Z-SOURCE INVERTER

Circuit Simulation done by

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Theory

The ZSI is shown in Fig. 1. It consists of voltage source, impedance network, and three phase inverter with A.C. load. The DC voltage fed to the Z-network, which consists of two equal inductors(L_1, L_2) and two equal capacitors(C_1, C_2). The network inductors are connected in series arms and capacitors are connected in diagonal arms.

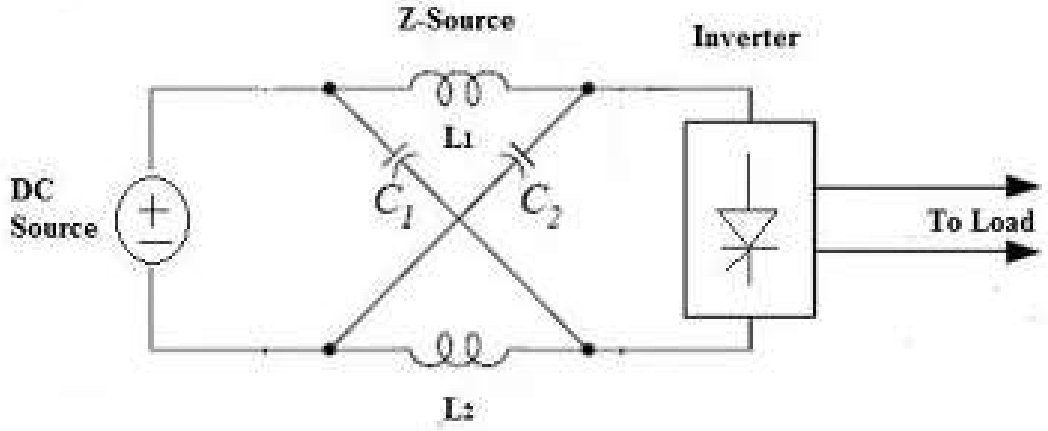

Fig.1. A general structure of the Z-source converter.

The impedance network is used to buck or boost the input voltage depends upon the boosting factor. This network also acts as a second order filter. The output voltage from impedance network is fed to the three phase inverter main circuit. The inverter main circuit consists of six switches. Gating signals are generated from the driving circuit and fed to the inverter operates and the output of inverter is fed to the AC load.

Equivalent Circuit of ZSI

The three phase impedance source inverter bridge has nine switching states unlike the traditional VSI that has eight switching states. Because of this special structure, the ZSI has an additional switching state, when the load terminals are shorted through both the upper and lower switching devices of any phase leg, which called the Shoot-Through (ST) state besides the eight traditional Non-Shoots Through (NST) states. The ZSI has two operating modes: non-shoot-through mode and shoot-through mode, as shown in Fig. 3 and 4 respectively. During the ST switching state, the input diode is reverse biased; the input DC source is isolated from the load, and the two capacitors discharge energy to the inductors and to the load. During the NST switching states, the input diode turns ON, and the DC input voltage source as well as the inductors transfer energy to the load and charge the capacitors, as a result the DC-link voltage of bridge is boosted. The impedance source inverter bridge has one extra zero state, when the load terminals are shorted through both upper and lower devices of any one phase leg or all three phase legs. This shoot through zero state is forbidden in the VSI, because it would cause a shoot- through. This network makes the shoot through zero state possible. This state provides the unique buck-boost feature to the inverter. The equivalent switching frequency from the impedance source network is six times the switching frequency of the main inverter, which greatly reduces the required inductance of the impedance source network. The equivalent circuit of the ZSI is shown in Fig. 2.

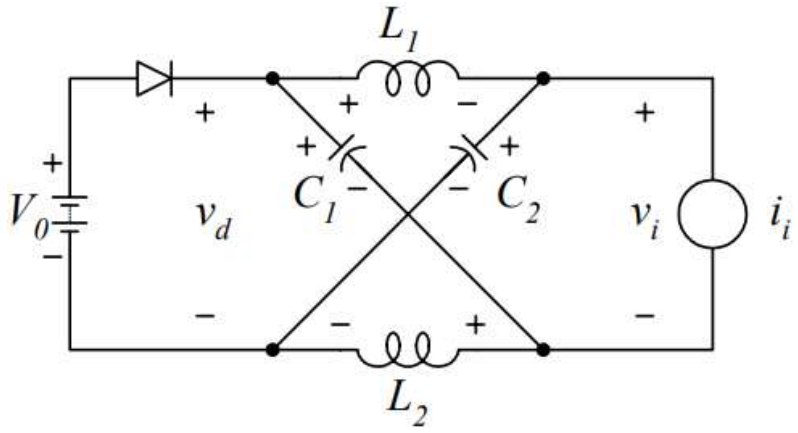

Fig 2: Equivalent circuit of ZSI

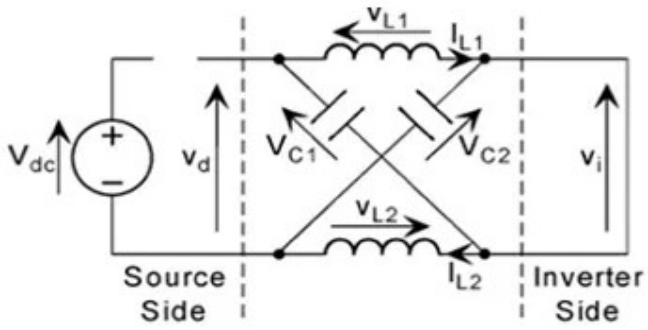

Fig 3: Equivalent circuit when ZSI in shoot through state

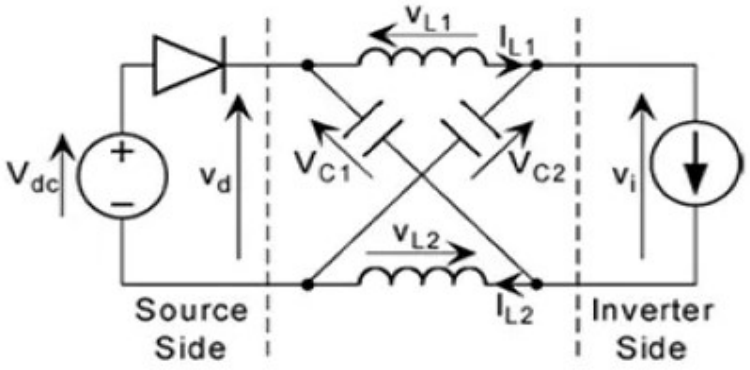

Fig 4: Equivalent circuit when ZSI in non-shoot through state

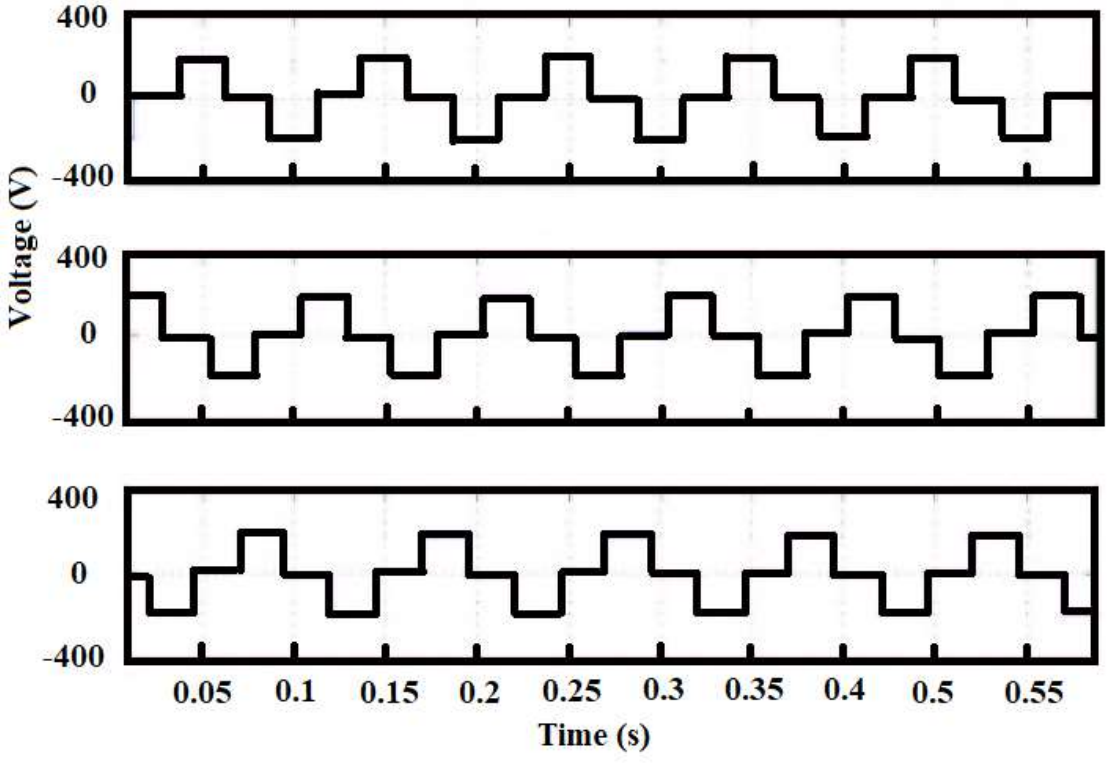

Figure 5 Inverter output line to line voltages

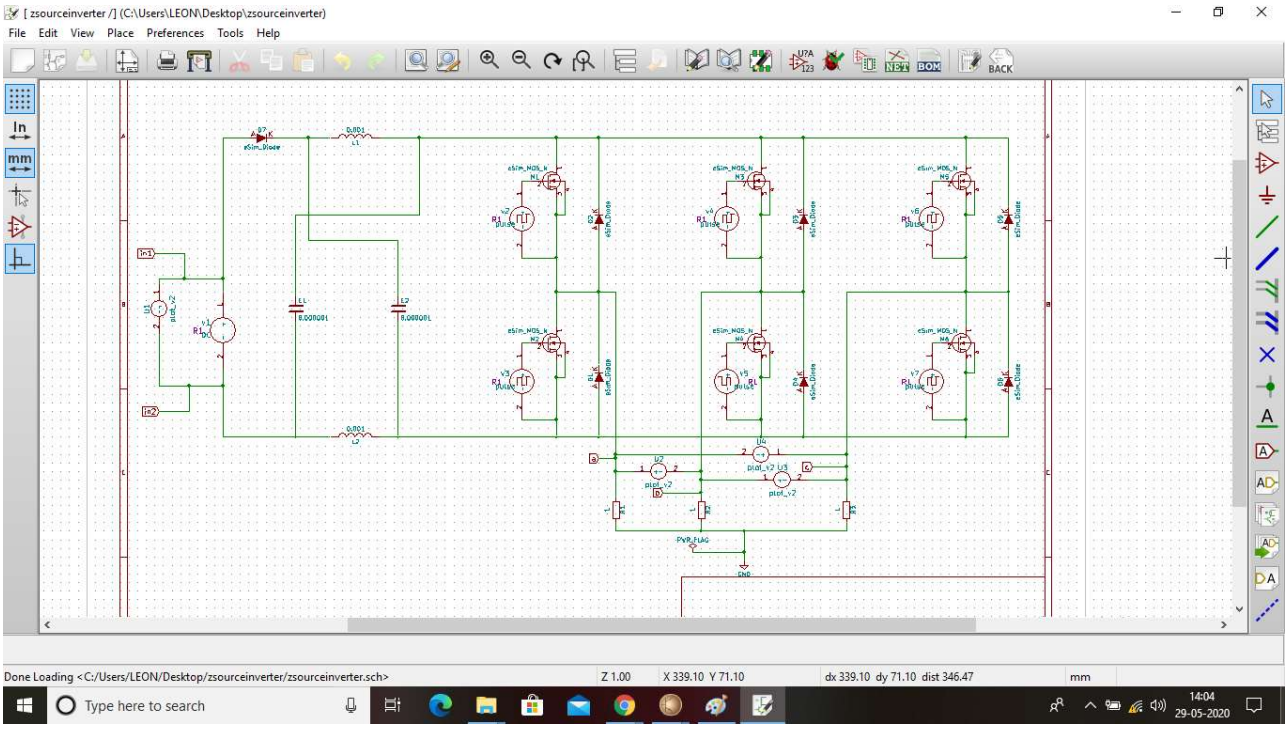

Figure 6: Schematic view of Z-source converter in eSim

Simulation results

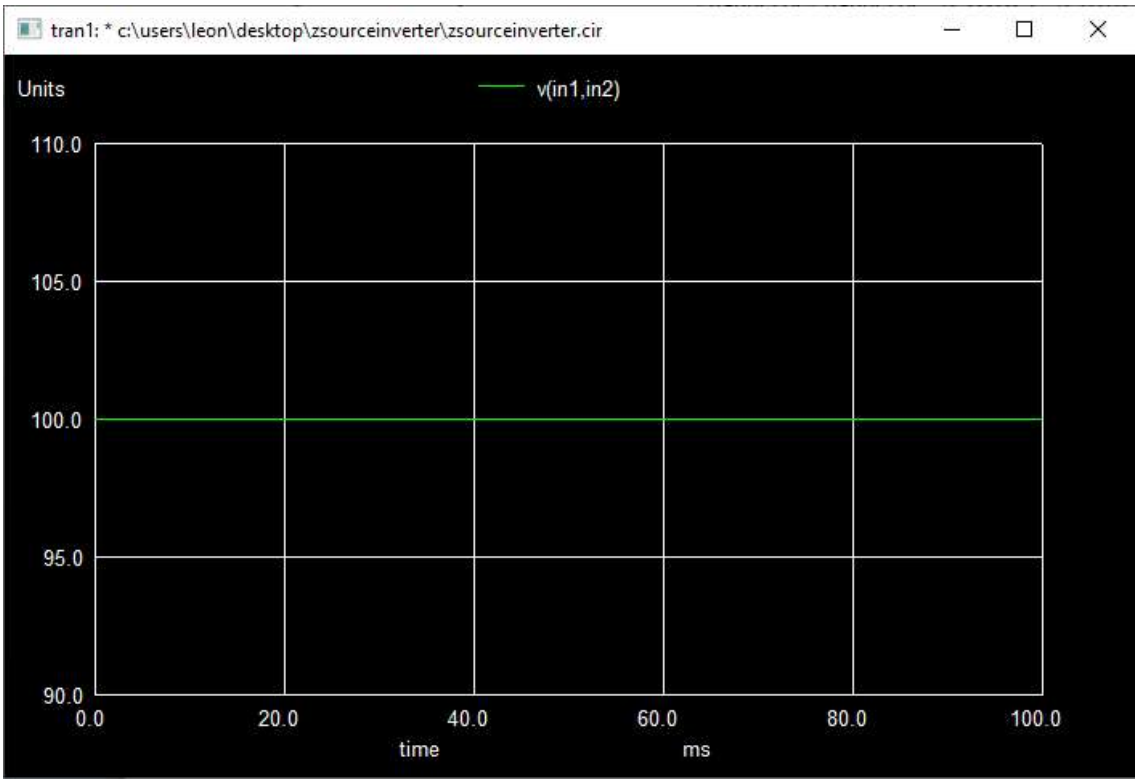

Figure 7: Input voltage wave form

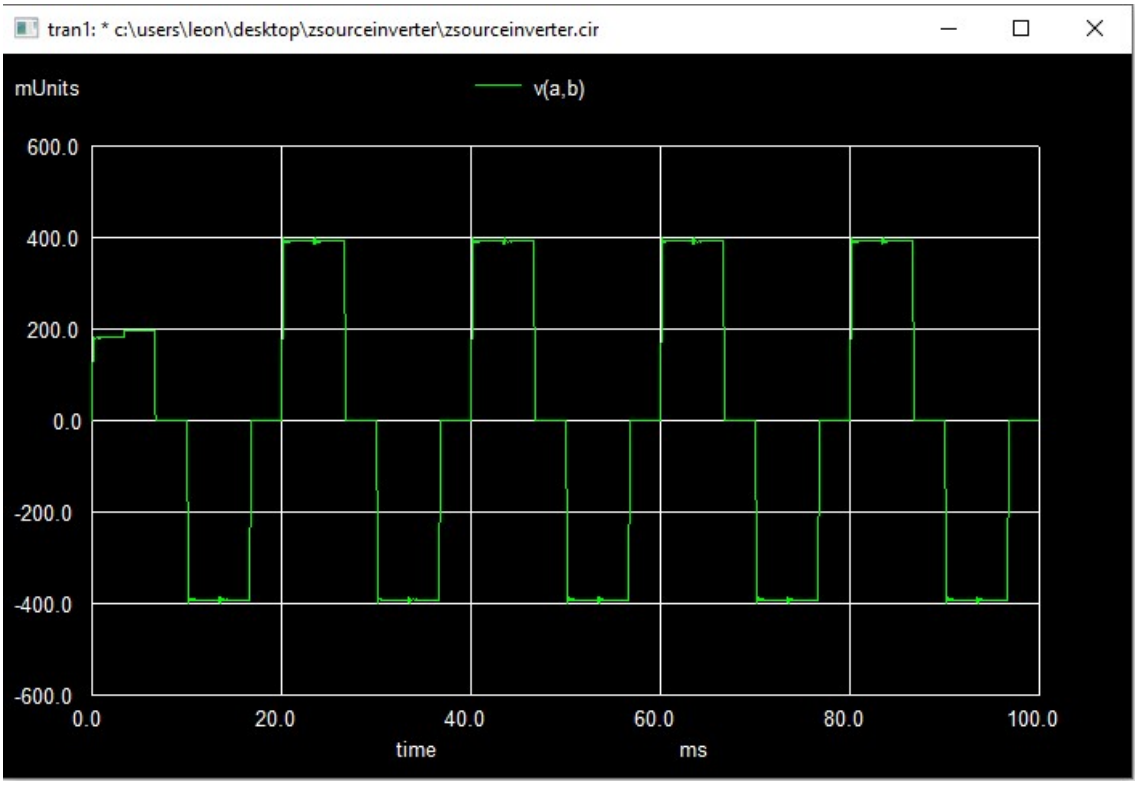

Figure 8: Output voltage of V_{ab}versus time

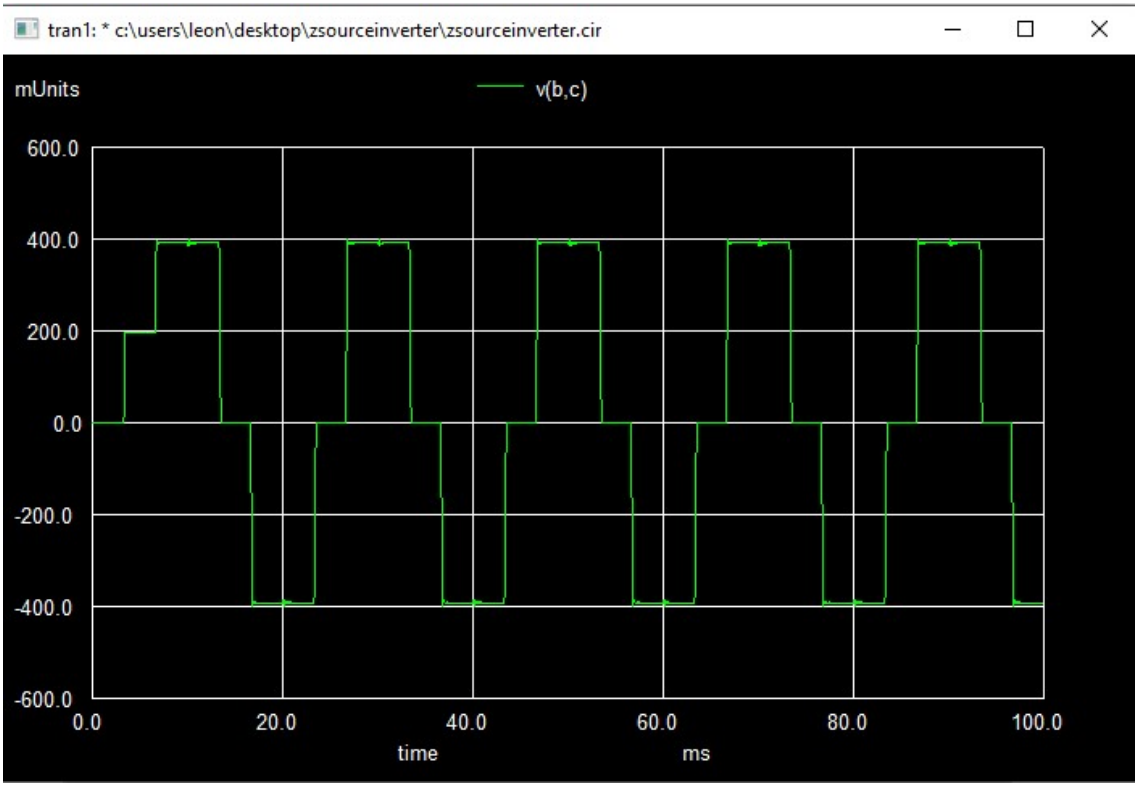

Figure 9: Output voltage of V_{bc}versus time

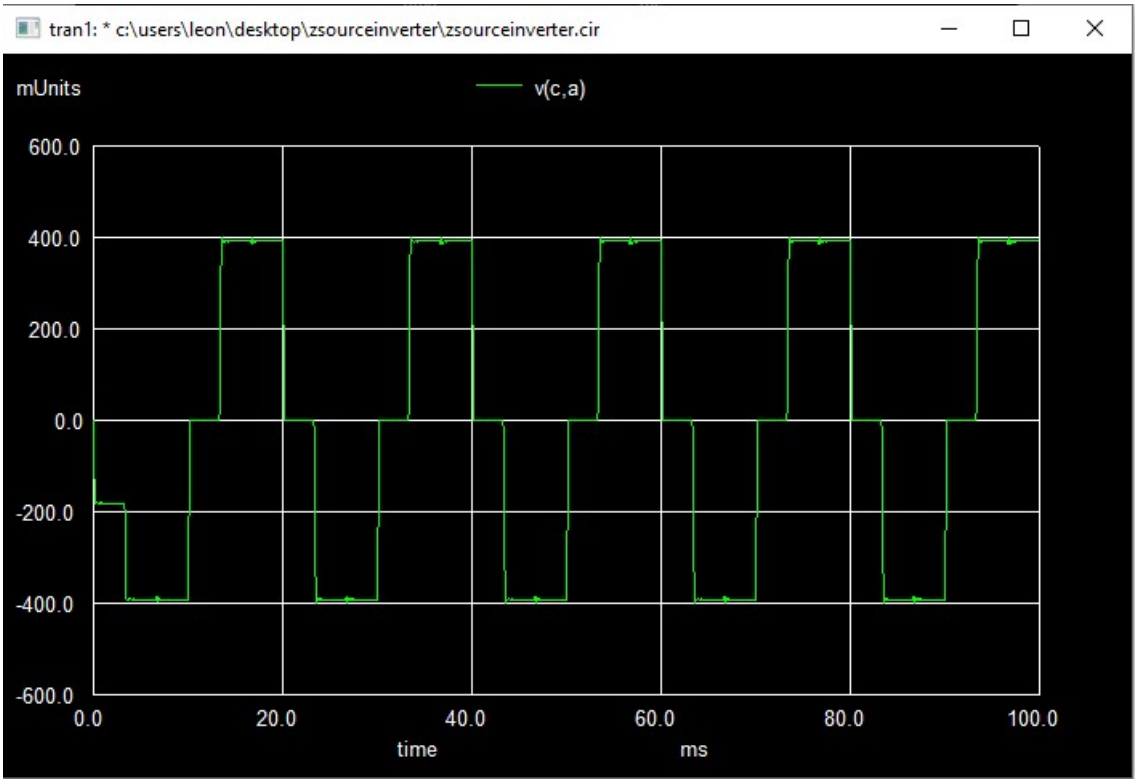

Figure 10: Output voltage of V_{ca} versus time

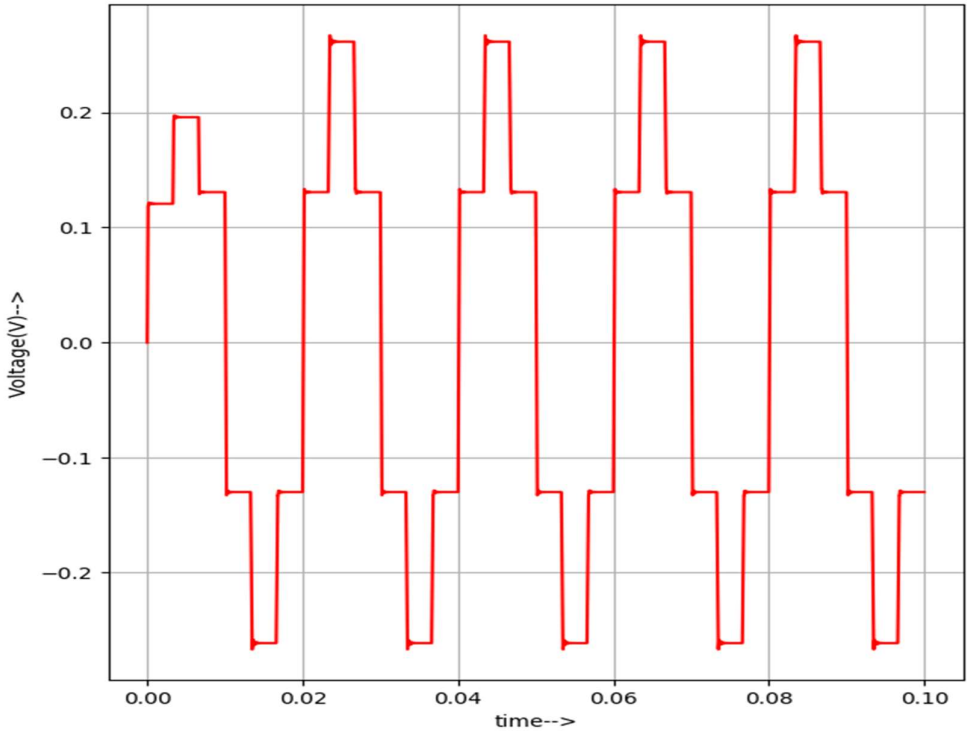

Figure 11: Python plot of V_{ab} versus time

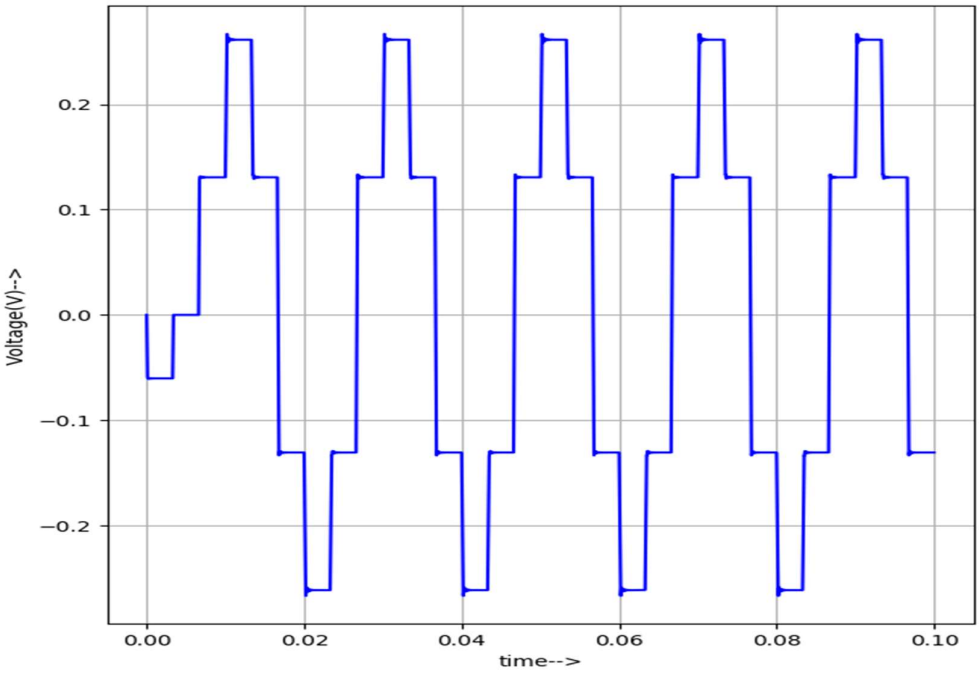

Figure 12: Python plot of V_{bc} versus time

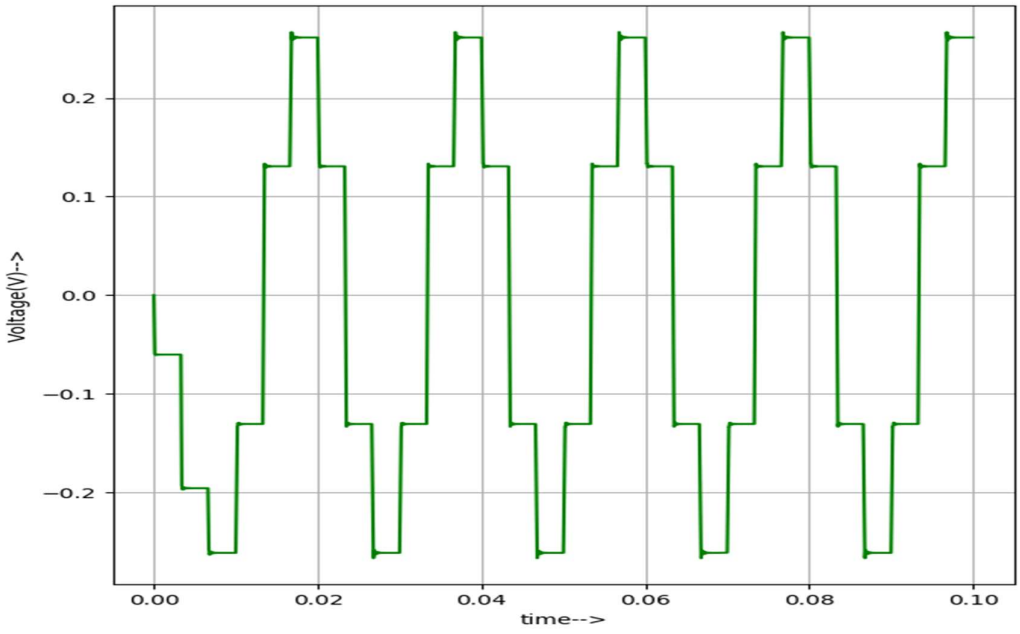

Figure 13: Python plot of V_{ca} versus time

Reference

https://www.electricalindia.in/z-source-inverter-fed-induction-motor/