

Three Level Inverter Algorithms

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Abstract

The 3 and 5 level DCMLI are popular models in industries to avail variable speed. In this paper various algorithms are discussed in the process of obtaining variable speed from Constant Flux Control technique. Simulation is carried on all these algorithms for induction machine to conclude which algorithm does result the best in reduction in harmonics using MATLAB-Simulink.

Keywords: DCMLI, PWM, SPWM, SVPWM, THD

I. INTRODUCTION

Three level and five level inverters are of first choice for medium and high power industrial applications. Figure 1 shows a three level inverter with diode clamped structure. In this paper, techniques used for generating modulating wave are presented and simulation results are discussed for the best method taking harmonic distortion as the reference parameter [1]-[3].

The three available voltage levels from Figure 1 are $+E/2$, 0, $-E/2$ shown in Table 1. Pulse width modulation techniques are categorized into two, one is Sine Triangle Pulse Width Modulation-SPWM and the other Space Vector Pulse Width Modulation-SVPWM. SPWM consists of 2 methods: Conventional SPWM and Modified SPWM. SVPWM for 3 level inverter are classified into two, one based on 3 hexagons and the other based on 34 regions. Bus clamped technique is applied onto 3H technique to get reduced THD. MATLAB-Simulink software is used to perform the simulation.

II. PWM TECHNIQUES

In Conventional SPWM, the modulation wave is obtained for 0.866, looks similar to a 2 level inverter's wave. Modified SPWM is used to generate modulating waveform for modulation index less than 0.866 by addition of voltage lost between the terminals neutral and mid point of inverter DC voltage sources to reduce harmonics. This wave is compared with carrier waves to generate pulses. Frequency of the carrier wave is an integer multiple of fundamental frequency to avoid triplen harmonics. Control is linear from 0 to 78.5% of 2 level inverter [4]. This poor voltage utilization is improved with SVPWM [1]-[3].

Figure 2 shows SVPWM for 3 level inverter 3H operation and Figure 3 for 4R operation. The 27 possible space vectors in 3LI are shown according to their magnitudes. Zero vectors at origin, small vectors with magnitude $E/\sqrt{6}$, medium vectors with magnitude $E/\sqrt{2}$, and large vectors with magnitude $E/\sqrt{3/2}$. Modulating wave is obtained by switching the nearest vectors [5]-[7].

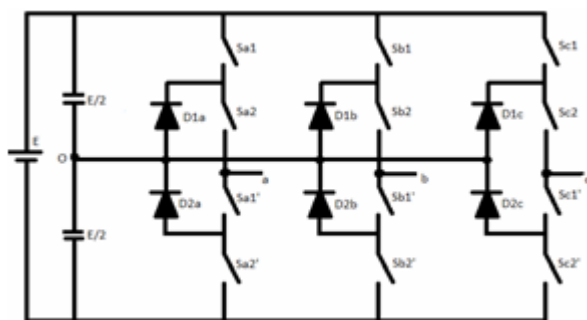


Figure 1. 3 Level Inverter

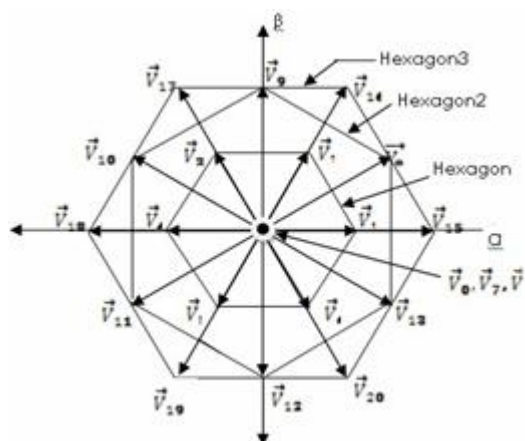


Figure 2. 3 Hexagon Model SVPWM for 3LI

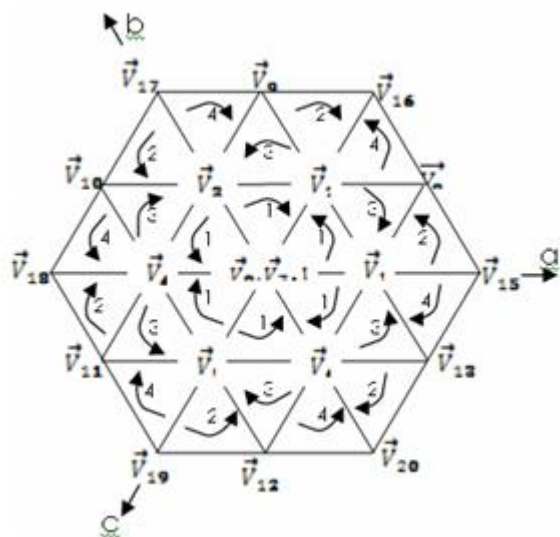


Figure 3. 4 Region SVPWM for 3LI

I. SIMULATION RESULTS

Simulation for two SPWM and two SVPWM techniques are done and result is shown in Figure 4. Switching frequency of carrier wave is 1.5kHz.

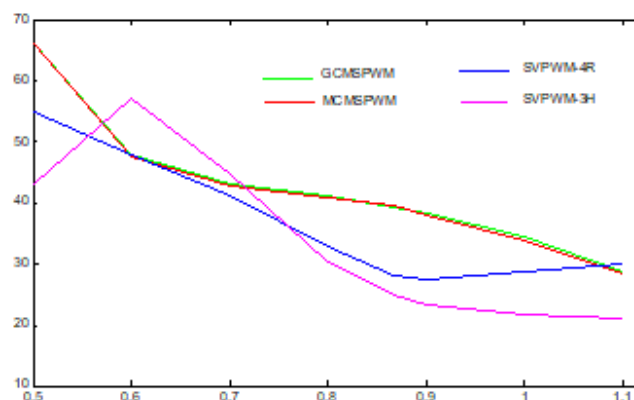


Figure 4 THD Vs Modulation Index for 3LI

II. CONCLUSIONS

Reduced Total Harmonic Distortion is observed with 3 Hexagon methods for less than 0.55 modulation index.

4 Region methods allow operating for better reduced THD in between 0.55 and 0.75 MI.

Bus Clamped Techniques improve MI.

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