iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** IX **Month of publication:** September 2020

DOI: https://doi.org/10.22214/ijraset.2020.31309

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue IX Sep 2020- Available at www.ijraset.com

Optimizing the Performance of Fuzzy Logic Controller in Power Quality Enhancement

Sonam[1], Er. Jatinderpal Singh[2]
[1]*M.Tech (CSE),* [2]*Assistant Professor, Department of Computer Sc. & Engg., St. Soldier Institute of Engg. & Technology, Near NIT, Jalandhar (Punjab)-144011*

Abstract: ***In many developing modern technologies demand for Fuzzy Logic controlled applications has increased. In various cases, the mathematical model of the control process is very difficult to implement with respect to computer processing power and memory and a system based on factual rules may be morel adequate. Furthermore, fuzzy logic is perfectly suited to low cost implementations based on less-resolution A/D converters, cheap sensors and 4-bit or 8-bit one-chip microcontroller chips. To enhance performance or add new attributes, new rules can be easily added in such type of systems. The performance of Fuzzy Logic Controllers is well implemented in the field of control theory because it provides robustness to dynamic system parameter variations as well as improved transient and steady state performances. In this work an attempt has been made to minimize the effect of disturbed supply on rectifier and to achieve low input current THD with reduced ripple DC output voltage using a fuzzy logic controller. This innovative method helps in better performance of rectifier with very simple implementation specially for real-time environment.***

Keywords: THD, FLC, AI

I. INTRODUCTION

The performance of Fuzzy Logic Controllers is well implemented in the field of control theory because it provides robustness to dynamic system parameter variations as well as improved transient and steady state performances. In this work an attempt has been made to minimize the effect of disturbed supply on rectifier and to achieve low input current THD with reduced ripple DC output voltage using a fuzzy logic controller. This innovative method helps in better performance of rectifier with very simple implementation specially for real-time environment. Fuzzy logic control can be used to improving the existing conventional controller systems by an additional layer of intelligence to the current control method. Fuzzy logic controller is chosen over the conventional PI and PID controller due to its robustness to system parameter variations during operation and it being simple in its implementation.

A. Types of Fuzzy Logic

There are two types of fuzzy models generally used i.e. Mamdani Fuzzy models as well as sugeno fuzzy models. Mamdani method is widely accepted for capturing expert knowledge. It allows us to describe the expertise in more intuitive, more human-like manner. In this paper Mamdani type fuzzy model is used.The basic theory of the proposed controller is form a particular trajectory of the space vector under undisturbed/disturbed ac mains. This works presents an implementation of Fuzzy Logic Controller based modified gate controlled for three-phase full wave controlled rectifier. In this chapter, the proposed traditional modulation strategy is implemented using Fuzzy Logic Controller.

B. Fuzzy Logic Controllers

The performance of Fuzzy Logic Controllers is well implemented in the field of control theory because it provides robustness to dynamic system parameter variations as well as improved transient and steady state performances. In this work an attempt has been made to minimize the effect of disturbed supply on rectifier and to achieve low input current THD with reduced ripple DC output voltage using a fuzzy logic controller. This innovative method helps in better performance of rectifier with very simple implementation specially for real-time environment.

II. THD

A. The Total Harmonic Distortion

(THD or THDi) is a measurement of the harmonic distortion present in a signal and is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency. Harmonics or harmonic frequencies of a periodic voltage or current are frequency components in the signal that are at integer multiples of the frequency of the main signal. This is the basic outcome that Fourier analysis of a periodic signal shows. Harmonic distortion is the distortion of the signal due to these harmonics

A voltage or current that is purely sinusoidal has no harmonic distortion because it is a signal consisting of a single frequency. A voltage or current that is periodic but not purely sinusoidal will have higher frequency components in it contributing to the harmonic distortion of the signal. In general, the less that a periodic signal looks like a sine wave, the stronger the harmonic components are and the more harmonic distortion it will have.

So, a purely sinusoidal signal has no distortion while a square wave, which is periodic but does not look sinusoidal at all, will have lots of harmonic distortion. In the real world, of course, sinusoidal voltages and currents are not perfectly sinusoidal; some amount of harmonic distortion will be present. Figures 1 and 2 provide visual comparisons, in the time domain and the frequency domain, of a sinusoidal voltage and a square wave voltage.

B. Proposed Algorithm

Fuzzy Logic theory based control scheme has been developed for the production of compensating gate signal for controlling rectifier . Linear as well as Non-Linear loads can be controlled by this scheme. At the time of any disturbance, an error signal is generated which is processed by controller based on Fuzzy Logic theory. The Fuzzy Logic controller modifies gate pulses for rectifier. The main motto of the proposed algorithm is to reduce the THD (total harmonic distortion) and to have less rippled DC voltage at the load side .By extensive simulation studies in MATLAB/Simulink and SimPowerSystem software, the above control strategy is tested. The proposed Fuzzy Logic Controller is modeled in MATLAB/Simulink software. Simulation results shows satisfactory performance of the rectifier for unbalanced supply conditions.

III. RESULTS AND DISCUSSION

Table 1 Shows the THD with Balanced and Unbalanced Supply

Parameters	Balanced supply	Unbalanced supply without Fuzzy Logic controller	Unbalanced supply with Fuzzy Logic controller
THD	31.17	38.11	19.40
Pulse size	Normal	Wide	More wide
Load Voltage and current increase	Normal	Yes	Yes

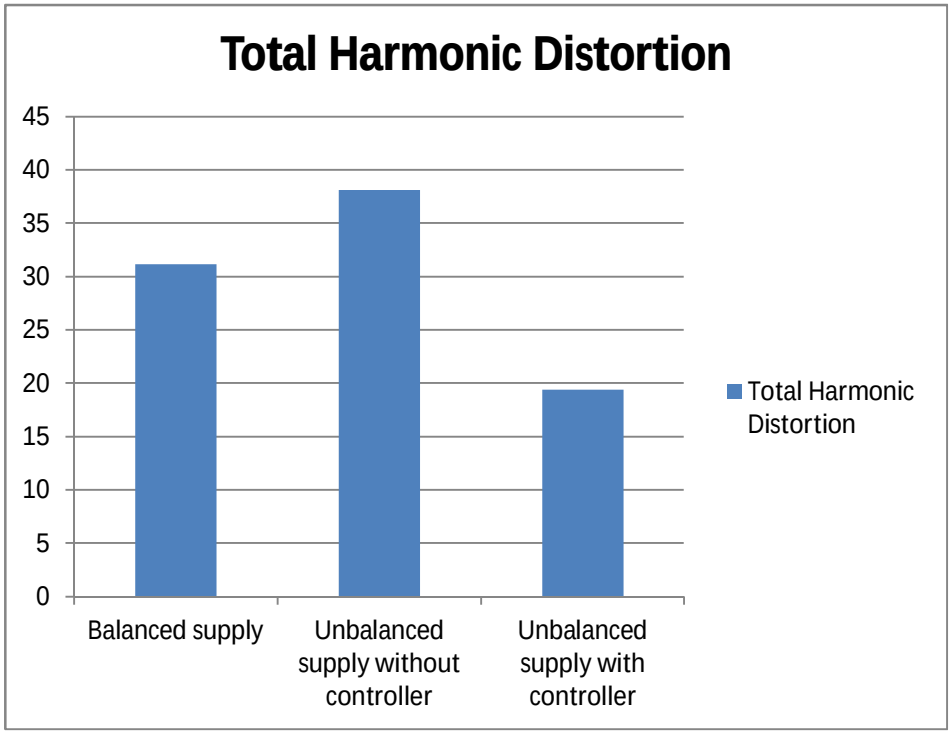


Fig. 5.8 Shows the THD with Balanced and Unbalanced Supply

Table 2 Shows the input voltage with TDH

Parameters	Balanced supply	Unbalanced supply without Fuzzy Logic controller	Unbalanced supply with Fuzzy Logic controller
Input Voltage	100	200	200
THD	31.17	38.15	19.40

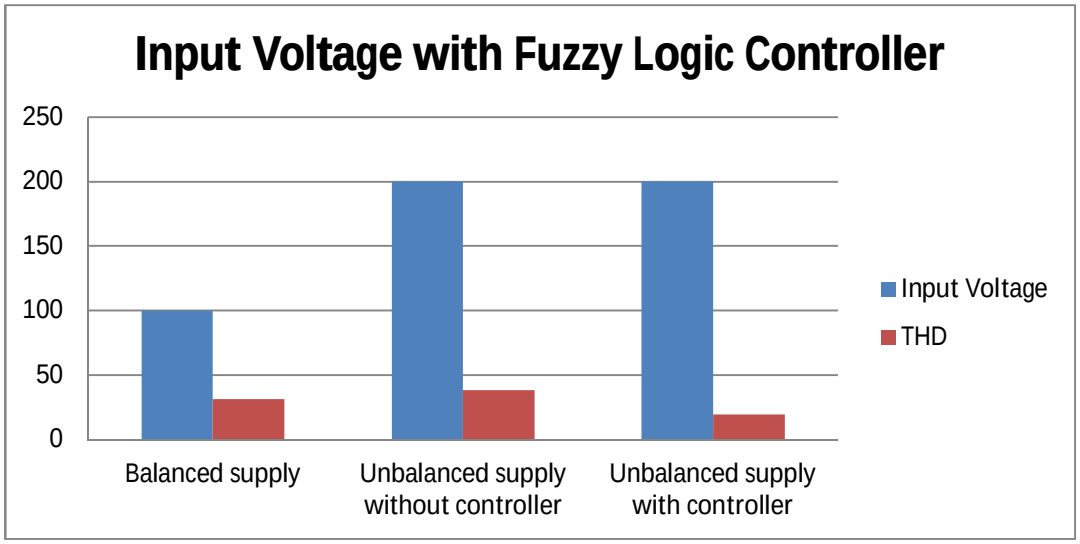


Fig. 5.9 Shows the Input Voltage and THD with Balanced and Unbalanced Supply

From the above tables we can conclude that with change in the input voltages, THD increases and also there is increase in the load voltage and current. This increase in the quantity of voltage and current is normal in rectifier. If more voltage is required by the electrical system , then the use of Fuzzy controller is mandatory to suppress the THD at the source currents.

IV. SUMMARY AND CONCLUSION

In this work, a new technique based on Fuzzy Logic controller is proposed to minimize the effects on the unbalanced voltage disturbances in the conventional rectifier controller. Simulation results are explored using Matlab/Simulink software. Relevant figures and graphs have been shown to understand the conclusive results for the simulation model. The source current harmonics are compensated very effectively by using the new proposed technique. The proposed control algorithm proves to be very effective in addressing the unbalanced voltages which are practically encountered in real power system

REFERENCES

[1] Ralph Baker Kearfott, Ildar Batyrshin, Marek Reformat, Martine Ceberio, Vladik Kreinovich, “Fuzzy Techniques:Theory and Applications”, Proceedings of the 2019 Joint World Congress of the International Fuzzy Systems Association and the Annual Conference of the North American Fuzzy Information Processing Society IFSA/NAFIPS’2019 (Lafayette, Louisiana, USA, June 18–21, 2019).Springer

[2] Hasmat Malik, Smriti Srivastava, Yog Raj Sood, Aamir Ahmad, “Applications of Artificial Intelligence Techniques in Engineering” SIGMA 2018, Volume 2. Springer

[3] Alok K. Mishra, Prakash K. Ray, Ranjan K. Mallick, Asit Mohanty, Soumya R. Das, “Adaptive fuzzy controlled hybrid shunt active power filter for power quality enhancement”, Neural Computing and Applications, Springer-Verlag London Ltd., part of Springer Nature 2020.

[4] Cao Van Kien & Ho Pham Huy Anh & Nguyen Ngoc Son, “Adaptive inverse multilayer fuzzy control for uncertain nonlinear system optimizing with differential evolution algorithm”, Applied Intelligence, Springer Science+Business Media, LLC, part of Springer Nature 2020

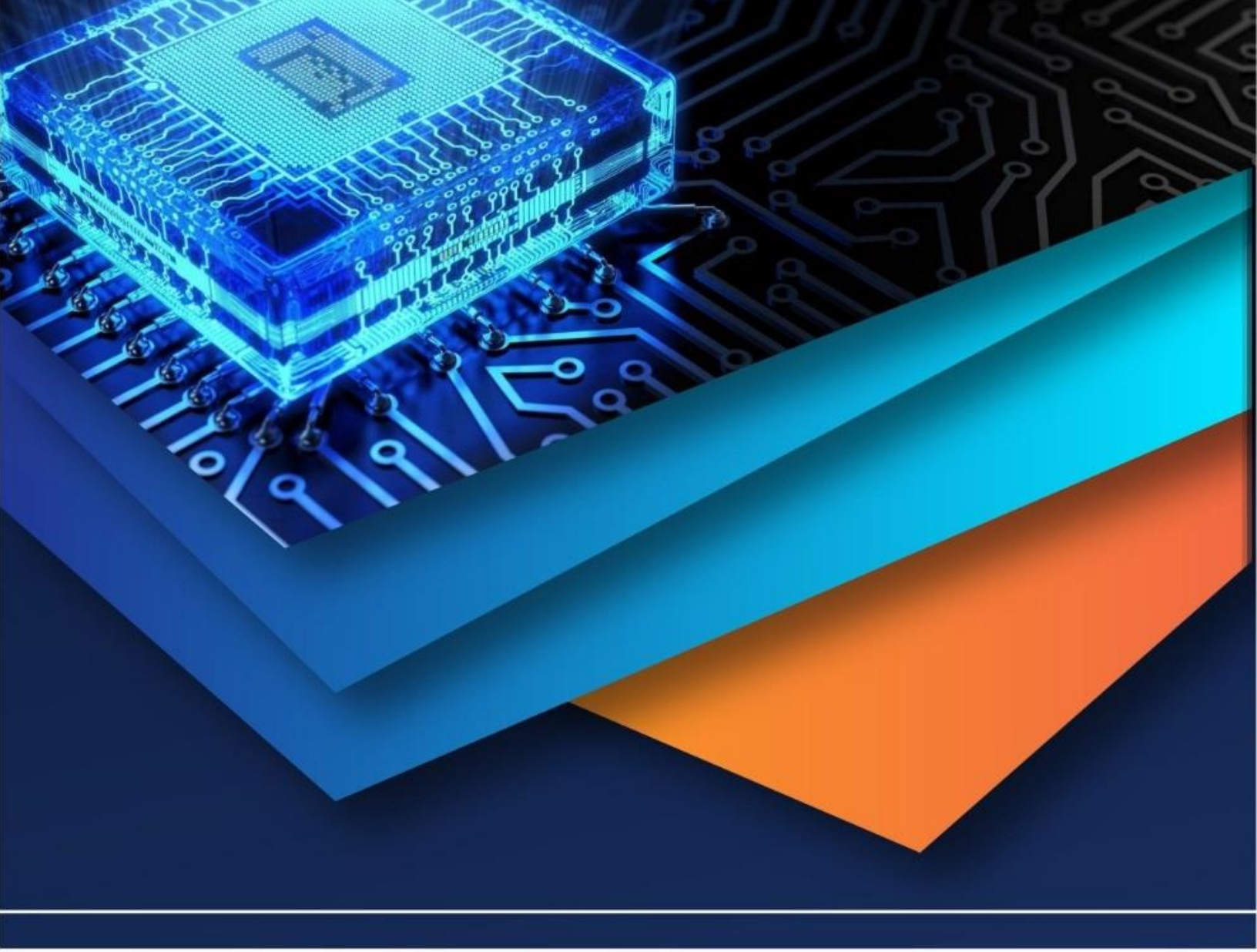
[5] Neeraj Priyadarshi, , Sanjeevikumar Padmanaban , *Senior Member*, Jens Bo Holm-Nielsen, Frede Blaabjerg , *Fellow* and Mahajan Sagar Bhaskar ,*IEEE.,”* An Experimental Estimation of Hybrid ANFIS–PSO-Based MPPT for PV Grid Integration Under Fluctuating Sun Irradiance”, IEEE SYSTEMS JOURNAL 2019.

[6] Aurobinda Bag, Bidyadhar Subudhi, Senior Member, IEEE, and Pravat Kumar Ray, “A Combined Reinforcement Learning and Sliding Mode Control Scheme for Grid Integration of a PV System”, Csee Journal Of Power And Energy Systems, Vol. 5, No. 4, DECEMBER 2019.

[7] *Yang Mei, Kai Sun, and Yuchao Shi,”* A 2-D Fuzzy Logic Based MRAS Scheme for Sensorless Control of Interior Permanent Magnet Synchronous Motor Drives with Cyclic Fluctuating Loads”, Chinese Journal of Electrical Engineering, Vol.1, No.1, December 2015.

[8] A. A. Abd Rahim, R. Boudville, Z. Hussain, S. Z. Yahaya, K. A. Ahmad, “Design of Fuzzy Logic Control for Automatic Switching OFF Electric Iron”, 2019 9th IEEE International Conference on Control System, Computing and Engineering (ICCSCE), 29 Nov.–1 Dec. 2019, Penang, Malaysia.

[9] Muhammad Adnan Mansoor Ali, Anas Basalamah And Muhammad Tariq, “Preventing Cascading Failure Through Fuzzy Co-Operative Control Mechanism Using V2G”, Preventing Cascading Failure Through Fuzzy Co-Operative Control Mechanism Using V2G VOLUME 7, 2019.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY