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Simulation and Analysis of H-bridge Cascade Multi level Inverter Fed Induction Motor Drive for Industrial Applications

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Abstract: Electrical drive using Induction motor draws heavy current during starting condition. The handling of large drives with variable speed in not possible with ordinary conventional inverter so the Multi level inverters are the best choice among available. The paper present MLI with H-Bridge cascade system for industrial application. The preset work is simulated with 7 and 9 level inverters and compares their results.

Keywords: MLI, Cascade, H-Bridge, Modulation index, Carrier Frequency.

I. INTRODUCTION

The electrical drive system has been an integral part of any industry. The performance enhancement for variable speed drive system is now possible with solid state controllers while earlier conventional controllers had many limitations and constraints like very low reliability. Three phase circuits are the first priorities of industrial and large size commercial electrical systems especially electric drives and use of three phase inverters for it is a most commonly used topology in today's era. The Inverter technologies has a vital role in modern power system for efficient operations of adjustable speed drives, Power backup sources and HVDC transmission these are the places where bulk power has to carry and single or common inverter is not capable to handle it. ML Inverter is the solution of such problems at once.

Cascaded H Bridge Inverter has H Bridge in each individual inverter and it may operate like an independent system which gains the input power from equal and independent DC source either through battery bank or using a converter system in case of two stage conversion used for VFD and primary available supply is AC. Cascaded H-bridge inverter consists of a number of H-bridge power conversion cells, each supplied by an isolated source on the DC side and series-connected on the AC side. The carrier frequency is the same as the switch frequency. If the modulation were reduced to Zero or a DC quantity, then the PWM spectrum would consist of the carrier and its harmonics Alone and the component at zero frequency (DC) if present. As the amplitude of the modulating Waveform is increased, sidebands appear and increase in amplitude either side of the carrier and its harmonics. As the frequency of the modulating waveform is increased, the sidebands spread Away from the central carrier frequency. The carrier frequency should be synchronous, that is an integer multiple of the fundamental frequency, if the pulse number is low. The utility power supply is of constant frequency, and it is 50 or 60Hz.Since the speed of ac machines is proportional to the frequency of input voltages and currents, they have a fixed speed when supplied from power utilities. A number of modern manufacturing processes, such as machine tools, require variable speed.

II. MULTI LEVEL INVERTER

The multilevel inverters came into existence few decades earlier and the concept behind this is to utilize more number of solid state switches to perform energy conversion in small steps. The number of advantages is present for doing this:

a. first one is to produce higher quality wave form
b. To Reduce dv/dt stresses
c. To Reduce the electromagnetic compatibility concerns
d. Due to series connection solid state devices may operate at higher voltage levels

III. SEVEN LEVEL INVERTER FED DRIVE

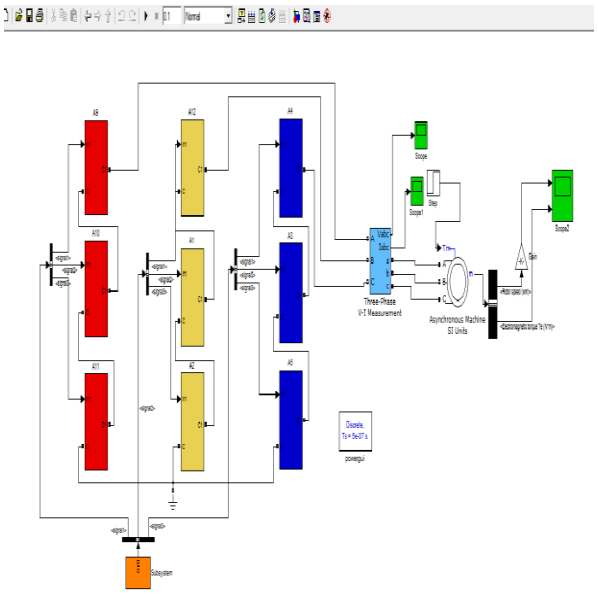

Fig.1 Seven Level Inverter fed Induction Motor Drive

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Fig.1 shows the seven level inverter fed induction motor drive, in this model cascade H-bridge seven level inverter is used and this model is connected to an induction motor drive and the result is obtained by the scope.

The Rotor Speed and Torque of seven Level inverter fed Drive are shown in Fig.2

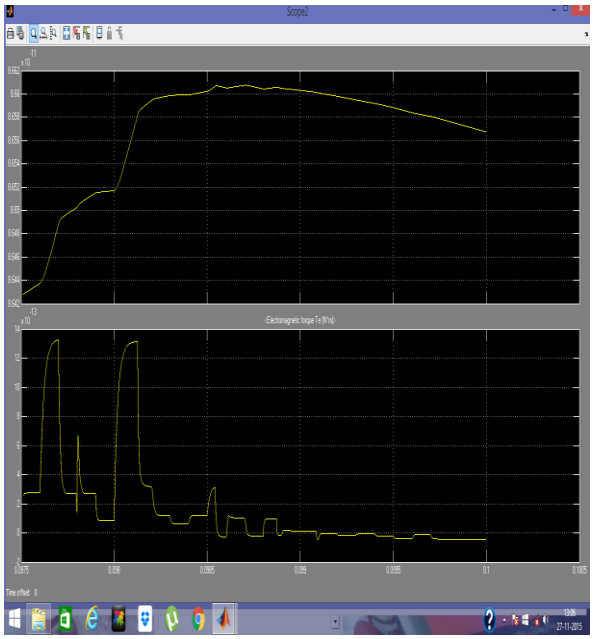

Fig.2 Rotor speed and Torque of seven level inverter

IV. NINE LEVEL INVERTER FED DRIVE

Fig.3 Shows the Nine Level Inverter fed induction motor drive ,in this model cascade H-bridge Nine level inverter used and this model is connected to a induction motor drive and the result obtained by the scope.

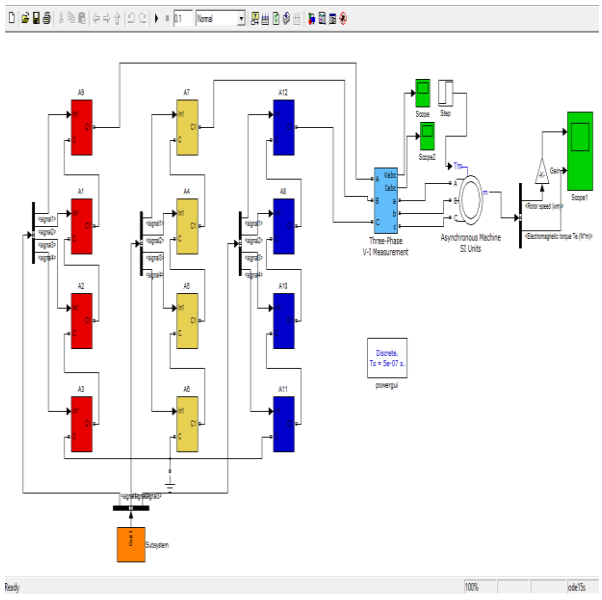

Fig. 3 Nine Level Inverter fed Induction Motor Drive

The Rotor speed and Torque of Nine Level inverter fed Drive are shown in Fig.4

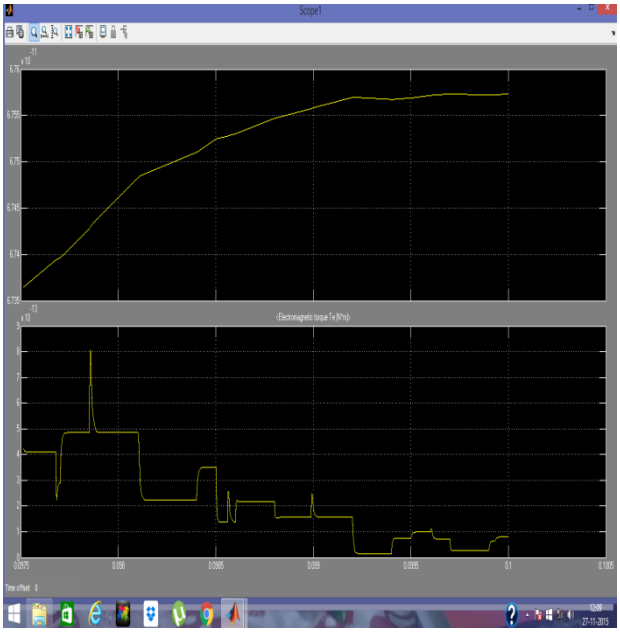

Fig.4 Rotor Speed and Torque of Nine Level Inverter

V. RESULT AND SIMULATION

The table 1 and table 2 given below the Result of seven levels and nine level inverter fed induction motor drive respectively.

TABLE 1 Comparative Result of Seven Level Inverter

Md. Index	Fundamental Freq.	Carrier Freq.	Rotor Speed (rpm)	Torque (N-m)
0.8	40	2500	7.7199×10^{-12}	8.2687×10^{-14}
0.8	50	2500	8.6516×10^{-11}	8.5821×10^{-14}
0.8	60	2500	7.2395×10^{-11}	2.5386×10^{-13}
0.8	70	2500	6.1653×10^{-11}	7.7065×10^{-13}
0.9	50	2500	1.9654×10^{-11}	2.1484×10^{-13}
1.0	50	2500	1.0942×10^{-10}	3.0909×10^{-12}
1.1	50	2500	2.8847×10^{-9}	1.8904×10^{-12}
0.8	50	1500	5.3735×10^{-9}	2.5776×10^{-13}
0.8	50	2000	8.0052×10^{-11}	1.3148×10^{-12}
0.8	50	3000	6.004×10^{-11}	9.3896×10^{-14}

TABLE 2 Comparative Result of Nine Level Inverter

Md. Index	Fundamental Freq.	Carrier Freq	Rotor Speed(rpm)	Torque (N-m)
0.8	40	2500	8.3683×10^{-11}	2.1841×10^{-13}
0.8	50	2500	6.7114×10^{-11}	4.1981×10^{-13}
0.8	60	2500	5.5421×10^{-11}	3.8428×10^{-13}
0.8	70	2500	4.7773×10^{-11}	3.8357×10^{-13}
0.9	50	2500	2.1512×10^{-10}	7.2448×10^{-13}
1.0	50	2500	8.1608×10^{-10}	2.8773×10^{-12}
1.1	50	2500	3.0728×10^{-9}	9.09455×10^{-12}
0.8	50	1500	6.2566×10^{-11}	1.6817×10^{-13}
0.8	50	2000	6.7452×10^{-11}	4.8634×10^{-13}
0.8	50	3000	6.2428×10^{-11}	4.5084×10^{-13}

VI. CONCLUSION

The proposed model has shown excellent result for industrial applications of MLI fed drive. The induction

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motor drive not only increases the reliability but reduces maintenance too.

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