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Speed Control of Split Phase Induction Motor with Full Bridge AC-AC Converter

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Abstract:

In small scale industries the induction motor is used with the cyclo converter. The converter can modify the speed of the motor by step down controller is used. The performance of the motor configuration is achieved by the controller method. The frequency of the motor is proportional to the speed. The step down cyclo converter is used for achieving the slow speed performance of motor. The cyclo converter has working in non circulating current mode, utilize less passive elements and reactor value is greatly reduced. The cyclo converter is more advantages such as high efficiency, easy to control and without dc link capacitor. The induction motor is interfaced with the converter method. The variable frequency and speed at the load based motor is analyzed and implemented. The merits of proposed bridge type cyclo converter for speed control of single and three phase induction motor is verified by simulations in MATLAB/Simulink environment.

Keywords: Induction Motor, Cyclo Converter, Variable frequency

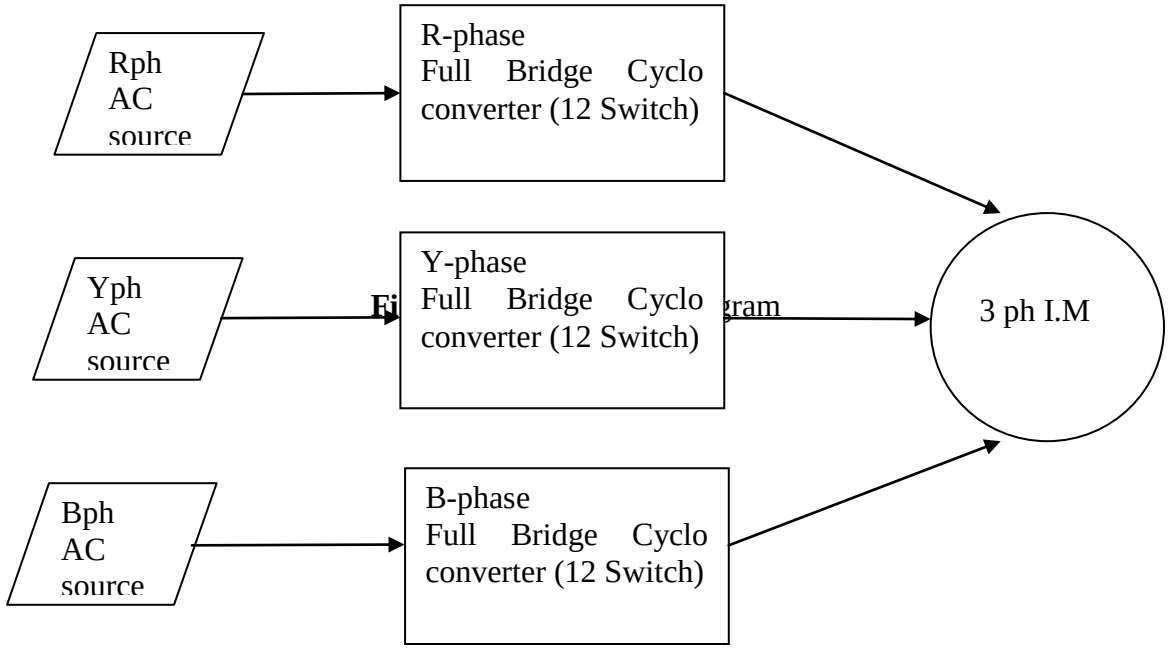
Introduction

In recent days the electrical demand is increasing and also the efficient power generation is less. The high efficiency based converter are used to generate the power and fed into the motor. The various converter topologies such as DC-AC, DC-AC, DC-DC and AC-AC converter [1-2]. The proposed circuit has utilized the AC-AC converter for motor application. The AC-AC frequency converter is a single step converter and speed control of induction motor but considering its efficiency, we proposed is designed to control the speed of a single phase induction motor in three steps by using cyclo convertor technique by thyristors [3-5]. Induction motors has robust and used in washing machines, vacuum cleaners, water pumps, and used in industries as well. The cyclo converter frequency can be adjusted by conduction period for each switch. The controller such as sliding mode control, fuzzy logic control and model predictive control and cyclo converters etc [6-7].

The clamped six-pulse cyclo converter for induction heating in the medium frequency range. The load-commutated circuit described here has the features of good output waveform, low SCR switching losses and an optimum performance in the frequency. The induction motor is connected in the cyclo converter. The motor has drawn more power compared to the other conventional motor. The cyclo converter the output frequency is less than the input frequency and fed into the three phase induction motor [8].

Proposed Methodology

The block diagram of proposed method is shown in figure 1. The three phase ac supply is fed into the cyclo converter. The cyclo converter function as ac-ac converter without dc link and used in high power drive circuit. The three phase induction motor speed and torque is regulated by changing the frequency [9]. The output characteristics of a motor depend on the frequency.



Cyclo Converter

The cyclo converter is used to generate variable frequency from the constant frequency AC supply without involving dc link capacitor. In full bridge converter has high efficiency and in high power application and it has more number of thyristors and generate high power [10]. TThe converter has both positive and negative sets of thyristor to operate and generate efficient power generation.

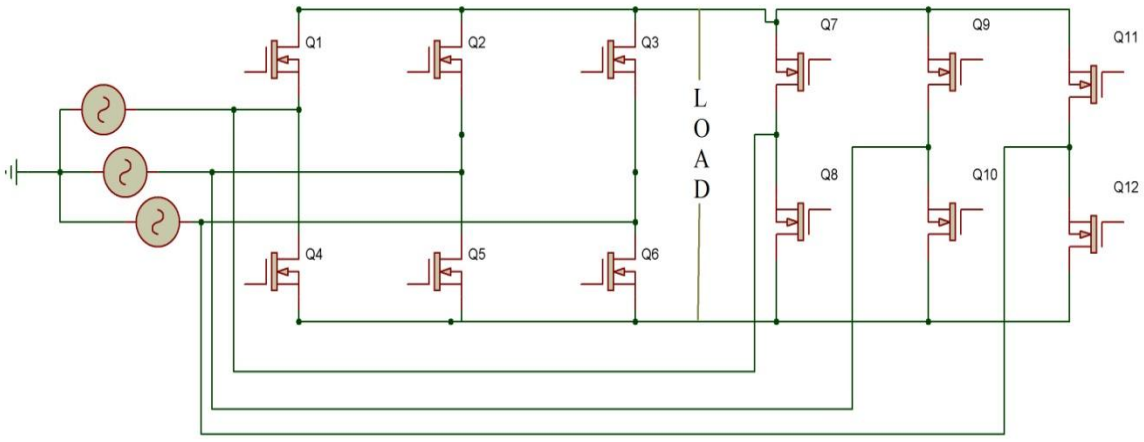


Fig 2: Circuit Diagram of Cyclo Converter

Split Phase Induction Motor

The Split phase induction motors are generally developed with two windings on the stator side and squirrel cage winding in the rotor side. The secondary winding is utilized to create a revolving field to begin the motor. The axis of the secondary winding is set 90 electrical in front of the primary winding. The energetic simulation of the engine is introduced in the stationary d-q axis to persuade the use of the inverter and, later on, the analysis controllers. Since the axis of the principle and secondary windings are now orthogonal, the stationary d-q frame is chosen lined up with the orthogonal axis of the physical windings. The squirrel cage rotor is characterized by comparable two coils changed to the stationary d-q axis. Since the two stator windings; to be specific the principle and secondary coils, have distinctive number of turns, they will yield different mutual reactance.

Simulation Result

The overall configuration of split phase induction motor with full bridge converter circuit is shown in figure 3. The control topology is shown in figure 4. The three phase voltage source is shown in 5. The parameter of an induction motor based on cyclo converter is given in Table 1. The stator voltage of an induction motor is shown in figure 6. The speed control and torque control of an induction motor is shown in figure 7 and 8.

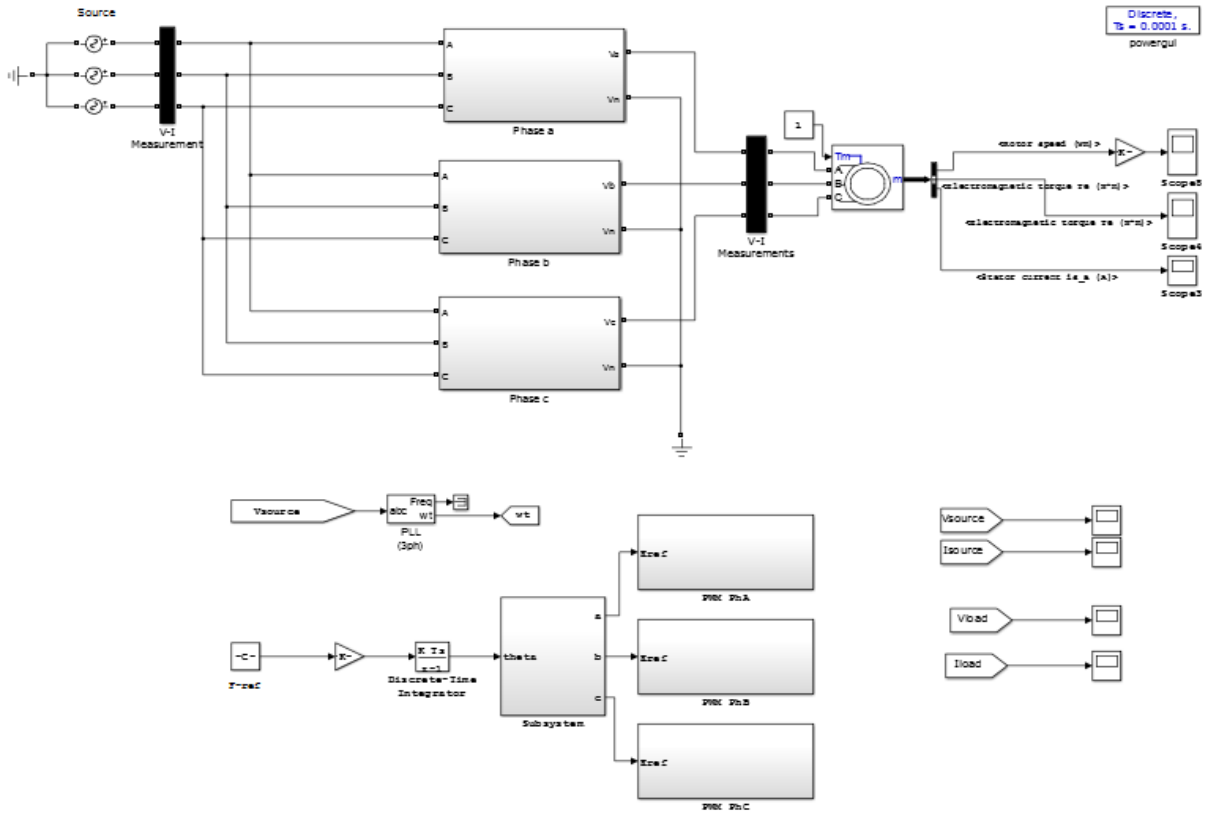


Fig 3: Overall Proposed Simulation

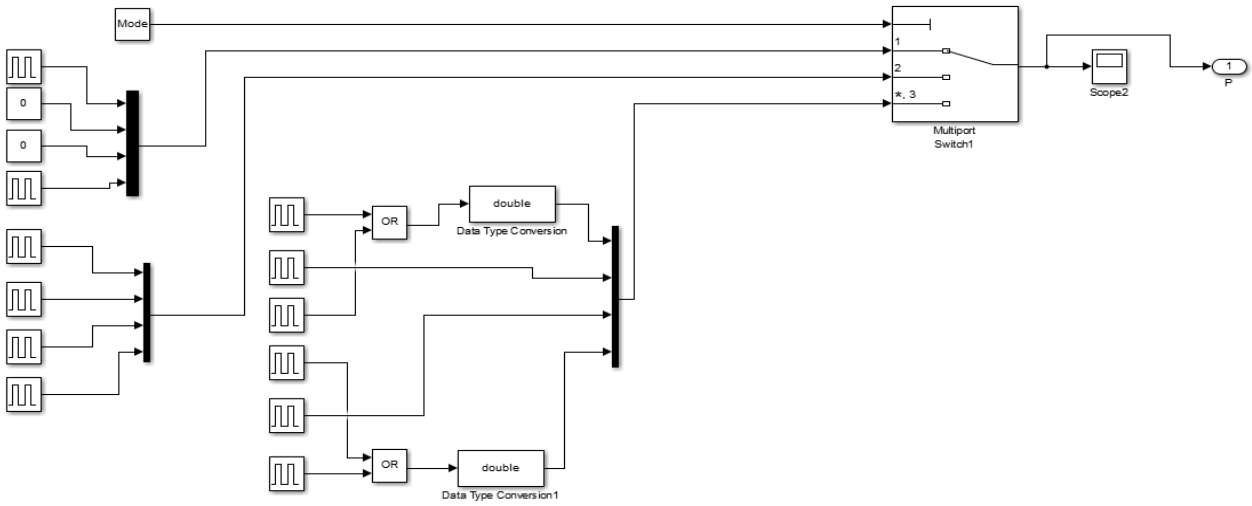


Fig 4: Control Method of Cyclo Converter

Table1 Simulation parameters

Three Phase I.M Parameters	
Rated Power	0.5 hp
Rated Voltage	460 v
Frequency	50 Hz
Stator Resistance Rs	0.435 ohms
Stator Inductance Ls	0.002 H
Rotor resistance Rr	0.816 ohms
Rotor inductance Lr	0.002 H
Mutual Inductance Lm	0.06931 H
Inertia J	0.0089
Pole pairs	2

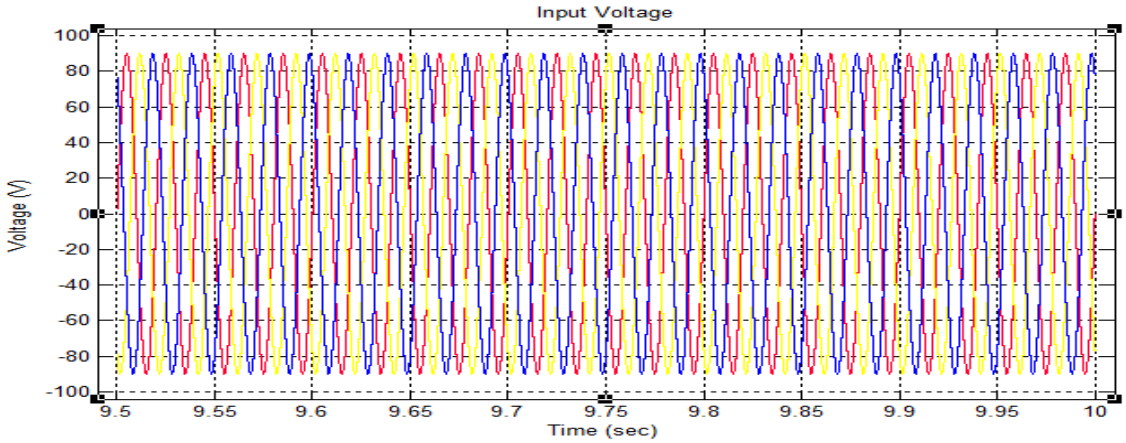


Fig 5: Voltage Waveform of Three Phase Source

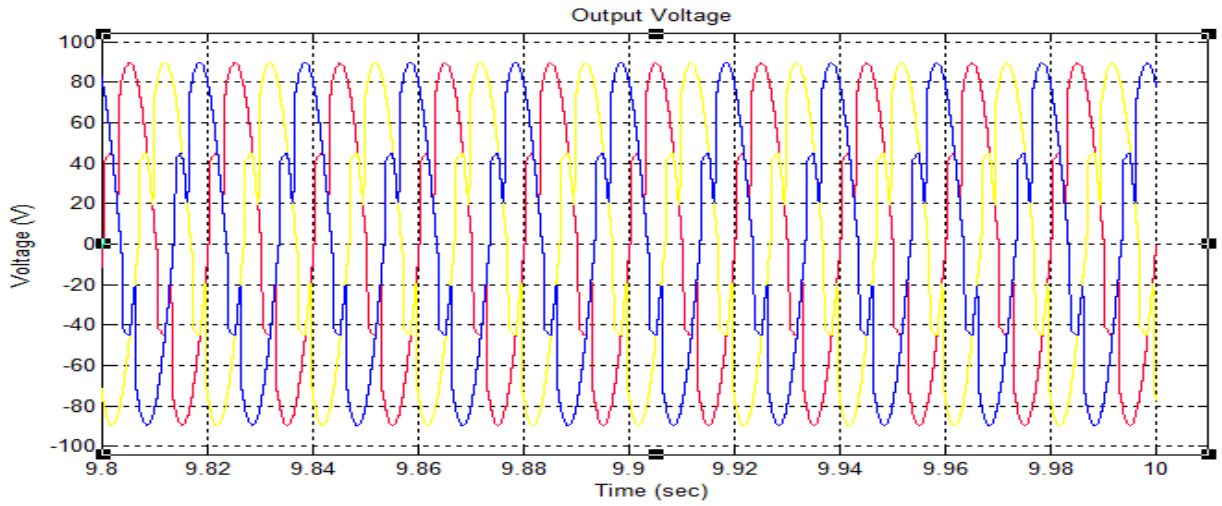


Fig 6: Stator Voltage of an Induction Motor

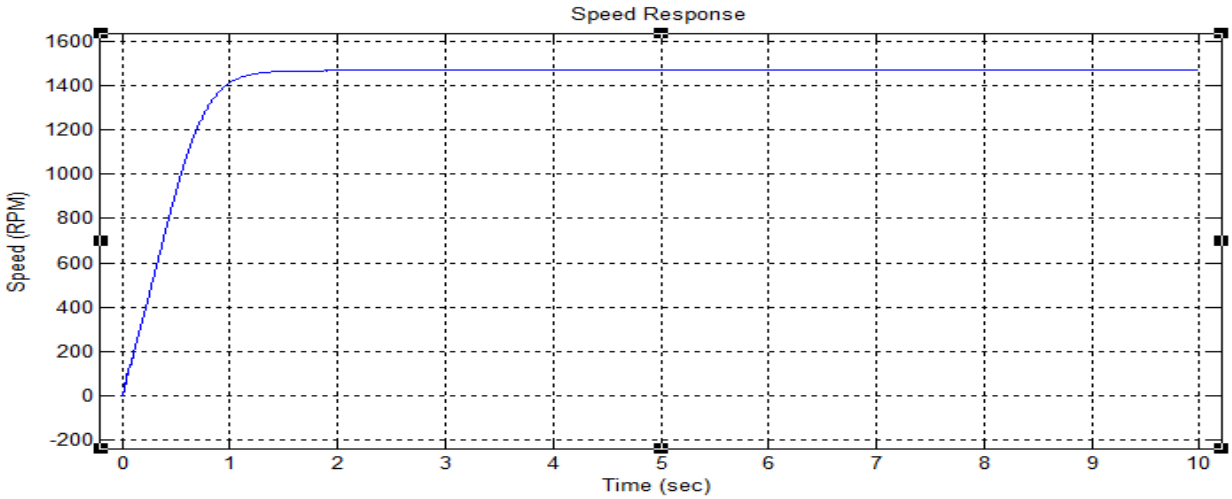


Fig 7: Speed Control of Three Phases IM

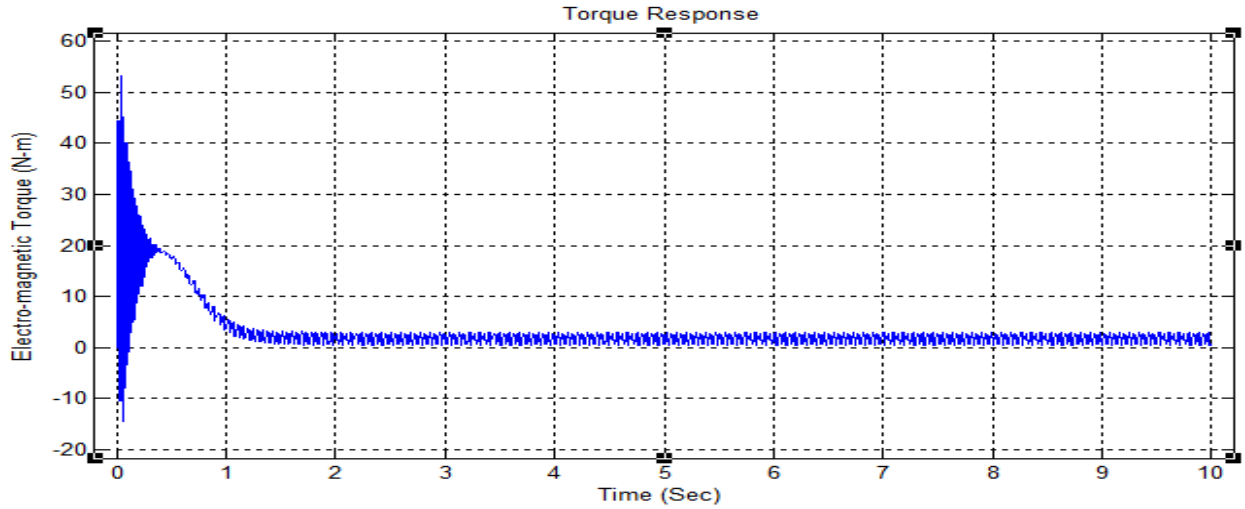


Fig 8: Torque Control of an Induction Motor

Conclusion

The single and three full bridge cyclo-converter circuits have been intended for speed control of induction motor with modified frequency. Single stage Cyclo-converter used to change the speed of induction motor with various preferred frequency is obtained to even out the desired speed. The speed control of Induction Motor is basic and can be made efficient by utilizing various strategies to control the performance of Cyclo-converter which in turn controls the performance of motor. The speed of the motor can be fluctuated in two ways, one is by changing the number of poles and the second method is by changing the frequency.

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