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IMPROVE DC-DC RESONANT CONVERTER EFFICIENCY BY FUZZY LOGIC CONTROLLER

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ABSTRACT

Resonant converters are becoming more and more popular these days due to their Soft-switching techniques, such as Zero-Voltage Switching and Zero-Current Switching can be implemented which provides better EMI performance along with higher efficiency Resonant Converters are capable of achieving higher power density meaning the overall converter size can be reduced as the converter can operate at higher switching frequencies due to soft-switching described above ability to achieve high efficiency through softly commutating the switching devices. in this paper the resonant DC-DC converter is proposed and verified by using MATLAB/SIMULINK ,The converter is controlled first by variable frequency and then by using fuzzy controller in order to improve the converter efficiency

Keywords- Resonant converter, Efficiency, Fuzzy logic, Matlab Simulation.

I. INTRODUCTION

Resonant converters have been confined in the last thirty years to niche applications such as very high voltage applications or high fidelity audio systems while much effort was spent in research by industries and universities because of its attractive features: smooth waveforms, high efficiency and high power density. In recent times the LLC resonant converter [1,2], in particular in its half-bridge implementation, has been widely and successfully applied to flat panel TV, 80+ ATX and small form factor PC, where the requirements on efficiency, power density and EMC compliance of their switching mode power supplies (SMPS) are getting more and more stringent. However future SMPS requirements will have to face one of the few remaining drawbacks of LLC resonant converter topology that is related to the output filter capacitors volume that represents the major limit for such applications. The injection of rectified sine wave currents into the output filter capacitor can be adequately mitigated by the parallel use of multiple modules such as in interleaved buck solutions for voltage regulator modules. This topology has been presented in [3, 4] for two modules operating with 90 degrees phase shift. One of the drawbacks of this solution is represented by the inherent current unbalance caused by resonant component mismatch that may cause one of the two modules to reduce its output power down to zero, thus requiring mandatory workarounds to overcome the problem [5].

PULSED power is needed in a variety of industrial, medical, and military applications. Now more than ever, the pulsed-power supply has evolved to have not only a higher power capability but also a compact size, which results in extremely challenging requirements for high power density. Since the power density is closely associated with the detailed specifications and operating conditions, it is difficult to have a direct comparison between the power densities of the reported state-of-the-art pulsed converters. Very often, literatures do not even provide the power density values. Based on an extensive survey, the converters with available power densities are summarized in Table I, where PWM stands for pulse width modulation, SRC stands for series resonant converter, PRC stands for parallel resonant converter, SPRC stands for series-parallel resonant converter, ZCS stands for zero current switching, and ZVS stands for zero-voltage switching. Even though it is difficult to compare the power densities of various pulsed-power converters, generally speaking, a higher switching frequency leads to a higher power density.

II. THE PROPOSED CONVERTER

The proposed converter is shown in Fig 1.It consists of input voltage 600v ,three level structure in order to allow to use high frequency devices MOSFETs, then the output of the inverter is connected to the resonant tank, the output is connected to the step up transformer, then to rectifier and finally to the load capacitor.

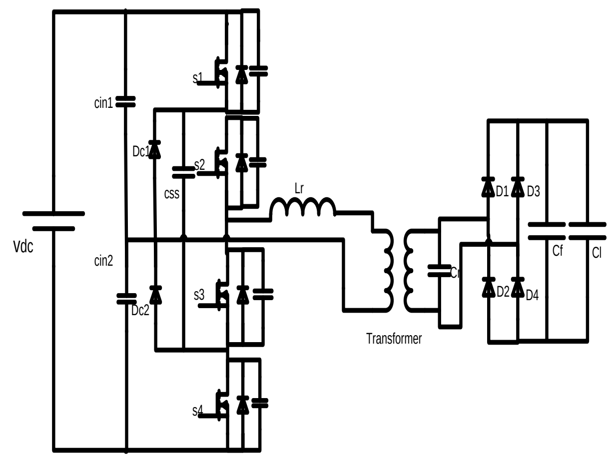

Fig 1 The proposed converter

III. FUZZY LOGIC CONTROLLER

Fuzzy logic is a form of many-valued_logic; it deals with reasoning that is approximate rather than fixed and exact. Compared to traditional binary sets (where variables may take on true or false values) fuzzy logic variables may have a truth_value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completelyfalse. Furthermore,when linguistic variables are used, these degrees may be managed by specific functions. Irrationality can be described in terms of what is known as the fuzzjective

What Is a Fuzzy Controller?

Simply put, it is fuzzy code designed to control something, usually mechanical.

• They can be in software or hardware and can be used in anything from small circuits to large mainframes.

Why Should We Use Fuzzy Controllers?

• Very robust

• Can be easily modified

• Can use multiple inputs and outputs sources

• Much simpler than its predecessors (linear
algebraic equations)

• Very quick and cheaper to implement

The fig2 shows the general look of fuzzy ,fig 3 shows fuzzy editor and fig 4 shows the fuzzy rules in MATLAB.

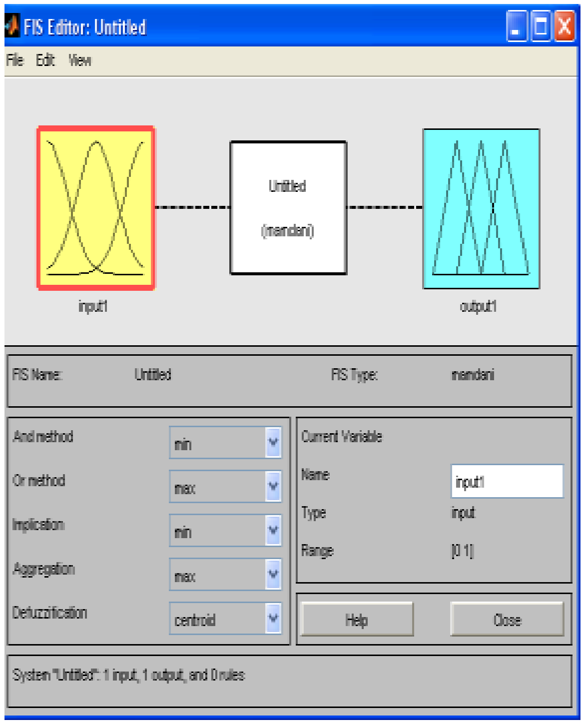

Fig 2: general look of fuzzy in MATALAB

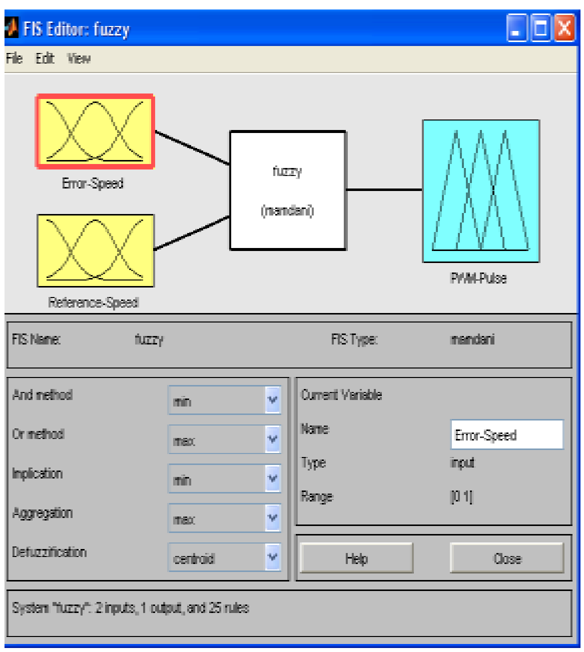

Fig 3 after importing the fuzzy

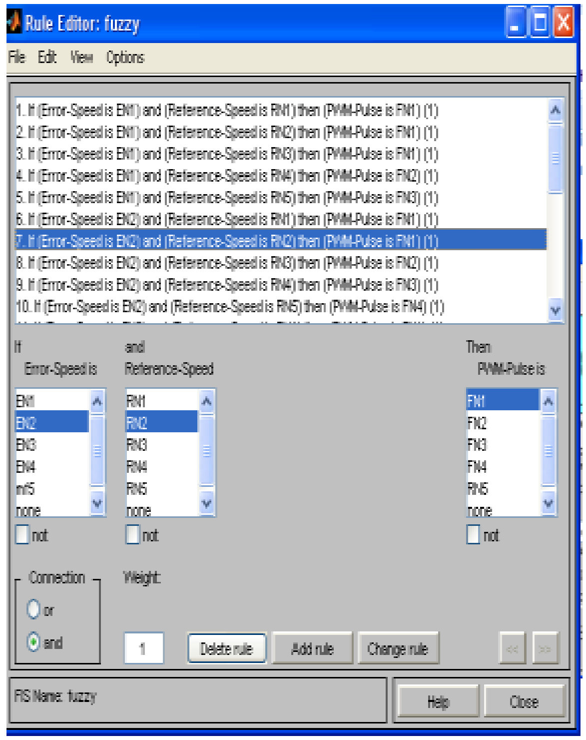

Fig 4: The fuzzy rules

IV. SIMULATION AND RESULTS

The MATLAB simulation circuit is shown in fig 5.

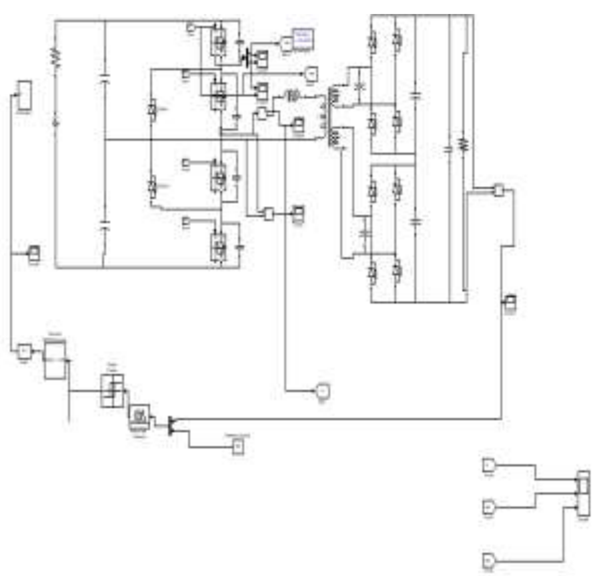

Fig 5.The simulation circuit

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The results are shown in the following figs.

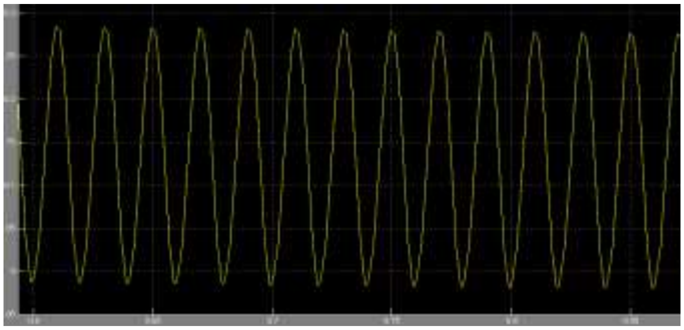

Fig 6. iL current

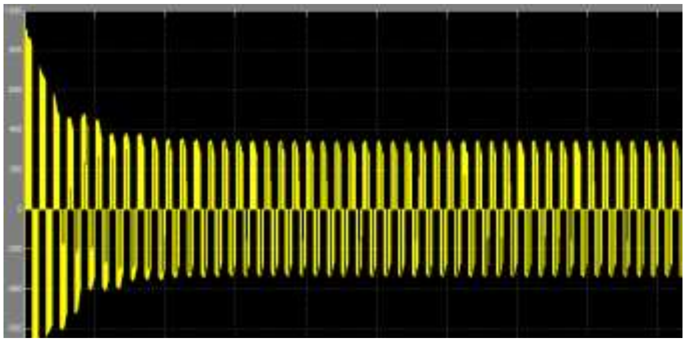

Fig 7.Three level output without fuzzy logic

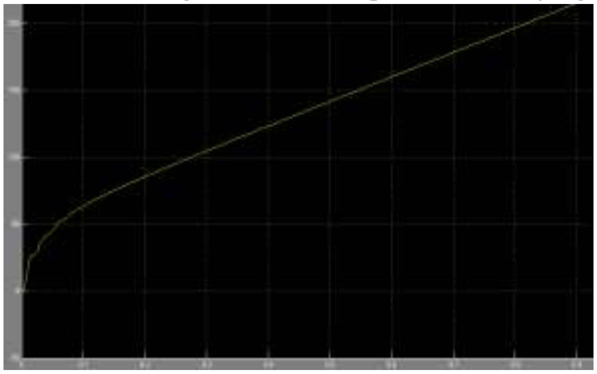

Fig8.output voltage without fuzzy logic

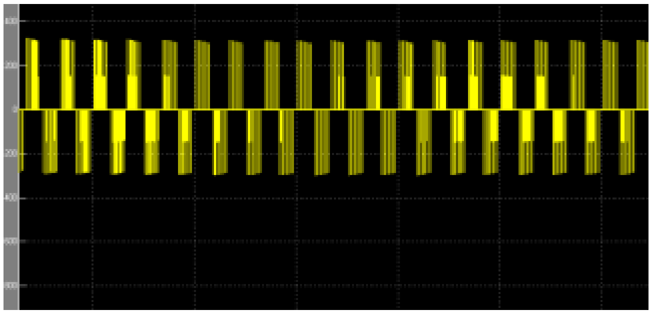

Fig 9. Three level output with fuzzy logic

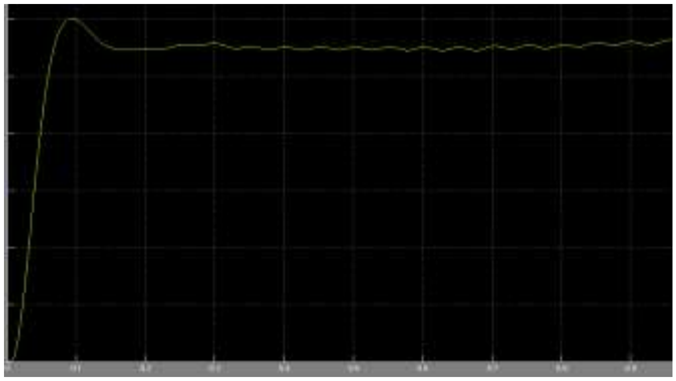

Fig 10.the output voltage with fuzzy logic

V. CONCLUSION

Resonant converters are becoming more and more popular these days due to their Soft-switching techniques, such as Zero-Voltage Switching and Zero-Current Switching can be implemented which provides better EMI performance along with higher efficiency the performance of the resonant converter is based on the control strategy and the results show that the outputs are smooth and stable by using fuzzy logic controller.

REFERENCES

[1] M. V. Fazio and H. C. Kirbie, "Ultra compact pulsed power," *Proc. IEEE*,vol. 92, no. 7, pp. 1197–1204, Jul. 2004.
[2] H. Akiyama, T. Sakugawa, T. Namihira, K. Takaki, Y. Minamitani, and N. Shimomura, "Industrial applications of pulsed power technology," *IEEE Trans. Dielectr. Electr. Insul.*, vol. 14, no. 5, pp. 1051–1064, Oct. 2007.
[3] J. Weihua, K. Yatsui, K. Takayama, M. Akemoto, E. Nakamura, N. Shimizu, A. Tokuchi, S. Rukin, V. Tarasenko, and A. Panchenko, "Compact solid-state switched pulsed power and its applications," *Proc.IEEE*, vol. 92, no. 7, pp. 1180–1196, Jul. 2004.
[4] H. G. Wisken and T. H. G. G. Weise, "Capacitive pulsed power supplysystems for ETC guns," *IEEE Trans. Magn.*, vol. 39, no. 1, pp. 501–504, Jan. 2003.
[5] J. S. Bernardes, M. F. Stumborg, and T. E. Jean, "Analysis of a capacitorbased pulsed-power system for driving long-range electromagnetic guns,"*IEEE Trans. Magn.*, vol. 39, no. 1, pt. 1, pp. 486–490, Jan. 2003.
[6] M. A. Kempkes, J. A. Casey, M. P. J. Gaudreau, T. A. Hawkey, and\ I. S. Roth, "Solid-state modulators for commercial pulsed power systems,"

BIOGRAPHY

Elmokhtar.A.Elhamruni received the BS_C degreeincommunication Engg.from higher institute of electronics, BeniWaled,Libya in 1989, MS_C degree in the field of electronics from Belgrade University ,Serbia in 2000. He is currently working toward Ph.D degree at Sam Higginbottom Institute of Agriculture, Technology & Sciences (Formerly AAI-DU) Allahabad.His area of interests power electronics and instrumentation .

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Earlier he was "Assistant Professor" in department of Electrical and Electronics Engineering, IMS Engineering College Ghaziabad (U.P.) India in the year 2005. He also worked for 6 years as faculty with IIT Ghaziabad (U.P.) India.

He is also having practical experience with top class multinational companies during 1985-1998. He has published several research Papers in the field of Electrical engineering as well as energy management. His research interest includes, power management, energy management, reactive power control in electrical distribution system.