IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

GREY WOLF ALGORITHM FOR GRID TIED SOLAR POWER GENERATION WITH IMPROVED DYNAMICS AND POWER QUALITY

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Abstract : Grey wolf algorithm for grid tied solar power generation with improved dynamics and power quality is presented in the proposed work that aims to reduce the problems occurring in the long transmission line. The proposed system consists of the system that is placed between the source and load in the long transmission line. When the current is said to travel a long distance, there occurs some of the major problems like less real power, low maintenance of power factor, large amount of harmonics. In order to inject the real power here we are using the solar panel, DC to DC converter, inverter, filter and MPPT. The real power is injected to a filter which makes the entire system to act as a shunt active filter. By this the power factor of the system is increased. By the increased power factor we can achieve the large amount of efficiency. In the long transmission line the harmonics are integer multiples of the fundamental power frequency. The stress caused by the harmonics affect the electrical network and potentially damage equipment. By injecting the feedback to the inverter the switching angle can be corrected and the percentage level of the harmonics can be reduced to 3-4%. The another problem that occurs in the line is the instability of the power at the point of common coupling when there is sudden change in the load. This instability can be overcome by using the grey wolf optimization which reduces the instability of the power and tends to reach near the stability level even when there is a sudden change in the load. The proposed system the main problems are reduced that are occurring in long transmission line and the efficiency is increased.

IndexTerms **- Real power injection, Reduce harmonics, Grey wolf optimization, Power factor maintenance, Shunt active filter.**

INTRODUCTION

A grid-connected photovoltaic system, or grid connected PV system is an electricity generating solar PV power system that is connected to the utility grid. A grid connected PV system consists of solar panels, inverters, a power conditioning unit and grid connected equipment. Moreover, since there are no batteries, maintenance cost is kept at a minimum. Here the solar power generated will not be stable and it varies time to time. In order to make the power stable the solar panel is connected to the DC to DC converter which stables the power flow. The output power from the DC to DC converter will not be able to connect directly to the grid since we have AC grid. Hence the DC to DC converter is connected to the inverter which converts the DC power to AC. Though it is converted to AC power the output cannot be connected directly to the line. It is connected to the filter and power quality conditioner and then the entire output is connected to the line at the point of common coupling. Here there are certain technologies like MPPT, GWO and PWM are used. These control technologies are used to control the devices in the circuit, in order to make the work under a stable condition. In short the above proposed system is used to reduce the faults in the long transmission lines and improve the power factor, makes the line stable and the harmonics are also reduced.

EXIASTING SYSTEM

The existing system is based on the reference frame theory for the grid connected solar system. The grid connected PV system consisting of MPPT tracking, PV panels, resistance capacitance ripple filter, linear and non – linear loads. The performance of the PV system depends on the effective working of control algorithm and comprising of two integral controllers. The controllers calculate the solar PV current which generate the required pulses for those source converter. The star – delta transformer which is a compensation for the neutral current and solar grid system eliminates harmonics and zero voltage regulation.

There exists the large number of losses due to long transmission line. By using the Proportional – Integral (PI) controllers there occurs the drawbacks like low maintenance of the power factor and less reduction of the harmonics that are occurring in the long transmission line. By the less maintenance of the power factor the efficiency of the entire system is said to be reduced and it also reduces the life time of the system and also increases the operating cost of the system. By this system the harmonics cannot be reduced to a large amount which also leads to the large amount of line losses.

GRID TIED – SOLAR POWER GENERATION

When the power transfers from the power station to the consumer through the long transmission line there tend to arise a lot of problems. One of the problems that are arising in the long transmission line power transfer are very poor power factor maintenance. This poor power factor maintenance in the line leads to less efficiency. The other problems are the harmonics, more heat generation and more amount of loss of power that flows through the long transmission line. It can be reduced by the proposed system of optimized controller gains using grey wolf algorithm for grid tied solar power generation with improved dynamics and power quality.

Major components

- solar panel
- DC to DC converter
- inverter
- filter

Here the real power is generated by the solar panel, it is the source and the power generated by the solar panel will not be stable and it varies time to time. In order to make the power stable the output of solar panel is injected to DC to DC converter. A DC to DC converter is an electronic circuit or electromechanical device that converts a source of direct current from one voltage level to another. In this way the real power is injected to the circuit.

The DC power cannot be injected directly to the line hence it is AC. To convert the DC into AC, the output of the DC to DC converter is injected to the inverter which converts DC to AC. Hence to maintain the frequency, the output of the inverter is given to filter. An inverter accomplishes the DC to AC conversion by switching the direction of a DC input back and forth very rapidly. As a result, a DC input becomes an AC output.

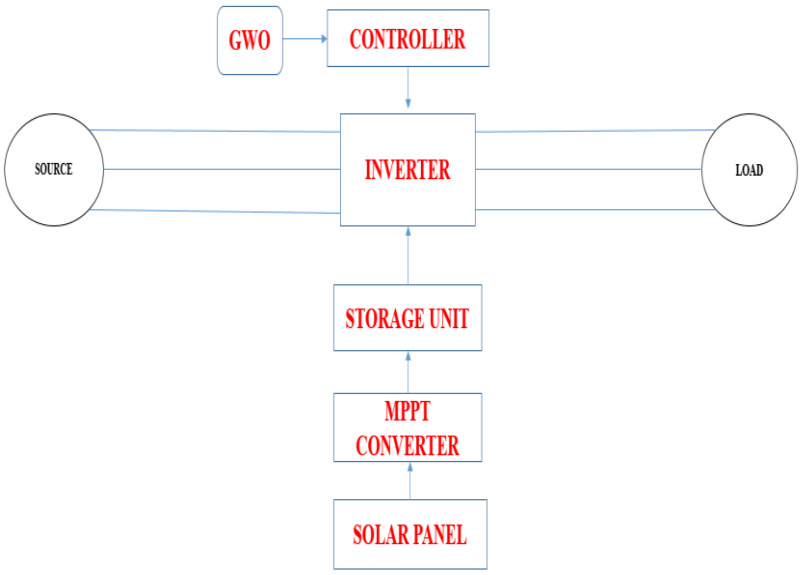

Fig 1. Block diagram for grid tied - solar power generation

In addition, filters and other electronics can be used to produce a voltage that varies as a clean, repeating sine wave that can be injected into the power grid. The sine wave is a shape or pattern the voltage makes over time and it's the pattern of power that the grid can use without damaging electrical equipment. In the filter the output frequency is maintained and the power factor is maintained. By the maintenance of the power factor the efficiency will be increased. By this increase in the power factor the total efficiency is also tend to increase. Fig 1 shows the Block diagram for grid tied - solar power generation.

In the long transmission line, during the power transmission there arises the harmonics which leads to the loss of power that is being transferred and increases the heat generation. It can overcome by taking the feedback from the load side and giving it to the inverter the level of the harmonics can be reduced to 3-4%. By the reduction of the harmonics the line losses can be reduced. In the proposed system we have made use of certain technologies which controls the working system they are as follows.

Technologies used:

- Grey Wolf Optimization(GWO)
- Maximum Power Point Tracker (MPPT)
- Pulse-Width Modulation(PWM)

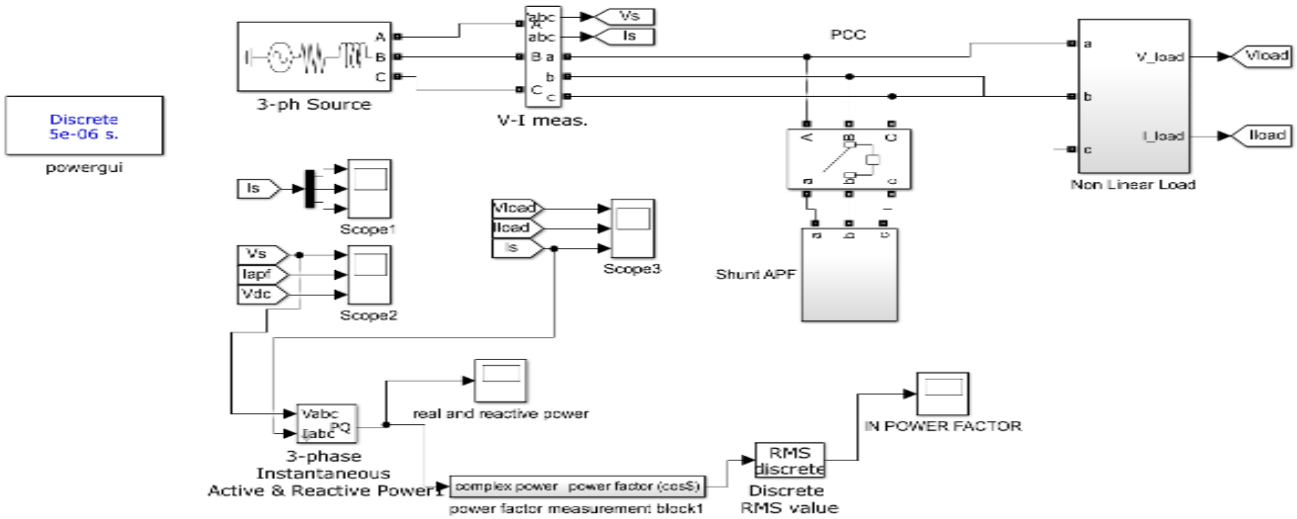

Fig 2. Simulation Block Diagram.

Grey wolf optimization algorithm (GWO) is a procedure which is executed iteratively by comparing various solutions till an optimum or a satisfactory solution is found. An MPPT is electronic tracking – usually digital. The charge controller looks at the output of the panels and compares it to the battery voltage. It then figures out what is the best power that the panel can put out to charge the battery. Pulse-Width Modulation (PWM) is a powerful technique for controlling analog circuits with a microcontroller's digital outputs. PWM is used in many applications ranging from communications to power control and conversion.

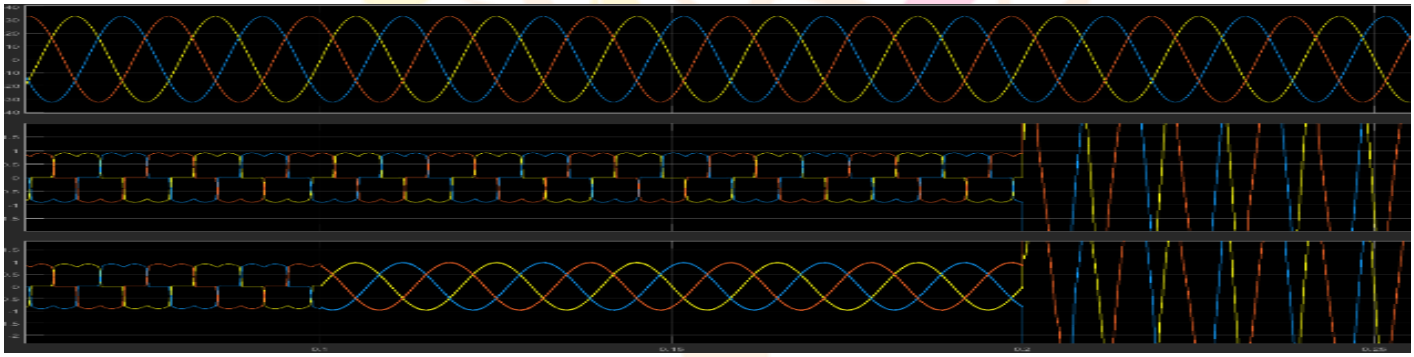

Fig 3. Simulation result

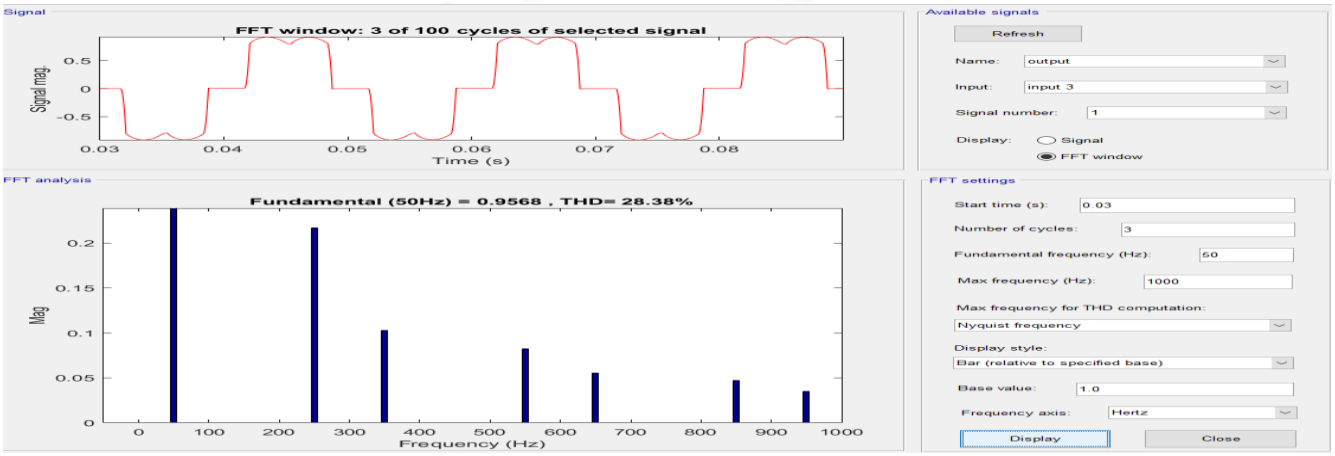

Fig 4.Simulation before compensation.

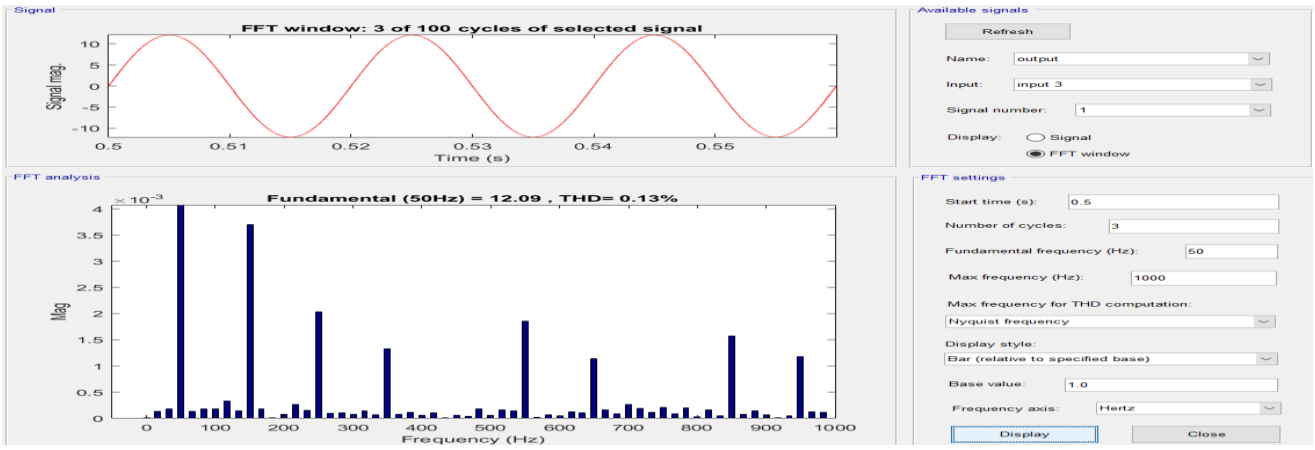

Fig 5. Simulation after compensation.

Benefits of grid tied – solar power generation

- It requires a low cost of equipment and installation
- Maintains power factor
- Less line loss
- Reduces harmonics
- Reduces heat production
- Maximum power can be transferred

CONCLUSION

The need of the integrating optimized controller gains using grey wolf algorithm for grid tied – solar power generation with improved dynamics and power quality in the power system is to reduce the problems that are occurring during the power transmission and make the system to deliver the maximum amount of power that is being transferred in the system.

References

[1] Veramalla Rajagopal, anthurthi Sharath, GundeboinaVishwas,ampanaBangarraju, Sabha Raj Arya and ChallaVenkatesh, "Optimized Controller Gains Using Grey Wolf Algorithm for Grid Tied Solar Power Generation with Improved Dynamics and Power Quality", Chinese Journal of Electrical Engineering, Vol.8, No.2, June 2022.

[2] KeGuo, Lichuang Cui, Mingxuan Mao, Lin Zhou and Qianjin Zhang, "An Improved Grey Wolf Optimizer MPPT Algorithm for PV system with BFBIC Converter under Partial Shading", Digital Object Identifier 10.1109/ACCESS.2017.Doi Number.

[3] Aftab Ahmed Almani, XueShan Han, FarhanaUmer, Rizwanul Hassan , Aamir Nawaz , Aamer Abbas Shah and Ehtasham Mustafa, "Optimal Solution for Frequency and Voltage Control of an Islanded Microgrid Using Square Root Grey Wolf Optimization", Electronics 2022, 11, 3644.

[4] Mohamed Abbas, Mohammed A. Alshehri and Abdulwasa Bakr Barnawi, "Potential Contribution of the Grey Wolf Optimization Algorithm in Reducing Active Power Losses in Electrical Power Systems", Appl. Sci. 2022, 12, 6177.

[5] Manoj Gupta and Pankaj Gakhar," Power Quality Improvement in a Grid Coupled Solar PV System using Grey Wolf Optimization", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-10, August 2019.

[6] SasmitaPadhy and Sidhartha Panda, "Application of a simplified Grey Wolf optimization technique for adaptive fuzzy PID controller design for frequency regulation of a distributed power generation system", Protection and Control of Modern Power Systems.

[7] B. Srikanth Goud, Ch. Rami Reddy , Ch. Naga Sai kalyan, Ramanjaneya Reddy Udumula, Mohit Bajaj, Bdereddin Abdul Samad, Mokhtar Shouran and Salah Kamel," PV/WT Integrated System Using the Grey Wolf Optimization Technique for Power Quality Improvement", Frontiers in Energy Research, 2 August 2022,Volume 10, Article 957971

[8] Prasad Kumar BandahalliMallappa, Herminio Martinez Garcia and Guillermo Velasco Quesada, "Power Quality Enhancement in a Grid-Integrated Photovoltaic System Using Hybrid Techniques", Appl. Sci. 2021, 11, 10120.

[9] Habib Kraiem, FlahAymen, LobnaYahya, Alicia Triviño, MoslehAlharthi and Sherif S. M. Ghoneim, "A Comparison between Particle Swarm and Grey Wolf Optimization Algorithms for Improving the Battery Autonomy in a Photovoltaic System", Appl. Sci. 2021, 11, 7732.

[10] Isaac Ebi, Zulkifli Othman and ShahrilIrwanSulaiman, "Optimal design of grid-connected photovoltaic system using grey wolf optimization", Published by Elsevier Ltd.

[11] DipanwitaDebnath, Nirmala Soren, Arun Dev Pandey and Noman HanifBarbhuiya, "Improved Grey Wolf assists MPPT Approach for Solar Photovoltaic System under Partially Shaded and Gradually Atmospheric Changing Condition", Debnath D., et al. / International Energy Journal 20 (2020) 87 – 100.

[12] Ali Arzani1, Student Member, ParanietharanArunagirinathan and Ganesh Kumar Venayagamoorthy, "Development of Optimal PI Controllers for a Grid-Tied Photovoltaic Inverter", 2015 IEEE Symposium Series on Computational Intelligence.

[13] Srishail K. Bilgundi, R. Sachin, H. Pradeepa, H. B. Nagesh and M. V. Likith Kumar," Grid power quality enhancement using an ANFIS optimized PI controller for DG", Bilgundi et al. Protection and Control of Modern Power Systems (2022) 7:3.

[14] RoshdyAbdelrassoul, Yosra Ali and Mohamed SaadZaghloul, "Genetic Algorithm-Optimized PID Controller for better Performance of PV System", Communications on Applied Electronics (CAE) – ISSN : 2394-4714 Foundation of Computer Science FCS, New York, USA Volume 5 – No.9, September 2016.

[15] Mohamed Iqbal M, AltafBadar, Pavithra C.V, Nithiyananthan K and Mohamed Yousuff, "Fuzzy gain Scheduled PID Controller for Power Quality Enhancement in Grid Connected Hybrid Solar PV-PEMFC Energy System", Journal of Engg. Research Online First Article.

[16] Alejandro Nieto, Vasiliki Vitaand Theodoros I. Maris, "Power Quality Improvement in Power Grids with the Integration of Energy Storage Systems", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 5 Issue 07, July-2016.

[17] Narendra Kumar YadavandMeghana N, "Power Quality Improvement In Microgrid Using Different Control Techniques", International Journal of Creative Research Thoughts (IJCRT), © 2018 IJCRT Volume 6, Issue 2 April 2018, ISSN: 2320-2882.

[18] SalihaBoutora, DhiaElhakMessaoud and Hamid Bentarzi, "Power Quality Improvement in Grid-Tied PV System", Proceedings of ICCESEN-2018.

[19] C.Sowmya, N.Mohananthini, S. Saravanan and A. Senthilkumar, "Using artificial intelligence inverter power control which is based on DC link voltage regulation for IPMSM drives with electrolytic capacitor", AIP conference Proceedings, 2020, pp. 050001-1050001-9.

[20] K. Manikanth, P. Manikandan, V. Dhinesh, N. Mohananthini, S. Saravanan, "Optimal Scheduling of Solar Wind Bio-Mass Systems and Evaluating the Demand Response Impacts on Effective Load Carrying Capability", International Research Journal of Engineering and Technology, Volume: 07 Issue: 02, 2020, pp.1361-1365

[21] G. Poovarasan, S. Susikumar, S. Naveen, N. Mohananthini and S. Saravanan, "Study of Poultry Fodder Passing Through Trolley in Feeder Box", International Journal of Engineering Technology Research & Management, Vol 04, Issue 01, ISSN: 2456-9348, 2020, pp.76-83.