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Simulation and Performance Analysis of Z Source Inverter Fed Induction Motor Drive

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ABSTRACT: The use of induction motors have been increasinggreatly since the day of its development. The reason for itsday by day increasing reputation can be primarily attributed to its robust construction, simplicity indesignand costeffectiveness. They are being used in robotics, domestic and other applications.So,for wide range of use in the industry, themachine requires an efficient drive circuit arrangement.Currently, conventional voltage source inverter (VSI) or current source inverter(CSI) is dealing askey part in the field of induction motor drive circuit. These inverters failto perform at our desirelevelduetosomecrucialdrawbacks.Inthisprojectthedrawbacksoftraditionalinvertersareeliminated by replacing it with Z – Source inverter (ZSI). This project is mainly focused on effectivecontrol of induction motorwithZ–Source inverter (ZSI).

KEYWORDS: VSI, CSI, Z- Source,

I. INTRODUCTION

Conventional converter topologies such as voltage source inverter (VSI) and current source inverter (CSI) are commonly used as power electronics circuits for power conversion purposes. The VSI produces an ac output (after filtering it) which is limited below the dc input voltage, which means that VSI is buck type converter. The buck operation nature of the VSI limits its operation to power conversion applications and ac drive circuits. An additional dc-dc unit is connected to the dc input of the converter in order to further increase the dc input voltage, which leads to an increase in the ac output voltage. As a result, the additional dc-dc boost converter increases the system cost, control complexity and reduces the efficiency. Further, animism-gating of the inverter bridge switches cause short circuit and destroys the power switching devices. For that, a dead-time is set between the upper and the lower switching devices of the same leg in order to avoid short circuit occurrences. The idea of impedance-source converter (ZSI) was originally developed due to the limitation in VSIs and CSIs. The conceptual and theoretical limitations in the conventional converters types reduce their application and complicate their control methods. While the ZSI great advantage can be seen as: it can operate as VSI inverter (buck type) or as CSI inverter (boost type) depending on the application. The output voltage can ideally ranges from zero to infinity. Since the invention of the ZSI inverter, there are number of research works on this interesting topology, and this project presents its basic operation and control. The limitations of traditional converter are:

- The capability of traditional converter is only used as buck converter or boost converter.
- Efficiency lower down where over drive is required
- No two thyristors can be gated ON in the same leg
- Only 8 switching states are available in traditional converter.
- Either capacitor or inductor available for energy storage and suppress ripples.

The Z-source inverter mainly used the shoot-through states to boost the dc bus voltage for the turning ON two thyristors of the upper and lower phase same leg. As a result the Z-source inverter can buck and boost voltage to a wanted output voltage that is more than dc bus voltage. Therefore improve the reliability of an inverter, the shoot-through cannot occurs to burnout the circuit. The advantages of ZSI has a low-cost, reliable and highly efficient single-stage structure for boost and buck power

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conversion. The main structure circuit of the Z-source inverter is presented in Fig.1. The maximum constant boost control can greatly reduce the L and C requirements of the Z-source impedance network.

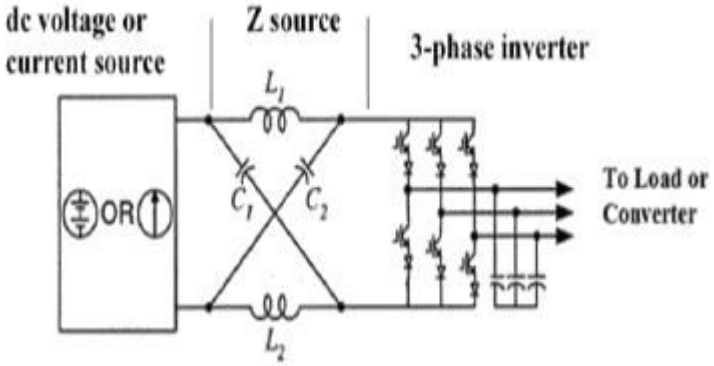

Fig. 1 Structure of ZSI

The purpose of this work is to investigate modeling and simulation of a single phase Z-source inverter and its control strategy for implementation dc-to-ac power conversion. The research motivation for this thesis also comes from the necessity of maximum power point tracking (MPPT) for the solar PV panels. The Z-source inverter and its control system should be capable of tracking individual maximum power point of the solar panels and ensures the maximum capture of energy on DC side.The ZSI impedance network has a unique LC network which is connect with dc link and controller to provide optimal output ac voltage. Also, a comparative performance analysis of a ZSI and VSI which is fed by a PV source is carried out using characteristics and torque.

II. PROPOSED MEHODOLOGY

The proposed work is planned to be carried out in the following manner:

1. Study of basic concepts of Induction motor
2. Study of basic concepts of Z- source Inverter.
3. Finding the problems from conventional system by surveying literature.
4. Design VSI fed induction motor deive/.
5. Analysis of the proposed topology.
6. Study of the control strategies of system.
7. Simulation of the model can be done in MATLAB software. Evaluation of the performance

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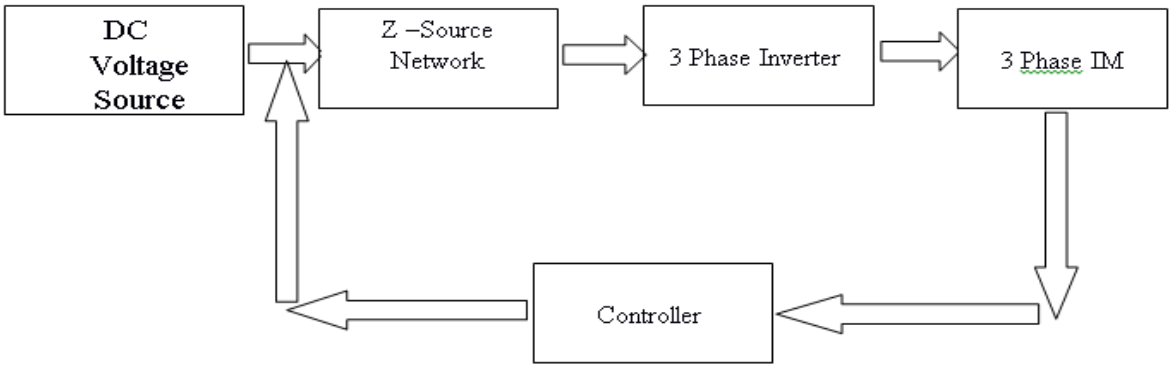

Fig. 2: BlockDiagramofZ-SourceInverterfedInductionMotordrivewithController

III. SIMULATION AND RESULT

Simulation of VSI and ZSI fed induction motor

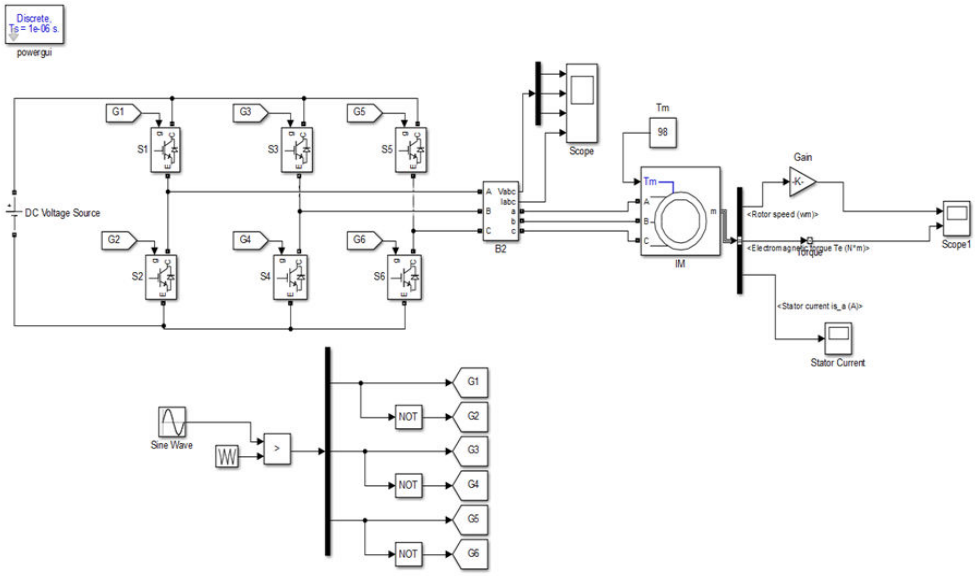

Fig 3 :Matlab Simulation Model of Vsi Fed Im Drive:-

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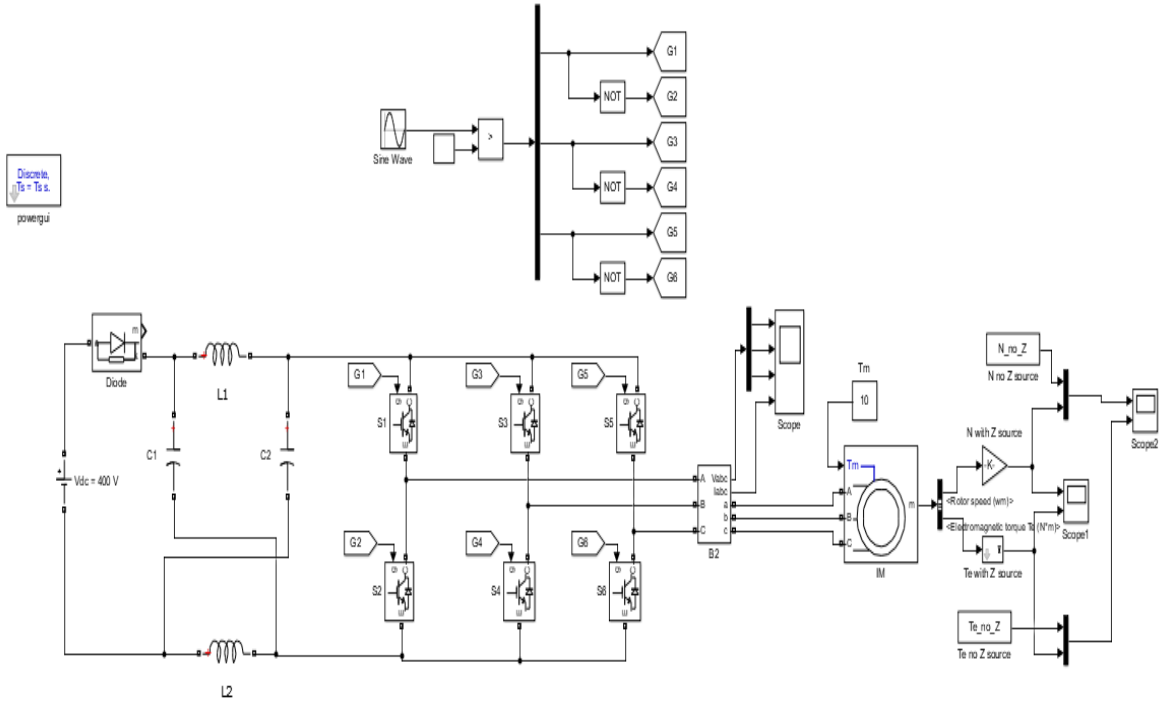

Fig4:Matlab Simulation Model Of open loopZ source Fed Im Drive:-

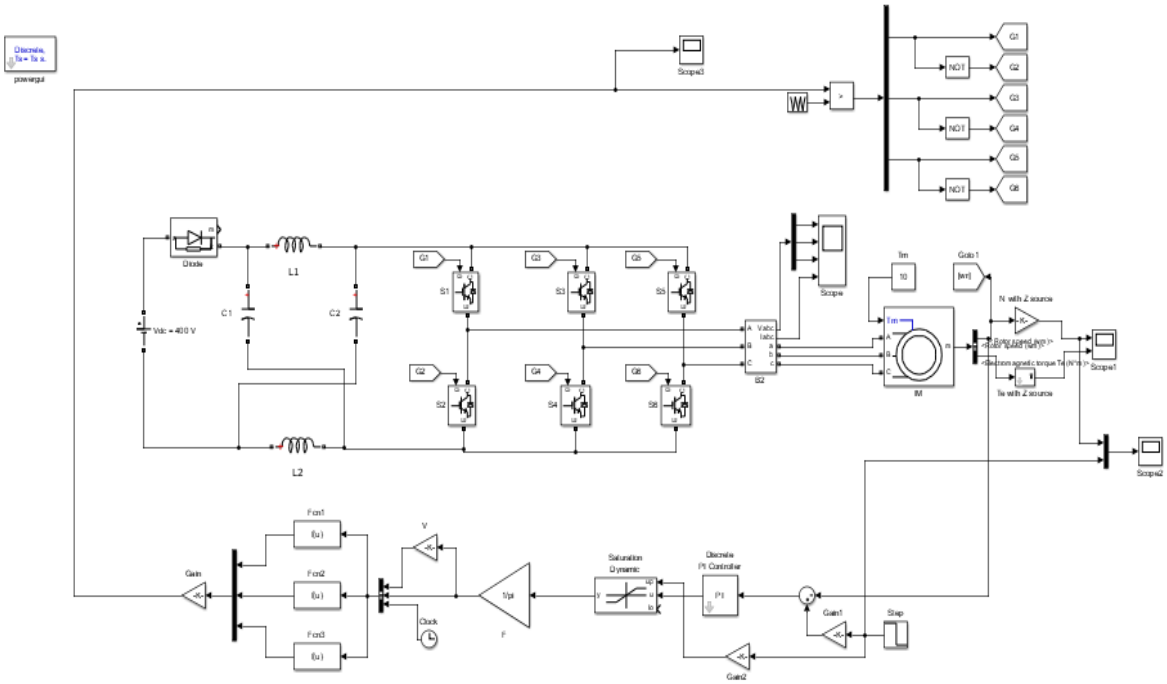

Fig:5Matlab Simulation Model Of open loopZ source Fed Im Drive:-

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IV. RESULT ANALYSIS

Matlab Simulation Result of Vsi Fed Im Drive:-

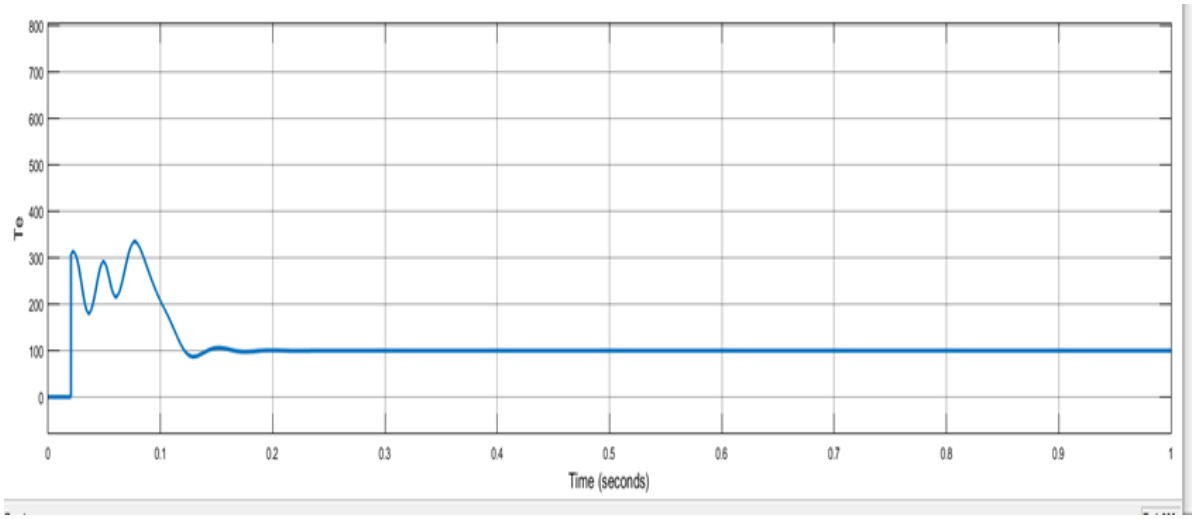

Fig 6 Performance characteristics of Electromagnetic Torque

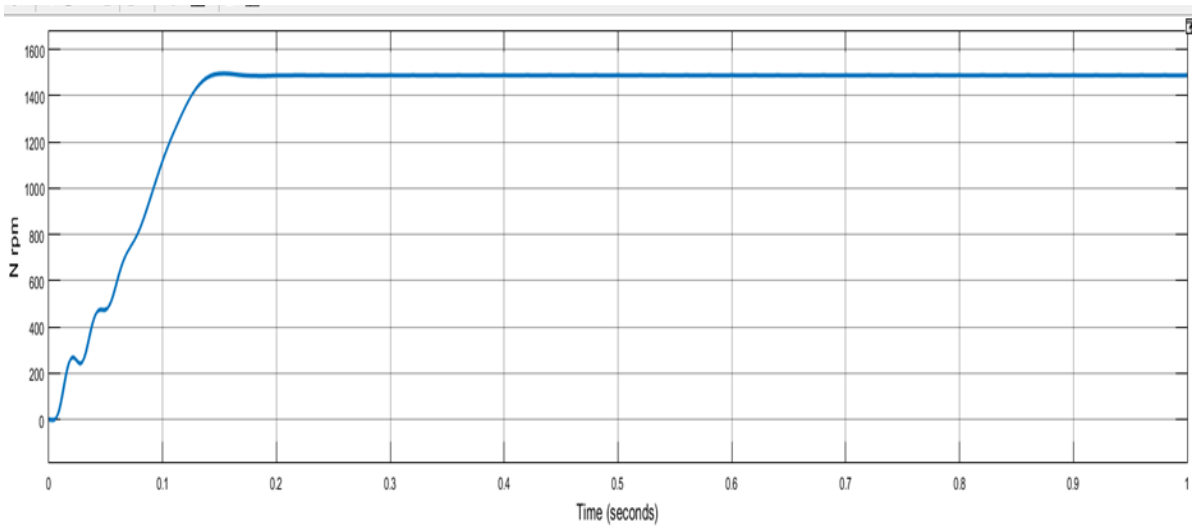

Fig 7. Performance characteristics of Rotor Speed

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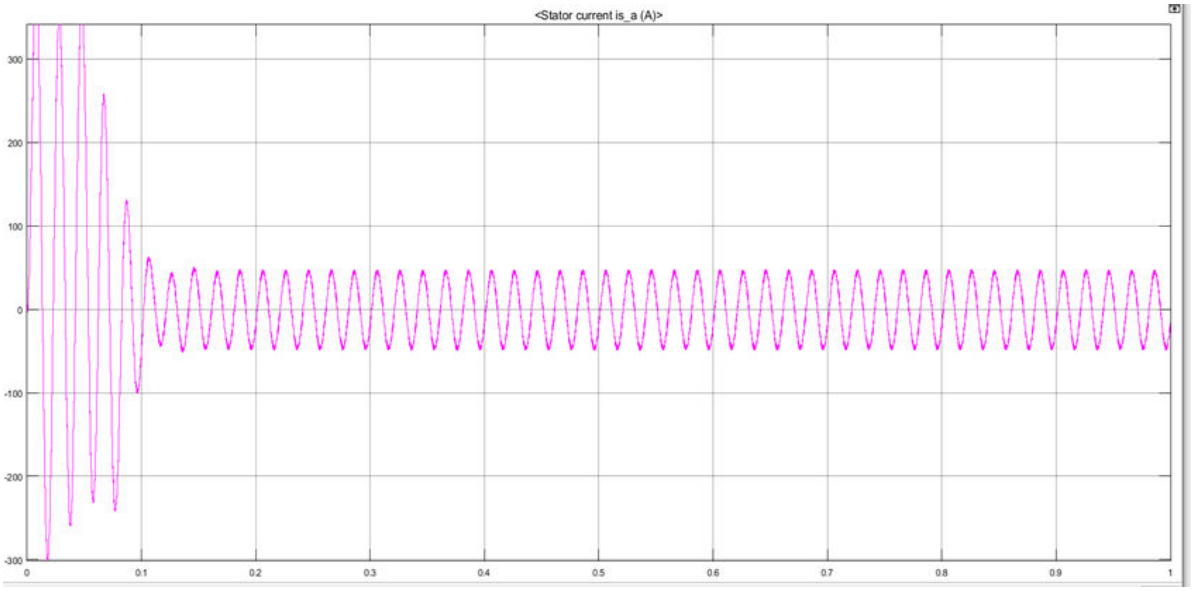

Fig 8 Performance characteristics of Stator Current

MatlabSimulation Result of Open loopZ Source Fed Im Drive:-

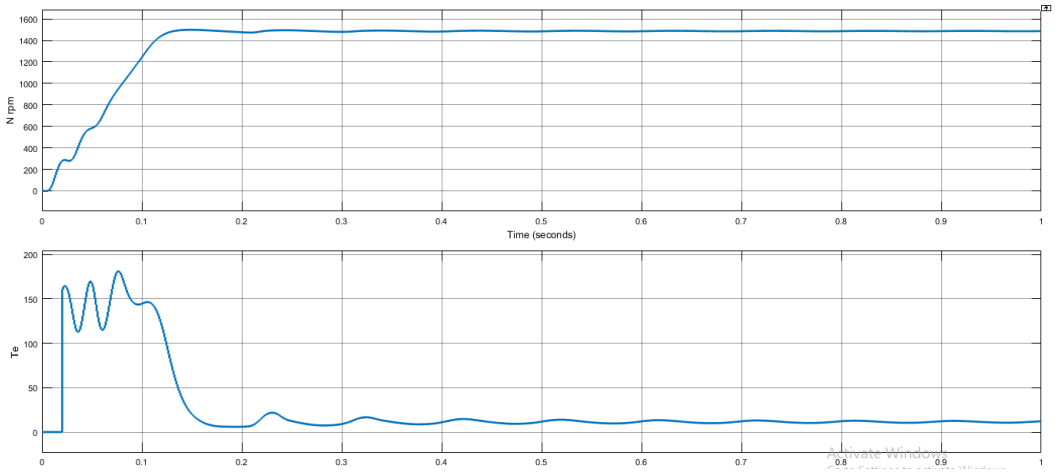

Fig 9. Performance characteristics of Rotor Speed and Torque using Open loop Z source

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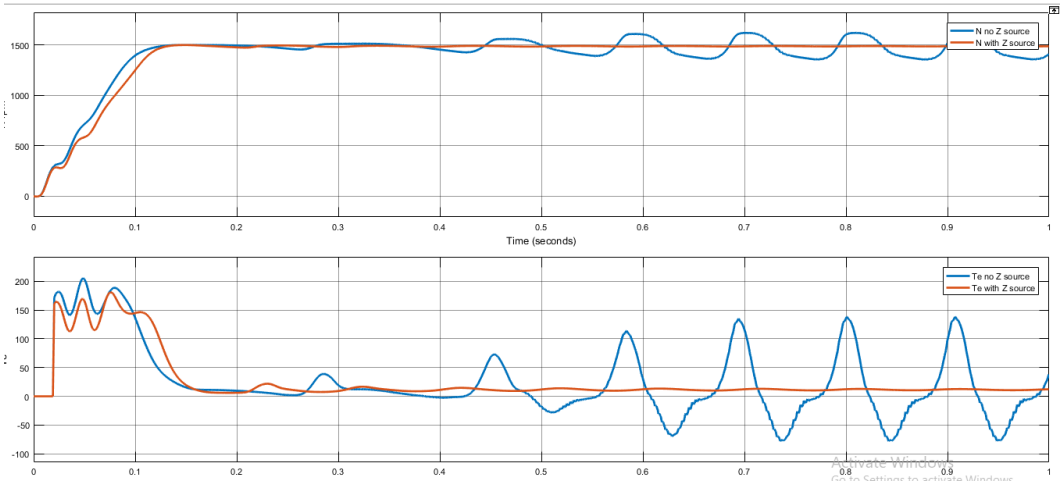

Fig 10. Performance characteristics of Rotor Speed and Torque with Z source and without Z source

MatlabSimulation Result of Closed loop Z Source Fed Im Drive:-

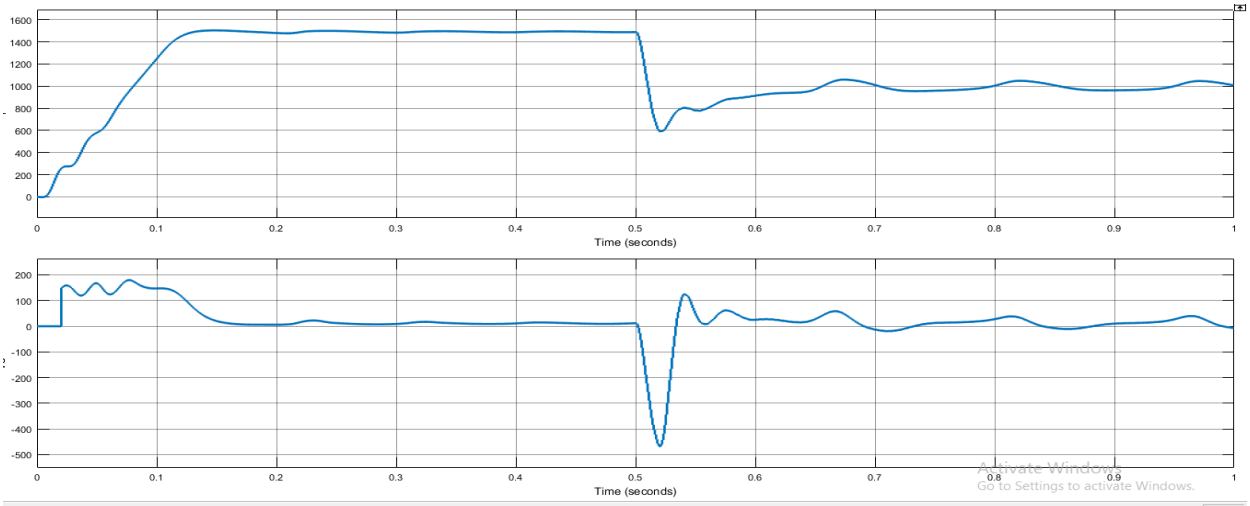

Fig 10. Performance characteristics of Rotor Speed and Torque with closed loop Z source Inverter fed IM

V. CONCLUSION

Z source inverter system and Voltage Source inverter fed induction motor system is explained in details. Limitation of convectional converter and advantages of ZSI are also listed and explained. The PV module is used as a source to fed the complete system. The design requirements of PV module and mathematical modeling have been presented with I-V and P-V characteristics indicating the maximum operating conditions. The MPPT control with P&O and Incremental Conductance is explained. The ZSI fed induction motor drive by PV source and VSI fed Induction motor drive by PV source modeling using MATLAB Simulink and result discussed. From the observations, it can be concluded that the Z source inverter fed induction motor drive has better settling time, less torque ripples, improved stator and rotor current for the same load and speed as compared to the Voltage Source inverter fed induction motor drive.

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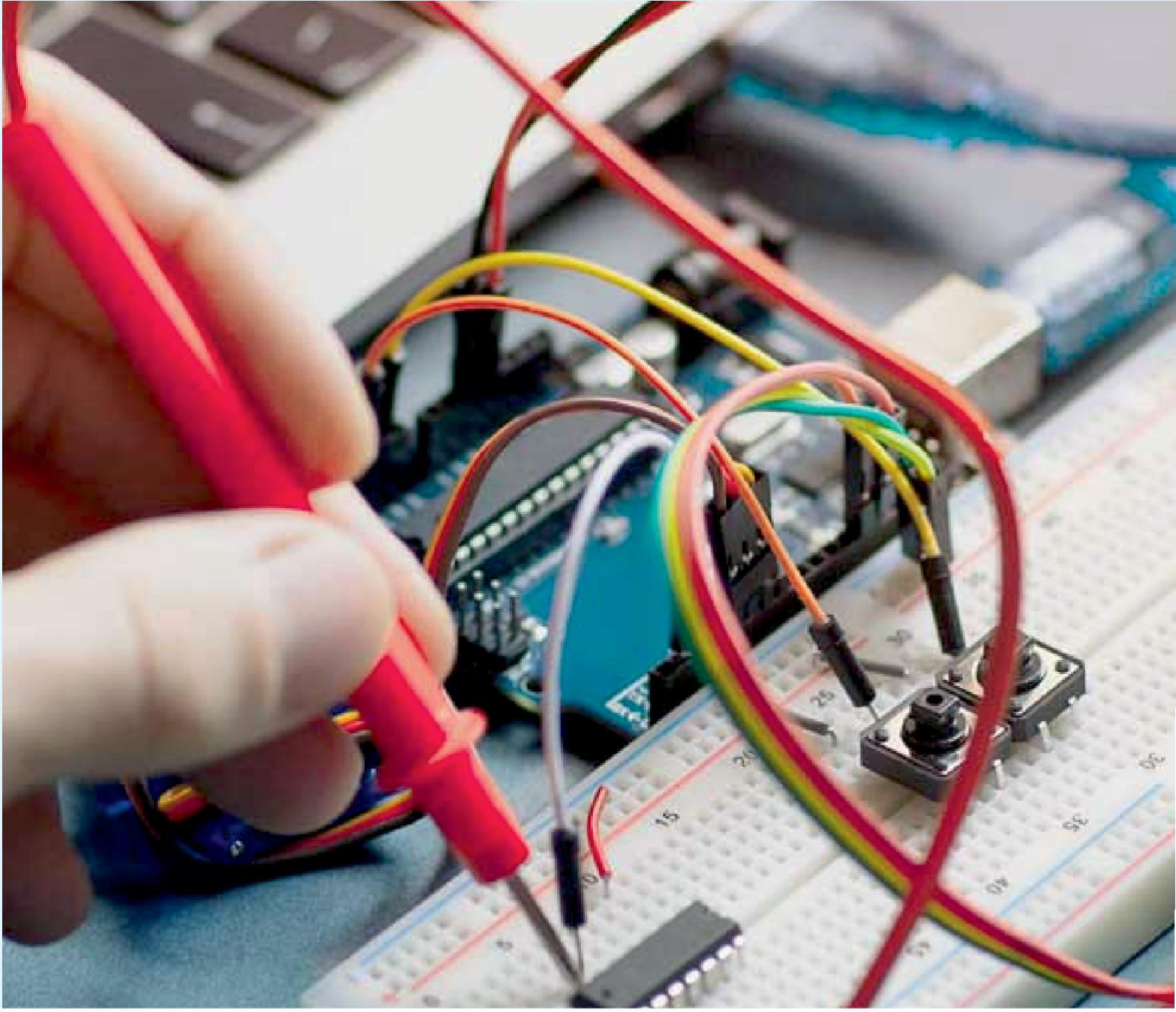

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