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Analysis of Line to Ground Fault in Inverter FED IM Drive System

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Abstract
Inverter configuration is presented for the Induction Motor drive. One inverter is design for the step-down voltage and the second inverter is designed for the step-up voltage. PWM use to provide the gate signal to the MOSFET in the circuit. The inverter and the induction motor used as industrial appliances, so it is important to monitor and analyse the fault of the inverter output. While doing the conversion of ac to dc and dc to ac using the power electronics device the harmonics exist. Due to the malfunction in the VSI and CSI the faults are introduced. The current waveform is taken from each phase and the spectrum is analysed. The harmonic analysis with the help of FFT transform is carried out for the short circuit as well as normal condition. The simulation of the VSI and CSI using MATLAB is compared for both conditions i.e. without fault and line to ground circuit faults.

Key word- FFT, Fault, Inverter, MOSFET.

1. Introduction

The power electronics play major function in the field of switching devices. The aim of the converter-inverter topology is to provide desired voltage. VSI used as it works as a step-down inverter and CSI for the step-up inverter. So the VSI and CSI used for the specific demand of voltage i.e. lower than the input voltage and higher than the input voltage depend on the requirement. Instead of using converter or rectifier unit direct DC source can be applied such as fuel cells, battery to feed inverter circuitry. The appropriate PWM is used to provide the sequences for inverter. As induction motor is not the linear load so the harmonics and the faults should be measure in early stage to prevent the motor from the sudden shut down or damage. The measurement of current spectrum and analyse the fault in time as well as frequency domain can achieve. FFT transform use for the analysis in the instant time. The harmonic need to be analyse in the normal operating condition and with the fault condition. The malfunction in the circuitry introduced faults. One of the fault i.e. short circuit fault is analyse in the present paper. According to the need of output range inverter is used. For less power require in the output VSI is the best inverter and for the higher range of output CSI is the best inverter. In the present work the VSI as well as the CSI is designed to form the operation of VSI and CSI and then find out the harmonic distortion effect on the circuitry. If in both the circuit of VSI and CSI due to some reason line to ground fault comes then the study of that particular fault need to be form, and identifies the spectrum of current to find value of the current as well as harmonic distortion. The comparison can be form so that we can identify that in which inverter the situation is dangerous and to be controlled.

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2. Literature Survey

The inverter topology is used in the daily life as the requirement increase for the domestic as well as in industrial application, so the need of analysis of faults taken into consideration. Nowadays the inverter is everywhere and required more reliability and the smooth operation (Sharma and Mendiratta, 2013). The S-Transform is used to detect the faults related to the voltage source inverter. In this the faults in the IGBT terminal is form and the analysis of these faults using the S-Transform (Manap et al., 2016). The current analysis is the procedure for identify and detect the faults presents in the circuit so that the motor can be prevent from the fault in the stage and the fault cannot harm the motor completely. The monitoring of faults can be form by the process step which is sampling, pre-processing, fault detection algorithm and the post processing and the different signal processing technique is use to detect the faults are Fast Fourier Transform, Short Time Fourier Transform and Wavelet Transform (Kalaskar and Gond, 2014). As the faults in the Dc link has been identified in case of short circuit and open circuit fault. The Wavelet transform is used for the faults diagnosis and simulation study is performs to find the faults effect (Mohanraj et al., 2014; Kavitha and Sujitha, 2014). The three phase analysis is form by using the Pulse Width Modulation. This method is suitable for the control purpose. As the output voltage control the lower harmonics minimized (Bhutia et al., 2014; Sharma and Nagwani, 2013; Pandian and Reddy, 2013). CSI is the solution for the drive where need of high power. Short circuit protection is provide due to the inverter circuitry is CSI. The scope of CSI is continuously growing and useful for the ac drives (Patel and Patel, 2013; Umamaheswari et al., 2013).

3. Results and Analysis

3.1 Voltage Source Inverter

The voltage source inverter topology is analysed using the circuit shown in Figure 1, where the inverter output is used to analyse the faults due to the inverter module. Figure 1 shows the condition where the system comes in the normal operation or in the healthy condition. The simulation is done by using the MATLAB software.

Figure 2 shows the response of the VSI inverter in terms of the FFT analysis, where the THD% is found at the fundamental frequency of 50 Hz.

Figure 3 shows the VSI module with the line to ground fault. Where phase A shows the condition of L-G fault.

Figure 4 gives the spectrum of fault in the condition of line to ground fault as well as the THD% using the FFT.

3.2 Current Source Inverter

The current source inverter used for the step-up operation and to maintain the operation it is required to analyse the circuit in the fault condition. Figure 5 shows the simulation circuit in the condition where the circuit is faultless.

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4. Conclusion

This paper shows the line to ground fault in the different inverter in comparison with the without fault condition. The Table 1 and Table 2 shows the VSI and CSI results in the tabular form. From both the table found that the VSI fed IM drive is having the higher THD% in compare with the CSI. As the current value is same in both of the case, but due to the higher value of THD the VSI shows that the line to ground fault generate more effect on VSI fed IM drive system.

Acknowledgements

This paper provides the details of VSI and CSI fed IM drive in the line to ground fault condition. Using various research paper this paper is prepare. The details from the references which are directly and indirectly used in this paper author like to acknowledge all.

Conditions	THD%	Current in Phase A
Without Fault	4.73	200
Line to Ground Fault	26.95	-700

Table 1. THD% Responses of the healthy and faulty condition of VSI fed IM

Conditions	THD%	Current in Phase A
Without Fault	4.71	220
Line to Ground Fault	26.90	-700

Table 2. THD% Responses of the healthy and faulty condition of CSI fed IM

This table shows the current as well as the THD response for the healthy and fault condition.

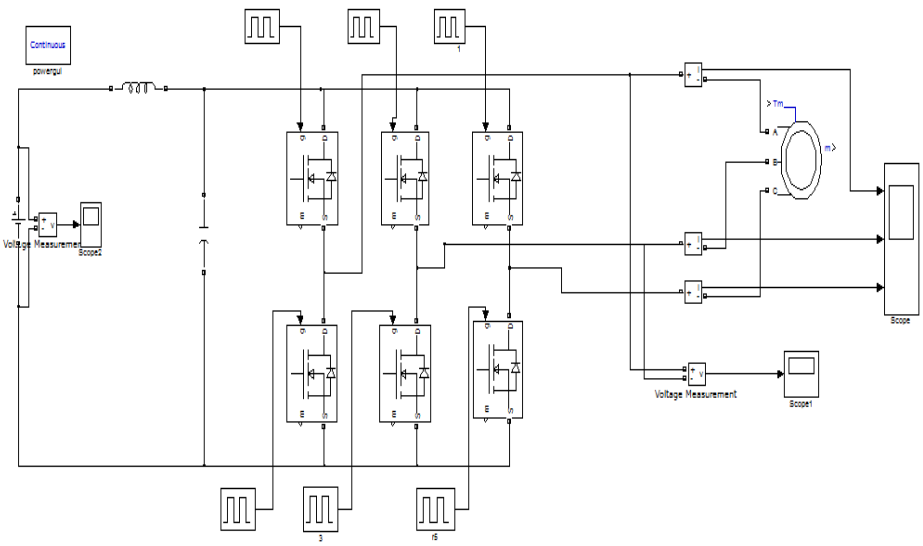

Figure 1. Simulation circuit for the VSI fed IM

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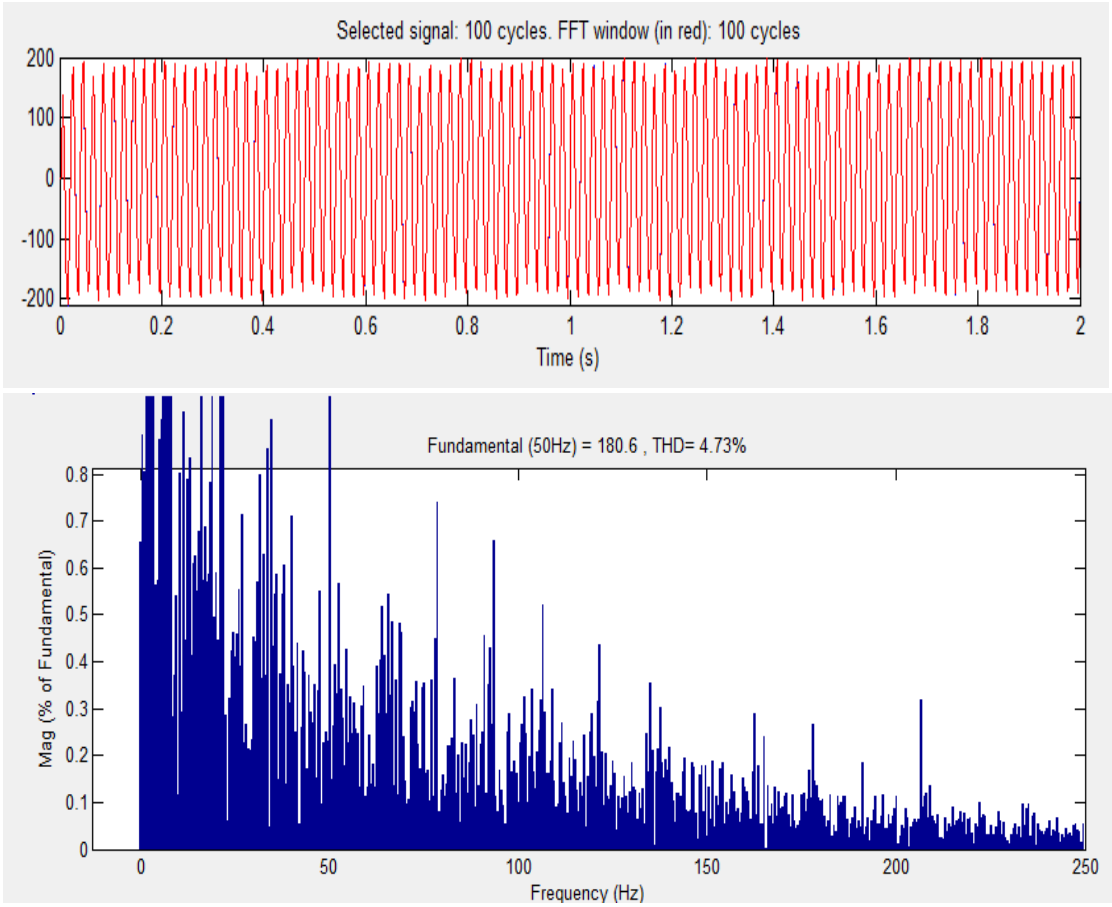

Figure 2. FFT for the THD% of healthy condition of inverter

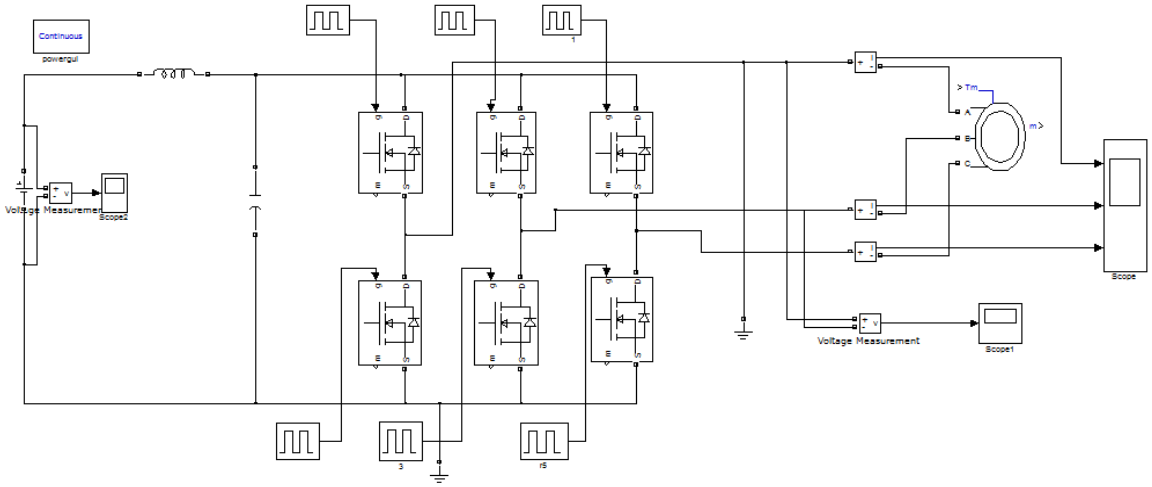

Figure 3. Simulation circuit for the VSI fed IM in the faulty condition

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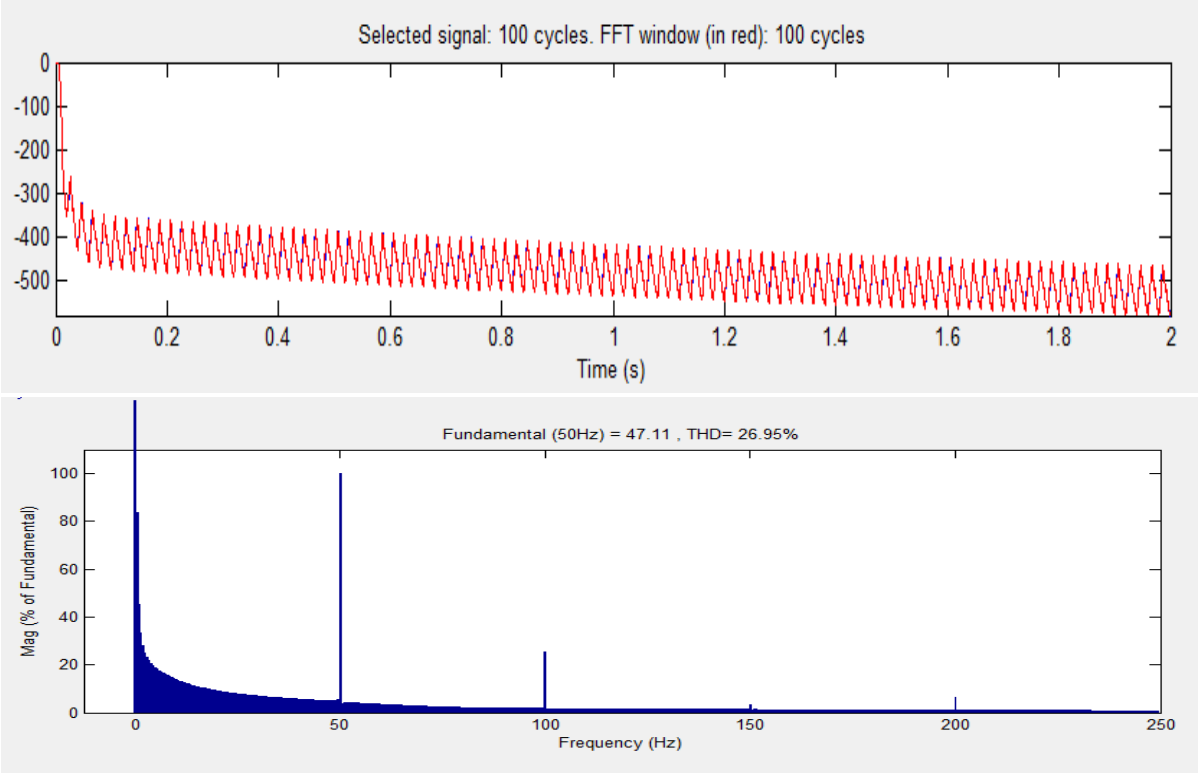

Figure 4. THD response for the L-G fault

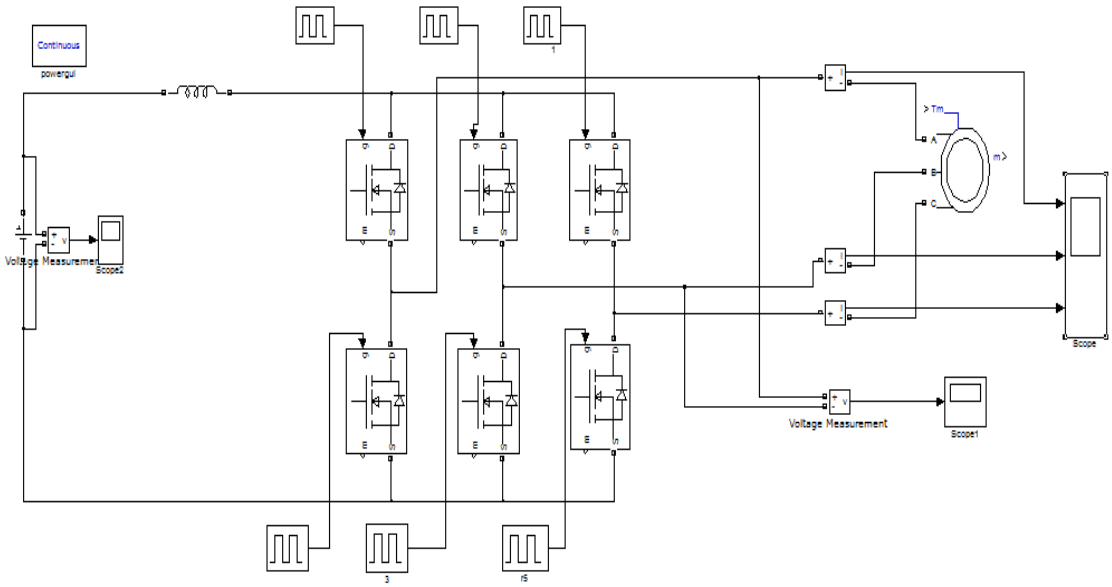

Figure 5. Simulation diagram for the CSI fed IM

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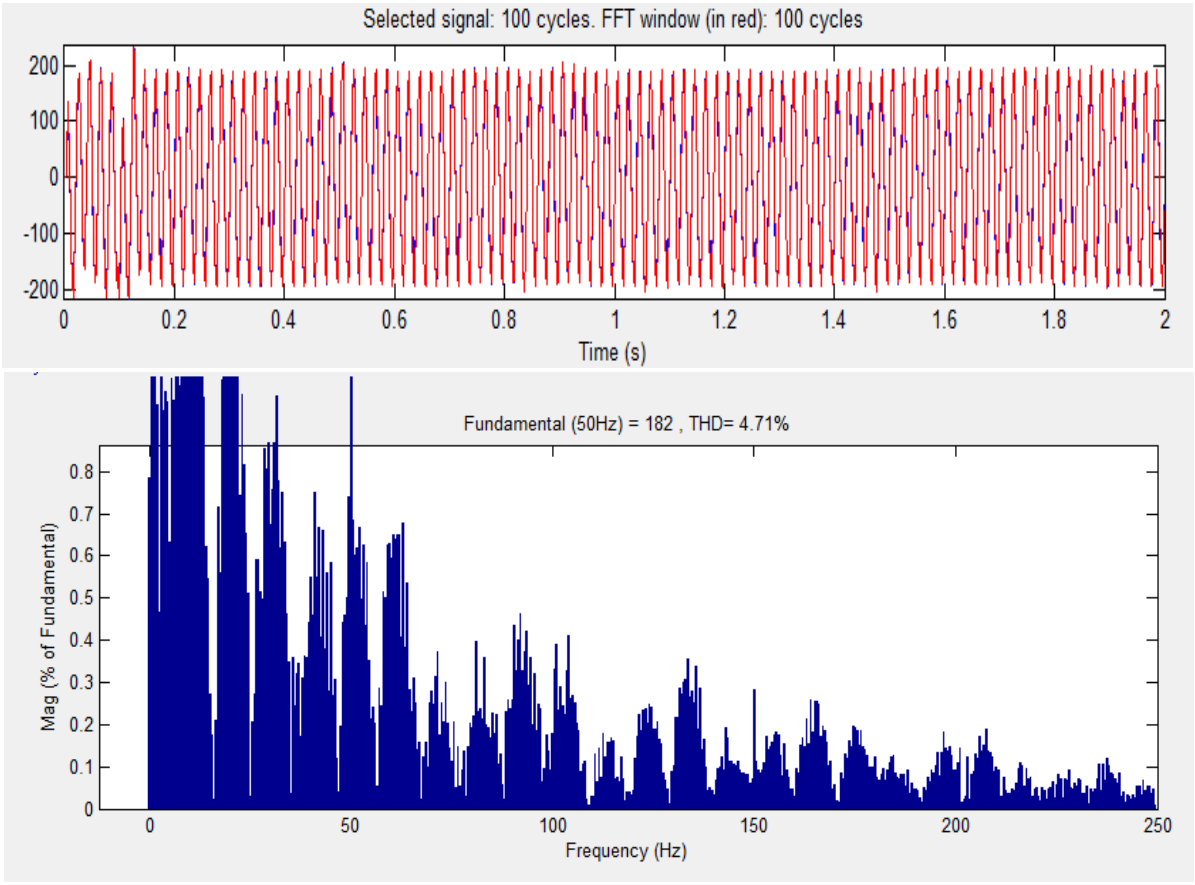

Figure 6. THD response for the CSI fed IM when faults not introduced

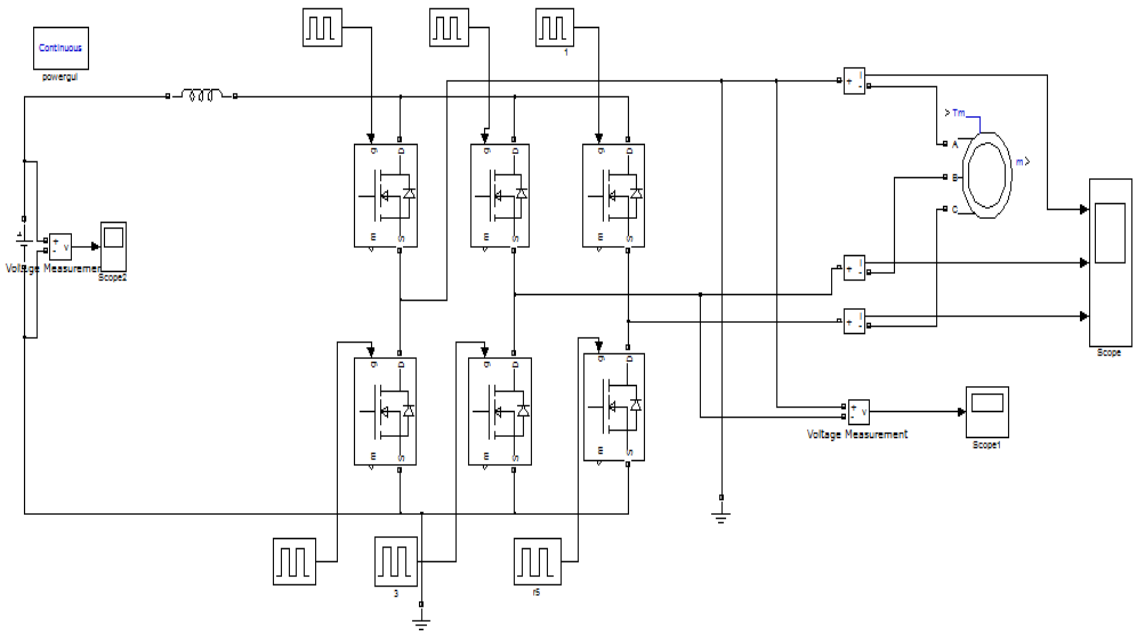

Figure 7. Simulation for the CSI fed IM under line to ground fault condition

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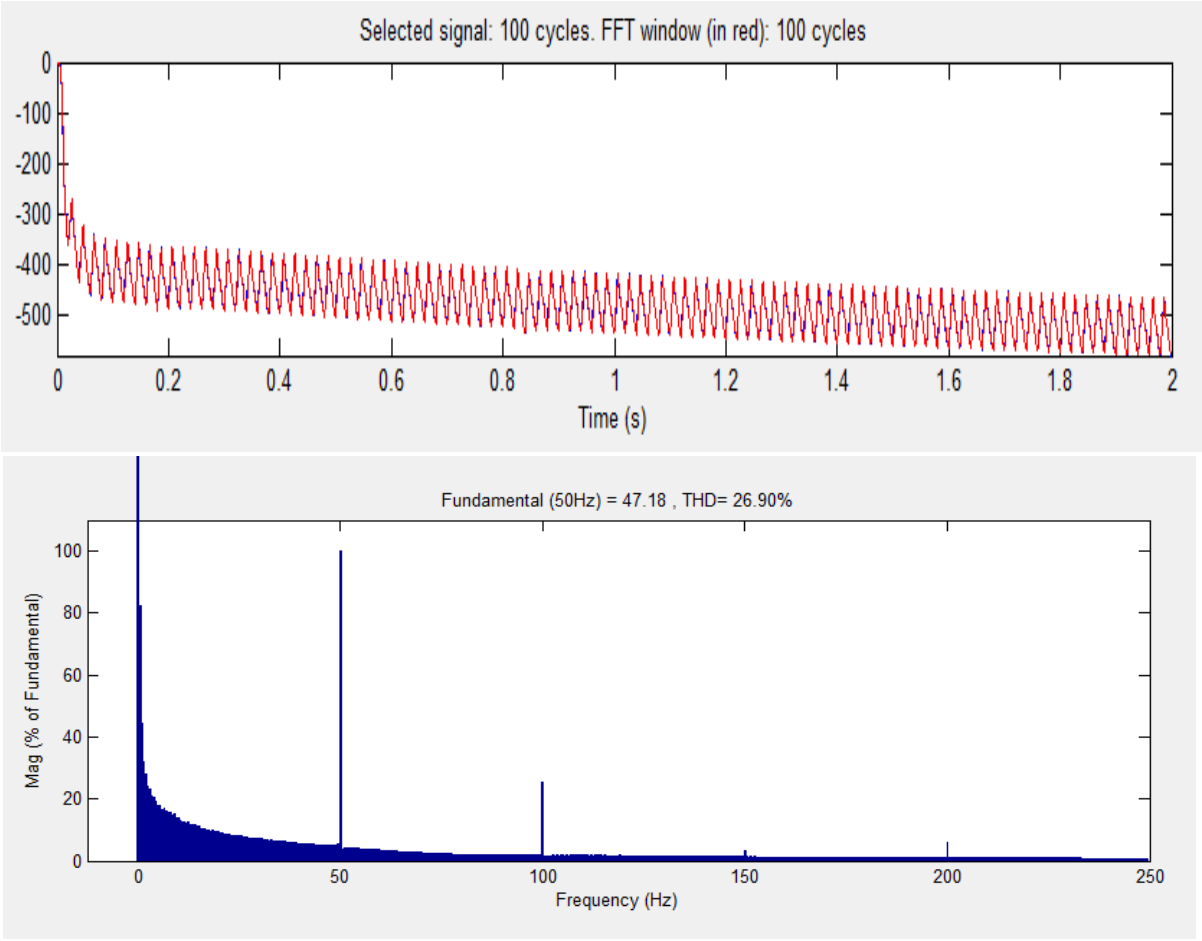

Figure 8. THD% for CSI fed IM when faults introduced

References

Bhutia, B., Ali, M., & Tiadi, N. (2014). Design of Three Phase PWM Voltage Source Inverter for Photovoltaic Application. International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, 2(4), 2321-2004.

Kalaskar, C. S., Gond, V. J. (2014). Motor Current Signature Analysis to Detect the Fault in Induction Motor. Int. Journal of Engineering Research and Applications, 4(6), 58-61.

Kavitha, M. N., & Sujitha, M. N. (2014). Motor current signature analysis of multilevel inverter fed induction motors using wavelets. International Journal of Advanced Information Science and Technology, 22(22), 145-149.

Manap, M., Abdullah, A. R., Saharuddin, N. Z., Abidullah, N. A., Ahmad, N. S., & Bahari, N. (2016). Voltage Source Inverter Switches Faults Analysis Using S-Transform. Power, 2, 3.

Mohanraj, K., Paramasivam, S., & Dash, S. S. (2014). DC Link Faults Detection in a 3 phase VSI fed Induction Motor Drive using Wavelet Transform. International Journal of Scientific & Engineering Research. 5(5), 625-629.

Pandian, G., & Rama Reddy, S. (2013). Simulation and implementation of PWM Inverter Fed induction motor drive. International Journal of Innovative Research in Science, Engineering and Technology. 2(11), 6103-13.

Patel, D., Patel, A. R. (2013), Current source inverter-fed AC machine drive system. Journal of Information, Knowledge and Research in Electrical Engineering. 2(2).

Sharma, C. S., & Nagwani, T. (2013). Simulation and analysis of PWM inverter fed induction motor drive. International Journal of Science, Engineering and Technology Research, 2(2), 359-366.

Sharma, V., & Mendiratta, G. (2013). Detection of faults in AC to AC converter fed induction motor driver. International Journal of Scientific & Engineering Research, 4(11), 85-88.

Umamaheswari, N., SrinivasRaju, P., Sravanthi, K., & Kumar, K. K. (2013). Performance analysis of CSI based PV system during LL and TPG faults. IOSR Journal of Electrical and Electronics Engineering, 6(3), 101-107.

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