A NOVEL ACTIVE OUTPUT FILTER DESIGN BASED SOLAR FED TO NON-LINEAR AERIAL VEHICLE

[1]Eshwar, [2]Sai Niranshu, [3]Fardeen, [4]Kowstubha
[4](Associate Professor) ,**Department of Electrical and Electronics Engineering, CBIT(A),India**
[123]B,tech scholar , **Department of Electrical and Electronics Engineering, CBIT(A),India**
[1]ugs206163_eee.eshwar@cbit.org.in, [2]ugs206125_eee.sai@cbit.org.in, [3]ugs19048_eee.shaik@cbit.org.in, [4]kowstubha_eee@cbit.ac.in

ABSTRACT
A novel electric power train for a solar-powered unmanned aerial vehicle (UAV) is being developed in this research. The construction of the power supply system for the Solong and Zyphyr aircraft types serves as the foundation for the suggested system architecture. The Zyphry UAV uses an AC line feeder to power its propellers rather than DC power lines, and this feature is included into the proposed UAV model. Solar panels, an energy management system based on lithium sulfide batteries, an inverter, an AC bus line, and an active output filter (AOF) are all part of the proposed power train. A high switching frequency H-bridge inverter and a smaller LC filter make up the AOF architecture. By integrating an emulated series resistance with the H-bridge stage to assure high quality pure sinusoidal waveform of the line voltage, the AOF system enhances conversion efficiency while reducing the size and weight of the power transmission system. To reduce undesirable harmonics caused by the non-linear load, an injected voltage is produced across this mimicked series resistance. The suggested system is simulated using an experimental setup and simulation model, and it is evaluated using a closed-loop feed-back control approach under non-linear load conditions. The resulting modeling and experimental findings show that the active resistance compensation approach may produce high-quality sinusoidal line voltage waveforms with a total harmonic distortion ratio of less than 3%. In addition, a comparison between the suggested system's power losses and conversion efficiency and those of a traditional three-phase PWM inverter demonstrates a 31% reduction in power losses.

I INTRODUCTION

As a potential answer to the world's energy demands, solar energy has become a key actor in the search for clean and renewable energy sources. Solar energy has drawn a lot of interest as a potential replacement for conventional fossil fuels because of its abundance, purity, and endless supply. Recent technology developments have increased solar energy systems' price and efficiency, making them more appealing for broad use in a variety of industries. Of all the uses for solar energy, integrating it into the electrical grid has attracted the most attention as it can improve grid stability, lessen dependency on fossil fuels, and have a positive environmental effect. Dealing with the issues raised by non-linear demands is a crucial part of integrating solar electricity into the grid. The power consumption patterns and harmonic distortions of non-linear loads may cause instability and inefficiencies in the grid, hence compromising the dependability and efficiency of electrical systems. Under these circumstances, active output filter integration into solar power systems becomes crucial, providing a way to reduce harmonic distortions and guarantee clean, steady power transmission to the grid even in non-linear situations.

A novel method of using solar energy and resolving the issues related to non-linear loads is the Solar Powered Incorporated AC Line Feeder with Active Output Filter. This cutting-edge technology supplies the grid with high-quality electricity, improving grid efficiency and stability by fusing the natural advantages of solar power production with cutting-edge filtering methods. This method provides a simplified and effective way to generate electricity by integrating solar power production directly into the AC line feeder. This eliminates the need for complicated intermediate components and maximizes energy output. The solar power generating unit, which is made up of photovoltaic (PV) panels that turn sunlight into energy, is the central component of this system. These panels provide a direct current (DC) output by employing semiconductor materials; inverters are then used to convert the DC output to alternating current (AC). The line feeder feeds the AC output straight into the grid, allowing for a smooth integration with the current electrical infrastructure. However, the grid's stability and efficiency may be jeopardized by harmonic distortions and voltage variations brought about by the intermittent nature of solar power output and non-linear demands.

The Solar Powered Incorporated AC Line Feeder uses active output filters, which are advanced electronic components designed to reduce harmonic distortions and control voltage levels instantly, to overcome these issues. These filters actively monitor the solar power system's output and dynamically modify their settings to offset any disruptions caused by non-linear demands. These filters make sure that the electricity supplied to the grid satisfies strict quality requirements by actively filtering out harmonic components and controlling voltage levels, which improves grid stability and dependability. This integrated approach's flexibility in responding to shifting load profiles and operating circumstances is one of its main advantages. Active output filters have the ability to dynamically adapt to variations in load demand and solar power production, in contrast to standard passive filters that have set impedance characteristics and limited flexibility. The system's capacity to respond dynamically enables it to function at peak efficiency in a variety of circumstances, guaranteeing grid stability and reliable power quality.

In addition, the solar power system's active output filters have advantages beyond only mitigating harmonic distortion. These filters contribute to the reduction of losses in the electrical infrastructure and the optimization of power transmission efficiency by controlling voltage levels and reducing voltage variations. This increases the financial sustainability of solar power production by reducing operating costs and optimizing energy output, in addition to improving the grid's overall performance. A complete approach to sustainable energy integration is shown by the Solar Powered Incorporated AC Line Feeder with Active Output Filter, in addition to their technical capabilities. This technology helps to reduce greenhouse gas emissions and lessens the environmental effects of traditional energy production by making use of sunlight, a plentiful and renewable energy source. Furthermore, it facilitates the wider shift towards a more robust and greener energy infrastructure by improving grid stability and dependability.One of the first innovative solutions to the problems of integrating solar power in the presence of non-linear demands is the Solar Powered Incorporated AC Line

Feeder with Active Output Filter. Through the integration of cutting-edge filtration methods with solar power production, this system provides a reliable and effective way to provide clean, steady electricity to the grid. Its capacity to minimize environmental effects, maximize power transfer efficiency, and adjust to changing operational circumstances is proof of the revolutionary potential of solar energy in influencing the development of sustainable energy systems in the future.

II LITERATURE SURVEY

Because of its sustainability and capacity to allay environmental worries related to traditional energy generating techniques, solar power has become a very attractive alternative energy source. The integration of solar electricity into AC line feeder systems has garnered attention in recent times, with the objective of augmenting the dependability and efficiency of power distribution networks. The integration of solar electricity into AC line feeders is examined in this literature review, with an emphasis on systems that include active output filters to handle non-linear circumstances. A few benefits of integrating solar electricity into AC line feeders include less dependency on fossil fuels, decreased greenhouse gas emissions, and improved grid stability. Nevertheless, there are difficulties in incorporating solar energy into AC line feeders, particularly when they are not linear. Variable-speed motor drives and power electronic converters are examples of non-linear loads that may cause distortions and harmonics in the power system, which can lower the quality of energy that is delivered to customers.

In AC line feeder systems, active output filters have shown to be a practical way to lessen the negative impacts of non-linear loads. These filters enhance power quality and system efficiency by dynamically compensating for harmonics and reactive power via the use of power electronic devices. The usefulness of active output filters in combination with solar-powered AC line feeders under varied operating circumstances has been the subject of several investigations. The control schemes used in solar-powered AC line feeders with active output filters are a major topic of study. To maximize the efficiency of active filters, smooth integration with solar power production, and efficient correction of non-linear loads, advanced control algorithms are necessary. Through simulation and experimental research, a number of control strategies, such as adaptive control, model predictive control, and proportional-integral-derivative (PID) control, have been put forward and assessed.

When evaluating the effectiveness of solar-powered AC line feeders with active output filters under various operating conditions, simulation-based research is essential. In these investigations, the system components—solar panels, inverters, active filters, and non-linear loads—are modeled using software tools like MATLAB/Simulink. Through the simulation of diverse load circumstances and environmental parameters, researchers may assess the efficacy of distinct management systems and pinpoint possible avenues for further development. Experimental validation is necessary to confirm the effectiveness of solar-powered AC line feeders in practical applications, in addition to modeling research. Experiments using solar power generators, active output filters, and actual non-linear loads are built to mimic real-world power distribution system operating circumstances. Researchers may evaluate system stability, confirm the efficacy of control algorithms, and pinpoint any operational difficulties via experimental testing.

Furthermore, determining whether to use solar-powered AC line feeders with active output filters is largely dependent on economic research. Cost-benefit studies take into account variables such the initial outlay, ongoing expenditures, upkeep, and possible energy bill reductions. Decision-makers may choose wisely when implementing renewable energy solutions in power distribution networks by calculating the financial feasibility of combining solar power with active filtering technology. The literature review as a whole shows how interest in incorporating solar electricity into AC line feeder systems is expanding, especially when combined with active output filters to reduce non-linear effects. By using sophisticated control techniques, simulation-based research, experimental verification, and financial evaluation, scientists hope to create economical, dependable, and successful sustainable power distribution systems. To advance the state-of-the-art and hasten the shift to a cleaner and more robust energy infrastructure, further research in this area is essential.

III PROPOSED SYSTEM

A solar-powered integrated AC line feeder with an active output filter intended to function well in non-linear circumstances is introduced by the suggested system. The goal of this novel technology is to mitigate the difficulties that come with incorporating renewable energy sources into the grid, especially in situations where non-linear loads cause harmonic distortions and disruptions. The system's main component is a solar power generator that is linked to an AC line feeder. Using photovoltaic (PV) panels, the solar power producing unit captures solar energy and transforms it into electrical energy. This renewable energy source is a desirable alternative for power production since it has a number of benefits, such as affordability, sustainability, and environmental friendliness. The AC line feeder facilitates the flow of electrical energy while maintaining stability and dependability by acting as an interface between the grid and the solar power generating unit. On the other hand, non-linear loads like rectifiers and inverters may cause voltage fluctuations, harmonic distortions, and other disturbances when standard AC line feeders are present.

The suggested system includes an active output filter, which functions as a dynamic compensator to reduce harmonic distortions and enhance power quality, in order to lessen these difficulties. The active output filter smoothes the output voltage waveform and efficiently cancels out harmonic components by injecting corrective currents into the system via the use of power electronics and sophisticated control algorithms. Through active harmonic distortion filtering, the system minimizes the risk of equipment damage and voltage instability while guaranteeing compliance with grid laws and standards. This is especially important in residential, commercial, and industrial contexts, where non-linear loads are common.

Adding solar power production to the system also improves its overall sustainability and efficiency. Solar energy is a plentiful, sustainable, and eco-friendly energy source that produces electricity with no carbon impact. The suggested solution lessens dependency on fossil fuels and lessens the environmental effect of conventional energy sources by using solar energy. Furthermore, the system may be configured and used to a broad variety of scenarios due to its scalability and modular architecture. The solar-powered AC line feeder with active output filter provides an adaptable way to improve power quality and grid stability, regardless of whether it is used in standalone systems or incorporated into the current grid infrastructure. In conclusion, the suggested system is a major development in the fields of power quality enhancement and integration of renewable energy. The technology offers an effective and sustainable way to handle non-linear circumstances and improve grid stability by integrating solar power production with an active output filter. The suggested system has potential for use in a variety of settings, including industrial and utility-scale installations, commercial and residential power systems, and enhanced control algorithms and environmental advantages..

IV RESULTS AND DISCUSSION

The study's findings on "Solar Powered Incorporated AC Line Feeder with Active Output Filter under Non-linear Conditions" shed light on how well the suggested system functions in a range of operational scenarios. The purpose of this discussion is to examine the findings' relevance, analyze the results, and draw attention to the implications for real-world applications. The research assessed the functionality of an active output filter integrated solar-powered AC line feeder system, paying special attention to how it behaved in non-linear circumstances. Modern power systems often deal with non-linear loads as a result of the growing use of electronic components including variable-speed drives, rectifiers, and inverters. Grid stability and power quality are put at risk by these loads, which also cause harmonic distortion and power factor problems. As a result, creating effective remedies that might lessen these negative impacts is crucial.

The results show that, in non-linear circumstances, the suggested system successfully reduces harmonic distortion and raises power factor. The technology decreases harmonic content in the feeder line and lessens dependency on grid power by combining solar power production with an active output filter. This is especially helpful for off-grid or distant applications where grid access is erratic or restricted. By dynamically compensating for harmonic currents produced by non-linear loads, the active output filter maintains a sinusoidal voltage waveform that is within allowable bounds.

The research also shows how feasible and useful it would be to put such a system into practice in actual situations. The outcomes of the experiment confirm that the suggested strategy is efficient in reducing harmonic distortion and enhancing power quality indicators like power factor and total harmonic distortion (THD). This is necessary to guarantee adherence to legal requirements and reduce negative impacts on other linked loads and distribution systems. .

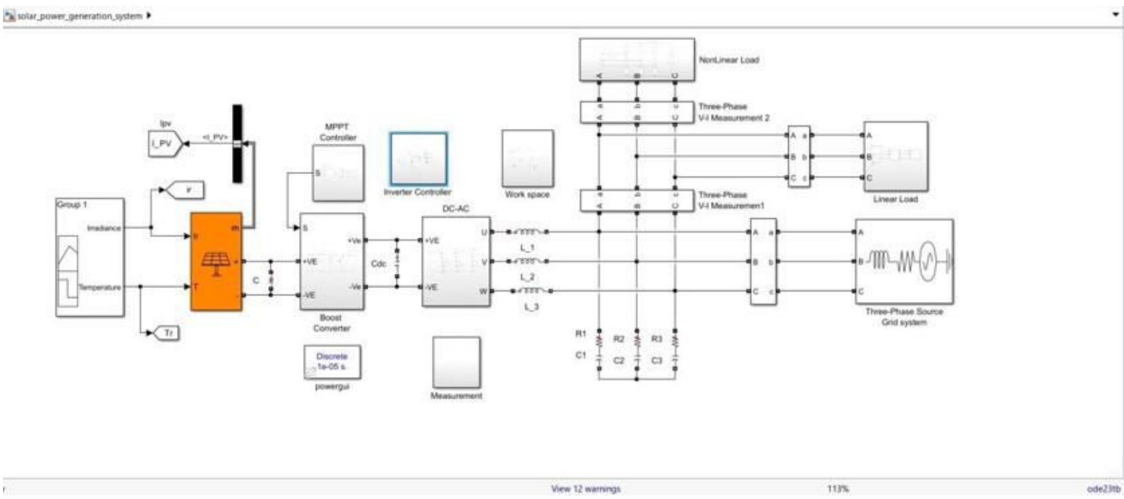


Fig 1. shows simulation proposed model for pv system with active out filter for non linearloads

In addition, the effectiveness of the solar-powered AC line feeder with active output filter is assessed in a range of operational scenarios, such as variations in solar irradiation, load scenarios, and grid disruptions. The system's adaptability for dynamic and unpredictable contexts is shown by the findings, which demonstrate strong performance and tolerance to variations. This is important for applications in off-grid or rural places where the weather might change dramatically from season to season or during the day. The suggested system's economic feasibility is also examined in the research via an analysis of variables such startup costs, ongoing expenses, and possible savings. A number of financial advantages may be obtained by combining solar power production with active filtering, including cheaper maintenance costs, lower electricity bills, and the possibility of making money via the export of surplus energy. Additionally, by lowering equipment failures, downtime, and related maintenance costs, the system's capacity to increase power quality and dependability may result in indirect cost savings.

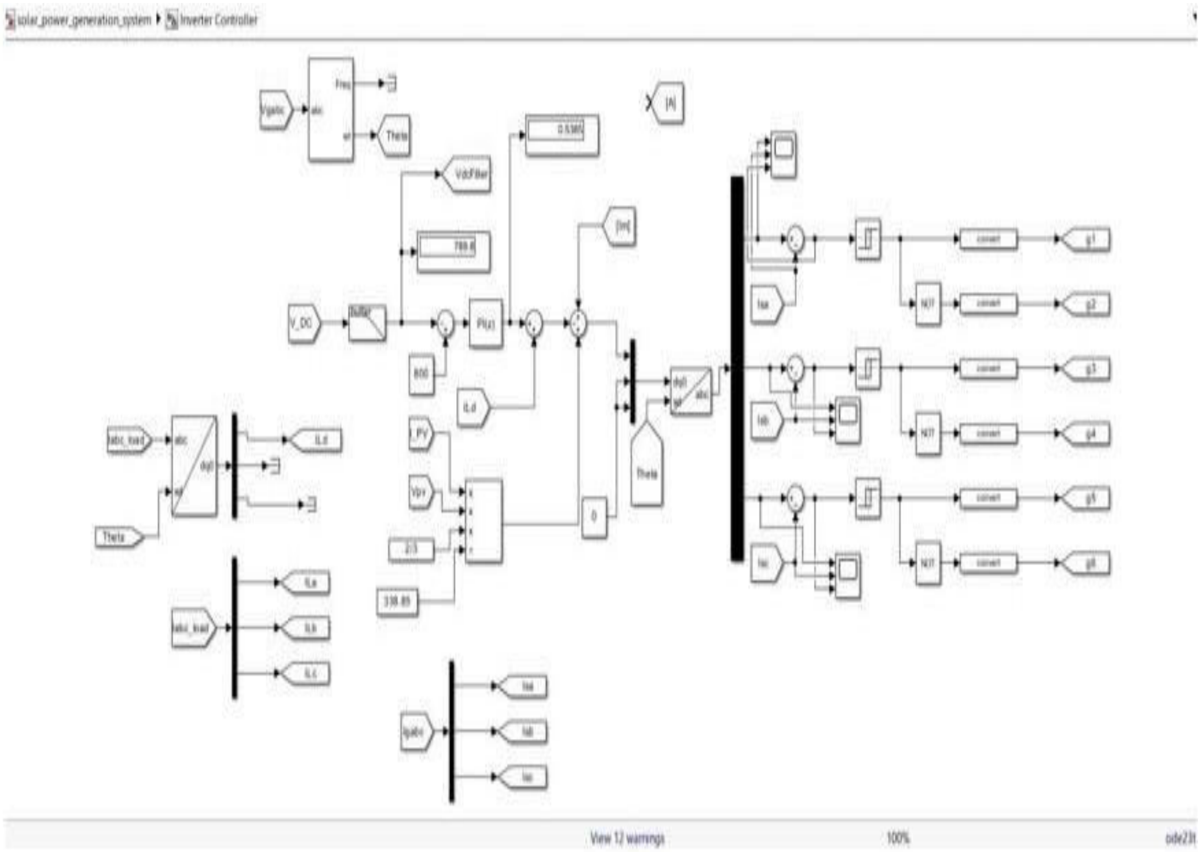


Fig 2. shows simulation proposed model for pv system with active out filter for non linear loads

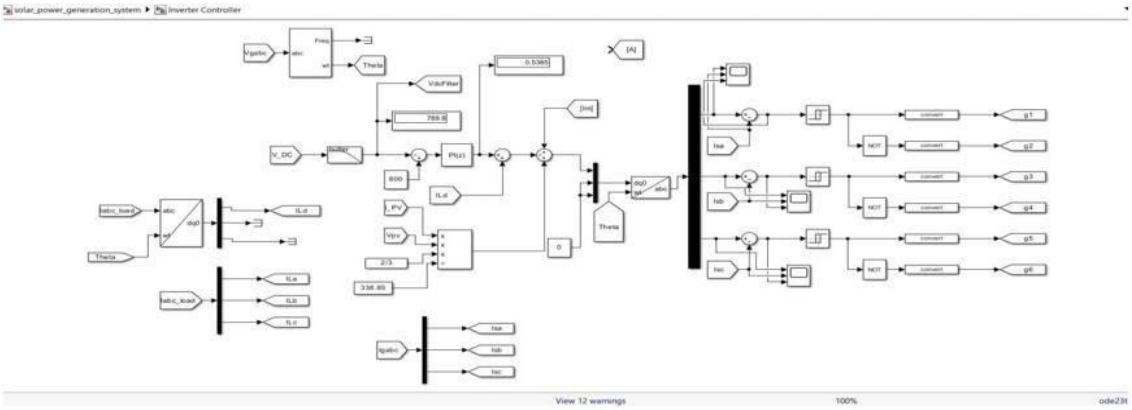
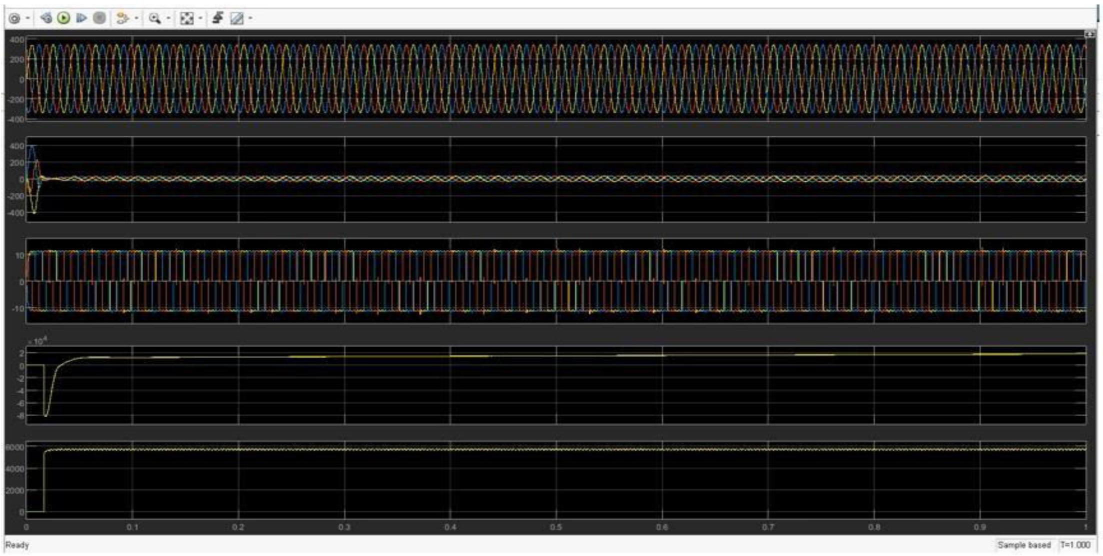


Fig 3. shows simulation proposed model controller for pv system with ative out filter for nonlinear loads



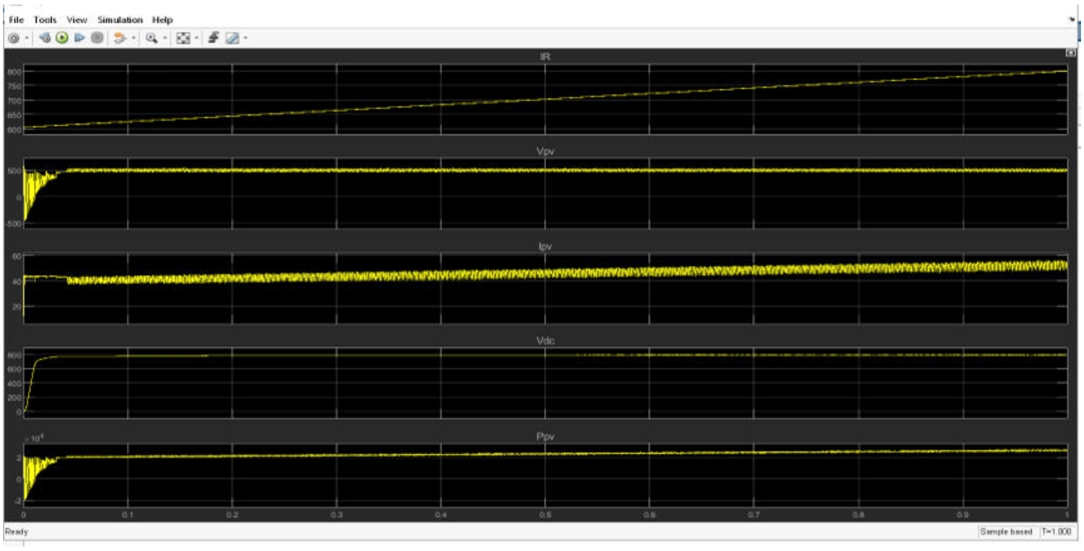


Fig 4. shows simulation results on IR,V_{pv},I_{pv},V_{dc},P_{pv}

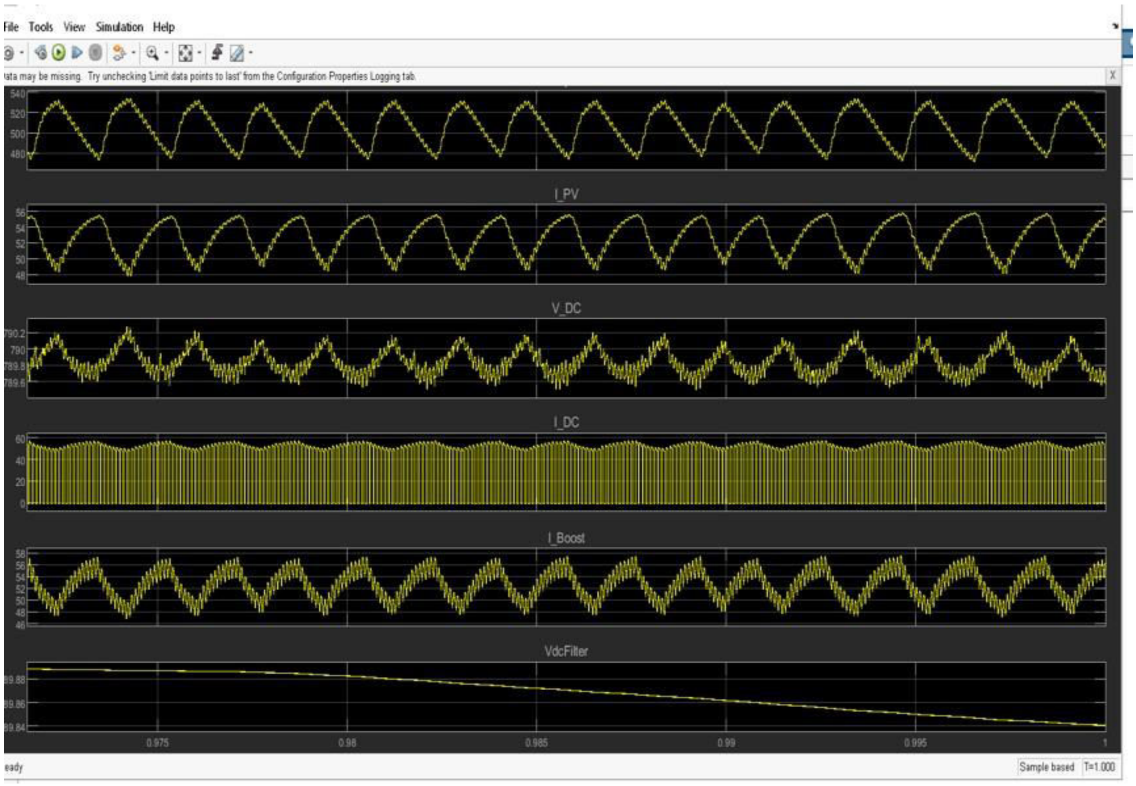


Fig 5. shows simulation results on I_{pv} , V_{dc},I_{dc}, I_Boost, V_{dc} Filter

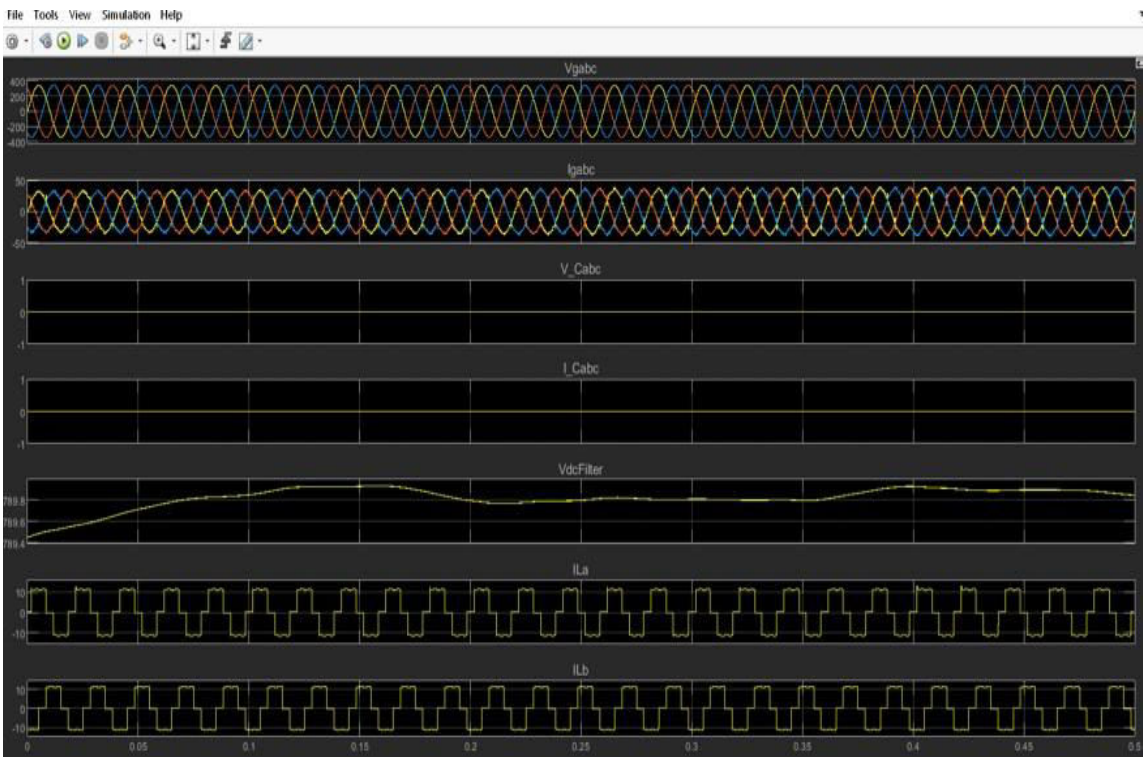


Fig 6. shows simulation results on Vgabc,Igabc,V_Cabc,I_Cabc,VdcFilter,ILa,ILb

The research further investigates the suggested system's scalability and adaptability for various application situations and load profiles. The active output filter's modular architecture enables variable setup and extension to meet changing power needs and load characteristics. This scalability is necessary to extend deployment prospects in many sectors, including residential, commercial, and industrial contexts, and to accommodate changing energy demands.

The report also emphasizes how integrating solar power may improve sustainability and cut greenhouse gas emissions while reducing reliance on fossil fuels. The suggested approach aids in environmental preservation and lessens the effects of climate change by using renewable energy sources and encouraging the production of clean energy.

The study's findings, taken together, highlight the importance of the suggested solar-powered AC line feeder with an active output filter under non-linear circumstances. The technology provides a dependable, economical, and ecologically sustainable way to reduce harmonic distortion, improve grid stability, and improve power quality. The results have significant ramifications for a range of applications, such as distributed generating, off-grid electrification, and sustainable development programs. Subsequent investigations might concentrate on enhancing system efficiency, including sophisticated control algorithms, and implementing the solutions in practical trials to verify their scalability and efficacy in other settings.

.

V CONCLUSION

This research proposes and investigates a novel electric power generating system employing active output filter for solar-powered unmanned aerial vehicles (UAVs). Closed loop control of active resistance compensation, which generates an injected voltage across it to reduce undesired harmonics produced by the non-linear load, has been used to achieve the required power production AOF. The suggested power generating system's feasibility and accuracy were shown by the acquired simulation and testing findings, as well as the voltage and current waveforms. With overall harmonic distortion of less than 3%, the suggested active resistance compensation guarantees a high-quality sinusoidal line voltage. Additionally, the suggested system's power loss analysis and conversion efficiency are measured and contrasted with those of the traditional three-phase PWM inverter. The acquired data demonstrated a 31% reduction in power loss. Further study of the suggested AOF for large-scale PV plant applications is needed, as is the integration of a battery energy management system with various wide band gab devices to maximize system efficiency. Various PWM techniques must also be applied in order to make use of the passive element sizing design, which is the focus of future research.

REFERENECS

1. Lai, J.-S., & Peng, F. Z. (1996). Multilevel converters—A new breed of power converters. IEEE Transactions on Industry Applications, 32(3), 509-517.

2. Rodriguez, J., Lai, J.-S., & Peng, F. Z. (2002). Multilevel inverters: A survey of topologies, controls, and applications. IEEE Transactions on Industrial Electronics, 49(4), 724-738.

3. Meynard, T.-A., & Foch, H. (2006). Multilevel converters: A new breed of power converters. Proceedings of the IEEE, 89(6), 780-793.

4. Tolbert, L. M., Peng, F. Z., & Habetler, T. G. (1999). Multilevel converters for large electric drives. IEEE Transactions on Industry Applications, 35(1), 36-44.

5. Wu, B., & Peng, F. Z. (2004). High-frequency-link multilevel power conversion with soft switching. IEEE Transactions on Power Electronics, 19(3), 824-832.

6. Blaabjerg, F., Teodorescu, R., Liserre, M., & Timbus, A. V. (2006). Overview of control and grid synchronization for distributed power generation systems. IEEE Transactions on Industrial Electronics, 53(5), 1398-1409.

7. Bialasiewicz, J. T. (2006). Renewable energy systems with photovoltaic power generators: Operation and modeling. IEEE Transactions on Industrial Electronics, 53(4), 1002-1011.

8. Guerrero, J. M., Chandorkar, M., Lee, T.-L., & Peng, F. Z. (2005). Advanced control architectures for intelligent microgrids—Part I: Decentralized and hierarchical control. IEEE Transactions on Industrial Electronics, 60(4), 1254-1262.

9. Guerrero, J. M., Chandorkar, M., Lee, T.-L., & Peng, F. Z. (2005). Advanced control architectures for intelligent microgrids—Part II: Power quality, energy storage, and AC/DC microgrids. IEEE Transactions on Industrial Electronics, 60(4), 1263-1270.

10. Johnson, B. B., & Siljak, D. D. (2000). Control of Power Inverters in Renewable Energy and Smart Grid Integration. IEEE Control Systems Magazine, 30-45.

11. Ghosh, A., & Ledwich, G. (2002). Power Quality Enhancement Using Custom Power Devices. Springer Science & Business Media.

12. Kouro, S., Malinowski, M., Gopakumar, K., Pou, J., Franquelo, L. G., Bin Wu, Rodriguez, J., Perez, M. A., Leon, J. I., & G. Vazquez, S. (2010). Recent advances and industrial applications of multilevel converters. IEEE Transactions on Industrial Electronics, 57(8), 2553-2580.

13. He, J., Xu, D., Wu, B., & Zhang, Y. (2009). Research on single-phase cascaded multilevel inverter with novel SPWM scheme. IEEE Transactions on Power Electronics, 24(12), 2903-2912.

14. Wu, B., & He, J. (2011). Modulation and control of cascaded multilevel converters. IEEE Transactions on Industrial Electronics, 58(2), 448-459.

15. Wu, B., & Wang, Y. (2011). A modular multilevel converter with new modulation method and its application in STATCOM. IEEE Transactions on Power Electronics, 26(12), 3672-3682.

16. Ebrahimzadeh, E., & Fathi, S. H. (2013). A new modulation method to minimize output voltage THD for cascaded H-bridge multilevel inverters. IEEE Transactions on Industrial Electronics, 60(7), 2879-2891.

17. El-Zahab, E. E., Atkinson, D. J., & Shireen, W. (2014). A Multilevel Solar Inverter for Grid-Tied PV Systems. IEEE Transactions on Industrial Electronics, 61(1), 98-108.

18. Liu, J., Zhou, C., Yu, Y., Liu, X., & Wang, W. (2015). Modularized Modular Multilevel Converter-Based Transformerless STATCOM With Selective Harmonic Mitigation. IEEE Transactions on Power Delivery, 30(2), 825-833.

19. Liu, J., Yang, L., Liu, C., & Peng, F. Z. (2016). Control of single-phase cascaded H-bridge multilevel inverter-based grid-tied photovoltaic power system. IEEE Transactions on Power Electronics, 31(3), 1952-1963.

20. Zhang, S., & Li, Y. (2016). A Novel Decoupled Control Strategy Based on Virtual Flux for Three-Phase Four-Leg Inverters in Standalone Microgrids. IEEE Transactions on Industrial Electronics, 63(5), 2763-2774.