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Hybrid Space Vector PWM Integrating Bus Clamping PWM Method for Torque Ripple Minimization of Induction Motor

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Abstract: The space vector based pulse width modulation used in the induction motor drive for regulating the voltage. The vector controlled pulse width modulation has to speed and torque control. The two level voltage source inverter using metal oxide semiconductor field effect transistor. The constant volts per hertz have generated the voltage in high gain and regulate the speed control of an induction motor. The space vector modulation has both active and zero state of three phase two level inverter fed induction motor drive system. The reduction of torque ripples using the bus clamping circuit by the control switching technique. The SVPWM based clamping circuit for reducing the torque ripple in IM is implemented in MATLAB/Simulink environment.

Keywords: Torque ripple, Space Vector Modulation (SVM), Pulse Width Modulation (PWM), Voltage Source Inverter (VSI).

Introduction

The pulse width modulation based on voltage source inverter fed induction motor. The three phase two level voltage-source pulse width modulation (PWM) inverters have been broadly utilized for dc/ac power change since they can create a variable voltage and variable frequency control [1-2]. Be that as it may, they require a dead time to maintain a strategic distance from the arm-short and snubber circuits to suppress the switching ripple. Aside from these auxiliary perspectives, the PWM inverters have a basic issue that they can't distribute voltages as substantial as the six-step inverters can. That is, the dc bus voltage can't be used to the maximum [3].

In other words, the peak to-peak torque ripple defines the harmonic in inverter output voltage in DTC drives. On the other hand, the voltage harmonic range, defined by the strategy for pulse width modulation (PWM), decides the peak to peak torque swell if there should be an occurrence of vector-controlled and open-loop drives [4]. Traditional space vector PWM (TSVPWM) is appeared to reduce the torque swell, compared to sine triangle PWM, by virtue of the equivalent division of null vector-time. This paper proposes a novel hybrid PWM system which decreases the peak to peak torque swell in each sub-cycle, contrasted with CSVPWM, in

open- circle and vector-controlled drives [5-6]. The proposed strategy is too relevant in constant switching frequency DTC plans such as DTC with space vector modulation (DTC-SVM) [7]. The proposed PWM technique is a hybrid of the CSVPWM and advanced bus clamping PWM (ABCPWM) techniques. ABCPWM techniques switch a phase at double the ostensible exchanging recurrence for 33% of the line cycle, clamp the phase of another one third, and switch the stage at the ostensible recurrence for the rest of the term [8-9].

Proposed Methodology

The voltage source based three phase bridge inverter block diagram is shown in fig 1. The pulse width modulation has utilize two zero state and six active state of inverter system. The switching energy lost in a device during turn on and switched off with the current is switched and change the line cycle in voltage source inverter [10]. The circuit diagram of proposed system is shown in fig 2.

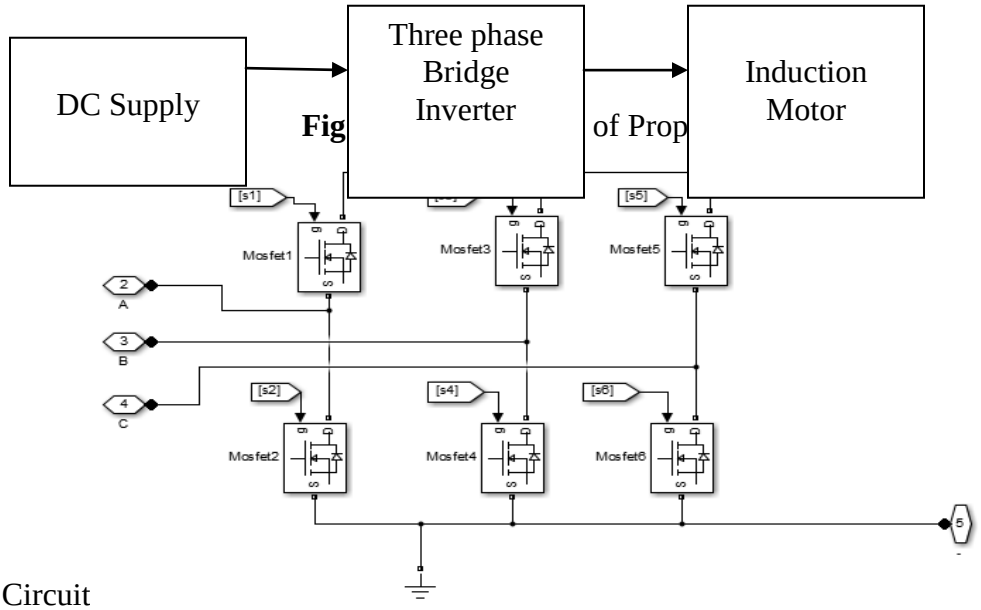

Fig of Prop

Circuit

Fig 2: Circuit diagram of Three Phase Bridge Inverter

Simulation Result

The bus clamping fed induction motor drive is implemented and shown in fig 3. The control strategy of proposed method is space vector modulation. This SVM is to regulate the speed of an induction motor. The space vector is the advanced method of PWM technique. To produce the less harmonic content of voltage and current in the inverter circuit. In three phase eight possible combinations of on and off states. The two zero vector and six non zero vector. The upper three switches on and the lower three switches off is the zero vector of SPM.

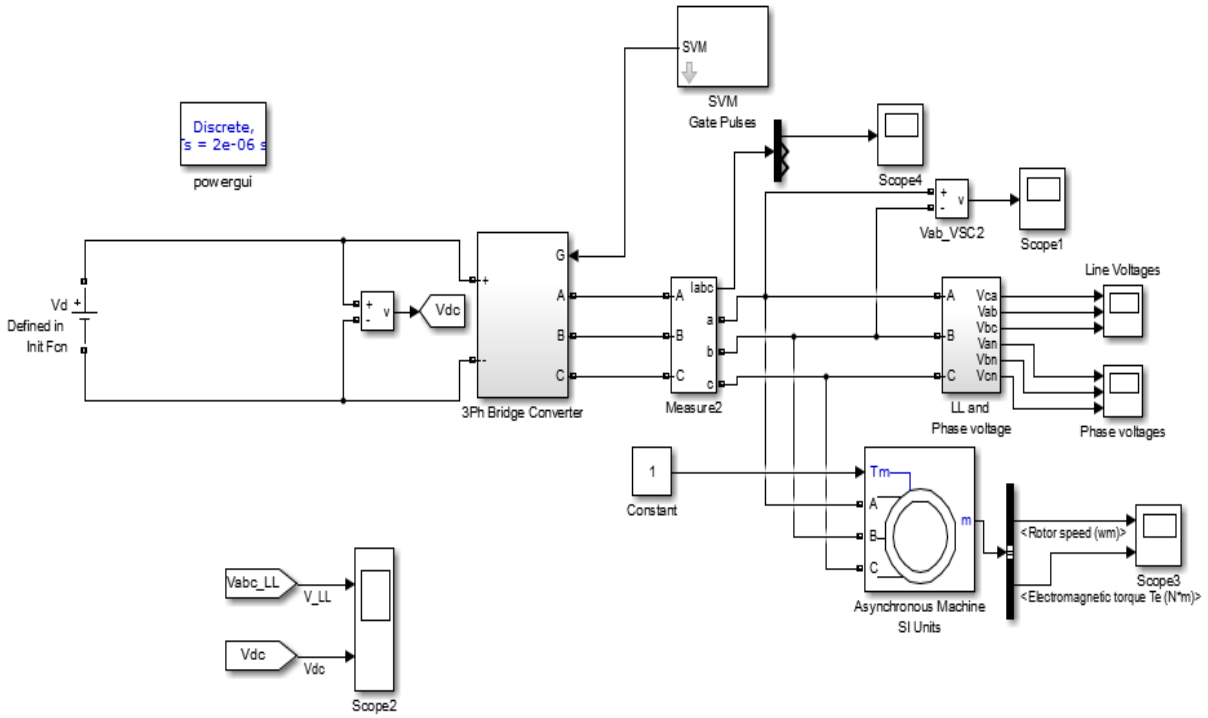

Fig 3: Overall Simulation of Bus clamping Three level inverter fed IM

The input voltage is shown in figure 4. The stator voltage and current of an induction motor is shown in figure 5 and 6. The speed and torque characteristics of an induction motor are shown in figure 7 and 8.

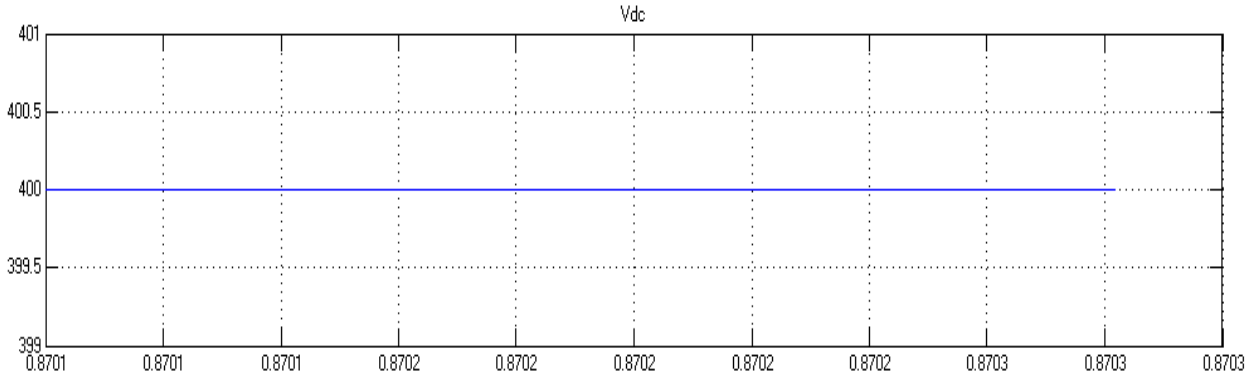

Fig 4: Input Voltage of proposed circuit

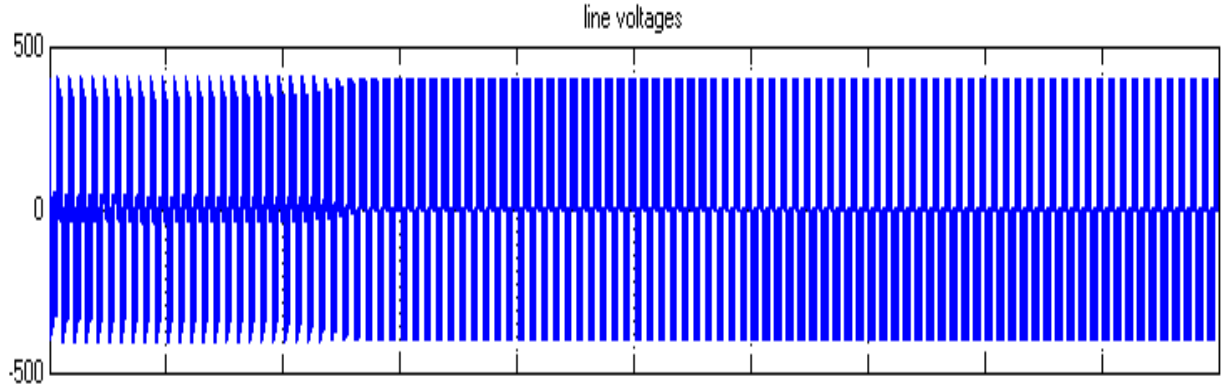

Fig 5: Stator Voltage of Induction motor

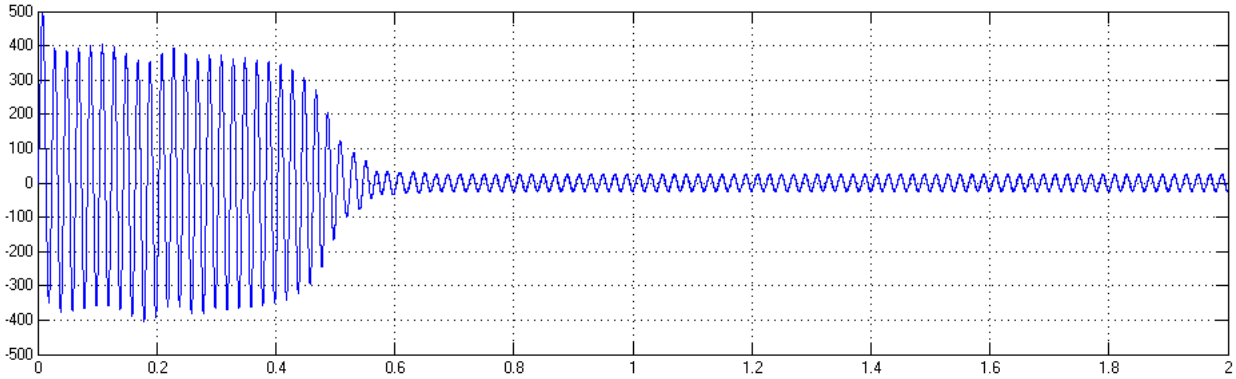

Fig 6: Stator current of Induction motor

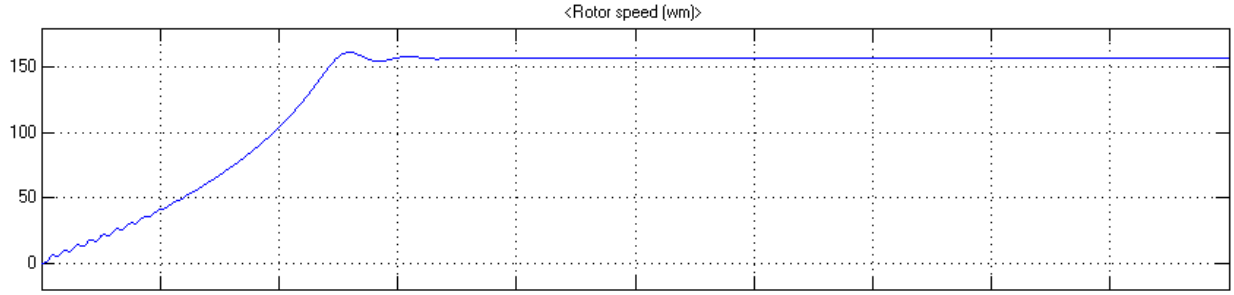

Fig 7: Speed waveform of an Induction motor

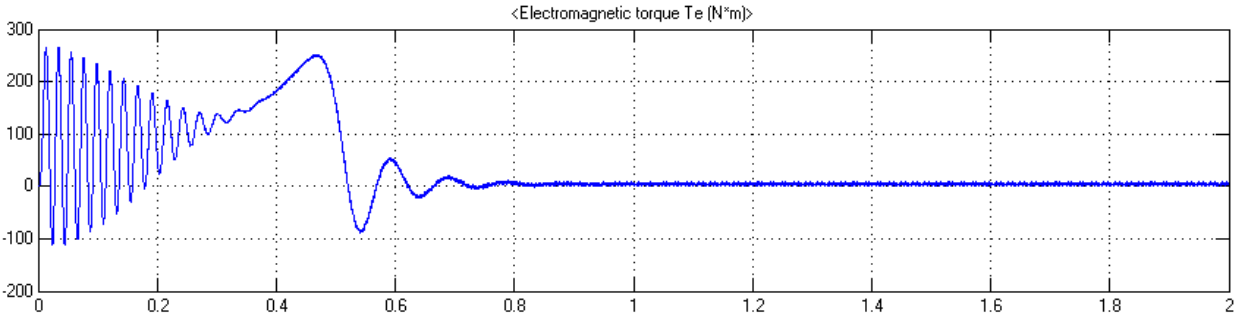

Fig 8: Torque waveform of an Induction motor

Conclusion

The space vector modulation based linear control in voltage source inverter. The speed and torque control is analyzed and implemented. The ripple is reduced by the proposed control method. The peak to peak torque ripple is minimized and enhance the efficiency of motor drive system compared to the conventional space vector pulse width modulation.

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