China Petroleum Processing and Petrochemical Technology

Catalyst Research Volume 23, Issue 2, November 2023 Pp. 5031-5044

IMPROVED POWER QUALITY OF GRID-INTEGRATED PHOTOVOLTAIC (PV) SYSTEM USING OPTIMIZATION : A REVIEW

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Abstract

This review examines the use of Distribution Static Synchronous Compensator (DSTATCOM) and optimization methods to increase power quality in grid-connected photovoltaic systems. DSTATCOM compensates for reactive power, regulates voltage, and suppresses harmonic distortions, enhancing overall performance. The review analyzes to highlight its efficacy in addressing voltage fluctuations and power factor deviations and explores the use of optimization techniques like particle swarm optimization, genetic algorithms, and artificial neural networks in enhancing power quality in grid-integrated PV systems. It highlights the potential of these techniques in minimizing losses, optimizing energy utilization, and ensuring reliable power supply. The review also highlights the need for further research to address evolving grid dynamics and emerging technologies, and the integration of energy storage systems and smart grid concepts.

Keywords: PV system, MPPT, DSTATCOM, optimization.

1. Introduction

As the globe moves toward more sustainable and renewable energy sources, photovoltaic systems integration into the electrical grid is becoming more and more common. While there are many environmental advantages to using solar electricity, there are drawbacks as well, including problems with power quality during grid operations. Variations in voltage, variances in power factor, and harmonic distortions can result from the intermittent nature of solar energy output and variations in sunshine intensity. It is essential to address these power quality issues if grid-connected PV systems are to integrate effortlessly and operate dependably. Deploying a Distribution Static Synchronous Compensator, a flexible power electronic device that can mitigate harmonics, adjust voltage, and compensate reactive power, is one viable approach. The potential for improving overall grid stability and the quality of power delivered is present when DSTATCOM and PV systems work together in harmony. The goal of this study is to present a thorough analysis of the status of research and advancements in the field of grid-connected photovoltaic systems power quality enhancement. The importance of DSTATCOM as a major mitigating factor and the use of optimization techniques to increase its effectiveness are given special attention. The purpose of this study is to offer a comprehensive knowledge of the gains gained, obstacles faced, and potential future directions in the pursuit of optimal power quality in grid-integrated PV systems by combining data from numerous research and experimental setups. The investigation of optimization methods in conjunction with DSTATCOM demonstrates the possibility of reaching economical and successful resolutions, advancing the development of a more robust and sustainable energy infrastructure

2.Review of Literature

Malan, et al. (2011) System design and engineering involve optimizing cost, schedule, performance, and risk based on stakeholders' perceived value. These objectives often conflict, and improvement in one can compromise others. Project managers handle cost and schedule, while system engineering handles performance, cost, and risk.

Kothari, (2012) one problem with dynamic programming is the dimensionality curse. Numerous well-known methods have been developed in the last ten years to deal with these issues, including genetic algorithms, neural networks, swarm optimization, differential evolution, hierarchical numerical methods, tabu search, evolutionary programming, and hybrid search techniques. Figure 2: shows the categorization of optimization methods

Zellagui et al (2021) this article uses an arithmetic optimization algorithm to demonstrate the optimal technique for installing a DSTATCOM in an EDS. To get the best DSTATCOM unit sizing, the study presents the Arithmetic Optimization Algorithm. The approach improves the Voltage Stability Index (VSI), Fast Voltage Stability Index (FVSI), and Power-Voltage Stability Index (PVSI) while minimizing APL. The method demonstrates efficiency and excellence in attaining the lowest power losses, voltage profiles, and stability when experienced on two IEEE distribution systems. This method works well and is dependable; it enables hybrid DSTATCOM allocation and multi-objective problem solutions. To reduce Active Power failure and enhance voltage stability index in Electrical Distribution Systems, the study suggests an Arithmetic Optimization Algorithm (AOA) for the best placement of DSTATCOM. The technique is evaluated on IEEE 33 and 69 bus Electrical Distribution Systems (EDS) and the simulation outcome illustrates that installing DSTATCOM optimally improves voltage profiles and drastically lowers power losses**.** Also presents the idea of Flexible Alternating Current Transmission Systems and how power electronic devices may be used to improve power system controllability. The best way to install DSTATCOM units in Electrical Distribution Systems is discussed in the study using the Arithmetic Optimization Algorithm (AOA).To obtain an appropriate voltage stability margin; it emphasizes the significance of power systems voltage stability and the necessity of reactive power resource scheduling done correctly. The paper mentions previous research that has addressed the best portion of DSTATCOM in distribution systems using different optimization algorithms**.**

Isha et al. (2021) Researchers have proposed the Fuzzy Lighting Search Algorithm to reduce radial distribution power loss networks by optimizing the assignment of DSTATCOM and PV array units. The method produced enhanced voltage shape values, decreased power failure, and lessened stability issues. The outcomes confirmed FLSA's advantage over alternative optimization methods. The proposed FLSA optimizes the PV array and DSTATCOM configuration in a radial distribution system to boost stability, enhance voltage profile, and lower power loss. The efficacy of the process was confirmed using the Newton Raphson power flow analysis and the IEEE-30 bus test scheme. To decrease power failure in a distribution system, the study suggests using the Fuzzy-Lightning Search Algorithm to optimize the arrangement of DSTATCOM and photovoltaic array units.

Oda et al. (2021) Proposed Using a multi-objective function for voltage profile, stability index improvement, and price decrease, the research suggests an optimum planning model for integrating Photovoltaic Distributed Generation (PV-DG) with DSTATCOM, taking uncertainties in solar irradiance and load demand into consideration Planning for integration of photovoltaic distributed generation as optimally as possible Because of the erratic variations in load demand and PV production power, it is imperative to design the integration of Photovoltaic Distributed Generation and DSTATCOM as best as possible which, in turn, are connected to changes in solar irradiance and client activity. The PV-DG and DSTATCOM system's optimum planning challenge is resolved in this article. The suggested model takes into description the uncertainties associated with solar irradiation and load require for a multi-objective task that includes price savings, an improved stability index, and a voltage profile. It is suggested to use two ways to improve the basic ALO searching skill with the Modified Ant Lion Optimizer. Levy Flight Distribution is the foundation of the first approach, which aims to fortify algorithm exploration and prevent the fundamental ALO from being used too soon. On the other hand, the second approach focuses on optimizing the algorithm's exploitation by modifying the answers in a spiral manner. The efficiency of the suggested approach is demonstrated using the IEEE 118 bus and 69 bus radial distribution systems, and the resulting simulations are contrasted by means of the fundamental ALO and other recognized optimization methods for power loss reduction under deterministic circumstances. The outcomes of the simulation show that the appropriate integration of two PV-DGs and DSTATCOMs might result in much higher techno-economic advantages as compared to a single system.

Chanakya et al. (2022) Uses a Active and reactive power control, as well as bidirectional power flow, is managed via the AC bus. For two-level voltage source converters, an incremental least mean square with configurable step size is employed in zero voltage regulation modes. The HESS current control method controls the flow of electricity from the DC bus to the grid. The PV-HESS system uses CGWO-tuned VSS-ILMS manage to filter out active load current constituents and reduce DC offset. Simulation results verify stable operation according to IEEE519 standards.

Amin et al. (2022) Researchers have proposed, because solar photovoltaic-based distributed generators (RDGs) are sustainable and clean, their use is growing in popularity. Nonetheless, it might be difficult to decide which locations and ratings for these generators are best. By using Gorilla Troop's optimizer (GTO) to optimize PV-DG allocation and reactive power injection, this article seeks to overcome this. According to the study, incorporating PV-DGs with DSTATCOM capabilities improved overall voltage stability by 25.43% over the basic scenario and greatly decreased overall system cost and voltage deviations.

Shaheen et al. (2023) Hunter-prey optimization is presented in this paper as a useful technique for power distribution systems' effective PV-STATCOM device allocation. The HPO simulates how animals would behave when hunting to decrease electrical power losses and improve voltage profiles while considering fluctuating 24-hour loadings. Tested on IEEE 33-node and 69-node networks, the suggested HPO significantly reduces voltage fluctuations and energy losses. Throughout the day, the HPO is very reliable and maintains a voltage profile that is higher than the 95% minimum required.

Monica et al. (2023) the improvement of electrical power utilization and conservation in many applications is the main goal of this study. To improve power quality, it presents the SPV-DSTATCOM, a distributed static synchronous compensator based on solar and photovoltaic technology. An MPPT controller and P&O are combined to create a hybrid controller. By using a DC-DC boost converter, DSTATCOM and SPV are integrated. The voltage and current levels are managed with a monarch butterfly optimization algorithm based on greedy control. The use of a self-adaptive crossover operator lowers overall harmonic distortion.

Rastogi et al. (2023) this paper details the integration of a distribution static synchronous compensator, based on a two-level, three-phase, reduced-switch voltage source converter, with a grid-tied solar photovoltaic array. It is recommended to implement a flexible control strategy that can maintain grid current at unity power factor while adhering to the maximum power point. The modified Synchronous Reference Frame theory-based current management solution is utilized to maintain DC-link voltage and voltage balancing across split capacitors. The system is evaluated using a digital real-time simulator once it has been replicated in MATLAB/Simulink.

Jawad et al. (2021) the use of non-linear loads has increased in recent years, causing harmonic non-sinusoidal currents and voltages to affect electricity infrastructure and client equipment. This has led to the development of Active Power Filters (APFs) as a solution for mitigating harmonics and reactive electrical strength compensation in AC networks by non-linear loads. This study is useful for the Ant Colony Algorithm to decrease Total Harmonic Distortion.

Hassan et al. (2023) to increase the efficiency of solar PV arrays, a novel hybrid MPPT move based on fractional open circuit voltage and genetic algorithms is suggested. The method is evaluated in both uniform and non-uniform irradiance scenarios, and it decreases complexity and convergence time. Results indicate a 3% increase in efficiency over traditional FOCV, with an average tracking speed of 0.07s and efficiency of 99.96%.

Teferra et al. (2023) suggest the Resources for wind and solar energy are plentiful sources in micro grid systems, but their uncertain nature can cause power quality and stability issues. Fuzzy-based models can manage this, but have limitations Performance is enhanced via a hybrid fuzzy-PSO intelligent prediction strategy that adds an error correction factor as a new fuzzy input variable. This model increases the forecasting accuracy of solar and wind PV electricity using MATLAB programming and the global optimization toolkit. The correctness of the hybrid fuzzy-PSO model is more advanced than that of the fuzzy and fuzzy-GA models.

Salem et al. (2022) suggest the Solar photovoltaic (PV) is increasingly being used as a renewable energy source to meet global energy demands and decarbonizes electricity production. However, power quality disturbances from PV grid-connected systems can hinder clean power supply. The study examines the system's design, THD problems, and connected meter disturbances, and discusses four techniques for harmonic mitigation.

Shezan et al. (2023) present the Energy consumption is increasing rapidly, making traditional power resources insufficient. Islanded hybrid micro grid systems (IHMS) combine sustainable sources like wind turbines and solar photovoltaic (PV) to meet growing energy demands. However, these sources face technological challenges because of their random characteristics. This article discusses challenges in integrating solar and wind power into existing systems, including variations in frequency, voltage swings, and unreliable solar and wind radiation. It also discusses control strategies to enhance IHMS integration and recent platforms used in IHMS.

Saha et al. (2021) Present the increasing energy demand necessitates innovative solutions to conserve energy. Eco-friendly systems are proposed to save electricity investment and maximize return on investment in solar modules. The photovoltaic industry is efficient and competitive, but challenges like unstable irradiation and panel temperature make electricity generation unstable. MPPT methods are in use to maximize the energy output of PV modules, with perturb & observe, Particle swarm 0ptimization, and Grey Wolf optimization methods tested in MATLAB/Simulink environments.

Yaghoubi et al. (2022) Studied the modified SALP swarm optimization (MSSA) is an effective metaheuristic method for determining PV model parameters that are presented in this study. The updated method increases exploration potential and avoids premature convergence by updating leaders and followers based on new formulae. Detecting different PV model features more effectively than rivals and maybe leading to more optimum solutions is what the MSSA is good at.

Veeraganti et al. (2021) this paper discusses the placement of DSTATCOM in a distribution network system under various conditions. A D-FACTS device called DSTATCOM is utilized for voltage profile enhancement, power loss reduction, and reactive power correction. The optimal placement of DSTATCOM is crucial for ensuring sufficient investment and enhancing voltage stability, power loss decrease, and power factor development. The paper provides a review of various techniques and classifications for determining DSTATCOM placement in distribution networks.

Tarraq et al. (2021) this paper reviews meta-heuristic optimization methods for integrating renewable distributed generation into the electricity grid. It aims to understand current trends and address research gaps in optimal RDG allocation planning while proposing recommendations to expand the field's scope.

Gade et al. (2021) Power quality concerns are a major concern for the electrical power industry, especially in light of dispersed generation and industrial automation. This essay examines the use of the Unified Power Quality Conditioner (UPQC) in distribution networks. UPQC helps integrate renewable energy systems, rectify power factors, and resolve PQ concerns relating to voltage and current.

Akkewar et al. (2021) Studied the Hybrid renewable energy sources have inconsistent output capabilities, requiring a combination of sources for real-time usage. Researchers propose various models for designing hybrid systems, each with its advantages and limitations. This makes it difficult for engineers to choose the best control strategy for their deployment. This text reviews optimum control strategies and compares them based on parameters like accuracy and response time. It helps system designers select the most efficient control models and recommends methods to improve their efficiency for real-time deployments.

Tabe 1. Power quality improvement models of PV (Solar) systems connected to the grid

Objective Function	**System Condition**	**Load Type**	**Methodology Used**
Enhancement of Power Quality Total Harmonic Distortion is reduced.	Grid-Linked Photovoltaic System Utilizing	Nonlinear load	Using PWM Inverter, MATLAB/SIMULINK The impact of a high-penetration photovoltaic system on total harmonic distortion is proposed and analyzed using software.
Voltage Regulation	PV System interfaced Grid	Nonlinear load	PV system with MPPT control and a current-controlled inverter
Taking the maximum out. Energy derived from the cell.	PV in the Distribution network	Nonlinear load	P & O (Perturb and observe) based MPPT PV System.
Taking the maximum out. Energy derived from the cell.	PV in the Distribution network	Nonlinear load	Incremental conductance-based MPPT PV System.
Extracting the max. power from the cell.	PV in the Distribution network	Nonlinear load	Fractional open circuit voltage method based MPPT PV System.
Balances the unbalanced current	Grid-connected PV System	imbalance in the local load's current	Enhancement of Power Quality through Boost Dual-Level Four-Leg Inverter (Multilevel))
total harmonic distortion reduction	Independent Photovoltaic Systems	Nonlinear load	LC, LCL, and LLCC filter are examples of passive filters that are used.
Voltage Regulation	PV System interfaced Grid	Non-linear load	An MPC-based controller is meant to be the coordinator between BESS and a collection of controllers.
The optimal power flow problem was solved (using FACTS devices)	PV System connected with grid	Non-linear load	computational technique as well as traditional techniques like the firefly algorithm, fuzzy genetic algorithm (GA), differential

			evolution, gravitational search algorithm, particle swarm optimization (PSO), bacterial forging algorithm, sparse optimization,and self-adaptive forging algorithm.
Voltage regulation	PV System connected with grid	Sensitive load	PWM-powered dynamic voltage restorer (DVR) linked to an MPPT solar PV system with an incremental conductance algorithm (INC)
Voltage Profile	PV solar system coupled with a weak utility grid after a fault	Varying load	Battery energy storage and STATCOM at the point of common coupling (PCC)
Voltage Profile	PV solar system coupled with a weak utility grid after a fault.	Varying load	DSTATCOM control method used.
THE	Multiple PV Systems Connected Grid	Non-linear load	Unified Power Quality Control (UPQC)
Reactive power, harmonics	PV System connected to Grid	unbalanced and non-linear loads	DSTATCOM based on Reduced Switch Count Multi Level Inverter.
Harmonics, Load balance, power factor	PV system with grid integration	Differential and Linear Loads	Adaptive noise reduction controls a multifunctional VSC that interfaces a two- to three-phase solar PV grid.
Power Quality and Analysis of Performance (Limitation of harmonic distortion)	Grid-Linked Photovoltaic System Utilizing	Current Requirements for Grid Integration	Using ETAP software

Table 2. Methodologies with Advantages and Disadvantages

Year	Findings	Methodology used	Advantages	Disadvantages
[2019]	Reduction of THD	By PWM Inverter using	Easy to implement, low	Possesses a limited life. To get an

		MATLAB/SIMULINK software. (MOSFET is used for PWM)	power dissipates; it can use very high frequency.	accurate measurement, repeated calibration was required.
[2019]	Maximize the PV cell's power output.	The P&O method, the hill climbing algorithm, the incremental conductance method, the short circuit current method, and the open circuit voltage method are examples of MPPT-controlled techniques.	Advantages of P & O method- simplicity, accurate, efficient, rapid response.	Disadvantages of another method over P&O method efficiency and accuracy. Temperature and solar radiation effects have not been taken into account, making the H/W complex and additional
[2019]	Makes up for imbalanced current	Enhancement of Power Quality Through Multilevel Inverter	As the quantity of levels rises, the output voltage and power decrease and the harmonic content increases.	Lower-order harmonics cannot be effectively eliminated without complex design and switching control circuits.
[2016]	Reduction of THD	Used L, LC, LCL, filter topologies	Profit of Inactive Filters Stability assured. No power source is required. Less costly. Higher occurrence rate. Simple to create.	They occasionally have problems responding. They're big in stature. Inductors always yield a bulky gain of 1 or less.
[2016]	Minimize the harmonics	Single-tuned, Double tuned, and high-pass harmonic filters are used	good performance to correct the power factor and compensate harmonic distortions	They're big in stature. The gain is consistently 1 or less. Hefty when combined with inductors.
[2017]	Minimize the harmonics	The DC-to-DC converter with PI	Any harmonics can be eliminated	It costs a lot. It offers a sophisticated

		controller and the Shunt Active Power Filter with fuzzy logic controller.	by it. It offers dependable operation and is used for reactive power compensation and voltage regulation.	control mechanism, It is only appropriate to use the active filter on low or moderate frequencies.
[2019]	Minimize the harmonics	With PID with Buck-boost converter	Effective. It adjusts voltage in steps of one or two. A lower operating duty cycle is provided. In comparison to most converters, its cost is lower.	It is impossible to obtain a high gain, and there is no isolation between the input and output sides.
[2019]	Minimize the harmonics	With fuzzy logic-based control strategy	Incredibly simple and clear. The majority efficient way to handle difficult problems. It is simple to modify the system to change or enhance its performance.	They rely entirely on the knowledge and experience of humans. Update the rules of a fuzzy logic control system regularly. These systems do not support machine learning or neural networks.
[2020]	Minimize the harmonics	Using the Adaptive Neural Fuzzy Inference System and neural networks	Detects process nonlinearity; Adapts automatically; Learns quickly; Has a high degree of generalization	Choosing the kind and quantity of membership features, Where a membership function is located
[2022]	Improve Voltage Profile	*STATCOM *SVC *DVR *UPFC	Small, compact, no harmonic pollution, high response speed.	The primary drawback of FACTS devices is their high cost of the procedure,

	(Using FACTS Devices)	*DSTATCOM.	(Main function of power flow control, and improve Power system constancy)	which makes it difficult to respond quickly and smoothly to the secure power system during normal and steady-state operations.
[2023]	Optimal Power Flow Problem	Particle swarm optimization, genetic algorithms, gravitational search algorithms, Differential Evolution, Sparse Optimization, Firefly algorithm, Bacterial forging Algorithm Crow search Algorithm. etc	(Maximize voltage profile to be tested with IEEE 30 and 57 buses and minimize power losses to improve power flow. more efficient, more clarity, It becomes easier to improve and grow.	Generally speaking, it is harder to debug the Optimization solution than the Rule-based Simulation. Requires large memory to calculate the gradient on the whole dataset.

Table 3: Taxonomy of the Reviewed Optimization Works

Method used	**Data used**	**Practical implication**	**Results**
Arithmetic Optimization Algorithm (AOA)	Data from IEEE 33- and 69-bus	(DSTATCOM Units in (EDS).	Reduction in active power losses
Fuzzy-Lightning Search Algorithm (FLSA)	IEEE 30-bus system	DSTATCOM) and photo voltaic	Reduce the radial distribution network's power loss
Modified Ant Lion Optimizer (MALO) and Levy Flight Distribution (LFD)	IEEE radial distribution of 69 and 118 bus schemes.	DSTATCOM and Photovoltaic Distributed Generation (PV-DG)	Power loss minimization under deterministic conditions
PV-HESS scheme uses CGWO-tuned VSS-ILMS manage	IEEE519 standards.	Two-level voltage source converters	Control to remove the DC offset and filter out the

Catalyst Research Volume 23, Issue 2, November 2023 Pp. 5031-5044

			components of the active load current.
Gorilla troop's optimizer (GTO)	Distributed solar photovoltaic generators	Optimize the allotment of PV-DGs and they're injected reactive power	Enhancing total voltage stability
Hunter-prey optimization (HPO)	IEEE 33-node and 69-node networks	PV-STATCOM device	Energy losses and voltage variations reductions.
A greedy control-based monarch butterfly optimization	MPPT (P&O) DSTATCOM.	SPV with DSTATCOM	Reduce total harmonic distortion
Reduced-switch, two-level, three-phase VSC based	The modified Synchronous Reference Frame theory-based	(DSTATCOM) combined with a solar photovoltaic.	To keep voltage balance and DC-link voltage stable
Hunter-prey optimization (HPO)	IEEE 33-node and 69-node networks	PV-STATCOM	Energy losses and voltage variations reductions
Ant Colony Algorithm	AC networks with non-linear loads	Active Power Filters (APFs)	Reduce Total Harmonic Distortion (THD)
Genetic Algorithm and Fractional Open Circuit Voltage.	Tested under both consistent and inconsistent lighting situations	Solar PV arrays and a new hybrid MPPT technique	The technique reduces complexity and convergence time,
Hybrid Fuzzy-PSO intelligent prediction approach	In micro grid systems	MATLAB programming and the global optimization toolbox	To improve the accuracy of solar PV power forecasting models

techniques for harmonic mitigation	PV grid-connected systems can hinder clean	MATLAB programming	For harmonic mitigation
Different control strategies	Integrating solar power	Hybrid micro grid systems	To enhance IHMS integration (Islanded hybrid micro grid systems)
Particle swarm 0ptimization, and Grey Wolf optimization methods	Solar modules	(MPPT) techniques, with perturb & observe	Extract maximum power from PV modules
Modified salp swarm optimization (MSSA).	PV model parameters	Efficient metaheuristic approach	Better optimal solutions
FACTS device	Distribution networks	DSTATCOM	Voltage profile improvement
Meta-heuristic optimization	Electricity grid	Distributed generation into the electricity grid	Development of power quality
Unified Power Quality Conditioner (UPQC)	Distribution systems.	integrate renewable energy systems	Correct power factors
Optimum control strategies	Hybrid renewable energy	Designing hybrid systems	Improve their efficiency for real-time deployments

3. Conclusion

This review discusses the use of DSTATCOM and optimization methods to enhance the excellence of energy in PV system grid integration. DSTATCOM reduces power quality issues like harmonics, swell, and voltage sag, ensuring grid stability and improving voltage management, power losses, and reliability. The paper discusses the importance of optimization techniques in optimizing DSTATCOM's performance in PV systems. It suggests that heuristic approaches, artificial intelligence, and mathematical algorithms can be used to find optimal parameter values, ensuring accurate compensation in dynamic conditions. This approach can mitigate power quality concerns and improve the efficiency of PV integration.

References

[1]. Ahmed, et al."Techno-Economic Evaluation of Optimal Integration of PV Based DG with DSTATCOM Functionality with Solar Irradiance and Loading Variations." *Mathematics 10.14 :* 2543. (2022).

[2]. Akkewar, Amit Nanaji. "Statistical analysis of hybrid renewable energy systems by using artificial intelligence." *Journal of Next Generation Technology* (ISSN: 2583-021X) 1.2. (2021).

[3]. Chanakya, Mukul, et al Stability analysis of chaotic grey-wolf optimized grid-tied PV-hybrid storage system during dynamic conditions." *Electronics 11.4* : 567(2022).

[4]. Gade, Swati, Rahul Agrawal, and Ravindra Munje. "Recent trends in power quality improvement: Review of the unified power quality conditioner." *ECTI Transactions on Electrical Engineering, Electronics, and Communications 19.3* : 268-288(2021).

[5]. Hassan A. Bass O., Masoum A.S.M.,. "An improved genetic algorithm based fractional open circuit voltage MPPT for solar PV systems", *Energy Reports*, journal homepage: www.elsevier.com/locate/egyr, Energy Reports 9, 1535–1548. (2023)

[6]. Isha, G., and P. Jagatheeswari"Optimal allocation of DSTATCOM and PV array in distribution system employing fuzzy-lightning search algorithm." *Automatika 62.3-4*: 339-352. .(2021).

[7]. Jawad R., Jawad R., Salman Z., "Ant Colony Algorithm (ACO) Applied for Tuning PI of Shunt Active Power Filter (SAPF)", Iraqi Journal for Electrical and Electronic Engineering, no. 2**.** (2021).

[8]. Kothari, D.P.. Power system optimization. *2nd National Conference on Computational Intelligence and Signal Processing (CISP)*, 18. (2012)

[9]. Malan, c & pretorius, leonMethods and metrics for the design of value-robust systems. ISEM 2011 proceedings, September 21-23, stellenbosch, South Africa , ISEM. . (2011).

[10]. Monica, Swetha, Alok Kumar Singh, and D. Vijaya Kumar.. "Design and implementation of GCMBO control strategy for grid integrated SPV-DSTATCOM." e-Prime-Advances in Electrical Engineering, Electronics, and Energy 6 : 100356 (2023)

[11]. Oda, Eyad S., et al."Stochastic optimal planning of distribution system considering integrated photovoltaic-based DG and DSTATCOM under uncertainties of loads and solar irradiance." IEEE Access 9: 26541-26555.(2021)

[12]. Rastogi, Meenakshi, Aijaz Ahmad, and Abdul Hamid Bhat. "Performance investigation of two-level reduced-switch D-STATCOM in grid-tied solar-PV array with stepped P&O MPPT algorithm and modified SRF strategy." Journal of King Saud University-Engineering Sciences 35.6 393-4(2023).

[13]. Saha B.C., Panday R.S., Awasthi S.R., "Optimization-based optimal control of solar PV system", Proceedings of the Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks ICICV. IEEE Xplore Part Number: CFP21ONG-ART; 978-0-7381-1183-4. (2021).

[14]. Salem W.A.A., Ibrahim W.G., Abdelsadek A.M., Nafeh A. A., "Grid-connected photovoltaic system impression on power quality of low voltage distribution system", Cogent Engineering, Cogent Engineering, (2022).

[15]. Shaheen, Abdullah M., et al. "Optimal Allocation of PV-STATCOM Devices in Distribution for Energy Losses Minimization and Voltage Profile Improvement via Hunter-Prey-Based Algorithm." Energies 16.6 : 2790(2023).

[16]. Shaheen, Abdullah M., et al. "Optimal Allocation of PV-STATCOM Devices in Distribution Systems for Energy Losses Minimization and Voltage Profile Improvement via Hunter-Prey-Based Algorithm." Energies 16.6;2790. (2023).

[17]. Shezan S.A., Kamwa I., Ishraque M.F., Muyeen S.M., Hasan K.N., Saidur R., Rizvi S.M., Shafiullah M., Al-Sulaiman F.A.,.“Evaluation of Different Optimization Techniques and Control Strategies of Hybrid Microgrid: A Review”. Energies 16, 1792. Https:/ doi.org/10.3390/en16041792. **(**2023)

[18]. Tarraq, Ali, et al. "Meta-heuristic optimization methods applied to renewable distributed generation planning: A review." E3S Web of Conferences. Vol. 234. EDP Sciences, (2021).

[19]. Teferra D.M., Ngoo L.M.H., Nyakoe G.N., “Fuzzy-based prediction of solar PV and wind power generation for microgrid modeling using particle swarm optimization”, journal homepage: www.cell.com/heliyon, https://doi.org/10.1016/j.heliyon..e12802. (2023).

[20]. Veeraganti, Suma Deepthi, Ramchandra Nittala, and K. Anitha Reddy. "an optimal location of dstatcom in a distribution system using various techniques." international bilingual peer-reviewed refereed research 7.27(2021).

[21]. Yaghoubi M., Eslami M., Noroozi M., Mohammadi H., kamari O., Palani S., “Modified SALP Swarm Optimization for Parameter Estimation of Solar PV Models”, Digital Object Identifier 10.1109/ACCESS..3213746,IEEE access. (2022).

[22]. Zellagui, Mohamed, et al.."Arithmetic optimization algorithm for optimal installation of DSTATCOM into distribution system based on various voltage stability indices.", 9th International Conference on Modern Power Systems (MPS). IEEE. (2021)