Comparative analysis of BSS-IBC, SW-PWM IBC and IBI-SW high efficiency converters

[1]R. Puviarasi, [2]M. K. Maraim Bee, [3]Mritha Ramalingam, [4]M. Saranya, [5]D. Dhanasekaran

Abstract--*The proposed work contributes to enhance the efficiency of DC-DC Boost Converter in high current and high power applications. The main objective of the research is given as follows. To improve the efficiency of DC-DC converter in high power application, a Bayes Soft Switching Interleaved Boost Converter (BSS-IBC) framework is designed. To identify the required number of parameters such as power, voltage and current ripple in the secondary layer soft switching, Naive Bayes classifiers are used in proposed BSS-IBC framework. To minimize the converter switching time and improve the output voltage and current, an integrated framework of Sliding Window and Pulse Width Modulation (SW-PWM) is developed. The integrated inter leavened and sliding windows (IBI-SW) based PWM strategy is developed for the development of the effective DC-DC boost converter in a high-performance application. The incorporation of a MPPT algorithm is given in architecture, to minimize switching noise and switching time.* Mritha Ramalingam

Keywords-- Converter*, sliding window, Bayes Algorithm, Interleaving technique, efficiency.*

I INTRODUCTION

An efficient DC-DC Boost converter merges predictable pulse-width-modulation technique and soft commutation method to encourage circuit performance. Each and every phase of conventional boost converter consists of integrated transformer voltage multiplier cell. Thus, it presents the additional voltage gain that is not including the excessive duty cycle.

Initially, Bayes Soft Switching Interleaved Boost Converter (BSS-IBC) framework is proposed to improve the efficiency of DC-DC converter in high current and high power application. An efficient high power DC-DC converter for higher end power required in automotive fuel cell application is achieved by introducing a Sliding Window-based Pulse Width Modulation (SW-PWM) technique is introduced. Therefore, SW-PWM technique for proposed DC-DC dc-dc converter arrives at high output power. The system design achieves a high-performance DC-DC boost converter which tests the interoperability of a multiple high-power application. The suggested IBI-SW PWM method consequently enhances significant the converter precision and efficiency with enhanced reliability and scalability to produce higher-energy implementations.

[1]R. Puviarasi, Saveeth School of Engineering, SIMATS, Chennai, India, Email: puviarasi88@gmail.com

[2] M. K. Maraim Bee, M. Saranya, D. Dhanasekaran, Saveeth School of Engineering, SIMATS, Chennai, India.

[3] Mritha Ramalingam, faculty of Computing, University Malaysia Pahang, Malaysia.

Received: 23 Dec 2019 | Revised: 05 Jan 2020 | Accepted: 27 Feb 2020

II LITERATURE REVIEW

Interleaved soft switching multilevel DC-DC converter algorithm [1] consists of an inductor based boost circuit and switched capacitor circuit. To improve the efficiency of 4-Phase Interleaved Boost Converter with IC Controller for Distributed Photovoltaic Systems algorithm [2] was proposed. Zero-voltage-switching pulse-width modulation (ZVS-PWM) interleaved boost dc/dc converter algorithm [3] combines conventional pulse-width-modulation technique and soft commutation technique to promote circuit performance. Every semiconductor devices can be turn on and turn off by operating interleaved boost converter at ZCS. In [4] using a ZCS-PWM auxiliary circuit. ZCS characteristic on main switches and auxiliary switches with a wide range of load to improve problem of switching losses and Electromagnetic interference (EMI).

A novel phase shedding scheme algorithm [5] is introduced for Interleaved Boost Power Factor Correction (IB-PFC) converter to improve light load efficiency. To improve conversion efficiency, Quantification analysis of input / output current algorithm [7] facilitates optimal design of interleaved PFC boost converter. Pulse Width Modulation in Body Coupled Communication [8] resulted in the efficiency of more distinct duty cycles. [9] With increase in the number of mobile users, the radio capacity of d DC-DC c-dc converter is fully occupied. A novel [10-11] PWM control scheme was designed in with the objective of providing high power permanent magnet synchronous motor (PMSM).

III PROPOSED APPROACH

In The proposed research work focuses on improving efficiency of DC-DC converter in high current and high power application. Therefore, the proposed research work is carried out in three phase as shown in below fig. 1.

3.1 Bayes soft switching interleaved boost converter:

A Bayes soft switching interleaved boost converter is introduced for improving the efficiency of DC-DC converter in high current and high and the introduction of Bayes soft switching interleaved boost converter, the DC-DC converter obtains high output power with reduced ripple effects. The higher voltage gain is achieved in converter. The characteristics of interleaved-boost converter are fit in for many applications. They are included with the requirement of higher voltage, energy required in the form of renewable source and applications for uninterrupted power states. The soft-switching interleaved boost converter comprises two components. They are auxiliary inductor and elementary boost conversion units with two shunts. This soft-switching interleaved boost converter turn on the active power switches at zero voltage. As a result, reduces the loss occurring during switching and in turn results in the efficiency in conversion.

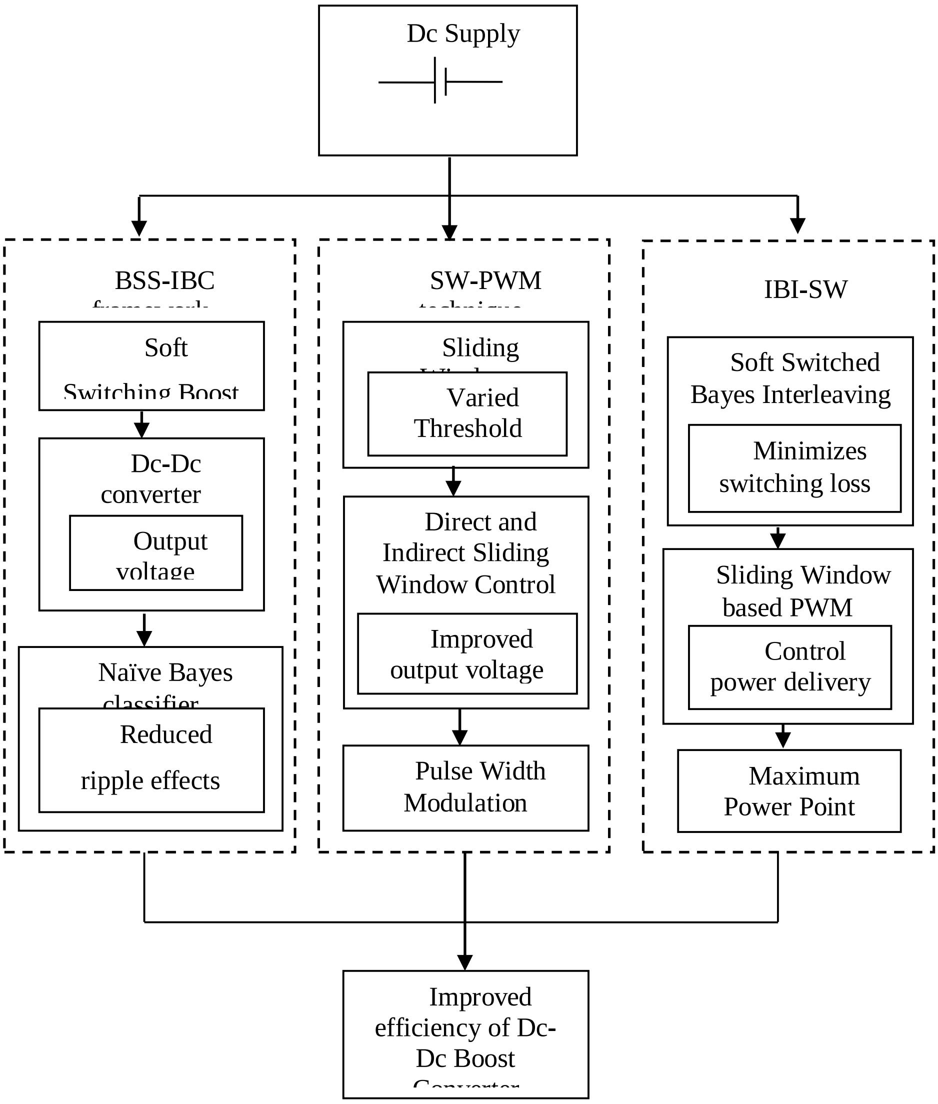

Figure 1: Flow process of proposed methodology

3.1.1 Soft Switching Interleaved Boost Converter:

Soft switching interleaved boost converter is designed in BSS-IBC framework to provide high voltage gain and efficiency. It is designed with the addition of multilevel Dc-to-Dc boost converter and interleaved boost converter. The Soft Switching Interleaved Boost Converter is applied for achieving high efficiency and it is more preferable when power attains is high state. The high voltage gain in Soft Switching Interleaved Boost Converter is obtained through efficient coupling with the inductor. A secondary layer switch to the DC-DC boost converter is introduced for improving the efficiency of Dc-to-Dc converter in high current and high power application. Hence, a secondary layer consists of inductor and capacitor.

Naive Bayes Soft Switching Classifier (NBSSC) algorithm is used for efficient classification for high current and high power application. Based in this algorithm, the output voltage of boost converter is increased with reduced ripple effects. Initially, soft switching interleaved boost converter is applied with input voltage.

3.2 sliding window in an automotive fuel cell application

Sliding Window shows the varied threshold constants operation. These two varied threshold constants are direct and indirect sliding window control aiming at improving the output voltage and current respectively. Direct Sliding Window control is based on the output zero voltage switching, where the output voltage is compared with the reference voltage. Based on the output voltage and reference voltage, direct sliding window is measured in a significant manner.

3.2.1 Sliding Window- Pulse Width Modulation

The noise occurring during switching from 'on-off' to 'off-on', noise is filtered with an inductor and a capacitor in the auxiliary circuit. When output voltage is lower than the desired voltage, slider window control turns on the switch. When the output voltage is greater than the desired voltage, slider window control turns off the switch. Followed by the alternate on-off behaviour value, the average power of the signal is measured due to slider window control.

3.3 integrated bayes using mppt algorithm

In order to achieve an effective DC-DC step up converter, the implemented embedded bayes Interleaved and Sliding Window. PWM structure is characterized as a PWM algorithme. For the removal of the bypass diodes, multiple power converters are included in the contact box of panels.

Input: Voltage 'V_{PV}', Current 'I_{PV}',
Output: High output power
Step 1: Begin
Step 2: For each cycle (PV)
Step 3: Sense the value of voltage and current at time 't'
Step 4: Measure output power
Step 5: Compare present output power at time 't_i' to that of the previous output power at time 't_{i-1}'
Step 6: If ($P_{o(t)} > P_{o(t-1)}$)
Step 7: Then $V_{ref} = V_{ref} - \Delta V$
Step 8: End if
Step 9: If ($P_{o(t)} < P_{o(t-1)}$)
Step 10: Then $V_{ref} = V_{ref} + \Delta V$
Step 11: End if
Step 12: If ($P_{o(t)} = P_{o(t-1)}$
Step 13: Then $V_{ref} = V_{ref}$
Step 14: End if
Step 15: End for
Step 16: End

IV SIMULATION AND PERFORMANCE METRIC ANALYSIS

A Bayes Soft Switching Interleaved Boost Converter (BSS-IBC) framework, Sliding Window-based Pulse Width Modulation (SW-PWM) technique and PWM framework is designed in software platform.

4.1 Performance analysis of Converter Power Output:

The converter represented in above figure. 2 illustrate the measure of converter power output with respect to the various input voltage and current.

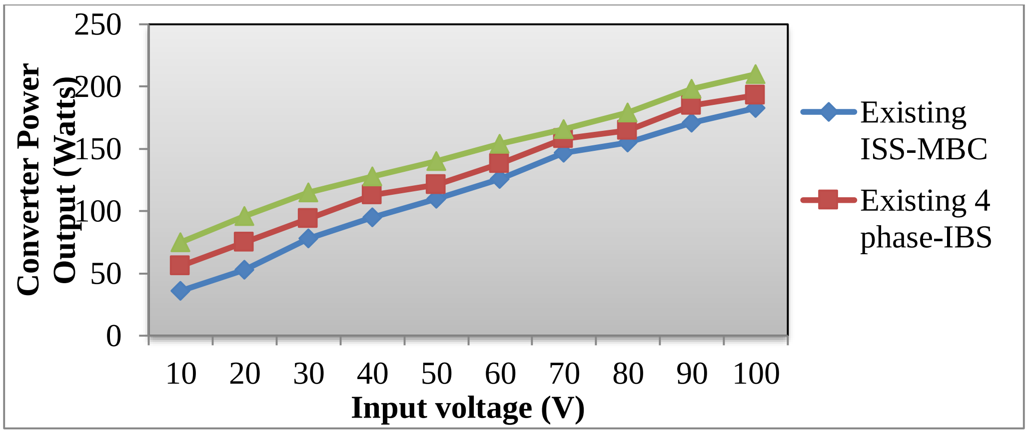

Figure 2: Measure of Converter Power Output

The figure shows the comparison results of proposed and existing methods. The proposed BSS-IBC framework is made comparison with existing ISS-MBC [1] and 4 phase-IBS [2 As a result, the BSS-IBC framework improves the power output by 38 % when compared to ISS-MBC [1] and improved by 15 % when compared with 4phase-IBC [2].

4.2 Performance analysis of Switching Noise:

The noise of switching is expressed in the output voltage to the absolute reference voltage value. For conducting the experimental work, absolute value of the reference voltage in the range of 10 V to 100 V is considered.

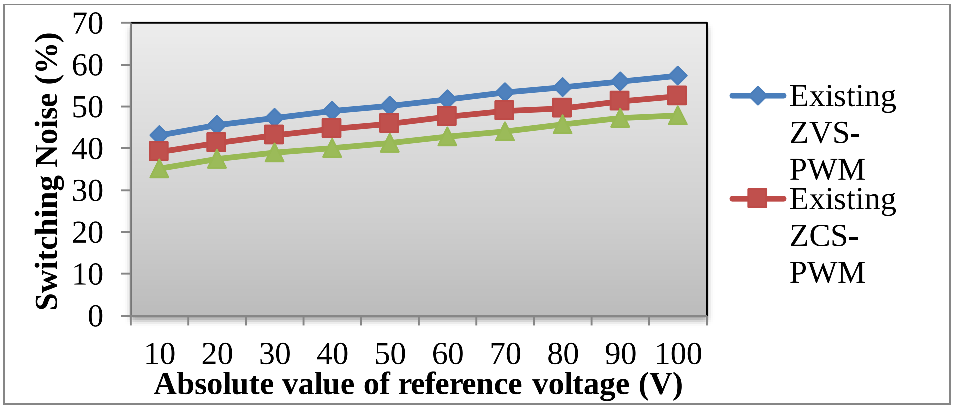

Figure 3: Measure of Switching Noise

Figure. 3 shows the measure of switching noise of the proposed SW-PWM technique. Above figure shows the comparison of proposed SW-PWM technique with existing methods namely ZVS-PWM [3] and ZCS-PWM [4]. Therefore, SW-PWM technique significantly minimizes the switching noise by 17% when compared to ZVS-PWM [3] and minimized by 9% when compared with ZCS-PWM [4].

4.3 Performance analysis of Converter Efficiency:

The converter efficiency using the proposed IBI-SW framework is defined as the ratio of output power to the input power.

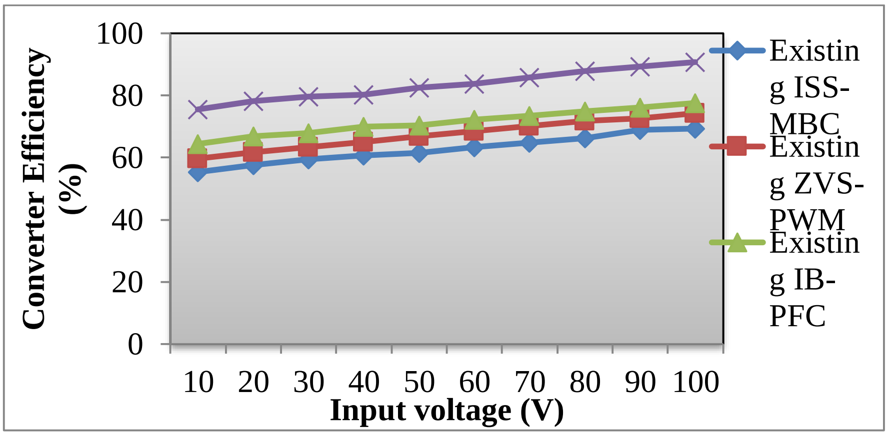

Figure 4: Measure of Converter Efficiency

Above figure.4 demonstrate the result analysis of converter efficiency according to the different input voltages. The figure shows the comparison of proposed IBI-SW framework with existing methods namely ISS-MBC [1], ZVS-PWM [3] and IB-PFC [5]. As a result, IBI-SW framework improves the converter efficiency by 33% compared to ISS-MBC [1], improved 24% compared to ZVS-PWM [3] and by 17% compared with IB-PFC [5].

V CONCLUSION

Three different methods namely BSS-IBC framework, SW-PWM technique and IBI-SW based PWM framework. BSS-IBC framework maintains the steady state behavior, thus improving the efficiency in high current and high power DC-DC boost application. A secondary layer switch is introduced and Naive Bayes classifiers are applied to identify the required number of parameters. As a result, high output voltage with reduced ripple is obtained. Sliding Window and Pulse Width Modulation are combined to perform different modes of operations. Consequently, the converter switching time is minimized and output voltage and current is improved. In addition, an powerful DC-dc boost conversion for high performance application is provided. This shows high output power with reduced switching noise and time. The introduction by way of a MPPT algorithm often improves power efficiency.

REFERENCES

1. Koichi Matsumura and Hirotaka Koizumi, "Interleaved soft-switching multilevel boost converter," Industrial Electronics Society IECON, 39th Annual Conference of the IEEE, Pages 936 – 941.
2. Francesco Pulvirenti, Amedeo La Scala, Domenico Ragonese, Keith D'Souza, Giuseppe M. Tina, and Salvatore Pennisi, "4-Phase Interleaved Boost Converter with IC Controller for Distributed Photovoltaic Systems," IEEE Transactions on Circuits and Systems I: Regular Papers, vol. 60, no. 11, pp. 3090 –102, 2013.
3. Chien-Ming Wang, Chien-Min Lu, Chang-Hua Lin, and Jyun-Che Li, "A ZVS-PWM Interleaved Boost DC/DC Converter," IEEE Conference on TENCON, 2013.

4. Chien-Ming Wang, Shih-Yung Hsu, Chang-Hua Lin, Chien-Min Lu, and Jyun-Che Li, "A ZCS-PWM Interleaved Boost DC/DC Converter," IEEE Annual Conference on Industrial Electronics Society, 2013.
5. Ying-Chi Chen, Jhih-Da Hsu, Yong-Ann Ang and Ta Yung Yang, "A New Phase Shedding Scheme for Improved Transient Behavior of Interleaved Boost PFC Converters," IEEE Applied Power Electronics Conference and Exposition, pp. 1916 – 1919, 2014.
6. Wuhua Li, Weichen Li, Xin Xiang, Yihua Hu, Xiangning He, "High step-up interleaved converter with built-in transformer voltage multiplier cells for sustainable energy applications," IEEE Transactions on Power Electronics, vol. 29, no. 6, pp. 2829 –36, 2014.
7. Saijun Zhang, Richard Garner, Yuting Zhang, Shashank Bakre, "Quantification Analysis of Input / Output Current of Interleaved Power Factor Correction (PFC) Boost Converter," Applied Power Electronics Conference and Exposition (APEC) IEEE, 2014.
8. G. Galma, B. Pattanaik, "Current fed switched inverter using sliding mode controller (SMC) for grid application," International Journal of MC Square Scientific Research, vol. 11, no. 4, pp. 34-43, 2019.
9. Miltiadis Moralis - Pegios, Pelagia Alexandridou and Christos Koukourlis, "Applying Pulse Width Modulation in Body Coupled Communication," Journal of Electrical and Computer Engineering Hindawi, pp. 6, 2015.
10. Yanjun Yu, Lixiao Gao, Yue Liu, Feng Chai and Shukang Cheng, "A Novel SHMPWM Technique for Sensorless Control in High-Power PMSM," Hindawi Publishing Corporation, Mathematical Problems in Engineering, pp. 9, 2015.
11. A. Gopi and R. Saravanakumar, "High step-up isolated efficient single switch DC-DC converter for renewable energy source," Ain Shams Engineering Journal, vol. 5, no. 4, pp. 1115–1127, 2014.