**ABSTRACT**

Variable speed inverter fed Induction Motor (IM) drives are increasingly used in many commercial and industrial applications, the high frequency switching operation (2 to 20kHz) has improved the system efficiency, energy saving and ease in control. But with high speed switching device such as MOSFET or IGBT, Inverter fed IM drives have the drawbacks like 1. Common mode voltage (CM) 2. Rotor shaft voltage and Bearing current etc. The CM voltage is the voltage between the star point of IM stator winding to ground. This voltage always disturbs the nearby measuring and controlling circuits. In a balanced sinusoidal 3-phase system, the 3-phase voltage vector sum is always equal to zero. But in the case of PWM inverter switched from same DC voltage source converted into 3-phase voltages, it is difficult to make the sum of the 3-phase output voltages equal to zero hence the voltage between star point of stator winding of an IM to ground will exist which has to be minimized.

With the development of multilevel inverter (MLI) in recent years the CM voltage problem has been minimized. Several MLI topologies have been identified for use in speed control of IM drive for variable speed applications. The main advantages of the MLI circuits are (1) Generation of voltage near to sinusoidal. (2) Less stress on the inverter devices for a given voltage rating of the IM. With modern control circuits the low voltage rating inverter devices can be used. In addition to reduce the
stress on the devices it will also reduces the harmonic voltages at the output of the inverter. MLI is started with 3-level inverter. Presently there are three kinds of MLIs namely, 1.Neutral Point Clamped inverter (NPC) 2.Flying Capacitor inverter and 3.Cascaded inverter.

Variable speed drives are widely used in modern industries. They involve the control of electrical machines to suit industrial requirements using solid state devices. Earlier, DC machines were most commonly used, and hence DC machines were of great importance in industries. But DC machines have many disadvantages like high cost, wear and tear of brushes etc. As opposed to this, AC motors, especially squirrel cage induction motors do not have these drawbacks. Moreover, they are more rugged and require less maintenance because of absence of brushes, reliability, low cost and high efficiency hence it is preferred.

To get the steady state and transient performance of the IM, it is necessary to split the phase current of it in to two parts like flux creating current and the current which produces torque.

With the development of µ-controllers and DSP chips have made it possible to get the steady state and transient performance from an IM drive similar to that of a conventional DC drives. The decoupling of flux and torque component of current in IM has been done and is known as field oriented control or space vector control.

The space vector modulation (SVM) gives the switching state as a point in complex ($\alpha, \beta$) plane. The reference vector rotating at the
required frequency is sampled within each switching period, and the nearest three inverter switching states are selected. The duty cycles can be calculated to get the required reference vector. With these procedures the inverter output line voltages can be controlled. In the SVM schemes the gating signals of the inverter devices can be easily programmed using \(\mu\)-controllers/digital signal processor (DSP). In this method it considers the inverter as a unit whereas in the other schemes for example in sine-triangle PWM, and dead band PWM it will consider each phase separately.

The proposed work investigates the Experimental measurement of CM voltage for 2-level and MLI (3-level, 5-level) used for the speed control of IM drives. Simulation is also done using MATLAB/SIMULINK software for 2, 3 and 5-level inverter for comparison and validation. The inverter is built using MOSFET as devices, DC link capacitors and clamping diodes. In this proposed work the neutral point clamped MLI circuit is used. The output voltage of the inverter will not be pure sinusoidal hence there will be harmonic voltages present. The harmonic voltages gives power loss, heating, produces EMI and in-addition creates the pulsating torque at the rotor. Hence reducing the harmonics will improve the efficiency of an inverter. In MLI, many pulse width modulation methods have been configured to obtain the required voltage and frequency with reduction in harmonic voltages.
This work also presents the experimental measurement of shaft voltage and the bearing current in 2-level and MLI (3-level and 5-level).

The thesis proposes a simple and efficient SVM method that uses only outermost active voltage vectors. For 2-level inverter, it is 6, for 3-level inverter it is 12 and for 5-level inverter it is 24 and so on. Due to these reasons the proposed SVM is computationally very simple.

All the proposed work presented in this thesis is experimentally carried out for a squirrel cage 3 phase, 0.37kW, 415V, 1390 rpm, 50Hz, star connected IM. The SVM signals for the inverter are generated using PIC-16F877 microcontroller. The simulation is carried out using MATLAB/SIMULINK software for 2, 3 and 5-level inverter. The experimental results presented are verified with the simulation results. It is found that the experimental results are in concurrence with the simulation results. In this thesis CM voltage, shaft voltage and bearing currents are experimentally measured for 2-level, 3-level and 5-level inverter fed IM drives and computed the % THD. It is found that in the 5-level inverter the above parameters are less as compared to 2-level and 3-level inverter.