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PERFORMANCE INVESTIGATION OF CASCADED MULTILEVEL INVERTER FED BRUSHLESS DC MOTOR DRIVE

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Abstract: Nowadays, BLDC motor *is increasingly popular in high voltage and electrical fields today, due to its higher efficiency and cost, less maintenance and simpler design as well as mechanical and electrical characteristics. These motors now replace brushed DC motors and induction motors in different applications. MLI has been used more extensively in high voltage and control applications in recent years. There are problems with harmonic distortions in two phase inverters. One approach is to raise the stress steps. Multi-level inverters can do this. This paper tests the output of a brushless DC (Level 31) motor inverter in three phases. It will analyse the results. In conformity with the PI Controller, the proposed model is used for the variable phase reference signal. The cascaded Brushless DC multilevel inverter drive in Matlab / Simulink is finally implemented and the results are shown.*

Key words: *BLDC Motor, Multi carrier PWM, PI Controller, MATLAB, Multilevel Converter topologies*

1. INTODUCTION

The inverter's goal is to produce a DC supply AC voltage waveform. The DC supply usually includes a number of serial batteries. Inverter input voltage in typical applications is equal to the supply voltage for the DC. Electricity is also the product of tension and current; for larger applications, more power is required from the DC supply to ensure design. Power can be maintained by increasing voltage and reducing the current by the same amount or lowering the voltage and increasing the current equally. While increasing the DC supply voltage, the components must withstand the maximum voltage of the DC supply.

A broad range of speed and torque control of the electric motor is needed for many applications such as electric traction, textile mills, and lifts. A good, simple and efficient solution to meet the needs of a variable speed drive is provided by the DC engine. This triggers a lack of robustness and routine maintenance of sparks during high-speed commuters. The DC motor offers required functionality, but it requires routine maintenance and its maximum running speed is restricted by its inherent presence of the switch. Technological progress continues to address the problems in these engines. By advancing technology and developing recent controller techniques, the Permanent Magnet Brushless DC engine can overcome the above limitations and meet the necessities of an adjustable speed track. Because of its compact size, reliability, high efficiency, quiet operation, and free maintenance, they are favorite as small power control motors.

A BLDC engine is a permanent magnet engine that controls the torque with the position detector and inverter. The BLDC engine is often called the DC inside-out engine because the armature is in the stator and the magnets in the rotor and the operating function is identical to the DC engine. BLDC engines are one of the fastest growing engine types, primarily because of their best performance and characteristics. Brush Less DC motor drives have been commonly used in various consumer and industrial systems, including servo engine drives, home appliances, computer peripherals and automobiles.

2. LITERATURE REVIEW

This chapter provides a brief review of previous research on the cascading multi-level inverter.

A theoretical analysis for the modern Multistage PWM approach was based on Carrara etal (1992): an improvement in the harmonic spectrum. PWM "Sub-harmonic" procedure was proposed to improve the output of single or three-stage inverters in multi-stage voltage sources [1].

Rodríguez & Pontt (2003) introduced new topologies for regenerative cascaded multi-level inverters. This paper presented the furthermost appropriate modulation and control methods developed for the family of converters [2].

José Rodríguez et Al (2007), Multi-Level Inverter Technologies, have proposed high-power energy storage technologies for medium voltage [3]. This paper introduced essential topology as well as cascaded multi cells with various DC-sources, such as diode-clamped inverters (neutsely clamped points) and condensers (flying condensers). Emerging topology, including modules of multi-level pulses sinusoidal widths, the basic multi-level harmonic elimination as well as space vector modulation, were studied for the converters family, such as asymmetric hybrid cells and the soft-switches.

A similar study has been suggested by Attaianese et al (2010) between the classical Neutral Clamped Point Converter (NPC) and emerging active NPC. For several known carrier-based PWM techniques numerical analysis of loss distribution across power units was published [4].

For three-phase neutral point clamped-inverter modulation methods to minimize leakage currents in photovoltaic systems, Cavalcanti et al (2012) have considered the need to adjust the multi-level inverter or other hardware [5].

Javad Ebrahimi et al (2013) suggested four methods for evaluating the magnitudes of CC sources. These procedures offer the development of several level inverters freedom and demonstrate the performance and feasibility of the proposed topological technology [6]. With the cascading of sub-multi-level cells, the performance of the output voltage, the number of switches reduced and was ideal for symmetric and asymmetrical operations.

The sine quantitative analysis of the asymmetric and the symmetrical three-phases cascaded MLI was proposed to Bhuvaneswari et al (2014) with multi-carrier modulation, THD content has been reduced. There were also reduced numbers of switches and prices [7]. Three techniques were suggested, such as constant frequency of switches, variable frequency of switching and phase-shifted PWM, for the modulation of multi carrier's plus (MBW).

3. DRIVE SYSTEM DESCRIPTION

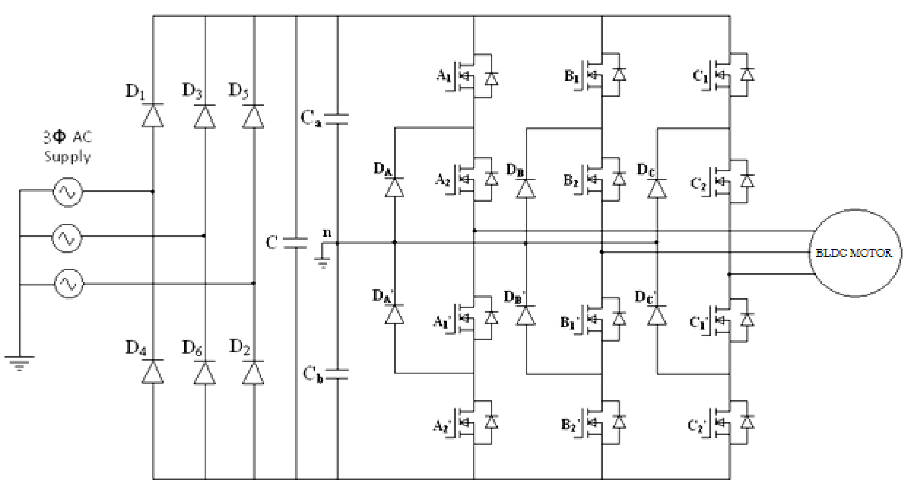

Fig 1: Multilevel Inverter based drive circuit

The standard PWM method is used in the traditional technique. The current and voltage are of low quality and the frequency of switching creates further losses. Such inconvenience is corrected using a multilevel inverter clamped three-phase diode [2-3]. The current and Voltage output is increased and the losses of switching are minimized compared to traditional technology. It is also found that the THD is higher.

The 3-level inverter is shown with a neutral point-clamped voltage source. It consists of 12 active unidirectional switches and 6 diodes with neutral dots. A neutral point can be described as the central point of the two condensers "n"[7]. -- Switch must block only half the dc Connexions voltage (Vdc/2), the biggest advantage of this design. Only two of the four switches in each step should be activated at any time in order for three levels to be achieved [5]. Two serial-connected bulk condensers, Ca and Cb, divise dc-bus voltage into three levels; the rating is similar. The diodes are of equal voltage and clamp around the switch to the same voltage when the switch is out of shape. This arrangement also gives the switch less voltage tension.

4. PROPOSED SCHEME

The multi-level inverter block scheme fed by the three-stage induction engine as shown in Fig.2. The entire system is divided into two sections: a power circuit and a control circuit. A power rectifier, philter condenser and three-phase, multilevel inverter servo are included in the control group [7]. The engine is attached to the inverter. A three-phase diode rectifier is supplied with ac input voltage so that a dc voltage is generated through a filter condenser. A condenser philter deletes the ripple material of the output voltage dc [10].

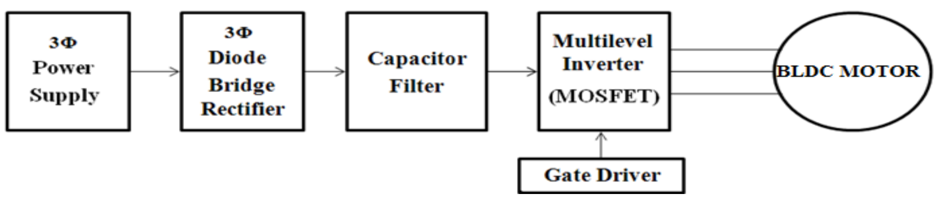

Fig 2: Block Diagram of Proposed System

The pure dc voltage is used via a condenser philter on the three phase multilevel inverter. The multi-level inverter has 12 MOSFET switches which are regulated to produce a dc output voltage [8]. The proposed device control circuit includes three blocks: microcontroller, opto-coupler and gate controller.

5. SIMULATION RESULTS

The proposed multi-level cascade half-bridge inverter has been developed using Matlab / Simulink software and has been created with the use of a phase-shifted PWM modulation technique [9]. Figure 3 shows the Matlab / Simulink model of the BLDC motor drive and three-phase cascading half bridge inverters. Figure 4 shows the 31 level inverter Simulink model Fig 5. Shows the proposed converter's 31 stage power output voltage.

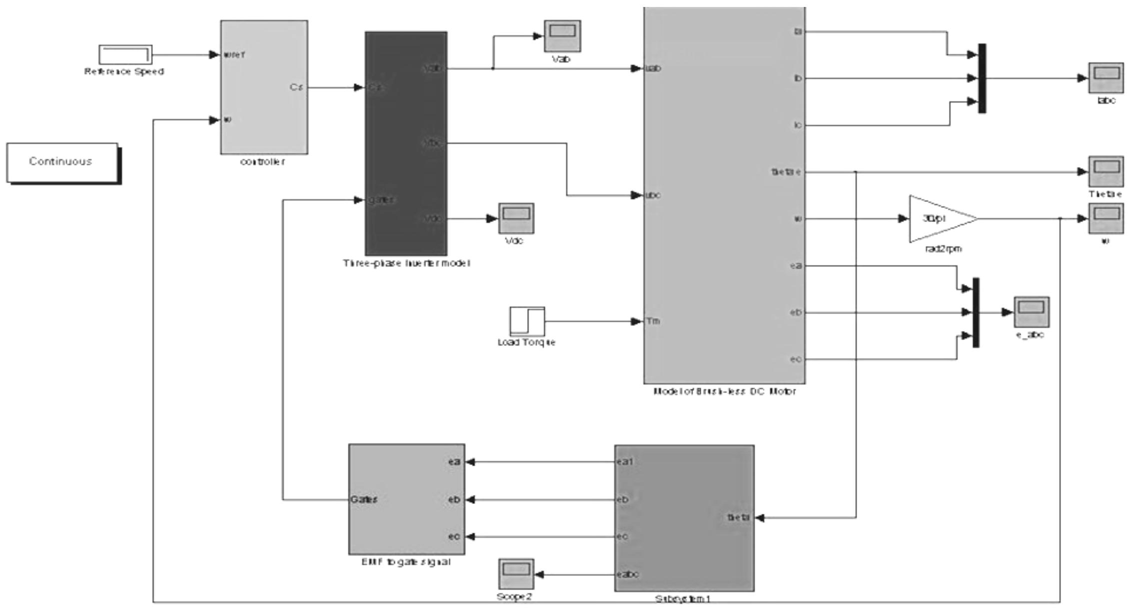

Fig 3: Simulink model of three phase cascaded Multi-level Inverter fed BLDC motor Drive

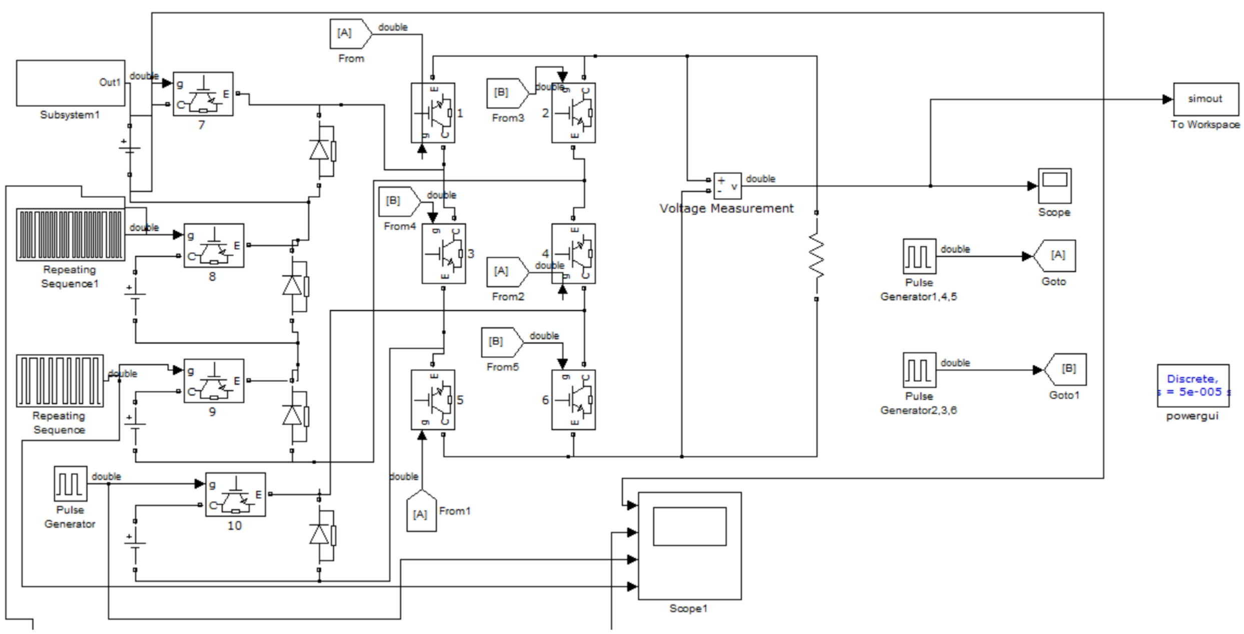

Fig 4: Simulink model of 31 Level Inverter

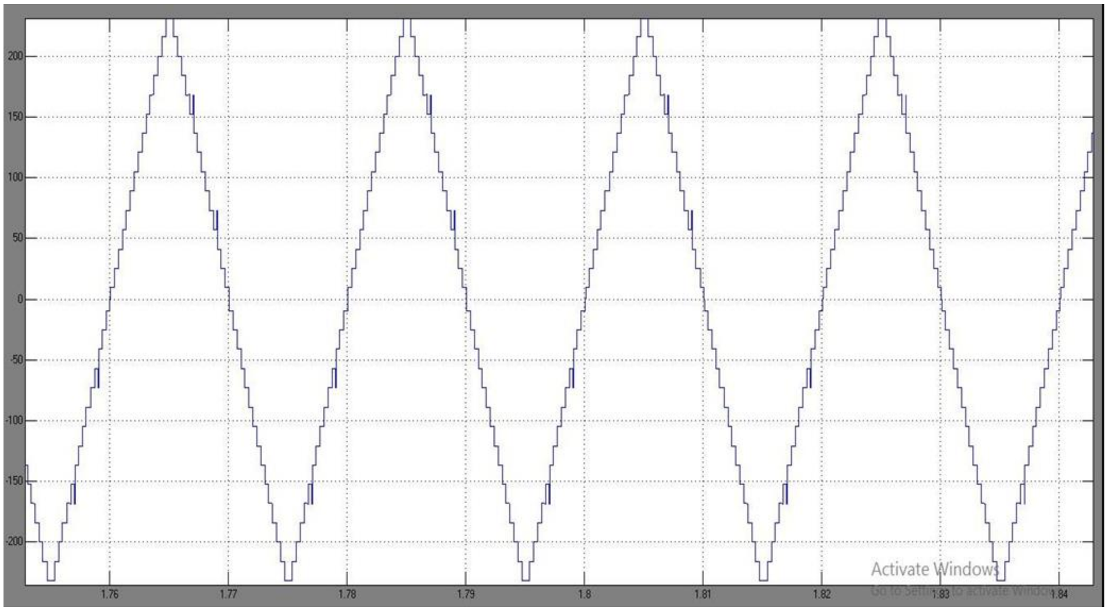

Fig: 5 Output of 31 Level Inverter fed BLDC Motor Drive

6. CONCLUSION

Matlab / Simulink software successfully presented the proposed BLDC Motor Multi-level Inverter-Based drive. Main work included the development and interaction with the engine of the 31-level inversion production. A higher-level inverter will easily broaden the proposed topology. The results of the simulation were sinus waves, with less rips and low losses. In reality, this method will be feasible. The findings of the proposed three-phase MLI were tested and were satisfactory. The goal was to create an exact, easy to change and simple to run model.

CONFLICT OF INTEREST

THE AUTHORS CONFIRM THAT THERE IS NO CONFLICT OF INTEREST TO DECLARE FOR THIS PUBLICATION.

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