

**KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE**

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కాకతీయ ప్రేక్షాగికి ఎవ్ విజ్ఞాన సంస్థాన, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారత్

కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము

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Message by HoD



With great pleasure and honour I write this foreword. Indeed, this **Technical Magazine** has a lot to look forward. **I am happy that our department started in the year 1994 with B.Tech-EEE programme has completed 25 years during 2019-20. During these 25 years EEE department has crossed several milestones and contributed to society in the form of education to engineering students.**

Started with B.Tech – EEE in 1994 with an intake of 60 later enhanced to an intake of 120 in the year 2012. PG programme of M.Tech-Power Electronics was started in the year 2013. B.Tech-EEE program has been accredited by NBA three times under Tier-II from 2011-14 and 2016-19. **I am glad to inform that now B.Tech-EEE program has been accredited by NBA under Tier-I for three years from 1st July 2019.**

Faculty have contributed whole heartedly for the growth of the Department. The Department has also witnessed the strong force of faculty. At present the Department has faculty strength 34 with diversity of specialization, out of which 18 of them have Doctorates, 10 are pursuing PhD and 06 are with M.Tech. There are four research groups in the department – **Power Electronics, Power systems, Electrical Machines & Drives, Control Systems and Instrumentation.**

The objective of Technical Magazine is to display the research culture in the department and publications made by the department faculty in terms of Journals / Transactions / Conference Papers during the academic year. Also, it provides an opportunity to students to publish technical articles.

I would like to offer a word of thanks to our readers, our contributors, and our editorial board for their support of the technical magazine and its mission: to improve the quality of research contribution and awareness on recent trends & life-long learning among students. This technical magazine will provide a glimpse of faculty and student contributions made during academic year 2021-2022.

Prof. C. Venkatesh
HOD, EEE Dept.

Faculty publications - Journals

List of Journals published by Faculty during A.Y. 2021-22:

S.No.	Name of the Faculty	Title of the Paper	Name of the Journal	Details of Paper
1	Prof. V. Rajagopal	An optimized Enhanced Phase Locked Loop Controller for a Hybrid System	MDPI Technologies	<i>MDPI Technologies</i> , vol. 10, no.2. pp. 1-18, 2022.
2	Prof. V. Rajagopal, Sri. M. Santhosh	Meta-heuristics Algorithms for Optimization of Controller Gains of DVR to Improve PQ and Dynamics	Wiley -Optimal Control. Applications and Methods	<i>Wiley -Optimal Control. Applications and Methods</i> , vol. 21, pp.1-20, 2022.
3	Prof. V. Rajagopal	Optimized PI Gains for Dynamic Voltage Restorer Control Using Admittance Estimation Strategy	Electrical Engineering – SCI Journal	<i>Electrical Engineering</i> , pp.1-16, 2022.
4	Prof. V. Rajagopal	Solar Photovoltaic System-Based Reduced Switch Multilevel Inverter for Improved Power Quality	MDPI Clean Technologies	<i>MDPI Clean Technologies</i> , vol. 4, no.1, pp. 1-13, 2022.
5	Prof. V. Rajagopal, Dr. C. Venkatesh, Sri. Danthurthi Sharath	Optimized Controller Gains using Grey Wolf Algorithm for Grid Tied Solar Power Generation with Improved Dynamics and Power Quality	Chinese Journal of Electrical Engineering- ESCI Journal	<i>Chinese Journal of Electrical Engineering</i> , (Accepted), pp. 1-15, 2022.
6	Prof. V. Rajagopal, Sri. Bochu Subhash	EPLL Control Technique Optimum Controller Gains to Control Voltage and Frequency in Standalone Wind Energy Conversion System	European Journal of Electrical Engineering – ESCI Journal	<i>European Journal of Electrical Engineering</i> , vol. 24. no. 1.pp. 55-65, 2022.
7	Sri. B. Pradeep Kumar	Identification and Localization of Array Faults with Optimized	IEEE Transactions on industrial Electronics	<i>IEEE Transactions on industrial Electronics</i> ,

		Placement of Voltage Sensors in a PV System		vol.68.no.7.pp. 5921-5931, 2021.
8	Prof. V. Rajagopal, Sri. Bochu Subhash	Optimization of controller gains to enhance power quality of standalone wind energy conversion system	International Journal of Emerging Electric Power Systems - ESCI Journal	<i>International Journal of Emerging Electric Power Systems</i> , vol.23.no.1.pp. 89-104, 2021
9	Dr. B. Jagadish Kumar	Investigations on Recharge Boost Converter	Journal of Information and Computational Science - ESCI Journal	<i>Journal of Information and Computational Science</i> , vol.14, no.1, pp. 42-45, 2021
10	Sri. T. Praveen Kumar	Genetic Algorithm Based Power Control Strategies of a Grid Integrated Hybrid Distributed Generation System	Technology and Economics of Smart Grids and Sustainable Energy - ESCI Journal	<i>Technology and Economics of Smart Grids and Sustainable Energy</i> , 2021.
11	Dr. D. Rakesh Chandra	Short Term Electric Power Load Forecasting Using Principal Component Analysis and Recurrent Neural Networks, Forecasting	Forecasting - ESCI Journal	<i>Forecasting- ESCI Journal</i> , vol.4.no.1.pp. 149-164, 2022.
12	Sri. G. Sunil Kumar	Discrimination of Transformer Inrush Currents and Internal Fault Currents Using Extended Kalman Filter Algorithm (EKF)	MDPI Technologies	<i>MDPI Technologies</i> , vol. 14, no.19. pp. 1-20, 2021.



Article

An Optimized Enhanced Phase Locked Loop Controller for a Hybrid System

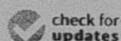
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Abstract: The use of renewable energy sources is the need of the hour, but the highly intermittent nature of the wind and solar energies demands an efficient controller be connected with the system. This paper proposes an adept control algorithm for an isolated system connected with renewable energy sources. The system under consideration is a hybrid power system with a wind power harnessing unit associated with a solar energy module. A controller that works with enhanced phase locked loop (EPLL) algorithm is provided to maintain the quality of power at the load side and ensure that the source current is not affected during the load fluctuations. EPLL is very simple, precise, stable, and highly efficient in maintaining power quality. The double-frequency error which is the drawback of standard phase locked loop is eliminated in EPLL. Optimization techniques are used here to tune the values of the PI controller gains in the controlling algorithm. Tuning of the controller is an important process, as the gains of the controllers decide the quality of the output. The system is designed using MATLAB/SIMULINK. Codes are written in MATLAB for the optimization. Out of the three different optimization techniques applied, the salp swarm algorithm is found to give the most suitable gain values for the proposed system. Solar power generation is made more efficient by implementing maximum power point tracking. Perturb and observe is the method adopted for MPPT.

Keywords: wind power generating unit; induction generator; enhanced phase locked loop; particle swarm optimization; selective particle swarm optimization; salp swarm optimization; voltage and frequency control; battery energy storage system

1. Introduction

The fossil-fueled power plants emit nitrogen oxides, sulfur oxides, and other harmful particles. The rate at which the carbon dioxide in the atmosphere increases is quite alarming. It is found that the carbon dioxide content is increasing in the wintertime, and during summer, when photosynthesis is active, the CO₂ content is less. According to National Oceanic and Atmospheric Administration (NOAA), as stated in its Global Climate Summary 2021, the global land and ocean temperature is increasing at the rate of 0.070 °C per decade, and the average global surface temperature was the highest for July 2021 since 1880. Accepting wind and solar energies as the primary energy sources will relieve our power sector from contributing to global pollution.

National Wind Energy Mission has announced a target of 60 GW wind power generation, whereas the target for solar power is 100 GW by 2022. Floating wind farms are seen as the future of the global offshore wind sector. There are floating wind turbine structures that are installed in water depths where a fixed structure is not feasible. Siemens has built a

Meta-heuristics algorithms for optimization of gains for dynamic voltage restorers to improve power quality and dynamics

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Abstract

This article discusses metaheuristic algorithms for optimizing controller gains for dynamic voltage restorers (DVRs) that use an impedance control strategy to compensate for unbalance in source voltages, voltage harmonics, and sag/swell in source voltages. The gains of the proportional-integral (PI) controllers become critical for proper DVR load voltage extraction. Various techniques for optimization, such as whale optimization technique, gray wolf optimization technique, particle swarm optimization technique, and antlion optimization technique, are used to obtain DC and AC PI controller gains for DVR. The impedance control strategy employs simple calculations to determine the resistance and reactance of a polluted source voltage, without the use of frame conversions as in synchronous reference theory, instantaneous reference power theory, and so on. The quick calculations of the impedance control scheme improve the power quality and dynamics. The Metaheuristic algorithms are used to calculate the number of iterations required to achieve the best possible controller gains, which further helps to improve power quality and dynamics. Among these optimization techniques, the antlion optimization technique provides fast convergence and the best possible controller gain values to improve the dynamics of the dc-link voltage of voltage source converter and terminal voltage, thereby improving power quality. The proposed antlion optimization technique-based DVR model is simulated in MATLAB R2019, and the results are validated with RT-LAB.

KEYWORDS

antlion optimization, dynamic voltage restorer, gray wolf optimization, impedance control strategy, particle swarm optimization, power quality, whale optimization

1 | INTRODUCTION

Industrial and commercial electric power users who connect to the distribution network are increasingly demanding higher quality electricity. Voltage distortions and fluctuations in distribution devices can have a negative impact on sensitive loads such as communication systems, computer equipment, variable speed drives, and manufacturing processes.



Optimized PI gains for dynamic voltage restorer control using admittance estimation strategy

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Abstract

This paper describes how to use particle swarm optimization to implement a neural network-based admittance estimation strategy for controlling a dynamic voltage restorer (DVR) with optimized controller gains (PSO). To improve DVR efficiency, robustness, and tracking capability, a control strategy based on source admittance components is used to determine fundamental admittance components from distorted supply voltages. Because of the algorithm's simple formulas, estimating conductance and susceptibility from load currents is quick. To minimize the gains of proportional integral controllers, particle swarm optimization (PSO) is used. This improves dynamic response, tracking capability, as well as transient and steady-state stability. When consumer loads change on a regular or irregular basis, this algorithm is very effective. The admittance control strategy for DVR is modeled and simulated using MATLAB/Simulink and implemented using hardware setup d-SPACE made MicroLab box DS1202/DS1302 for mitigating harmonics and voltage sag/swell (2 GHz dual-core real-time processor and user-programmable FPGA). The suggested DVR's test results were satisfactory under both balanced and unbalanced load conditions.

Keywords Dynamic voltage restorer · Admittance estimation algorithm · Harmonics · Kohonen learning · Voltage sag/swell

1 Introduction

Dips and distortions in current and voltage waveforms have recently received a lot of attention due to increased awareness of PQ at consumer loads. Modern computerized systems

used in the textile, food control, and automation industries have become more sensitive to PQ interruptions and disturbances in recent years [1, 2]. The reactive power demand and harmonics are critical parameters for specific loading [3]. DVR and other CPDs (custom power devices) can be used to compensate for voltage dips, unbalanced loads, and waveform distortions [4, 5]. Voltage sag/swell is one of the most serious PQ issues for sensitive loads. At various stages, the magnitude and duration of voltage sags affect and damage industrial and domestic consumers [6]. Harmonics and reactive power demand are critical parameters for specific loading [7]. Chattopadhyay et al. [8] discuss power quality unbalance, harmonics, and transients. IEEE 519–1992 PQ standards are used as PQ standards for monitoring and compensating PQ problems in distribution systems [9]. DVRs are series-type compensating devices that are used in distribution networks to reduce voltage sag/swell. By injecting compensating voltage in series with the source voltage, this device can keep the distribution system load voltage close to the rated voltage [10]. DVR can correct a voltage drop or rise above the nominal value by injecting reactive power, which minimizes the voltage drop [11, 12]. The control strategy used to derive the fundamental component of source voltages determines the

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Article

Solar Photovoltaic System-Based Reduced Switch Multilevel Inverter for Improved Power Quality

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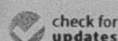
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Abstract: This paper deals with a reduced switch multi-level inverter for the solar photovoltaic system-based 127-level multi-level inverter. The proposed technique uses the minimum number of switches to achieve the maximum steps in staircase AC output voltage when compared to the flying capacitor multi-level inverter, cascaded type multilevel inverter and diode clamped multi-level inverter. The use of a minimum number of switches decreases the cost of the system. To eliminate the switching losses, in this topology a square wave switch is used instead of pulse width modulation. Thereby the total harmonic distortion (THD) and harmonics have been reduced in the pulsating AC output voltage waveform. The performance of 127-level MLI is compared with 15 level, 31-level and 63-level multilevel inverters. The outcomes of the solar photovoltaic system-based 127-level multi-level inverter have been simulated in a MATLAB R2009b environment.

Keywords: reduced switch multilevel inverter; power quality; solar photovoltaic system; cost saving



Citation: Andela, M.; Shaik, A.; Beemagoni, S.; Kurimilla, V.; Veramalla, R.; Kodakkal, A.; Salkuti, S.R. Solar Photovoltaic System-Based Reduced Switch Multilevel Inverter for Improved Power Quality. *Clean Technol.* **2022**, *4*, 1–13. <https://doi.org/10.3390/cleantechnol4010001>

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1. Introduction

In the current generation, the demand for electricity is growing day by day. Nowadays, most electricity is generated through conventional energy sources (thermal, nuclear, etc.), which are not environmentally friendly. Due to these processes of generating electricity, the availability of fossil fuels is being reduced. Therefore, due to the reduction in conventional energy sources, we are unable to meet demand. To meet the demand, the alternative method of generating electricity is via non-conventional energy sources (wind energy, solar energy, hydro, biomass, etc.) which are environmentally friendly.

The Earth grabs a significant amount of solar power, at nearly 173 terawatts. This is around ten thousand times more power than the world's population uses. As such, it is possible that one day the world could be entirely reliant on solar energy, which could present an available, clean, pollution-free, highly efficient, and long-life energy source. With the help of technology, the cost of the SPV panels and associated equipment has reduced tremendously over recent decades [1]. To interface solar energy to the grid, low voltage PV cells are aligned in a series to acquire high DC output voltage [2]. This process needs high-rated voltage equipment for inversion and a step-up transformer, which increases the losses, cost, weight and size of the system [3]. To overcome these issues, the transformer can be eliminated.

Therefore, a multilevel inverter (MLI) uses the power of semiconductor device sources to integrate the staircase waveform near a sine waveform. The multilevel inverter is the best option for the majority of electricity production in an SPV system. The traditional 2-level inverters face high switching voltage stress, less efficiency and low power quality,

Optimized Controller Gains using Grey Wolf Algorithm for Grid Tied Solar Power Generation with Improved Dynamics and Power Quality

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Abstract— This paper deals with control algorithm based on synchronous reference frame theory with unit templates instead of phase locked loop for grid connected photo-voltaic solar system, which consists of solar PV panels, dc-dc converter, controller for maximum power point tracking, RC ripple filter, IGBT based controller, interfacing inductor, linear and non-linear loads. The dynamic performance of the grid connected solar system depends on the effect operation of control algorithm; the control algorithm has two proportional-integral controllers which is the key for estimation the reference solar-grid currents in-turn generates pulses for three-leg voltage source converter (VSC). The Grey Wolf Optimization Algorithm is used to obtain optimized controller gains of proportional-integral controllers which give very competitive results compared to other optimization algorithms. The compensation for neutral current is provided by a star-delta transformer (non-isolated) and the proposed solar PV grid system can provide zero voltage regulation, harmonic elimination along with load balancing. Maximum power extraction from the solar panel is obtained by means of incremental conductance algorithm for dc-dc converter to supply solar power to the dc bus capacitor which in turn it pumps solar power to the grid with improved dynamics and quality. The solar system with control algorithm with controller is modeled using SIMULINK in MATLAB 2019.

<https://mc03.manuscriptcentral.com/cjee>

EPLL Control Technique Optimum Controller Gains to Control Voltage and Frequency in Standalone Wind Energy Conversion System

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ABSTRACT

This study describes how to regulate the frequency and terminal voltage of a freestanding wind energy conversion system using an Enhanced Phase Locked Loop (EPLL)-based strategy to supply power to varied loads regardless of wind speed. In a standalone wind turbine energy conversion system, the EPLL control scheme extracts the reference source currents (SWECS). The control algorithm employs two proportional-integral (PI) controllers to create the active and reactive power components of the consumers' load currents, estimate reference source currents, and connect the zigzag transformer to PCC with VSC for neutral current compensation. To obtain optimal PI controller gains and most-suited settings to apply to SWECS, optimization approaches are used. The control algorithm is the most significant aspect of the system, and the speed with which it calculates, evaluates, and guesstimates determines the generation of source currents based on the algorithm's ideal controller PI gains. By properly estimating source currents, the EPLL control method improves dynamics and power quality issues, and the optimization technique is employed to acquire the gains of PI controllers. The proposed system employs the EPLL algorithm on a three-phase, four-wire system with changing loads to achieve ideal total harmonic distortion of source currents and voltages on the PCC, as defined by IEEE-519 standards. A battery energy storage device coupled to the VSC dc link keeps the load's necessary power constant. If the generator output exceeds the consumer demand, the excess power is delivered to BESS for temporary storage. When consumer demand exceeds generated power, a BESS delivers deficit power to the load, which adjusts and the frequency under various load conditions. The suggested system simulated results were tested with 3-phase 4-wire for harmonics reduction, load balancing, neutral wire current compensation, frequency and voltage control using MATLAB / Simulink.

Keywords:

standalone wind energy conversion system (SWECS), induction generator (IG), battery energy storage system (BESS), PI controller, voltage and frequency controller (VFC), zigzag transformer, particle swarm optimization (PSO)

1. INTRODUCTION

Now the whole world is facing today environmental degradation due to intensifying fossil fuels usage and conventional natural resources exploitation along with growing different consumer's power demands and significant transmission cost its losses and power generation to remote regions are great challenges. The great awareness regarding environmental issues, government initiatives lead us to utilization renewable resources and the main objective, importance, ground level targets are with operational design model and electro-mechanics for power generation with non-conventional resources are described. The technocrats, power providers focused on the uppermost consumer demand along with maximum electricity price and feeding largest generated electricity power to existed utility grid with increased the system efficiency and power reliability storage requirements [1]. Nowadays Remote area power supply (RAPS) patterns, schemes are attractive, more demanding for remote, hill areas and islands. In absence of main grid, RAPS system design and operation is more challenging in power generation supply system with distinctive nature and described unexpected voltage and frequency unallowable limits due to less(X/R) ratios, deficiency of reactive power support and low damping,

therefore the voltage and frequency control is the prime important aspects which to be controlled whenever we design and implement RAPS systems [2, 3]. In the last decade, the entire world's many engineers concentrated and put their attention on wind energy conversion systems due to environmentally friendly and playing key role in producing the electrical power according to increased load demand from rural, hilly areas to high density populated urban areas, domestic consumer, industrial, agricultural demand which huge gap between generation and consumer demand overcoming by wind energy conversion systems which can be advisable plans for remote, isolated areas and islands and stand-alone wind energy generation is the one of the most demanded resources among Non-Conventional generation power systems, used for isolated consumer loads as well [4]. Since from last decades, the worldwide green energy source is a substantial significant effect on SWECS growth in wind energy generation from 19902 GW to present global installed capacity reached about 100 GW and future predictable growth to 1000 GW by 2025 and wind energy among several renewable energy resources expressed as rapid emergent energy industry in the electricity market [5].

Gowtham et al. [6] stated that the electrical engineers are resolved ground technical issues for smooth effective

Identification and Localization of Array Faults With Optimized Placement of Voltage Sensors in a PV System

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Abstract—The traditional protection devices installed in photovoltaic (PV) arrays generally detect line–line (LL) and line–ground (LG) faults when the fault current magnitude exceeds its threshold value defined by various international standards. However, the magnitude of fault current is greatly reduced, due to low irradiance levels, active maximum power point tracker, location of fault, minimal fault mismatch, and presence of blocking diodes. Consequently, majority of such faults remain obscured even when the irradiance reaches to a higher level and thereby constitute to reliability issues and severe fire risks. Therefore, both timely fault detection and localization become highly obligatory for sustainable power generation and safety. Thus, this article proposes a new, robust, and efficient fault localization method based on the principle of differential voltage measurement between PV modules of adjacent strings. For accomplishing this task, a new optimized voltage sensor arrangement with minimal number of sensors is followed. Moreover, the proposed convention 1) is proficient to detect any LL/LG faults independent of its detection challenges, 2) suits both grounded and floating PV systems, and 3) is compatible for systems with/without blocking diodes. For a realistic validation, testing has been performed on a small-scale grid-connected PV system and the efficacy in detecting various array faults is demonstrated via extensive investigations.

Index Terms—Differential voltage measurement, LL faults, open-circuit fault, partial shading conditions, photovoltaic array.

I. INTRODUCTION

FAULT diagnosis in a photovoltaic array is crucial to enhance the system safety, reliability, and efficiency. Pertinent to international standards, array faults such as line–line (LL) and line–ground (LG) faults are conventionally detected using over current protection device (OCPD) and ground fault protection device (GFPD), respectively. However, certain faults are not cleared by these protection devices, particularly due to nonlinear PV operating characteristics, active maximum power point trackers (MPPTs), presence of blocking diodes, low fault mismatch levels, and low irradiance conditions [1]–[3]. More importantly, undetected array faults induce huge power loss and, even, it may create fire hazards [2]. In addition, PV output characteristics during most partial shading conditions (PSCs) are analogous to electrical faults [4]. As a result, there ascends an exigent demand to develop effective fault detection techniques to ascertain and differentiate the electrical array faults and partial shade conditions.

Among advanced fault detection techniques, multiresolution analysis and artificial intelligence (AI)-based techniques such as wavelets and fuzzy inference system in [5], artificial neural networks [6], support vector machine [7], random forest-based approach [8], and k-nearest neighbors (kNN) with nonparametric thresholds [9] are used to identify the faults. However, these methods require voluminous training data sets for efficient operation. However, detection approaches presented in [10] and [11] are based on the wavelets and necessitate advanced controllers and additional sensors in [11] (pyranometer and temperature sensors) for its implementation, making protection system expensive. Distinctive techniques based on time response analysis of externally injected signals such as time domain reflectometry [12] and spread spectrum time domain reflectometry (SSTDR) [13] are used for fault localization. However, hardware integration and distance between fault location and external device drastically affect the detection accuracy.

Besides, some techniques apply statistical difference measurement between simulated and field electrical quantities of PV

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Optimization of controller gains to enhance power quality of standalone wind energy conversion system

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Abstract: This article presents optimized gains for regulation of frequency and terminal voltage irrespective of the varying wind speeds in an autonomous wind power generation feeding linear and non-linear loads. Icosp control algorithm is used to calculate and estimate reference source currents in a remote area wind energy conversion system (WECS) using an Induction Generator (IG). The Icosp control algorithm do not have any phase locked loop or any conversions from one reference frame to other, which improves the dynamics and power system quality issues. The heart of the control algorithm is how quickly it estimates the reference source currents; this in turn depends on values of proportional and integral controller gains in the control algorithm. Here we are applying three optimization techniques to find the optimal proportional-integral (PI) controller output gains, the best convergence values are taken from optimization technique and applied for WECS. Battery energy storage system (BESS) connected to the direct current (DC) link of voltage source converter (VSC) manages the power of WECS. When load useful power level is less than the generated power level, the excess will be diverted and stored in the battery. But when generated power level is less than the load applied on WECS then the excess power requirement of the load is met by the battery, thus regulating the frequency under varying wind speeds. An isolated zigzag transformer is connected between point of common

coupling and controller for neutral line current compensation. The controller is used for load balancing, current harmonic suppression, voltage and frequency regulation.

Keywords: ant lion optimization (ALO); battery energy storage system (BESS); dragonfly optimization algorithm (DOA); particle swarm optimization (PSO); voltage and frequency controller (VFC); wind energy conversion system (WECS).

1 Introduction

Nowadays, as per the Industrial and Technological world scenario the whole world is operating based on the electrical energy and it needs more electrical energy for consumers from hill areas to urban areas consumer as well as from small domestic equipments to industrial element and there is a greater power demand by the consumers across world and there is a maximum gap between consumer demand and the power generation due to decaying fossil fuels like coal and oil with high price fluctuations, releasing more harmful emissions and also impacting the climate change [1, 2]. In order to meet the Consumers demand which is increasing day by day, at this present scenario, many countries are looking forward for feasible, environment-friendly Non-Conventional power generation and placed a greater concentration due to non-polluting and it's numerous advantages [3, 4]. Power system engineers, planners are carefully examining many issues of technical feasibility of synchronizing the Non-Conventional power to the main transmission grid and furthermore, wind energy conversion system is a good method of supplying power to remote areas, hill areas consumers, those consumers are away and unable to connect to the main grid [1]. However, F. A. Ferret [5] given the wide views about the wind energy system and its potential in remote, hill areas and explained in literature about tapping technologies even it is in vast availability of large amount of wind energy potential across the world, the majority of wind potential is still untapped.

In order to tap the major amount of wind potential, the various technologies are developed, wind turbines are

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INVESTIGATIONS ON RECHARGE BOOST CONVERTER

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ABSTRACT:

In this paper, A Boost converter with a coupled-inductor is explored. In the proposed method a coupled inductor and a switch with low voltage rating is used for improving voltage gain. A passive regenerative snubber circuit is used for reviving energy of the stray inductance, makes the switch to operate in a wide range of duty cycle which relatively increase the voltage gain, compared to coupled inductor-based converters. These scheme have voltage clamped properties, low voltage stress than output voltage made to choose low-voltage low conduction devices, with no reverse-recovery currents within diodes used in the circuit. Moreover, the closed loop control technique used to reduce the voltage drift problems. The proposed converter topology boost the voltage gain of a conventional Boost converter using single inductor, and mitigate the demagnetization of transformer and leakage inductor of coupled-inductor based converter.

Keywords: Battery, Passive Regenerative snubber circuit, coupled-inductor, reverse recovery, fuel cells, proton exchange membrane.

INTRODUCTION:

In present days, many industrial application require steep voltage ratio. For example, boost converters are used in hybrid electric vehicles (HEV) and lighting systems, telecommunication industry. By using conventional Boost converter, results in serious reverse-recovery problem, with low voltage gain, even for extreme duty cycle, cause the efficiency to decrease and the Electromagnetic interference problem is more. Several converter topologies are proposed in past decades.

By using conventional Boost converter, results in serious reverse-recovery problem, with low voltage gain, even for extreme duty cycle, cause the efficiency to decrease and the Electromagnetic Interference problem. Even though Voltage clamped techniques are used to decrease the reverse-recovery problem, The switch voltage stress is more and voltage gain is limited by turn-on time of the switch, a boost soft-single converter topology in pulse width modulation manner is used. The high-step up ratio is achieved by using coupled inductor and switch voltage accordingly, also improves the reverse-recovery problem of output diode.

8

ORIGINAL PAPER



Genetic Algorithm Based Power Control Strategies of a Grid Integrated Hybrid Distributed Generation System

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Abstract

In this manuscript, a genetic algorithm (GA) is proposed for the power management (PM) of a grid integrated hybrid distributed generation (DG) system. The hybrid distribution generation (DG) system incorporates photovoltaic (PV), wind turbine (WT), fuel cell (FC) and battery. The power fluctuations are produced in the distributed generation system, because the hybrid resource utilization and the generation of power is changeable. The major purpose of the proposed control method is “to control the power flow (PF) of active with reactive energy amid the source and grid side. The proposed GA-based power control system is mainly utilized for optimizing active with reactive power flow controllers. By controlling charge with discharge of battery, the proposed system met the energy requirement of the charge and managed the sensitivity of the charge. The proposed method provides an optimal power flow in DG systems. To evaluate the management of PF, the equality with inequality constraints is determined that is used to specify the accessibility of renewable energy sources (RES), the demand for electricity and storage components load level. The security of power system is improved with the help of proposed control system. Moreover, the battery is used to allow the renewable energy system and maintain a stable power output. The proposed method is activated in MATLAB / Simulink work site and the performance is compared with existing methods. The statistical analysis of mean, median and standard deviation (SD) are also analyzed for proposed with existing methods. The proposed technique mean value is 1.5784, median is 1.4892, SD is 0.5883.

Keywords Photovoltaic · Wind turbine · Fuel cell · Battery · Distributed generators · Genetic algorithm · Power flow management · Source side control · Grid side control

Introduction

The world countries are met most of the total electricity demand through the power generated by the traditional power plants [16]. In the power generation process, major fossil fuels, like diesel, gas and coal are used as fuel to power turbines used [20, 22]. These power generations based on fossil fuel release dangerous as well as toxic gases which causing harm in human health and animals [15, 35]. Global warming is a major effect of these toxic gases produced by power plants [21]. Moreover, the fossil fuels availability is very low, but the requirement of energy consumption is growing rapidly [13,

27]. Therefore, in the power generation process, these conventional fossil fuel based plants cannot be used for a long time [25, 32].

At present, the consumption of RES is growing at a faster pace because of the environmental issues in reducing greenhouse gases (GHG) that is broadly accepted as alternative electricity [28]. One of the major concepts of RES based on power generation is distributed generation [14]. The distributed generation is also called embedded generation, dispersed generation or decentralized generation [8]. The infrastructure of existing power grid must be developed as an advanced grid to meet the increasing power requirement, service quality demands and minimize the pollution, [18]. The distributed generation is considered as an important source for controlling power generation process and minimization of cost, which is also considered as alternatives of conventional power systems [36].

DG is directly linked with distribution network [6]; it is a small scale generation [9]. DG is based on the renewable

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Article

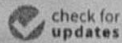
Short Term Electric Power Load Forecasting Using Principal Component Analysis and Recurrent Neural Networks

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Abstract: Electrical load forecasting study is required in electric power systems for different applications with respect to the specific time horizon, such as optimal operations, grid stability, Demand Side Management (DSM) and long-term strategic planning. In this context, machine learning and data analytics models represent a valuable tool to cope with the intrinsic complexity and especially design future demand-side advanced services. The main novelty in this paper is that the combination of a Recurrent Neural Network (RNN) and Principal Component Analysis (PCA) techniques is proposed to improve the forecasting capability of the hourly load on an electric power substation. A historical dataset of measured loads related to a 33/11 kV MV substation is considered in India as a case study, in order to properly validate the designed method. Based on the presented numerical results, the proposed approach proved itself to accurately predict loads with a reduced dimensionality of input data, thus minimizing the overall computational effort.

Keywords: load forecasting; recurrent neural network; self adaptive Adam optimizer; Principal Component Analysis; Hourly Ahead Market



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1. Introduction

Nowadays, the energy system is facing a radical revolution towards a green transition, with increasing penetration of renewable energy sources (RES), migration to distributed systems, with new actors like prosumers, and storage integration, both utility scale and domestic, which represent a key technology to decouple energy production and consumption [1].

In this regard, distributed sensor architectures, digital technology, data analytics and computational tools would represent crucial enabling technologies for monitoring, forecasting and maintenance purposes, to better manage the balance between power demand and supply, and to improve embedding of distributed RES; additionally, for the particular case of stand-alone hybrid systems, energy forecasting will particularly help anticipating customers' behavior, sizing the electrical infrastructure and improving overall system reliability [2]. Therefore, forecasting capability brings helpful insights for security of energy supply, supporting power companies in providing their end-users with advanced demand-side services, and safe and stable systems.

Utility companies have several advantages with accurate load forecasting, such as reduced operation and maintenance costs, optimized management of demand-supply, increased system reliability, effective long-term strategic planning for future investments [3,4]. Electrical load forecasting can be generally divided into four main categories based on forecasting time, such as very short-term, short-term [5], medium-term and long-term load forecasting [6]. Load forecasting with different applications with respect to the specific

Article

Discrimination of Transformer Inrush Currents and Internal Fault Currents Using Extended Kalman Filter Algorithm (EKF)

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Abstract: The discrimination of inrush currents and internal fault currents in transformers is an important feature of a transformer protection scheme. The harmonic current restrained feature is used in conventional differential relay protection of transformers. A literature survey shows that the discrimination between the inrush currents and internal fault currents is still an area that is open to research. In this paper, the classification of internal fault currents and magnetic inrush currents in the transformer is performed by using an extended Kalman filter (EKF) algorithm. When a transformer is energized under normal conditions, the EKF estimates the primary side winding current and, hence, the absolute residual signal (ARS) value is zero. The ARS value will not be equal to zero for internal fault and inrush phenomena conditions; hence, the EKF algorithm will be used for discriminating the internal faults and inrush faults by keeping the threshold level to the ARS value. The simulation results are compared with the theoretical analysis under various conditions. It is also observed that the detection time of internal faults decreases with the severity of the fault. The results of various test cases using the EKF algorithm are presented. This scheme provides fast protection of the transformer for severe faults.

Keywords: transformer; internal fault currents; magnetic inrush currents; extended Kalman filter (EKF) algorithm; harmonic estimation

1. Introduction

Transformers require an efficient protection system from faulty conditions in the power system network. The classification of magnetic inrush currents and internal fault currents is a challenging issue for proper relay design. The magnetizing inrush current results in maloperation of the differential relay in transformer protection. The transformer may become saturated with inrush currents and internal faults due to the presence of zero-sequence components, which may lead to maloperation of differential current protection. The waveform correlation technique is suggested for differential current protection of transformers. The analysis of zero sequence currents due to inrush currents and internal faults can be performed using the waveform correlation technique [1].

An accelerated Convolutional neural network (CNN) was suggested for estimating the transformer magnetizing current from internal faults on a 230 kV transmission network. It was observed that the CNN can have feature extraction and fault detection blocks in a single deep neural network block by enabling the system to provide important features automatically [2]. The fundamental theory and principles of magnetizing the inrush current of the transformer are essential when it is energized. The analysis of the magnetizing current is important for transformer protection [3]. A new technique was proposed with two moving windows to predict the magnitude of differential currents of the transformer for the discrimination of inrush currents from internal faults [4]. The least error square (LES) was proposed to classify the fault currents and the magnitude of magnetic inrush currents with the two moving windows technique. The LES method has a very fast response

Faculty publications – Conference Papers

List of Conference Papers published by Faculty during A.Y. 2021-22:

S.No.	Name of the Faculty	Title of the Paper	Name of the Conference	Details of Paper
1	Dr. P. Nagarjuna Reddy,	Outcome-based education framework integrating 12RE skills in course teaching for quality assurance, 2022	OBE Framework	
2	Prof. C. Venkatesh	Outcome-based education framework integrating 12RE skills in course teaching for quality assurance, 2022	OBE Framework	
2	Prof. K. Ashoka Reddy	Outcome-based education framework integrating 12RE skills in course teaching for quality assurance, 2022	OBE Framework	
3	Prof. V. Ashok	An Intelligent Scheme for Classification of Shunt Faults including Typical Faults in Double Circuit Transmission line	Artificial Intelligence Applications in Electrical	ISBN 978036755234 3
4	Dr. B. Vijay Kumar	Recent Developments in Engineering and Management	TECH Press, Delhi	ISBN- 976436678543 7
5	Dr. B. Jagadish Kumar	Grid Connected PV System with a Feed Forward Control	LAMBERT Academic Publishing	ISBN- 978620474697 5
6	Prof. C. Venkatesh & Sri. C. Pavan Kumar	Hybrid UPQC arrangement for power quality improvement	E3S Web of Conferences	

7	Prof. C. Venkatesh	A comprehensive Analysis of 17- level Modified H Bridge Multilevel Inverter	IEEE International conference on Distributed computing, VLSI, Electrical Circuits and Robotics(DISCOVER), 2021	
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Outcome-based education framework integrating I²RE skills in course teaching for quality assurance

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Abstract:

With multiple reforms coming in higher education in the recent past, engineering education in India is witnessing rapid increase making the country one among those having large number of engineers in the world. There is an ever-growing need for quality assurance in Higher Education Institutions which is required to meet the targets of Industry 4.0. The programme outcomes (POs) stipulated by NBA insists that various courses offered as part of program should contribute towards imparting both domain-dependent (DD) skills (PO1-PO5) and domain-independent (DI) skills (PO6-PO12) to students. Teachers being prime stakeholders shall take the role of custodians of quality assurance by integrating focussed teaching-learning activities to impart both DD and DI skills as part of their course teaching. Towards this requirement, we developed an effective outcome-based education (OBE) framework which integrates Innovation, Incubation, Research and Entrepreneurship (I²RE) skills in course teaching. Under this OBE framework, the course teacher adds mandatory course projects, course research papers, course patents, course presentations as part of formative assessment of course. This tailor-made OBE framework has been implemented in all the courses offered w.e.f the academic year 2019-20. It is expected to enhance the industry relevant skills in students for Industry 4.0, making them independent thinkers and prepare them for the future challenges. This paper presents the impact of integrating I²RE in course teaching.

Keywords: OBE framework, Higher education, Quality assurance, I²RE, course projects, course patents, course research papers.

Introduction:

With the world changing and humankind witnessing Industry4.0, the role of engineers is increasing unlike any other. Engineers are aiding the society in creating a wealth of knowledge with their innovations and creativity. They bring in ideas into reality with the knowledge of mathematics, science and engineering discipline. Engineers are required to engage in self-learning and lifelong learning after their formal education ends. They need to

Hybrid UPQC arrangement for power quality improvement

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Abstract. In the forthcoming gap, throughout the world storage systems will carry the leading role, the reason is of providing energy in distant places. The utilization of storage elements in almost all applications are tremendously changed by the researchers. Here, mentioning the theory to increase the quality benefits in all corners of power utilization. By summing potential elements such as Unified power Quality conditioner, fuel cell to suppress the problems at the consumer points. UPQC is capable to supporting dynamic conditions at combined common connection in the system. To achieve the consumer expectations in our country, Power Quality is a big subject as there are frequent power variations, outages and frequency. Hence, it is required to take crucial steps in the direction of the growth. This hybridization of different elements gives the research in the angle of improving several issues, for unbalanced distribution system. This paper comes up with a configuration of UPQC that incorporates DC -to-DC converter along with the fuel - cell at the DC-link side, the whole setup run under MATLAB environment.

1 Introduction

The nonlinear devices are increase in number every day, the power quality problems are multiplied by 'n' No.of times, slowly spoiling of the system and at the same time it is very tough for electrical engineers for eliminating the power issues [1]. With the continuous usage of power electronic converters, harmonics are injecting into the system. The latest equipments that are used in home and industries for various commercial applications are prone to harmonics and also effected with the poor power factor. In our daily life, some of the devices are delicate and produce harmonics also create voltage disturbances cause low power factor. This type of disturbances definitely create unwanted results. As a result, there may be a chance of network failure or break down of devices which spoil the delicate loads.

UPQC is also an acceptable approach for handling linear and non-linear burden on the system. Series active power filter of the same acts as DVR to sort out the voltage problems and shunt active power filter acts as STATCOM takes care of current distortions, a DC link shared by both filters [2-4], [20]. The fuel cell along with super capacitor can be used on the DC link for smaller durations. Fuel cells are employed in electric vehicles, UPS, hospitals, defence equipments and residential purpose [5-6] & [9], because very low pollution, less mass, less volume. The rate of discharge is slower in batteries because of mild chemical reactions. Super capacitors can be observed in hybrid vehicles, buses, trains, elevators. The recent trend is changed to super capacitors, because of faster charge and discharge

rate. The supercapacitors store less energy, whereas batteries normally having frequent maintenance with low discharge rate. Because of the merits such as higher power density, good efficiency and maintenance free etc., super capacitor are used [7-8].

Paper [10] describes the behaviour of a non-linear nature of a rectifier with R-C load. In paper [11-12] information is about employment of Bi-directional full bridge DC-DC converters in UPQC. As per IEEE 519-1992 standard accessible limit of source current THD is 5% in all successful working conditions. This hybrid system is set to reveal the importance of the UPQC, DC/DC converter and fuel cell system along with super capacitor. To nullify the harmonics in currents, voltages and strengthening of power factor value at the point of installation and also reduction of THD value. The operation of the presented system was simulated in the course of MATLAB environment. This work is presented as: Section 2; explains the hybridization of fuel cell with super capacitor based UPQC with DC-DC converter. Section 3; explains the series and shunt converter control method. Section 4; explains about analysis of results. Section 5; depicts the conclusion. Section 6; give out the appendix.

2 HYBRID UPQC

The hybrid UPQC shown in Fig.1. The active filters are using a dc link connected to a fuel cell along with super capacitor setting up by a sharing a dc capacitor.

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A Comprehensive Analysis of 17-level Modified H-Bridge Multilevel Inverter

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Abstract— Analysis of 17-level modified H-Bridge multilevel inverter is performed and presented in this paper. The number of components is limited to reduce the total number of components per levels factor, and DC sources are held in the circuit in such a way as to decrease the maximum voltage on the switches. In addition, PWM techniques such as level shifted carrier PWM and ANDED PWM is used to decrease the THD. Thus, parameters deciding the efficiency of the multilevel inverter are improved and simulation results are presented. Finally, analysis of a three-phase H-Bridge MLI connected to squirrel cage induction motor is performed to validate its performance for industrial applications. Parameters deciding the efficiency of multilevel inverter such as maximum voltage rating on the switches, THD, and total number of components per levels factor are addressed with a solution. Performance of the inverter are presented and compared with other topologies to justify 17-level modified H-bridge MLI performance.

Keywords— Modified H-bridge inverter, level shifted carrier PWM, ANDED PWM, Total harmonic distortion,

I. INTRODUCTION

An Inverter should efficiently convert DC power to AC power by minimizing the parameters such as Harmonic Distortions, Switching losses, and Voltage stress on the power switches. Initially, a 2-level inverter was developed to convert DC power to AC power. However, the Harmonics and voltage stress on the power switch in a 2-level inverter are large enough to be industrially inapplicable. For example, A 2-level inverter in [1] produces a THD of 6.02% using SVPWM with a maximum voltage rating of 100V on the power switch produces high dv/dt at the output terminals. Motor Harmonic losses is another factor where a 2-level inverter lags behind the ideal inverter and can be solved by using proper LC filter but increases manufacturing cost. After the advent of Multilevel Inverters till now are considered closest to the ideal inverter because of properties such as high voltage generation using low rating power switches, increasing voltage levels, and low THD [1]. Hence, multilevel inverters are preferred for industrial applications in high voltage and high-power applications [2], [3].

Modulation techniques are the key to reduce THD and control the circuit. There are two types of PWM techniques based on frequency: (1) Low or fundamental switching frequency, and (2) High switching frequency [4]-[6]. The low switching frequency PWM strategy reduces THD less than the high switching frequency strategy [7]. However, for the better transient response high switching PWM techniques are utilized. Although low switching frequency PWM techniques perform better, they are industrially not functional. Therefore, nowadays, high switching frequency

PWM techniques such as SPWM, SVPWM, and LSCPWM are used.

SPWM technique is simple and easy to implement, but when motor drive applications are concerned, SPWM produces high switching losses [8], [9]. On the other hand, SVPWM can generate low THD, but for 17 levels, the SVPWM becomes complex in generating a switching pattern [10], [11]. LSCPWM reduces THD significantly, but this technique is not approachable to the FC inverter since it deals with the capacitor [12]-[14]. So, another technique called PSPWM (Phase shifted carrier pulse width modulation) is used for an inverter with and without capacitors [15], [16].

A Nine-level topology in [11] use a Level-shifted control strategy and produces a THD of 0.01612% at the fundamental frequency of 48Hz and with a switching frequency of 144Hz. A level-shifted control strategy is a simple technique where a simple comparison between sinusoidal and carrier waves is done. A 17-Level topology in [13] uses an ANDED PWM technique that moves harmonics around the fundamental frequency to a higher frequency. A proper LC filter can easily remove these harmonics for better motor drive applications.

In this paper, a comprehensive analysis of 17-levels H-Bridge multilevel inverter is performed for single-phase and three-phase modules. This paper also addresses the problems of maximum voltage stress on switches, C/L factor, and amount of THD. Theoretical and experimental analysis is observed for a 17-level modified H-bridge inverter, and the results are presented. Control strategies such as Level shifted carrier PWM and ANDED PWM are implemented to reduce the THD. The three-phase 17-levels modified H-Bridge multilevel inverter is fed to a squirrel cage induction motor to observe the performance of the motor drive, and the simulation results are presented. Comparison between different topologies is presented to validate the importance and application of 17-level H-Bridge multilevel inverter.

Configuration of modified H-bridge MLI topology is presented in section II. The Level Shifted and ANDED PWM control strategies are implemented in Section III. In Section IV, a three-phase topology is presented. Section V presents simulation results of MHB-MLI. Comparison with recent topologies is discussed in Section VI and finally conclusion in Section VII.

II. MODIFIED H-BRIDGE MULTILEVEL INVERTER TOPOLOGY

Fig-1 shows the circuit diagram of single-phase modified H-bridge topology comprising two pairs of equal DC sources (v_1, v_2), six unidirectional switches (S_3 to S_8), and two bidirectional switches (S_1, S_2). The modified H-bridge

Student's Publications

List of Students' Journals and Conference Papers published during A.Y. 2021-22:

S.No.	Name of the Student(s)	Title of the Paper	Name of the Journal/Conference	Details of Paper
1	V. Lakshmi	A Cascaded H-Bridge Multilevel Inverter with Soc Battery Balancing	International Conference On Research And Innovation In Science, Technology And Management 07th & 08th January, 2022 – Virtual Conference	IFERP, Jan 7 th – 8 th , 2022
2	M. Pavan Kumar	A Nine-Level Fault-Tolerant FC Multilevel Inverter Topology with Preserved Output Voltage under Pre and Post-Fault Operation	AICTE Sponsored 1st International Conference	“Energy Sustainability (AICTE-ES-2022)”, 20-21 May, 2022
3	Sumayya Kounain	Investigations on Mitigations of current ripple in Fuel-cell for a single-phase isolated inverter		
4	Ch. Ravali	Power Quality Improvement with Transformer-less Dynamic Voltage Restorer (TDVR)	AICTE Sponsored 1st International Conference	“Energy Sustainability (AICTE-ES-2022)”, 20-21 May, 2022
5	Lingabathini Shiva Rama Krishna Prasad	Comparative Analysis of Resonant Converters	In: Saroj Hiranwal and Garima Mathur (eds), Artificial Intelligence and Communication Technologies, SCRS, India, 2021, pp. 73-82.	https://doi.org/10.52458/978-81-955020-5-9-7
6	Mohammed Raziuddin Shareef	Analysis of general-purpose fuzzy controller for second and fourth order DCDC converter	Positif Journal	ISSN No. 0048-4911, Vol.22, ISSUE 9, 2022
7	D. Moulika	Multilevel inverter with self-balanced switched capacitor for vehicle application	Positif Journal	ISSN No. 0048-4911, Vol.22, ISSUE 9, 2022

A Cascaded H-Bridge Multilevel Inverter with Soc Battery Balancing

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Abstract

Multi-level inverters are most widely used inverter topologies which are having more applications in various domains. This project presents a cascaded H-bridge multi-level inverter along with the state of charge balancing technique. Each H-bridge is connected directly to the battery in the power bank. Different switching combinations are provided to control the discharging of batteries and equalization algorithm is used in this project for controlling the state of charging (SOC) of batteries. In this cascaded H-bridge multi-level inverter SOC balancing is simulated using MATLAB under normal operating condition i.e., without and with SOC balancing.

Keywords

Multi-level inverter, SOC, cascaded H-bridge

ID: ES-023

A Nine-Level Fault-Tolerant FC Multilevel Inverter Topology with Preserved Output Voltage under Pre and Post-Fault Operation

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Abstract—Multilevel Inverters are having more attention in renewable energy sources because it produces less total harmonic distortion. But the limitations of conventional Multilevel Inverters are requirement of more switching components for a given number of voltage levels, therefore reliability issues with increase in number of switching components, and capacitor voltage balancing problems. In this paper a Fault Tolerant single-phase FC (Flying capacitor) nine-level inverter topology is discussed. The topology having capability to tolerate for open circuit and short circuit faults in case of single and multiple switch failure. In the paper only discussed about open circuit faults. With tolerance capability at three switch failure the topology having capability to tolerate at 120 switching failure combinations. It maintains voltage levels, output power, and capacitor voltage balancing under pre and post fault operation. And this nine-level inverter topology having less number of switches, capacitors, clamping diodes and DC voltage sources. Hence with least number of components used in the inverter circuit, it will provide better efficiency under pre and post fault conditions. The entire operation of the converter is carried out in MATLAB/SIMULINK software.

1. Introduction

Most of the industries processes need to increase efficiency and reduce production costs. This can happen with the increasing in the size of installations and increment in the power of all electrical machines and equipment and this will lead to increase in power. It is possible to directly connect the power converter to the medium-voltage network. At low voltage, there is a single topology that dominates the market, the voltage-source two-level inverter. However, at medium and high voltages, the situation is completely different.

Multi-level power converters attracting the industries from last few years because of their advantages as compared with existing two-level inverters. The multi-level inverters having the advantages like less total harmonic distortion, voltage stress reduction and dv/dt stress reduction with that less switching losses are obtained [1]. These multi-level inverters having less reliability compared to two level inverters [2]. So that, most of the researchers proposing new topologies for increase the reliability of multi-level inverters with fault tolerate capability. The main theme behind fault tolerant topologies based on

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DESIGNING OF A NINE-LEVEL INVERTER TOPOLOGY FOR OFF-GRID APPLICATION FED FROM SOLAR PV SYSTEM

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Abstract-

In a multi-level inverter, the switching component number effect on volume and reliability is a major concern in on-grid and off-grid applications. The recent trend in MLI, reduced component number of power switches, and capacitors in multi-level inverter topologies have been driven for power conversion. Multilevel inverters play an important role in many high power applications. The main attractive feature of multilevel inverters is minimizing harmonic content in inverter output voltage. But the main limitations of multilevel inverters are more number of switching devices. A new multilevel inverter is designed with minimum number of semiconductor switches to obtain reduced harmonic distortion and reduced switching losses. To reduce the harmonic distortion, switching losses and to enhance the performance of multilevel inverter configuration, the power semiconductor switches (IGBTs) gate switching operation is carried out with simple and logical pulse width modulation technique such as phase disposition PWM. The proposed inverter topology is simulated by using MATLAB/SIMULINK environment.

Keywords— PDWPM, PV.

I- INTRODUCTION

Day to day increment of utilization of electrical energy and for the future generation of electrical energy it should be focused on Non-Conventional Energy Sources (NCES). Due to shortage of fossil fuels and without any pollution effect, the NCES are more predominant in generation of electrical power. Different types of NCES are available in the nature, but due to the advantages of solar and wind energy sources are more predominant and also pollution free energy sources [1]-[2]. Due to rapid development of power electronic control techniques in electrical power generation and more advantages of solar PV systems, the SPV systems are used in many industrial and residential applications. In order to utilize this SPV power, for these application two stage power conversion is required. This involves boost up the voltage from lower voltage to higher magnitude and inversion of

power from DC to AC [3,4]. But to avoid the increment of losses and improve the efficiency the single stage power conversion of two level inverters are used [4]. The conventional two level inverters are having, high harmonic content, more switching losses and lower fundamental magnitude.

To overcome these drawbacks in conventional two level inverters, the multilevel inverters (MLI) are predominantly developed with the help of power electronic devices for medium and high voltage applications [5]-[6]. The output voltage of MLIs is in stepped in nature, and then the error between the reference waveform to actual waveform may reduce. So the MLIs are having less harmonic content with improved performance with development of pulse width modulation technique for switching operation of devices [7]-[9]. The MLI are having in different configurations such as diode clamped [10], flying capacitor [11] and cascaded H-bridge inverters [12]. But to increase the number levels, the number devices are required more and the switching losses are higher in the above type of configurations. And also the sharing of voltage across each device is also not in same. So, the new topologies of MLI are introduced with modular of addition and subtraction of sources for lower switching losses along with equal sharing voltage across each device, which are Hybrid Multilevel inverters [13]-[14].

In off grid or islanded application, the solar PV power generation systems are more preferable as compared to other Non conventional energy sources [15]. Generally, a small scale power supply network in remote areas will operated in off grid application. But the probability of power failure issues, because of source and switches of inverter topologies are more. So, this effect may cause to damage the solar PV system and it requires more time to settle in steady state. To avoid these issues, the MLI are operated with fault resilient ability technique for SPV systems without any interruption of power supply to loads [16]. In the paper [17], the multilevel inverter with switch failure problem under fault condition and in paper [18], coupled scott transformer based fault tolerant configuration for grid connected fed solar PV

Power Quality Improvement with Transformer-less Dynamic Voltage Restorer (TDVR)

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Abstract—At present days the use of power electronic devices are increasing and making the power System network pollutant which causes power quality issues. Majorly power quality issues are because of voltage sag and different issues inclusive of voltage swell, flicker, voltage variation, notches, and voltage imbalance. In this paper 'Predictive Voltage Control of Transformer-less Dynamic Voltage Restorer(TDVR)' is proposed. A Dynamic Voltage Restorer (DVR) is a series compensator connected in series with a line at the level required to balance the voltage waveform on the load side and maintain a sine wave in the event of a power quality problem. The proposed control scheme uses the system's discrete-time state-space model to generate the switching states of a voltage source inverter (VSI) switches. The modelling of the proposed system will be carried out through the MATLAB environment.

1. Introduction

Modern industrial and domestic applications need continuous supply for the proper functioning of the machines, and equipment. Failing to provide continuous supply leads to huge economic losses to industries or complete plant shutdown, and equipment failure. The term power quality defines maintaining balanced sinusoidal voltage and current waveforms. With the advancement in power electronic-based devices such as better efficiency and proper control, customers are showing interest in using these devices. We know the population is ever-increasing and in turn use of loads also increasing. When the loads drawing non-sinusoidal current from the supply behave as non-linear loads. At present days the use of non-linear loads is increasing in distribution system which causes severe power quality issues. These power quality issues [1] are classified as voltage-related and current-related issues. The voltage disturbances such as voltage dip/sag, voltage rise/swell, flicker, harmonics, voltage unbalance, voltage transients, etc affect the performance of sensitive loads. The concept of "CUSTOM" power devices was invented to address these voltage irregularities. There are many custom power devices are available such as DSTATCOM, DVR, and UPQC. Among them, DVR is considered the effective solution to solve voltage-related problems.

A DVR is a series-connected device connected to a power distribution system between supply and load. The DVR uses an injection transformer to inject the required amount and return the load voltage to its nominal value in the event of a voltage failure on the supply side. The purpose of using an injection transformer is it boost up voltage generated by the voltage source converter and provides isolation. But the limitations associated with the transformer are large size, cost, and weight, which also contribute to losses to DVR.

To overcome the limits of the traditional DVR, a Dynamic Voltage Restorer without Transformer (TDVR) is implemented. In this method, the required voltage is supplied by the

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Comparative Analysis of Resonant Converters

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This paper presents the comparison among the different resonant converters especially in the Analysis of Total Harmonic Distortion (THD). The THD of output current from the inverter circuit (or) resonant current of different resonant converters such as series LC, LLC and LCC is determined. The resonant converters are to be operated above the resonant frequency to obtain the Zero Voltage Switching (ZVS) to achieve the lesser switching losses. The simulation of various resonant converters is performed in the MATLAB/Simulink software.

Keywords: Resonant Converter, Resonant Frequency, Total Harmonic Distortion (THD), Resonant Current.

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Analysis of general purpose fuzzy controller for second and fourth order DC-DC converter

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ABSTRACT

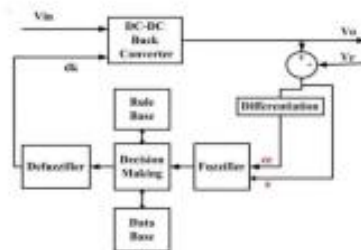
In this paper implementation of fuzzy controllers for DC-DC converters is presented. Fuzzy logic control topology is developed and implemented for different types of DC-DC converters such as the buck, the boost, the buck-boost, and the sepic converters. In this paper sudden changes in a load is considered and discussed. The fundamentals governing the design, control and performance of the DC-DC converters are also illustrated. Simulation results have been obtained by considering appropriate scaling factors associated with the input variables of the fuzzy controller.

INTRODUCTION

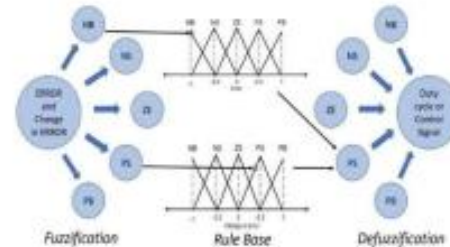
We can see large number of DC-DC converters families and all of them consist many hundreds of network topologies. Dividing each converters property and the characteristics is the challenging task. All the converters are designed to avail the requirements of particular application. There are several converters were classified based upon their applications like, buck converter, buck-boost converter, boost converter, Cuk converter, fly back converter etc. The DC-DC converters were widely using in the world, based upon the application requirements. The chapter discusses the classification of DC-DC converter and its conduction mode of operation. The device which has the property to take the input voltage and gives out the output voltage which both of DC are actually accepted by chopper. The input voltage which is given and output voltage we get is of different level. The circuits of power electronics which convert the electrical voltage of one level to another level by the action of switching.

Applications of DC-DC converter:

In the present study, the converters such as buck, boost and buck boost are considered for the analysis of fuzzy. Here, the output voltage is step down or less leveled the input in the case of buck converter. Whereas, in boost converter the output voltage is leveled up which transformed by input voltage. In case of buck boost converter the output voltage is leveled up or leveled down which based on the requirement.



Buck and Boost converter block diagram



Fuzzy rule base defining relation between input and output

Given below is the tabular form representing the membership function rules.

MULTILEVEL INVERTER WITH SELF-BALANCED SWITCHED CAPACITOR FOR VEHICLE APPLICATION

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Abstract: This paper describes a three-phase multilevel inverter used in renewable energy sources and electric cars applications. This inverter includes two low-voltage transistors, two high-voltage transistors, two diodes, and two capacitors in each phase, each of which is supplied with power from a single dc voltage source. Except for the two high-voltage transistors, which can withstand twice the dc input voltage, every component is rated for the dc input voltage. Phase-disposition pulse width modulation technique is used to operate transistors with high and low voltages operating at different switching frequencies. This is very beneficial for reducing switching losses. The two capacitors are linked to the dc source in parallel and series alternatively, yielding a high ac output voltage with various levels, self-balanced capacitor voltages, and low voltage ripples. The topology, working principle are examined for RL-load and induction motor load. The SCMLI topology is demonstrated using MATLAB/simulink software.

Keywords

Pulse width modulation (PWM), multilevel inverter (MLI), switched-capacitor

1. Introduction

With the quick advancement of electric vehicles (EVs) and sustainable power sources (RES, for example, sunlight based chargers and energy units), supporting sort inverters are turning out to be progressively significant in applications involving low voltage when it is necessary to boost a dc source's low voltage before changing it to a high relative ac voltage to power an EV driver's engine (or) interface with the framework. Course supporting sort dc-dc converters with an ordinary two-level inverter is the popularised answer for this kind of inverter. All semiconductors in the 2-level inverter should get through high voltage and work at a high exchanging recurrence in this framework, bringing about expanded exchanging misfortune and a significant EMI issue happens. Another kind of multilevel inverter (MLI) in view of exchanged capacitor (SC) innovation has been acquainted all together with addressing this issue[1].

SuperCapacitor based MLIs (SCMLIs) are used for low-voltage applications, as opposed to traditional MLIs such as Neutral Point Clamped (NPCMLI), Fixed Capacitor (FCMLI), Cascaded H-bridge (CHBMLI), which are used in both medium- and high-voltage operations commercially. These inverters provide features of voltage-boosting and self-balanced capacitor voltages. Furthermore, without the usage of additional balancing circuits or control algorithms, the voltages of all capacitors in this SCMLI are automatically balanced.

The low voltage of a single dc source is converted to three-phase high ac voltages with four levels per phase using a SCMLI with motor applications developed in this paper. The suggested three-phase SCMLI is suitable for low-