IMPROVED PERFORMANCE OF A GRID-CONNECTED INVERTER WITH TWO PV ARRAY INPUT UNDER DIFFERENT ENVIRONMENT CONDITIONS USING ADAPTIVE NEURO FIS BASED CONTROL

Ankit Shukla[1], Dr. Rajesh Kr Ahuja[2], Bharti Thakur[3]

[1]M. Tech Scholar, J.C. Bose UST, YMCA, Faridabad

[2,3] Faculty of Electrical Engineering Department, J.C. Bose UST, YMCA, Faridabad, Haryana, India

ankitshuklaj004@gmail.com 1; rajeshkrahuja@gmail.com 2;
thakur.bharti21gmail.com 3

Abstract-

Grid-connected inverters based on solar PV cells are becoming increasingly common. At times, the PV can be subjected to a certain environmental situation, such as varying irradiance or temperature. Present developments in gird-connected PV inverters do not have many reliable yields or reliability in this case. In this article, an improved control framework system is intended for two PV that are mismatched in various ways, resulting in a highly effective grid-connected solar inverter with THD under 1% for both voltage and current. The regulator employs a control scheme comprised of an ANFIS-based control system that works in tandem with the incremental conductance technique of MPPT. The outcomes are simulated and validated using MATLAB Simulink.

Keywords- Solar, anfis, 2 PV , array

1. Introduction

The operating atmosphere and temperatures have a major impact on the solar panels. When operating with many arrays, it is critical to obtain a stable performance. [1] In the case of solar-based grid-connected inverters, the after effects primarily address power output loss, reliability, and high distortions. [2] If there are multiple arrays and the output is subjected to high distortions, the load attached in a certain manner can be affected in terms of lifespan. There is already a strong demand for solar-based inverters, which fuels researchers' curiosity for improved distortion-free waveforms. [3] This sparked interest in buck and boost-based inverters rather than conventional transformer-based inverters, which are bulky and expensive and cannot be operated by the transformers. As a result, the power yield from a structure-related transformer-less PV system, such as single-stage inverter-based systems, received more attention, and inverter-based systems were affected in this situation. [4] Formal paraphrase

The enthusiasm for unlimited energy has grown steadily in response to environmental issues and the need for urgency, which makes sources such as solar and wind very useful and promising in nature. [5] Solar or photovoltaic vitality is currently one of the most well-known and sustainable power supply resources. Inverters play an important role in network-related PV systems, and they are widely used in every scenario for power generation and are a fundamental necessity. [6] This study is focused on inverter tests for structure-related PV systems, a couple of inverter designs for interfacing PV-based arrays to the three step or single-stage environment, and their advantages and disadvantages. The distortion-free inverter, which uses one or more solar PV arrays and is not influenced by any environmental restrictions, is one of the most important points. [7] The PV power system is used to convert solar imperativeness into electrical imperativeness by using solar cells. The system's main components are solar cells, a battery, a regulator, a booster, and an inverter. It receives the benevolence of public efforts and has tremendous potential for future advancement due to its strong constancy, long support life, no tainting, and rendering power selfgoverning. [8] As a result, the advancement and application of solar imperativeness is an extremely genius method for comprehending the challenge of electricity gracefully in distant district. The monitoring mechanisms of PV-based systems are normally managed by various types of control systems, which provide numerous design possibilities and new calculative-based responses for the inverter. Many conventional controllers, such as Perturb and Observe, PI proportional integral control, and ANFIS, can be used to target the optimum power point. Machine learning and artificial intelligence methods can also be used to track the grid-connected PV inverter. [10] Formalized paraphrase

By incorporating a buck and boost power, the above control is able to minimise error between PV arrays, thereby boosting output yield but with higher distortions. [11] Formalized paraphrase The control system's simple stability is that it can be manipulated in such a way that a high repeat operation is guaranteed without extending the trading setback, which increases the error efficiency in the grid-connected PV inverter. High repeat operation also causes a reduction in the size of the uninvolved bits, which is an advantage of using buck and boost dependent inverters. [12] Formal paraphrase

This paper presents a single stage structure based transformer less photovoltaic solar grid linked inverter for use. The grid-connected inverter is allowed by the use of buck and boost configurations [13]. As PV inverters offer more scope in the future for free source power in grid with very low maintenance cost [14], there is a need to strengthen the distortions present if any using different control strategies. As a result, the configuration of an interleaved distinct stage is suggested to have a low corresponding inductance, thus improving wave distortions and reducing transformer usage. More PV-influenced phases may be added in a similar manner.

Using a solar inverter, simpler and more efficient conversion of DC voltage to AC voltage can be done in grids, which is very useful conversion of DC voltage to AC voltage as needed. [15] Formalized paraphrase In this article, an effort is made to increase the efficiency of two PV inverters with mismatched environmental conditions by employing a specialised controller technique known as ANFIS with Modified Incremental Conductance.

2. Implementation

Currently, the execution used in the previous chapter has been modified for the proposition of the current job from the foundation work [1]. Rather than using just the IC MPPT conductance technique, an ANFIS-based control regulator is used in this work for greater precision and lower distortions. In figure 1, the circuit outline is taken as is to allow an inspection for effects, and ANFIS is used to boost this circuit.

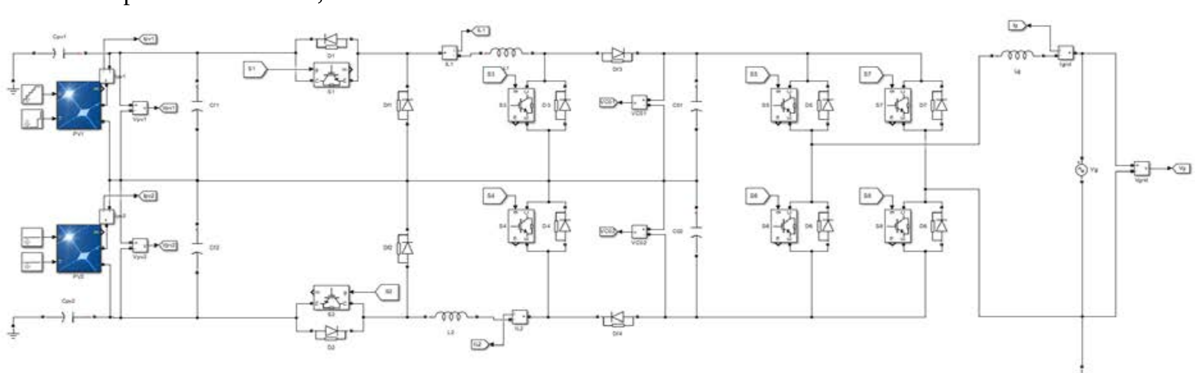

Figure 1: Final Model for Two PV array Inverter

Figure 2 shows the ANFIS regulator, and in the subsystem the power is measured, resulting in a change in power that is incorrect and a change in power noise as two sources of information that are multiplexed and taken into the input of the ANFIS regulator in an attempt to boost the error that was generated by using PV arrays in mismatched environmental conditions. This yield has a dimension that increases the distortion proportion for both current and voltage outputs.

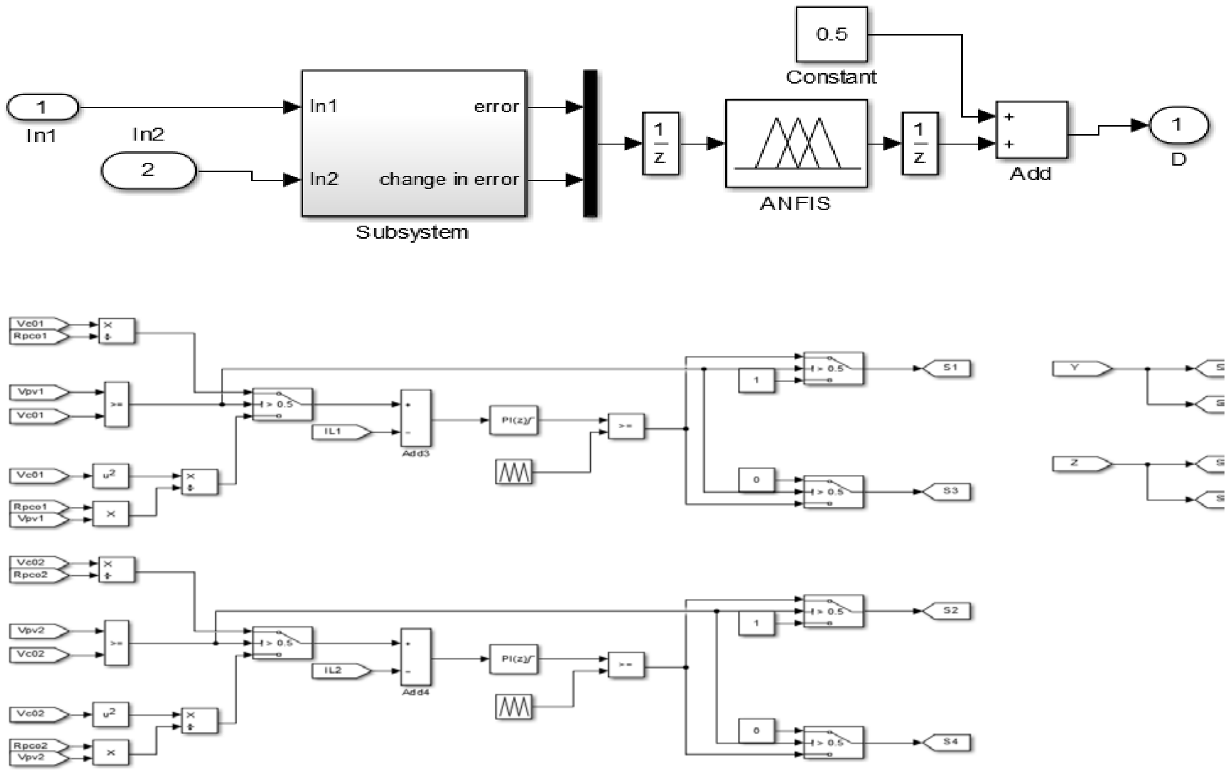

Figure 2: ANFIS Controller for Two PV inverter

Figure 3 shows how the subsystem is defined in terms of error and improvement in distortion yield from PV current and voltage. Since the PV exhibits are mismatched and can result in different yields and mismatches, two ANFIS regulators are used for each PV cluster.

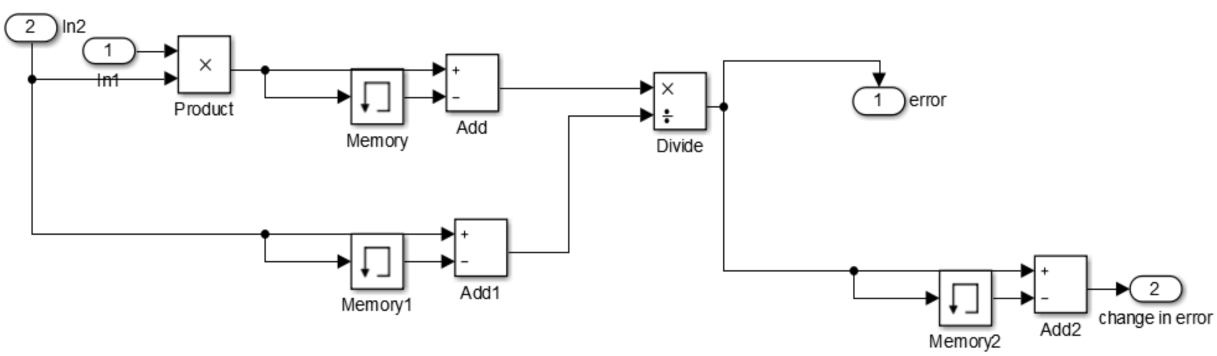

Figure 3: Subsystem for Power Error and Change in Error

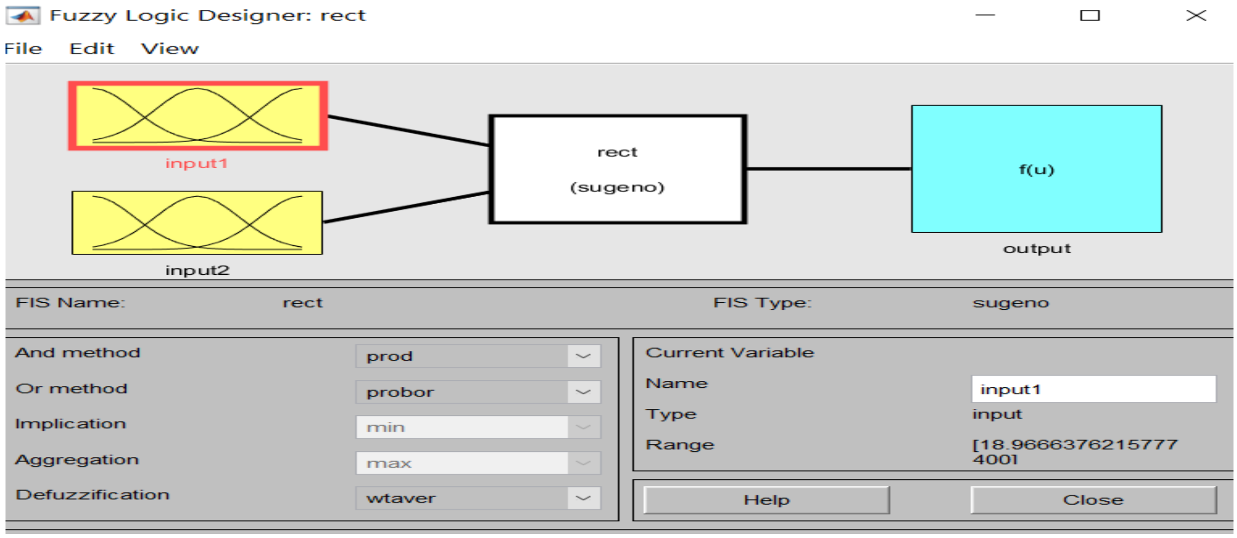

Figure 4: ANFIS Toolbox and rule view for Power Error and Change in Error and Output

Figure 4 depicts the ANFIS regulator instrument, which demonstrates the Sugeno requirements used by ANFIS regulators.

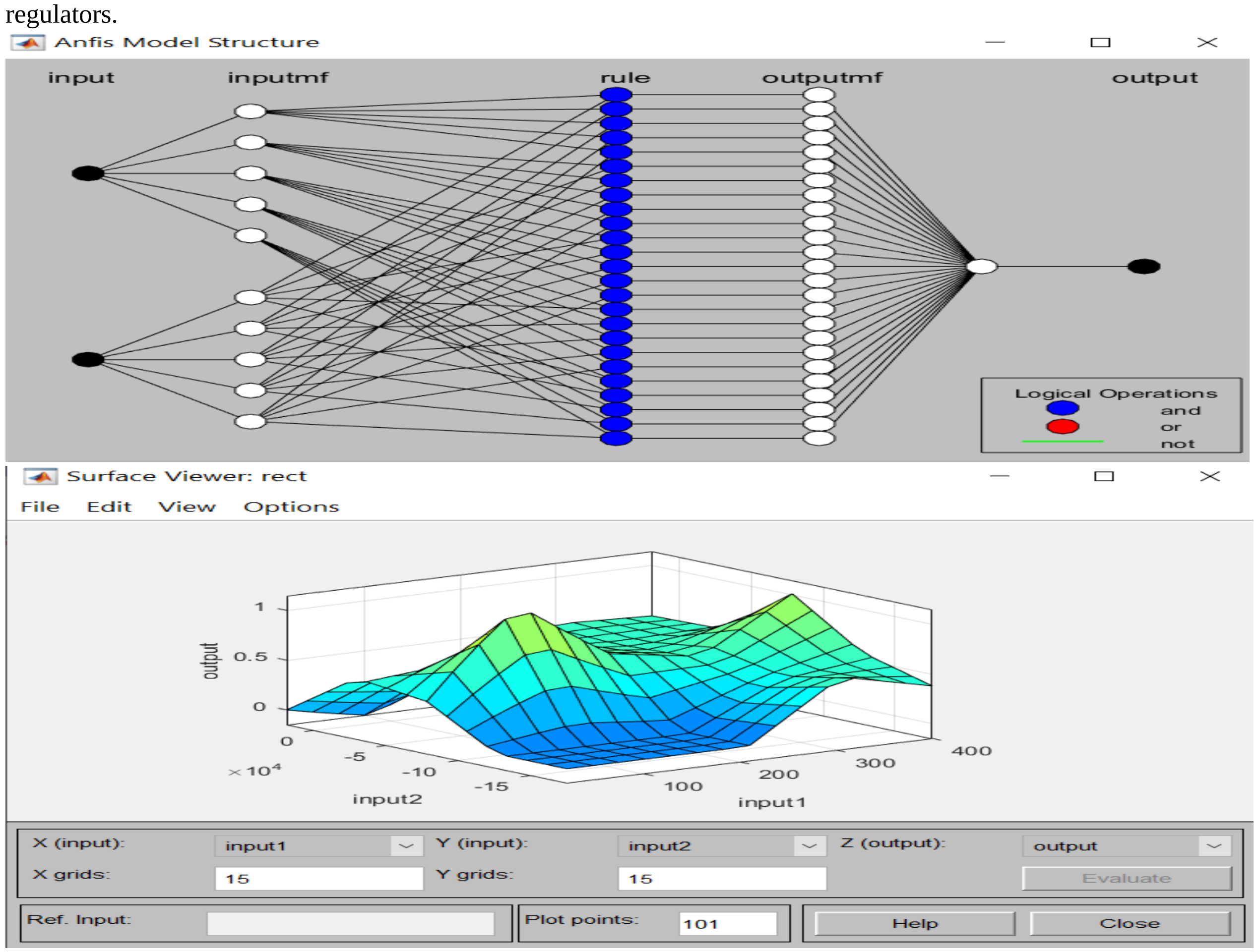

Figure 5: The Surface View and model structure of Rules range

Figure 5 depicts a surface view graph of the rules described in two PV arrays ANFIS controllers.

3. Results:

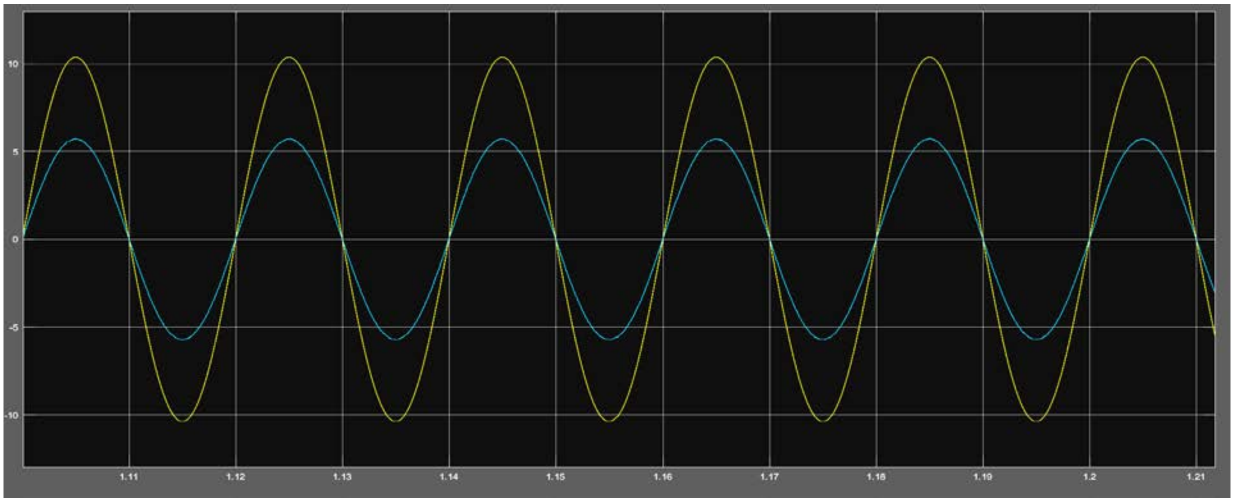

Figure 6: Output Current and Voltage of Inverter

The zoomed output of current and voltage in figure 6 shows a sine wave, which is perfectly fine.

The final comparison is seen in table 1 below, based on the findings shown in the previous section. For planned work, the outcomes are improved.

Table 1: Comparison results for Two Inverters

	Existing	**Proposed**
THD Voltage	0.09%	0.05%
THD Current	2.12%	0.43%

In addition, the data are described graphically in contrast, as seen in figures 7 and 8 below.

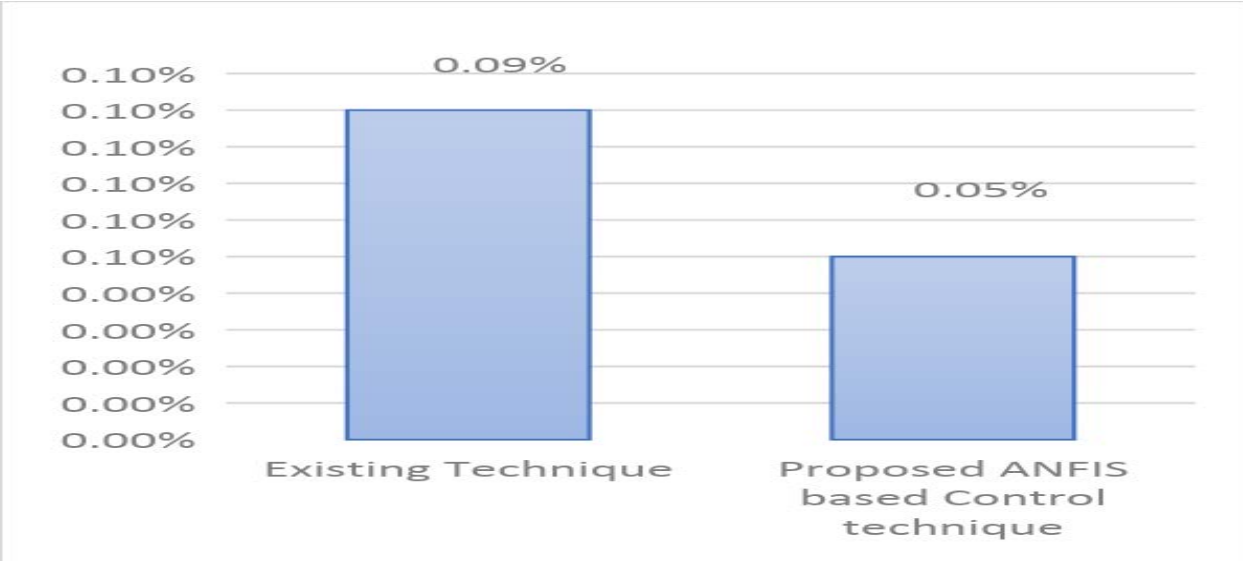

Figure 7: THD comparison for Voltage

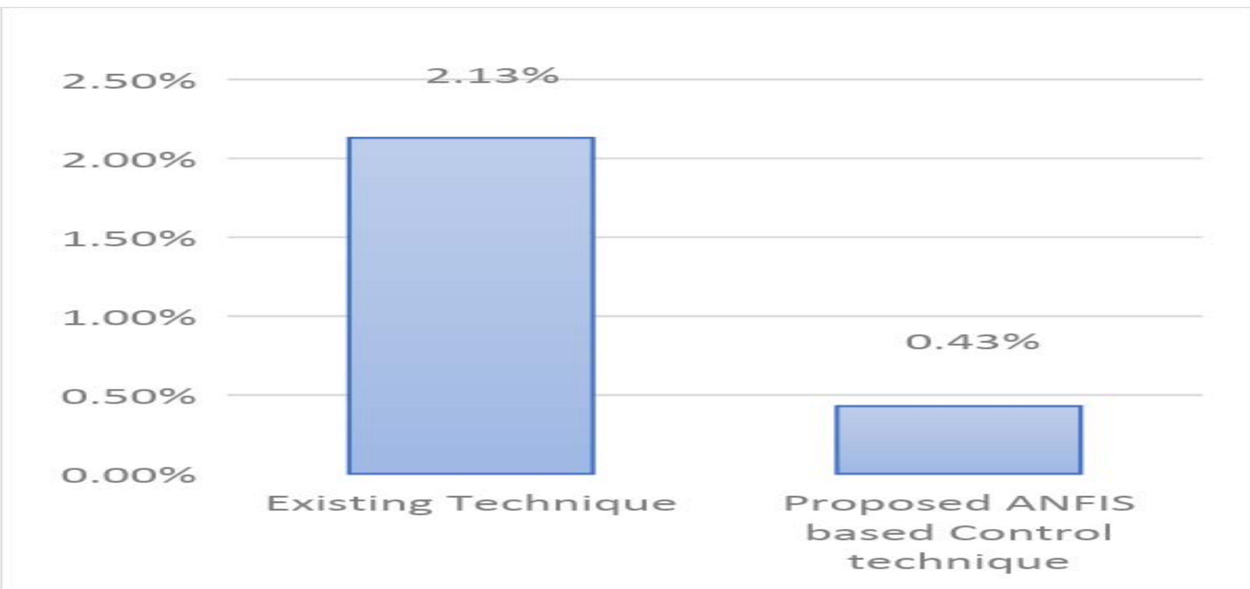

Figure 8: THD comparison for current

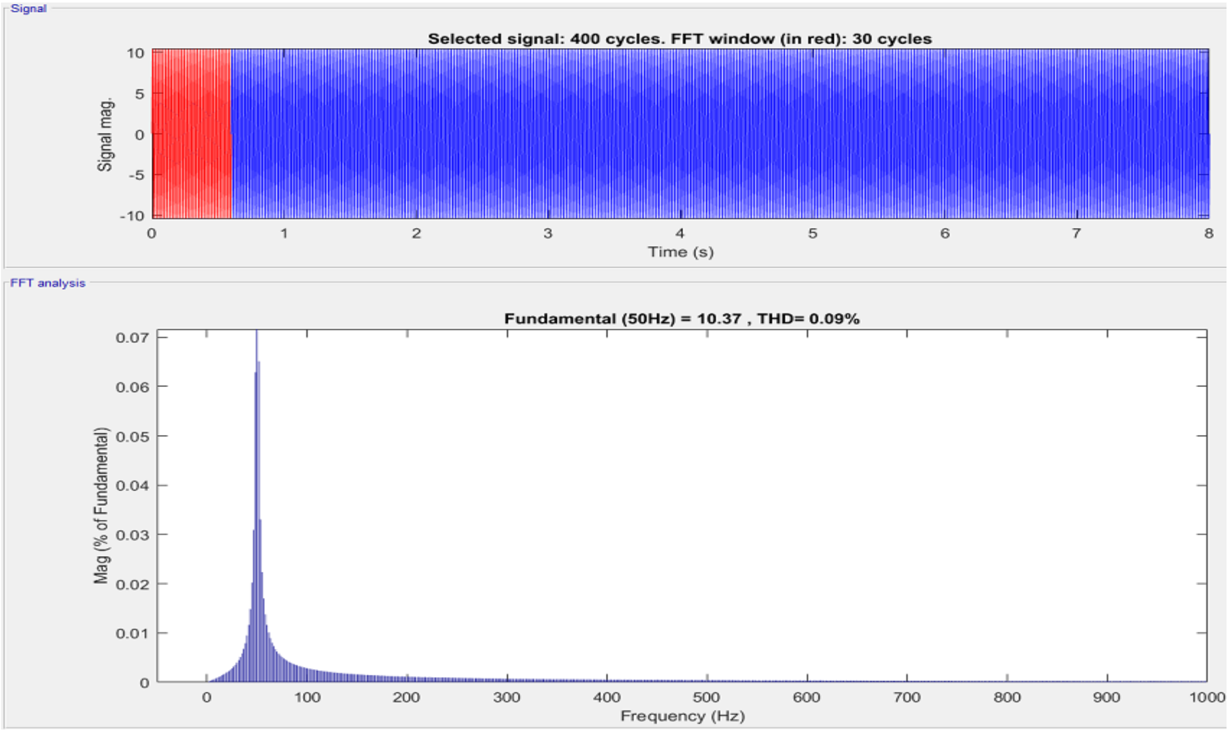

Figure 9: THD Output for voltage

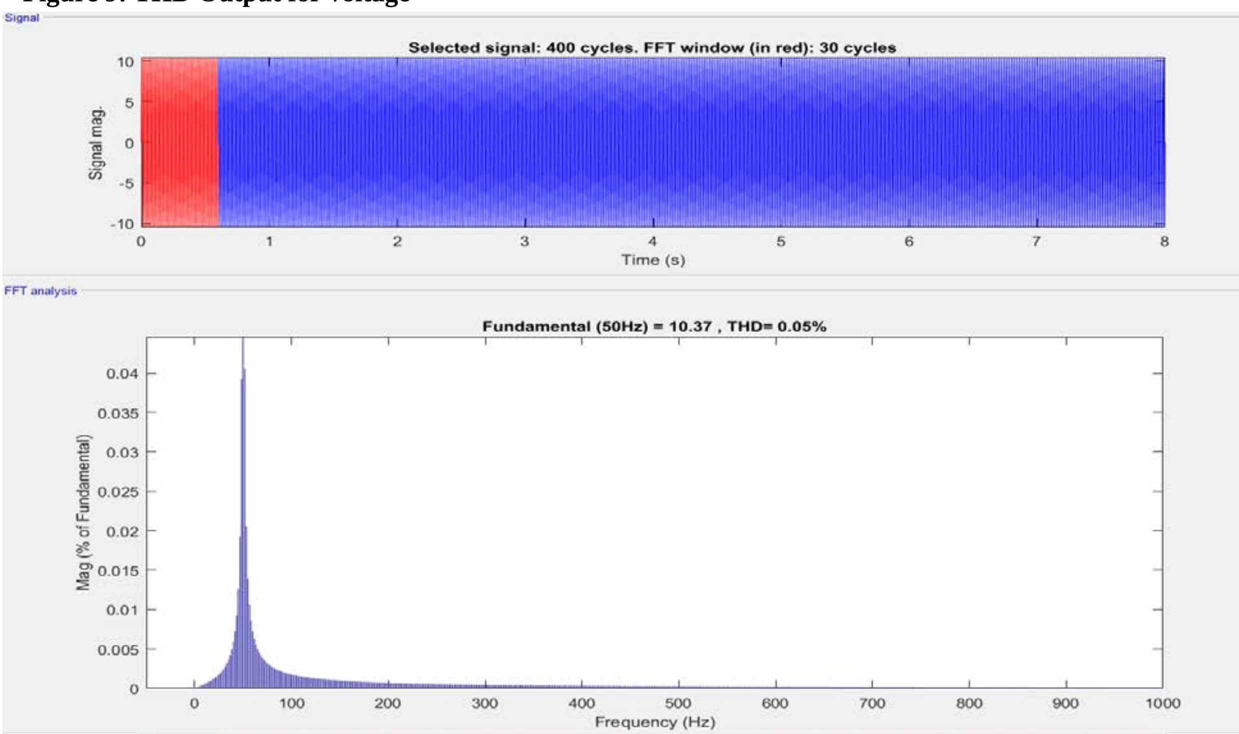

Figure 10: Improved THD for Voltage

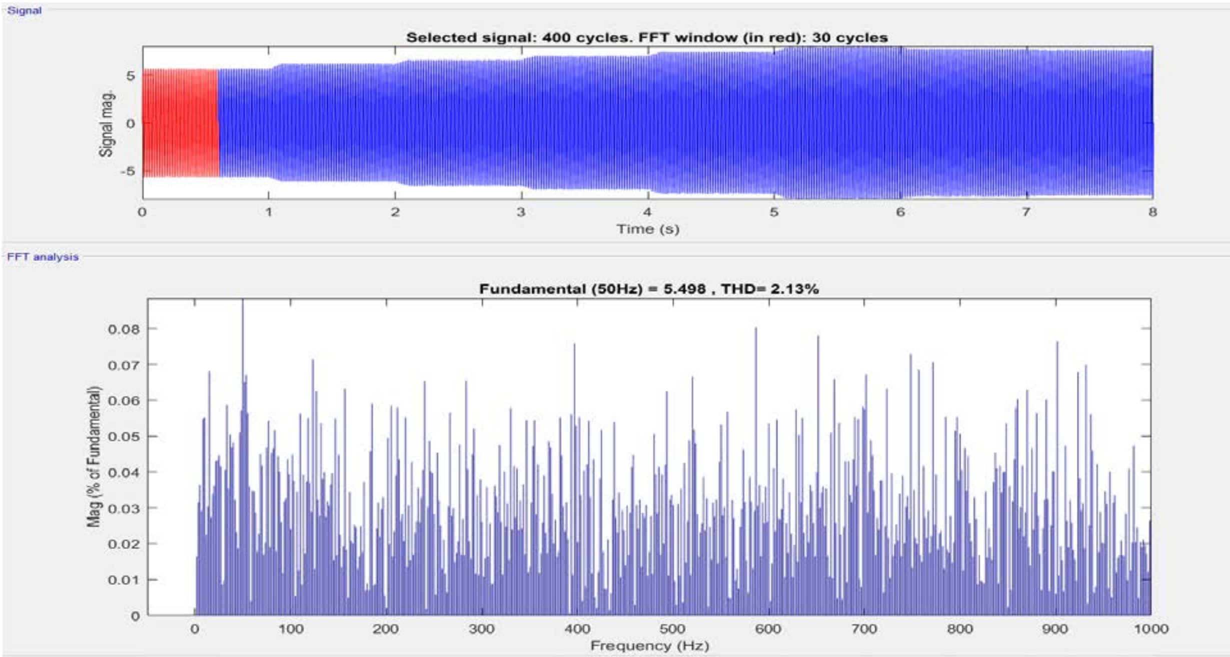

Figure 11: THD Output for current

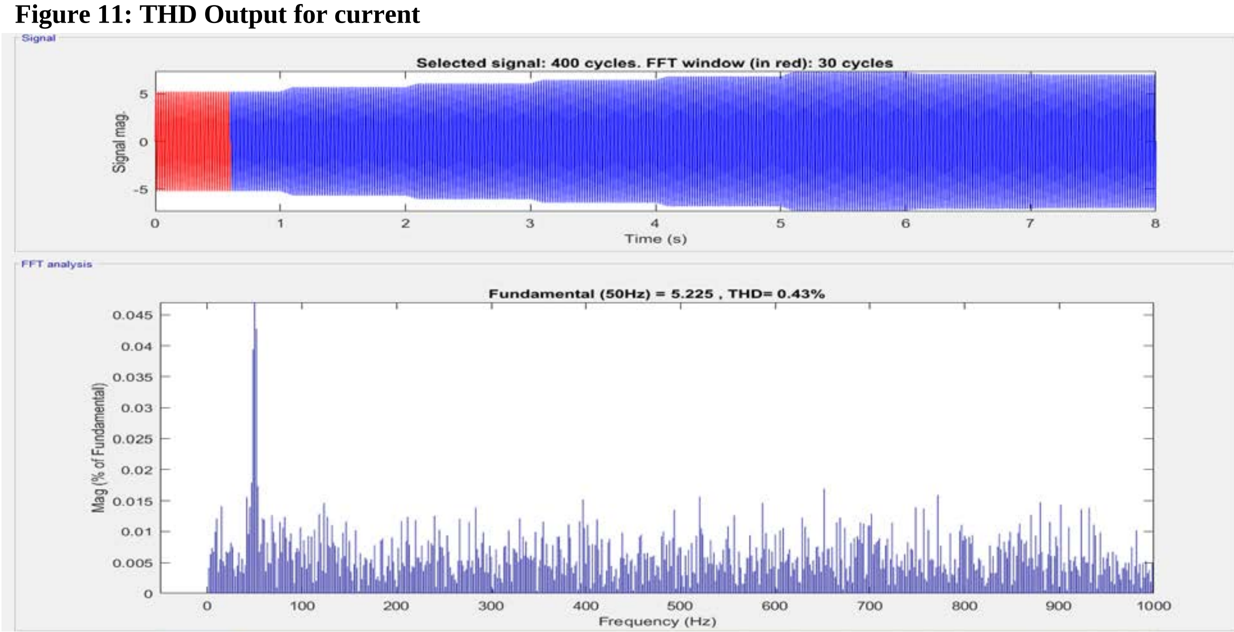

Figure 12: Improved THD Output for Current

4. Conclusion

The execution of two PV-based arrays in mismatched natural environmental conditions is actualized in this paper to form an inverter with fewer noises and distortions. The experiment is carried out efficiently, with the findings shown in MATLAB Simulink. The distortions are less than 0.5 percent, and the yields have efficiency of more than 99.5 percent. The yield current and voltage waveforms demonstrate correct yield, and low variances for PV yields are monitored. The ANFIS regulator is the most accurate because it takes into account the problematic states of error detections and changes in power mismatch in MPPT.

REFERENCES

[1] Subhendu Dutta, and Kishore Chatterjee, "A Buck & Boost based Grid Connected PV Inverter Maximizing Power Yield from Two PV Arrays in Mismatched Environmental Conditions" IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS DOI 10.1109/TIE.2017.2774768, IEEE
[2] Muhammedali Shafeeque K, Subadhra P.R, "A Novel Single Stage DC-AC Buck Boost Inverter for Solar Power Extraction" International Conference on Microelectronics, Communication and Renewable Energy (ICMiCR-2013)
[3] Sannasy Mageshwari, S. Kanagalakshmi and Hannumath Rao, " Design and Implementation of Buck-Boost Converter for Residential PV Application" International Journal on Electrical Engineering and Informatics - Volume 9, Number 4, December 2017
[4] Santosh Singh Yadav, Vaibhav Singh Chauhan, "SOLAR POWERED BUCK BOOST INVERTER BASED INVERTER TOPOLOGIES FOR DOMESTIC APPLICATIONS" 978-1-5386-9316-2/18/$31.00 ©2018 IEEE
[5] A. Testa, S. De Caro, T. Scimone, S. Panarello, "A Buck-Boost based DC/AC Converter for Residential PV Applications" 978-1-4673-1301-8/12/$31.00 ©2012 IEEE
[6] Prasanth Kumar Sahu, Madhav Manjrekar, Ronak Bhatt, "Maximum Power Point Tracking for Solar Panel Companion Inverters" 978-1-5090-5326-1/17/$31@2017 IEEE
[7] Mohamed Ahmed Hassan El-Sayed, Steven B. Leeb, "MAXIMUM POWER POINT TRACKING OF PV ARRAYS IN KUWAIT"
[8] T.Dineshkumar, P.Thirumoorthi, S.Rajalakshmi, "Design of Boost Inverter for Solar Power Based Stand Alone Systems" International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-6S, August 2019
[9] Komal H. Nanwani, Dagadu S. More, "A Buck-Boost Common-Mode Transformerless Inverter for Photovoltaic Applications" 978-1-5386-9316-2/18/$31.00 c2018 IEEE
[10] S. S. Patil, G. S. Patil, "High Efficiency Single-stage Grid-tied PV Inverter Topology for Renewable Energy System" Volume III, Issue V, May 2014 IJLTEMAS ISSN 2278 - 2540
[11] A. Zahedi, "Solar photovoltaic (PV) energy; latest developments in the building integrated and hybrid PV systems" 0960-1481/$ - see front matter q 2005 Published by Elsevier Ltd. doi: 10.1016/j.renene.2005.08.007
[12] XU Jun, Han Kailing, "The Single-phase Inverter Design for Photovoltaic System" 2016 International Symposium on Computer, Consumer and Control
[13] Soham Deshpande, Dr. N. R. Bhasme, "A Review of Topologies of Inverter for Grid Connected PV Systems" International Conference on Innovations in Power and Advanced Computing Technologies [i-PACT2017]
[14] Shadi H. Shehadeh, Student IEEE, Hamed H. Aly, Member IEEE, and M. E. El-Hawary, "Photovoltaic Inverters Technology" Proceeding of the IEEE 28th Canadian Conference on Electrical and Computer Engineering Halifax, Canada, May 3-6, 2015
[15] O. S. Kim*, N. A. Matchanov, M. A. Malikov, and B. R. Umarov, "A Study of Main Causes of Malfunction and Breakdown for PV Inverter and Suggestion of Some Practical Measures" ISSN 0003-701X, Applied Solar Energy, 2017, Vol. 53, No. 1, pp. 35–38. © Allerton Press, Inc., 2017.