Advancements in Motor Drive Technology using PI Controlled Bootstrap Converter with SVM Inverter Based IM Drive

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ABSTRACT:

This idea uses a cascaded bootstrap converter with an SVM inverter for induction motor drive. The goal of this project is to use a PI controller to improve the speed control of a boot- strapped converter-inverter supplied induction motor drive (BSC-SVMIIM). This chapter coordinates the examination of BSC-SVMIIM systems that are both open-loop and PI regulated. To improve the voltage, gain, the BSC is recommended in between the rectifier and the SVMI. The BSC-dynamic SVMIIM's reaction could be improved by using PI. The goal of this work is to improve the performance of the BSC-SVMIIM scheme by employing a closed-loop controller. There are two types of BSC-SVMIIM systems: open loop with perturbation and closed loop PI-driven BSC-SVIM systems. The Simulink-model was used to display and recreate the results, which were then presented. The settling time and steady state error are used to assess the system. The tests show that the controlled BSC-SVMIIM device executes at an unmatched level. The suggested approach priorities low harmonic content and quick reaction.

Key words: *SVM-Space vector Modulation, PI-Propotional Integral, BSC-Boot Strap Converter.*

Introduction:

In the realm of motor drive technology, constant innovation continues to enhance efficiency, reliability, and performance. One such advancement lies in the integration of a Proportional-Integral (PI) controlled bootstrap converter with a Space Vector Modulation (SVM) inverter for Induction Motor (IM) drives. This article explores the features, benefits, and applications of this sophisticated system. Understanding Bootstrap Converter and SVM Inverter: Before delving into the integration, it's crucial to understand the components involved. The bootstrap converter is a circuit used to drive high-side MOSFETs in applications where the gate voltage needs to be higher than the available supply voltage. It's commonly used in motor drive systems to ensure proper gate driving for MOSFETs. On the other hand, SVM is a sophisticated modulation technique used in inverters to synthesize high-quality output voltage waveforms with reduced harmonic content. By controlling the switching states of the inverter switches, SVM achieves precise control of the output voltage, resulting in improved motor performance and efficiency.

2 BSC-SVMI STRUCTURE WITH PI CONTROL

Fig.1 shows a schematic diagram of a PI-controlled BSC-SVMI setup. The IM's speed is measured and compared to a reference speed to determine the speed error (SE). A PI-controller is the target of this SE. To get the reference current, the "yield of PI" is employed. The current-error is applied to a PI-controller after comparing the reference current to the actual current. The BSC's Pulse Width (PW) is adjusted using the output of current-PI.

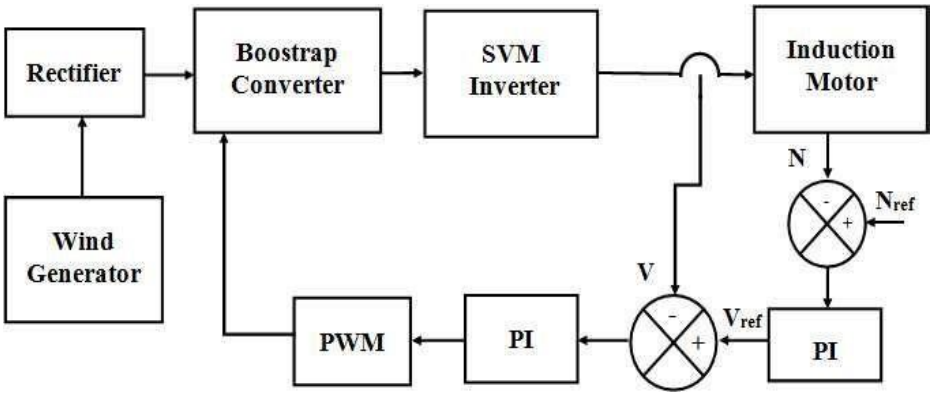

Fig 1 Schematic Diagram of a PI Controlled BSC-SVMI Setup

2.1 SIMULATION OUTCOMES

The converter was first simulated in Matlab to ensure that the analysis, design, and performance of the converter were all correct. Fig.2 shows a Bootstrap converter with an SVM inverter with PI controller for load disturbance. Fig.3 shows the input voltage with the SVM inverter for load disturbance. The input voltage is 170 volts. Fig.4 shows a circuit illustration of a bootstrap converter.

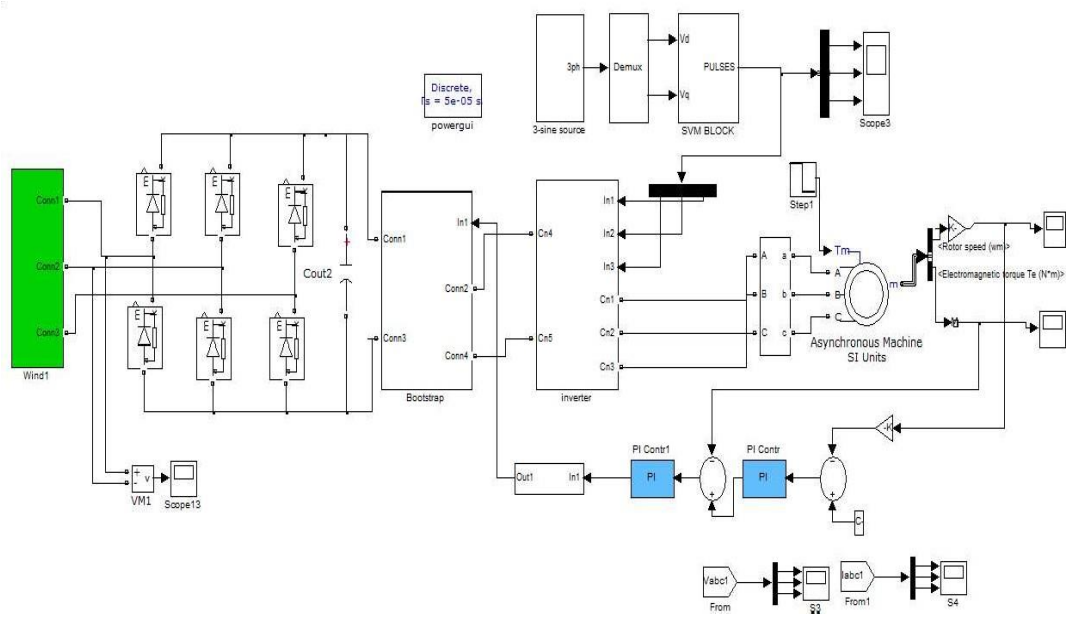

Fig.2 BSC-SVMI system with PI controller circuit diagram

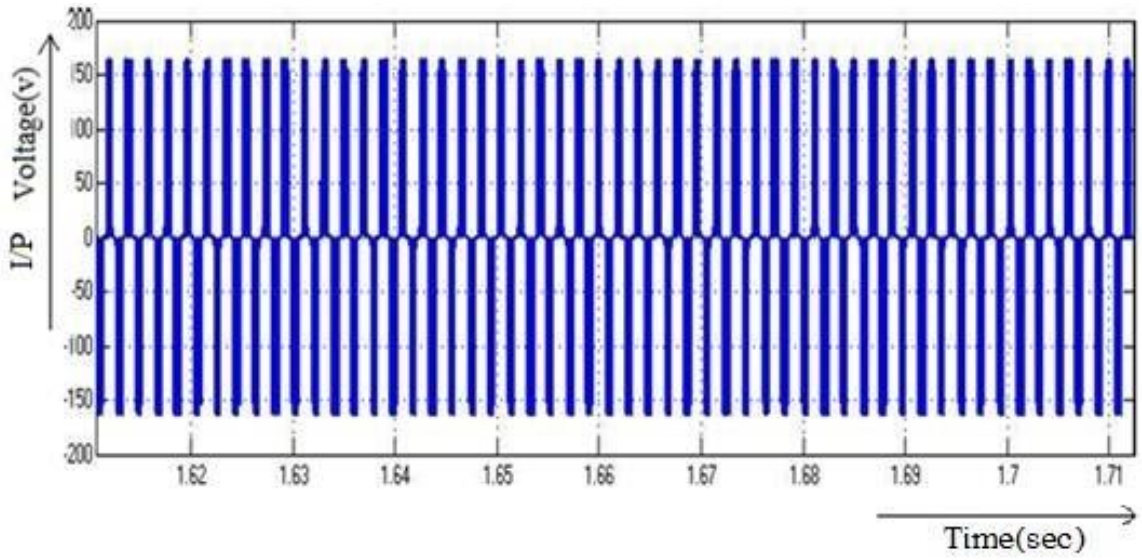

Fig.3 BSC-SVMI system input voltage

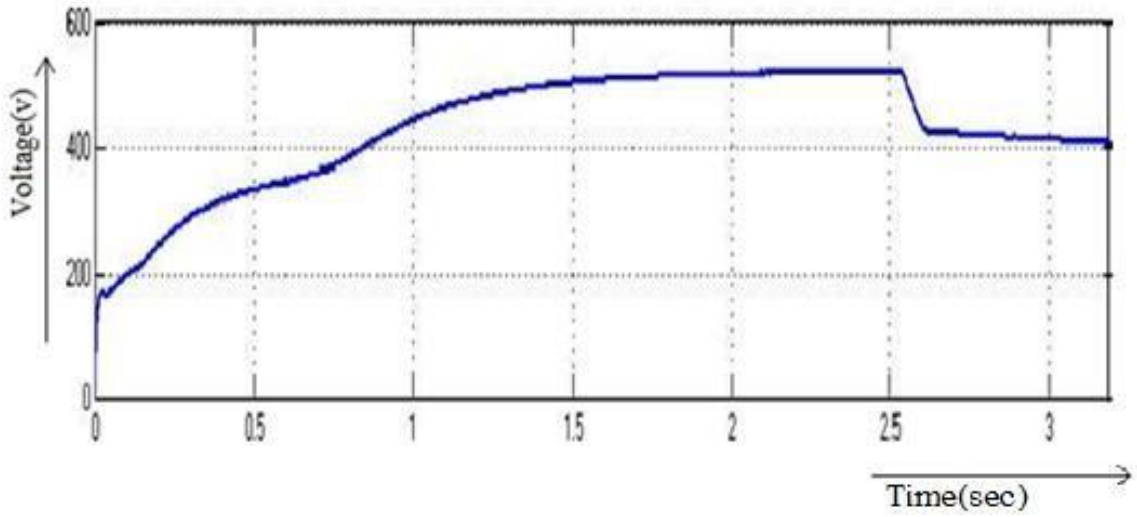

Fig.4 BSC-SVMI system with PI controller voltage across bootstrap converter

Fig.5 depicts the voltage across the motor load in the BSC-SVMI system with the PI controller. The voltage at which the motor is loaded is 450 volts. Fig.6 shows the motor speed of the BSC-SVMI system with the PI controller, which is 1250 RPM.

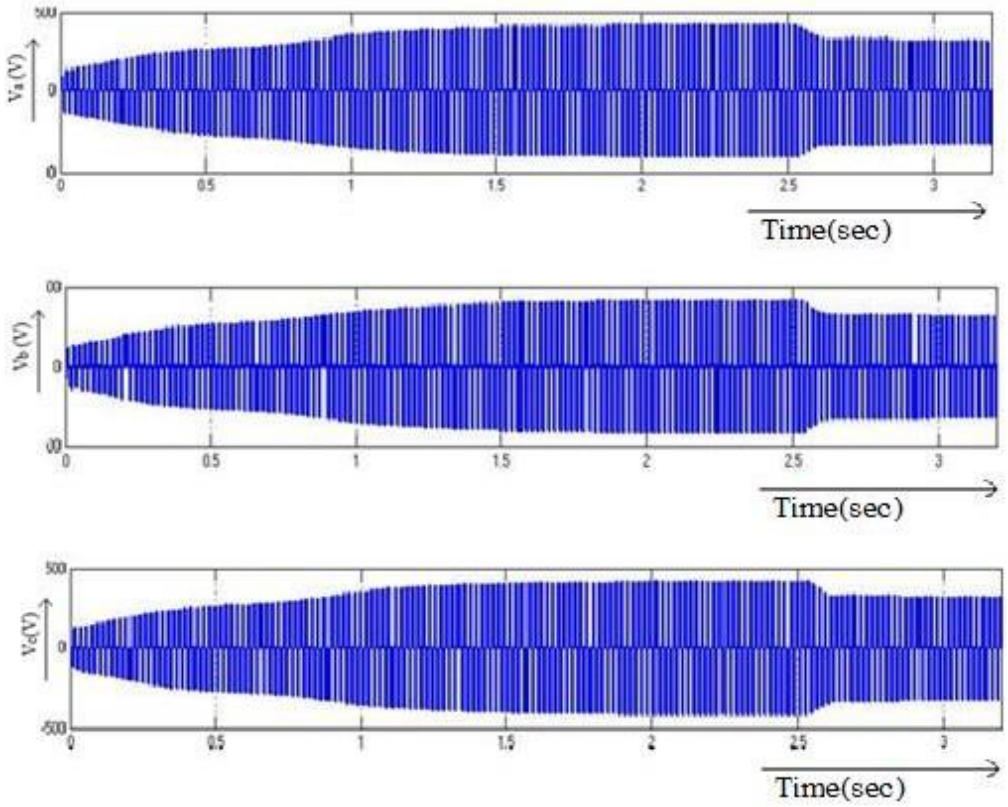

Fig.5 BSC-SVMI system with PI controller voltage over motor load

Fig.7 shows the zoomed motor speed of the BSC-SVMI system with the PI controller. The motor speed is zoomed out to 1290 RPM. Fig.8 shows the motor torque of the BSC-SVMI system with the PI controller. 1N-m is the motor torque value.

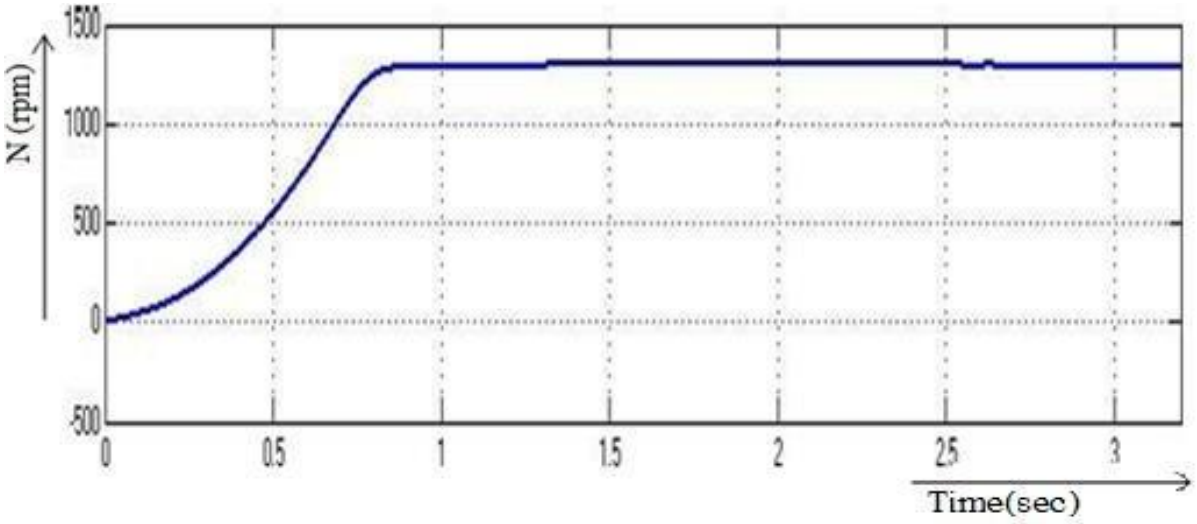

Fig.6 BSC-SVMI system motor speed using PI controller

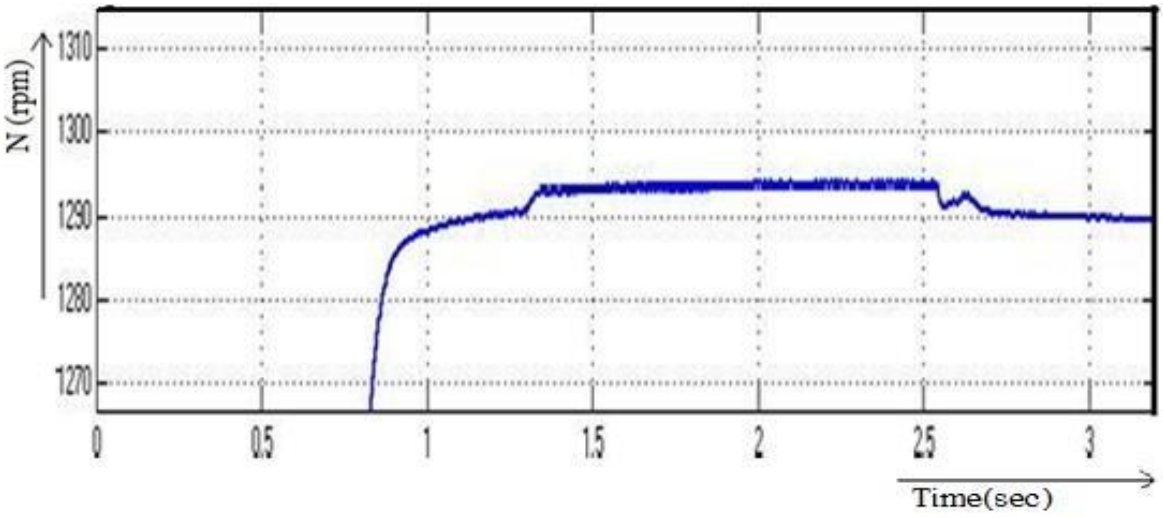

Fig.7 zoomed out motor speed of SVM inverter using PI controller

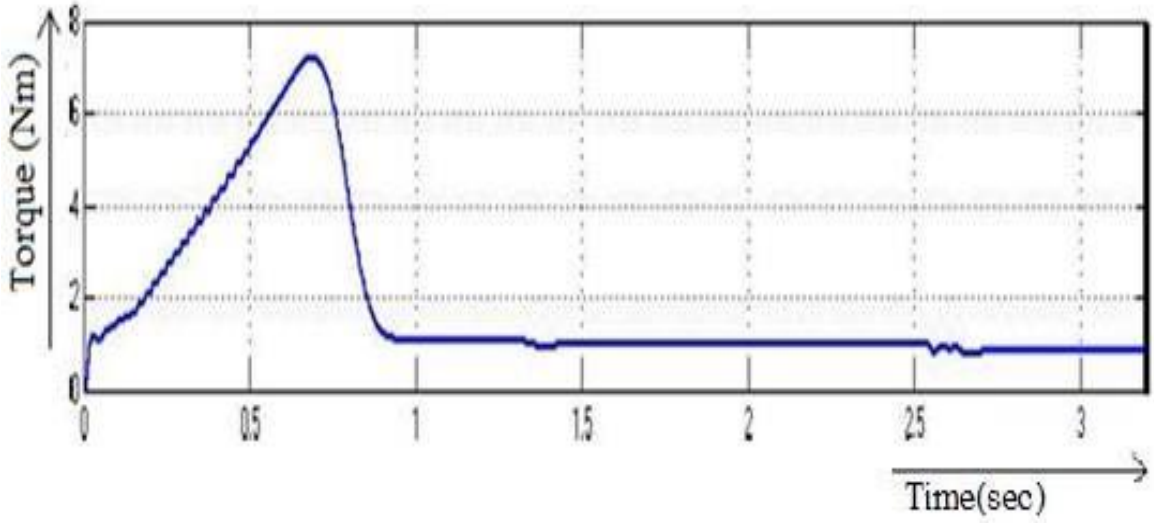

Fig.8 Motor Torque with SVM inverter using PI controller

3 Conclusion:

The integration of a PI controlled bootstrap converter with an SVM inverter in an IM drive system represents a significant advancement in motor drive technology. By combining efficient gate driving, precise control, and reduced harmonics, the integrated system offers superior performance, reliability, and energy efficiency across a wide range of applications. Continued research and development in this area will further enhance the capabilities and applicability of such systems, driving innovation in the field of motor drive technology.

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