement in many applications of DC-DC converter to prevent DC flow between input ground and output ground.

The direct current flowing between the input and output grounds can reduce system reliability and cause load side failures. If galvanic isolation between the input and output stages is a problem compared to conventional boosters, this is impractical, and transformer-based DC / DC converters must be used. The transformer-based main booster converter is indirect because it is derived from a step-down converter. The flyback converter is typically used up to 100–150 watts. However, there are some disadvantages of increasing load power and power demand. The

switch voltage is high due to the topology. If the output power also increases, the energy stored in the parasitic induction of the transformer increases significantly and causes a large voltage spike in the switch. This phenomenon limits the output power of the converter. When the total power requirement exceeds 250-300 watts, the load for the separate DC / DC converters is preferable to the full-bridge structure. The conventional full-bridge topology reduces the input voltage to a lower level, which is usually a one-dollar differential, as the energy taken from the source is quickly transferred to the load.

However, a step-up transformer with a full-bridge voltage-supplied converter and a full-bridge current-fed converter may be used for boosting applications. A voltage-supply full-bridge converter for upstream application has already been analyzed, and the effect of transformer ratio and transformer parasitic induction and output induction. This pin shows that the effective current flowing in the MOSFETs increases as the current ratio of the transformer increases. It leads to a greater power loss and a reduced conversion efficiency of the MOSFETs. Another study, described in the literature, of using a full-voltage DC to DC converter has minimized switching losses in MOSFETs and line losses in transformers.

2. LITERATURE SURVEY

Mosa [6] presents a predictive control strategy for a three-phase qZSI that fulfills these requirements without adding additional control loops layers. The approach is to improve the overall performance of the converter with a switching strategy that reduces inverter switching losses. In this paper, author Vafaie[7] shows a new advanced deadbeat direct torque and flux control (ADBDFTC) system is proposed to improve the permanent magnet synchronous motor's steady-state and transient state performances by adopting two improved deadbeat methods. Chung [8] described A sensorless FSTP AC motors driver based on six space-vectors based on cost down strategy. Due to the low resolution of the position sensing scheme, the speed variable sampling effect is rising. A fuzzy gain scheduling PI controller is proposed. Chowdhury [9] In the simulation model, introduced the four switches three-phase ACW' motor drive in which the rotor position is estimated using back EMF detection technique. Madhurima [10] A simulation model has been developed to study the behavioral characteristic of

a Brushless DC motor and analyses the harmonics present in the stator current, rotor speed, and acceleration of the BLDC drive circuit. Hence in order to improve the accuracy of the motor drive control system, we have introduced a denoising module in the feedback path. Vashist [11] aims at the design of BL-Zeta (bridgeless Zeta) converter fed BLDC (Brushless DC) motor drive. A single voltage sensor is used for achieving PFC (Power Factor Correction) and DC link voltage control. Unlike the conventional approach of using a PWM (Pulse Width Modulation) switching of VSI (Voltage Source Inverter), a new speed control approach is used to control the voltage at the DC link of VSI.

3. PROBLEM STATEMENT

A Shoot-through state is allowed by switching on all devices in the main inverter; thus, EMI noise does not affect the operation of the Z-source inverter. This shoot-through state does not allow in the traditional inverter. The low-frequency ripples in the inductor current and capacitor voltage are eliminated. The output voltage can be boosted to any desired value by varying shoot-through period T_0 in zero states without changing the active state for a fixed modulation index. Two straight lines determine the Shoot-through state, so it is easier to maintain a constant shoot-through state and hence the boost factor for all the time. Component size (L & C) and hence cost required less as compared to traditional PWM inverter. Stator current is smooth as compared with the traditional PWM inverter. Small permissible ripples in stator current are observed at the lower carrier frequency, and a very smooth stator current is observed at the higher carrier frequency.

4. PROPOSED ALGORITHM

It employs an impedance network to couple the main converter circuit to the source. It provides unique features that cannot be observed in traditional V and I source converters where a capacitor and inductor are used. A two-port network that consists of a split inductor L_1 and L_2 and capacitors C_1 and C_2 connected in X-shape is employed to provide a Z-source.

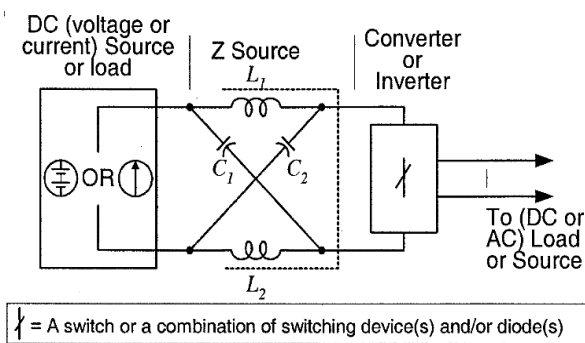


Figure 1 General structure of Z- Source

5. RESULT AND ANALYSIS

Scalar control of ac drives produces good steady-state performance but a poor dynamic response. It manifests itself in the deviation of air gap flux linkages from their set values. This variation occurs in both magnitude and phase. Vector control (or field-oriented control) offers more precise ac motors than scalar control. Therefore, they are used in high-performance drives where oscillations in air gap flux linkages are intolerable, e.g., robotic actuators, centrifuges, servos. Why does vector control provide the superior dynamic performance of ac motors compared to scalar control? There is an inherent coupling effect in scalar control because both torque and flux are voltage or current and frequency functions. It results in sluggish response and is prone to instability because of 5th order harmonics. Vector control decouples these effects.

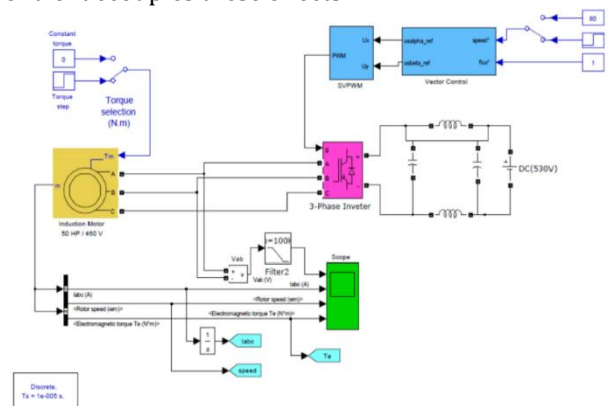


Figure 2 Simulink Model

6. CONCLUSION

Z-source overcomes the conceptual and theoretical barriers and limitations of the traditional voltage-source converter and current-source converter. Z-source inverter can boost-buck voltage, minimize component count, increase efficiency, and reduce cost. The Z-source concept can be easily applied to adjustable-speed drive (ASD) systems.

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