ISO 9001:2015 AICTE-CII: GOLD Category Institute NAAC-'A' Grade Institute (CGPA: 3.21) NIRF-2020 Rank Band: 201-250

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
Estd-1980 KITSW
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

TECHNICAL MAGAZINE

A.Y. 2022-23

DEPARTMENT OF

ELECTRICAL & ELECTRONICS ENGINEERING

Technical Magazine Committee:

Editor	:	**Dr. G. Rajender**	**HoD, EEE Dept.**
Members	:	**Sri. T. Praveen Kumar**	**Asst. Prof., EEE Dept.**
		Dr. G. Sunil Kumar	**Asst. Prof., EEE Dept.**
		K. Srinivas	**Asst. Prof., EEE Dept.**

CONTENTS

Technical Magazine Committee:

Editor	:	Dr. G. Rajender	HoD, EEE Dept.
Members	:	Sri. T. Praveen Kumar	Asst. Prof., EEE Dept.
		Dr. G. Sunil Kumar	Asst. Prof., EEE Dept.
		K. Srinivas	Asst. Prof., EEE Dept.

Students Editorial Board:

Sumayya Shanaz	(II/II, M.Tech)
Mekala Raju	(II/II, M.Tech)
K. Sujeeth Kumar	(IV/IV, B.Tech)
K. Sujith Kumar	(IV/IV, B.Tech)
B. Sruthi	(IV/IV, B.Tech)
Ch. Sheetal	(IV/IV, B.Tech)
Nishath Tabassum	(IV/IV, B.Tech)
G. Santhosh Kumar	(IV/IV, B.Tech)
T. Eshwar Naik	(IV/IV, B.Tech)
J. Sai Chandu	(IV/IV, B.Tech)

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.

Dr. G. Rajender
HOD, EEE Dept.

Faculty publications - Journals

List of Journals published by Faculty during A.Y. 2022-23:

S. no.	Name of the Faculty	Title	Journal
1	Prof. V. Rajagopal, Sri. D. Sharath	Optimized Controller Gains Using Grey Wolf Algorithm for Grid Tied Solar Power Generation with Improved Dynamics and Power Quality in *Chinese Journal of Electrical Engineering*, vol. 8, no. 2, pp. 75-85, June 2022, doi: 10.23919/CJEE.2022.000016.	Chinese Journal of Electrical Engineering
2	Dr. B. Jagadish Kumar	Certain Investigations On Current Ripple Free In A Single Phase Isolated Converter For Fuel Cell Applications *Positif Journal*, ISSN NO : 0048-4911, vol. 22, no. 7, July. 2022, pp. https://doi.org/10.37896/psj30.7/1240	Positif Journal
3	Dr. C. Venkatesh, Prof. V. Rajagopal	Multilevel Inverter with Self-Balanced Switched Capacitor for Vehicle Application in *Positif Journal*, vol. 22, issue 9, pp. 1-10, Sept. 2022, doi: https://doi.org/10.37896/psj30.9/1400.	Positif Journal
4	Dr. A. Madukar Rao	Fault tolerant nine-level inverter topology for solar water pumping applications, *International Journal of Electrical and Computer Engineering (IJECE)*, vol.12, no.4, August 2022, http://doi.org/10.11591/ijece.v12i4.pp3485-3493.	International Journal of Electrical and Computer Engineering (IJECE)
5	Dr. M. Santhosh	A novel dynamic selection approach using on-policy SARSA algorithm for accurate wind speed prediction. Electric Power Systems Research *(Elsevier journal).* 2022 Nov 1; Vol. 212: p.108174. (https://doi.org/10.1016/j.epsr.2022.108174)	Elsevier journal

S. no.	Name of the Faculty	Title	Journal
6	Dr. B. Jagadish Kumar	Dynamic performance of solar PV array Fed water pumping system using Boost-buck converter Fed permanent magnet synchronous motor drive", *Journal For Basic Sciences*, Volume 23, Issue 3, , ISSN: 1006-8341,pp-49-63,March, 2023	Journal for Basic Sciences
7	Dr. B. Jagadish Kumar, R. Sunnymisthavani	Investigations on solar PV and battery storage using a novel configuration of a three-level NPC inverter with an innovative control technique", *Journal For Basic Sciences*, Volume 23, Issue 3, , ISSN: 1006-8341,pp-518-525,March, 2023.	Journal for Basic Sciences
8	Dr. B. Jagadish Kumar, D. Vishal, K. Sujith Kumar	Investigations on Solar PV Array Fed Water Pumping System using Permanent Magnet Synchronous Machine through Boost Buck Converter", Journal For Basic Sciences, Volume 23, Issue 3, , ISSN: 1006-8341,pp-49-63,March, 2023.	Journal for Basic Sciences
9	A.M. Rao, C.P. Kumar	Open-circuit fault resilient ability multi-level inverter with reduced switch count for off grid applications" , International Journal of Electrical and Computer Engineering (IJECE) Vol. 12, No. 3, June 2022, pp. 2353~2362 ISSN: 2088-8708, DOI: http://doi.org/10.11591/ijece.v12i3.pp2353-2362 .	International Journal of Electrical and Computer Engineering (IJECE)

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

V. Rajagopal*, Danthurthi Sharath*, G. Vishwas*, J. Bangarraju#, Sabha Raj Arya$ and Ch. Venkatesh*

*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, Warangal, Telangana, India,

#Department of Electrical and Electronics Engineering, B V Raju Institute of Technology, Narsapur Medak, Telangana, India,

$Department of Electrical Engineering, Sardar Vallabhbhai National Institute of Technology, Dumas Road, Surat – 395007, (India),

vrg.eee@kitsw.ac.in, sharathdanthurthi.02@gmail.com, vishwas13213@gmail.com, bangarraju.jampana@bvrit.ac.in, sabharaj79@gmail.com, cv.eee@kitsw.ac.in

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 estimatation 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

CERTAIN INVETIGATIONS ON CURRENT RIPPLE FREE IN A SINGLE PHASE ISOLATED CONVERTER FOR FUEL CELL APPLICATIONS

B.Jagadish Kumar
Department of Electrical and Electronics Engineering,
Kakatiya Institute of Technology and Science, Warangal, India,
Email: bjk.eee@kitsw.ac.in

Abstract: *The ripple current causes power excess flow and heat up the device and electrical capacitor are exposed to rise in temperatures overall reduces the capacitor's lifespan. A single-phase direct current-alternating current converter in a fuel cell stack draws an alternating current ripple current at double the output frequency. Because of the hysteresis effect, a ripple current like this could degrade the life and efficiency of a fuel cell. In this paper a circuit is designed using lesser capacitor value and less number switching components in the MATLAB by attaching an LC filter directly to the transformer where the input and output are not connected.*

Keywords: **Fuel Cell, Ripple Current Reduction, Frequency, PWM.**

1. INTRODUCTION

Renewable energy sources refers to all of nature's unlimited energy sources, such as the sun and wind. Because these energy sources are found in nature and are replenished organically, they never run out. Renewable energy sources are ecologically benign since they do not emit carbon dioxide or other greenhouse gases. They are endless since they are derived from non-depleting and naturally renewed natural resources. They are healthier since they do not produce poisonous residues that are hazardous to people's health. Due to the increasing demand of renewable energy sources many researches have done to achieve environmentally friendly energy systems like PV and newly fuel cells have been installed and the project is still working on improving its performance. But one of the most serious issue with fuel cells is that their lifetime is shortened owing to ripple current. As a result, in order to extend its lifespan, grid interconnection converters must reduce ripple current.

1.1. Fuel Cell

A fuel cell is a type of galvanic cell that converts the energy of a fuel-chemical oxidant into electrical energy. There are two electrodes and an electrolyte in a fuel cell. The fuel and oxidant are continuously and independently provided to the cell's two electrodes. Sir William Grove has first developed a fuel cell in 1839.He used platinum electrode and H2 and O2 as reactants. The electrodes are porous providing a large surface area. Chemical energy is first transformed into heat, followed by heat being transferred into mechanical energy, and finally mechanical energy being converted into electrical energy. Heat can only be transferred to mechanical energy to a certain amount. However, chemical energy is totally transformed into electrical energy with 100% efficiency in fuel cells.

1.2. Overview

As when the single-phase pulse width modulation (PWM) inverter is applied while connecting the grid the frequency will be increased and it will become twice higher frequency of power ripple of the electricity grid. PWM lowers the average power generated by an electrical source by separating a single signal into discrete pieces. The PWM approach distributes the signal's energy across a sequence of pulses rather than a

MULTILEVEL INVERTER WITH SELF-BALANCED SWITCHED CAPACITOR FOR VEHICLE APPLICATION

Moulika DANDU[1], Venkatesh CHALLA[2], Rajagopal VERAMALLA[3]

[1, 2, 3]Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology & Science, Warangal, Telangana, India

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-

International Journal of Electrical and Computer Engineering (IJECE)
Vol. 12, No. 4, August 2022, pp. 3485~3493
ISSN: 2088-8708, DOI: 10.11591/ijece.v12i4.pp3485-3493

Fault tolerant nine-level inverter topology for solar water pumping applications

Narasimha Rao Mucherla[1], Nagaraj Karthick[1], Airineni Madhukar Rao[2]
[1]School of Electrical Engineering, Lovely Professional University, Phagwara, India
[2]Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, Warangal, India

Article Info

Article history:

Received Apr 17, 2021
Revised Mar 13, 2022
Accepted Mar 26, 2022

Keywords:

Fault tolerant inverter
Nine level inverter (9-L)
Solar photovoltaic generation system
Water pumping applications

ABSTRACT

Diminished voltage pressure and occasional-general harmonic distortion are the essential causes for such a ways and extensive usage of multi-level inverters (MLIs) in numerous industrial applications. Nonetheless, unwavering quality is one of the significant worries of MLIs as it utilizes countless switches as contrasted to 2-level inverters. Here, a fault tolerant 9-level inverter setup for the use of photovoltaic (PV) system-water pumping applications is suggested. This fault tolerant 9-level inverter is accomplished by combining a 2-level inverter, a 3-level fault tolerant inverter alongside switches with bidirectional ability. The setup is taken care of with four PV fed sources. The arrangement suggested shows the behavior towards switch fault in at least one inverter legs under open circuit conditions. On account of source failure, it could use the better hotspot for introducing continuous power to the water pumping motor. Meanwhile, the suggested fault-tolerant inverter works as seven-level inverter. The activity related to proposed inverter in the course of various failure modes is mentioned and simulated the usage of MATLAB/Simulink.

Corresponding Author:

Narasimha Rao Mucherla
School of Electrical Engineering, Lovely Professional University
Phagwara, India
Email: narsimhakits@gmail.com

1. INTRODUCTION

Water is a need for enduring. It is required for drinking and home grown uses, and it is required for huge scope water system, development, and force creation. Water assumes an important feature within the advancement of any country. The non-public pride in any kingdom pretty is based on the quantity and nature of reachable water assets in that kingdom. It is classed that an ordinary of five liters of recent water is needed according to individual each day for day-by-day survival [1]. Although a lot of fine water is available in the world, regularly it is not always accessible at areas wherein it thoroughly can be directly applied. This increases the want to pump excellent water from its supply to the regions where it is miles popular. For this purpose, water pumping had been being used for quite a long term. Sun photovoltaic energy has been supplied in overdue eighties and has expanded excessive significance by mid-nineties. Earlier sunlight totally based photovoltaic (PV) cells had been very wasteful with the effectiveness as low as 5-6% and profoundly pricey [2]. Farmers in a country like India are subjected to difficulties with respect to water starting from lack of rainfall for months together in the summers to heavy, crop destroying rains in off seasons. This results in an inevitable drought leading to several socio-economic problems that affects the food chain of the whole country. Solar powered water pumping system will effectively terminate this problem with its ability to store solar power thereby strengthening the pumping system.

***Journal homepage**: http://ijece.iaescore.com*

Electric Power Systems Research 212 (2022) 108174

Contents lists available at ScienceDirect

Electric Power Systems Research

journal homepage: www.elsevier.com/locate/epsr

A novel dynamic selection approach using on-policy SARSA algorithm for accurate wind speed prediction

Vishalteja Kosana [a], Madasthu Santhosh [b], Kiran Teeparthi [a,*], Santosh Kumar [c]

[a] Department of Electrical Engineering, National Institute of Technology Andhra Pradesh, India
[b] Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, Warangal, 506 015, Telangana State, India
[c] Department of Computer Science Engineering, International Institute of Information Technology, Naya Raipur, India

ARTICLE INFO

Keywords:
Wind speed prediction
Dynamic variation
On-policy learning
Off-policy learning
Dynamic selection

ABSTRACT

Wind speed forecasting (WSF) is a viable option for increasing energy consumption efficiency. Previous forecasting methods rely on global accuracy, and the performance of these models changes with each time step due to local variations in wind characteristics, which is not ideal. Considering this problem, a novel dynamic selection of the best model (DSM) approach using reinforcement learning (RL) is proposed based on-policy state action reward state action (SARSA) for improved wind speed forecasting. DSM is defined as an RL problem and solved with an on-policy SARSA agent. The proposed approach is divided into a forecasting pool of models (FPM) and a learning agent, respectively. FPM comprises five robust forecasting approaches that have been trained and tuned. These models perform the WSF individually, and the SARSA agent is developed to perform the DSM for each step. The proposed approach is evaluated for 1 h ahead (1HA) WSF using two real-time wind speed datasets from Garden City, Manhattan, and Idalia, Colorado. This study provides a thorough examination of the proposed approach performance with an off-policy Q-learning algorithm for the DSM (QL-DSM). Compared to FPM's models, the proposed SARSA-DSM approach enhanced prediction accuracy by 24.27% and 39.73% in two case studies. The proposed approach also improves 14.57% and 30.25% over the QL-DSM.

1. Introduction

The main aim of the 26th United Nations Climate Change Conference (COP26) is to acquire global net-zero emissions by 2050. Long-term goals set by the governments are increased to attain net zero in 2050, while short-term targets are indistinct. Progress is still far from the level needed despite young activists' increased concerns and anger. To achieve the world's net zero objectives, there is a need for rapid transition to renewable energy sources (RES) such as solar and wind. Global annual installations of RES are around 180 GW per year to obtain the COP26 goal. For wind energy, global new installations are 93 GW in 2020 to achieve a total installed capacity of 743 GW [1]. Hence, wind energy plays a prominent role in attaining net-zero objectives. WSF is essential for enhanced wind energy integration, building smart grids, and optimal dispatch planning and WSF gives requisite tools to avoid anticipated loss. Due to the volatile and intermittent nature of wind speed time-series, WSF is a challenging task requiring adamant care and caution. The implemented WSF model needs proper validation [2]. Accurate WSF methods provide essential information to help network operators and system designers design optimal wind farms and balance electricity demand and supply. Therefore, wind speed forecasting has always attracted special attention from both academia and industry.

WSF approaches are divided into different categories: persistence approach, physical approach, statistical approach, AI-based approaches, hybrid approach and ensemble approaches. The persistence approach is the most simple and direct method of predicting wind speed. According to the persistence approach, the current wind speed value is equivalent to the future wind speed. Physical models utilizes terrestrial variables and predicts wind speed by solving a complicated mathematical equation [3,4]. Physical models include numerical weather prediction (NWP) models. Predictor, UK Met Office, and High-Resolution Limited Area Model (HIRLAM) are some available types. In [5], the analysis of the NWP predictions for wind power generation is presented. As the gathering of physical data is complex, these models are not ideal for making short-term forecasts. For this reason, the statistical approaches are introduced, in which the model is trained using an instant collection of wind data from that area, which includes various

* Corresponding author.
E-mail addresses: kosanavishal@gmail.com (V. Kosana), madasthusanthosh@ieee.org (M. Santhosh), kiran.t39@nitandhra.ac.in (K. Teeparthi), santosh@iiitnr.edu.in (S. Kumar).

https://doi.org/10.1016/j.epsr.2022.108174
Received 5 February 2022; Received in revised form 12 May 2022; Accepted 4 June 2022
Available online 15 June 2022

Dynamic Performance of Solar PV Array Fed Water Pumping System Using Boost-Buck Converter Fed Permanent Magnet Synchronous Motor Drive

B.Jagadish Kumar[a], D. Vishal[b,*], P.Sai Tharun[c], G.Srikanth[d]

[a]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*
[b]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*
[c]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*
[d]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*

Abstract

The world is shifting is from conventional energy sources to non-conventional energy sources, due to decrease of the fossil fuels available on the earth crust and to establish a new energy to produce the electricity from it. One such energy is solar energy. Solar energy is used in producing electricity, by converting the photon energy into electrical energy, to convert this a medium is used knows as the solar panel. This solar energy is usually weather dependent. It is available free of cost, but the availability time is less, usually in the mornings. In the rainy seasons, chances of using solar energy are less. Many factors are affecting the solar energy generation like temperature, weather, sun angle towards the panel. From these conditions, extracting the same amount of solar energy is a bit of a task, such conditions are called dynamic conditions. And this project tests under dynamic conditions, so it is called the dynamic model for testing the behavior of the solar PV array fed water pluming system using PMSM through boost-buck converter under dynamic state.

Keywords: Solar PV Array, MPPT, Three voltage source inverter (VSI), Dynamic Condition

*corresponding author

Preprint submitted to *April 10, 2023*

Investigations on solar PV and battery storage using a novel configuration of a three-level NPC inverter with an innovative control technique

R. Sunnysmithavani [1]*, *Dr.* Jagadish Kumar B [2]
[1] M-Tech student, Department of Electrical and Electronics Engineering ,Kakatiya institute of technology and science, KITSW, Telangana, India.

[2] Associate professor Department of Electrical and Electronics Engineering, Kakatiya institute of technology and science, KITSW, Telangana, India

[1]*R.Sunnysmithavani . E-mail: m21pe009@kitsw.ac.in
Dr. Jagadish Kumar B [2] .E-mail: bjk.eee@kitsw.ac.in

Abstract: *Evolved power electronic systems have become compulsory in use to expand renewable energy resources. Major job performed by power electronic systems in solar or wind energy functions is to extract ample power as possible from the source. In this study, a single, MPPT-capable three-level converter is used to implement and study a grid-tied, three-phase solar PV system combined battery storage. Costs will fall, efficiency will rise, and power flow control will become more flexible as a result. The ethos of the suggested configuration as well as the theoretical foundation of the suggested modulation method. Novel control MPPT program is also provided for the given system to govern the power transfer among the solar PV modules. Efficiency of suggested methodology is evaluated by simulating multiple situations, battery charging and discharging with varying solar irradiations. MATLAB Software SIMULINK package are utilised to further develop and validate the proposed strategy and topology .* [1]

Keywords: MPPT- maximum power point tracking

1. INTRODUCTION

The power electronic topologies that are commonly utilised in three-phase applications to transmit power originating in renewable energy source to the grid are one-stage and two-stage conversion. A dc-to-dc converter is often utilized as the first stage in a double-stage conversion for a PV system, followed by a dc/ac inverter. The dc/dc converter, also delivers the necessary dc voltage for the dc to ac inverter, makes (MPPT) easier. The inverter's job in a grid-tied or stand-alone PV solar structure is to provide 3 phase sinusoidal voltages or currents to pass on electricity to the grid or any load.

Because single converter is required to perform the dual-stage activities, the structure will be less expensive and more efficient with the single-stage connection. A useful active control method is required. For heavy power applications, 3 phase, one-stage PV systems with a voltage-source converter (VSC) are now the industry standard. One of the major difficulties is the unpredictability and fluctuation of solar and wind energy functions. This issue can be solved by utilising battery energy storage along with Grid-tied renewable energy sources.

[1] R.Sunnysmithavani

Investigations on Solar PV Array Fed Water Pumping System using Permanent Magnet Synchronous Machine through Boost Buck Converter

B.Jagadish Kumar[a], D. Vishal[b,*], K.Sujith Kumar[c], P.Sai Tharun[d]

[a]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*
[b]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*
[c]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*
[d]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, opp: Yerragattugutta, Bheemaram(v), Hasanparthy (M), warangal, 506015, Telangana, India*

Abstract

The use of solar energy and its advancement have greatly increased. Numerous applications have been created and continue to be developed. Using a solar PV array to pump water is one of the more intriguing applications. The effective water pumping system described in this study makes use of a solar PV array, DC-DC converters, a voltage source inverter (VSI), and a PMSM motor. Attaining good performance under steady-state conditions. There is one standard insolation value for testing. The water pumping must function at a standard insolation level with a minimum amount of converter loss in order to get the intended results. Under various dynamic settings, such as variable insolation levels and various temperatures, this project may be expanded further.

Keywords: Solar PV Array, DC-DC converter, voltage source inverter (VSI), PMSM motor

*corresponding author
Email addresses: bjk.eee@kitsw.ac.in (B.Jagadish Kumar), vish2512d@gmail.com (D. Vishal), sujithkumar29b@gmail.com (K.Sujith Kumar), pulitharun21@gmail.com (P.Sai Tharun)

Preprint submitted to *February 28, 2023*

International Journal of Electrical and Computer Engineering (IJECE)
Vol. 12, No. 3, June 2022, pp. 2353~2362
ISSN: 2088-8708, DOI: 10.11591/ijece.v12i3.pp2353-2362

Open-circuit fault resilient ability multi level inverter with reduced switch count for off grid applications

Pavan Kumar Chillappagari[1], Karthick Nagaraj[1], Madhukar Rao Airineni[2]
[1]School of Electrical Engineering, Lovely Professional University, Punjab, India
[2]Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology and Science, Warangal, India

Article Info

Article history:

Received Apr 17, 2021
Revised Dec 22, 2021
Accepted Jan 2, 2022

Keywords:

Fault resilient ability
Multi-level inverter
Phase disposition pulse width modulation
Reliability

ABSTRACT

In a multi-level inverter (MLI), 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. The concept of fault tolerance is not considered in many such configurations; due to this the reliability of the MLI is very low. So now it is a major research concern, to develop a strong fault resilient ability power electronic converter. In this work, a novel configuration of a multilevel inverter with a lower switch count is proposed and analyzed with fault tolerance operation for improvement of reliability. Generally, the fault-tolerant operation is analyzed in only any one of the switches in MLI. But the proposed topology is concerned with multiple switch fault tolerance. Further, the phase disposition pulse width modulation (PDPWM) control scheme is utilized for the operation of the proposed inverter topology. The proposed inverter topology is simulated in MATLAB/Simulink environment under normal and faulty condition; the results are obtained and validated.

Corresponding Author:

Pavan Kumar Chillappagari
School of Electrical Engineering, Lovely Professional University
Jalandhar, Punjab, India
Email: pavanram1947@gmail.com

1. 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 [1]. Due to rapid development of power electronic control techniques in electrical power generation and more advantages of solar photovoltaic (PV) systems, the solar photovoltaic (SPV) systems are used in many industrial and residential applications. In order to utilize this SPV power, for this application two stage power conversion is required. But to avoid the increment of losses and improve the efficiency the single stage power conversion of two level inverters are used [2], [3]. The conventional two level inverters are having, high harmonic content, more switching losses, and lower fundamental magnitude.

To overcome these drawbacks in traditional2-level inverters, the multi-level inverter (MLI) are predominantly developed with the help of power electronic devices for medium and high voltage applications [4], [5]. 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 [6]. The MLI are having in different configurations such as diode clamped [7], flying capacitor [8] and cascaded H-bridge inverters [9]. But to enhance the voltage levels, the number devices are required more

Faculty publications – Conference Papers

List of Conference Papers published by Faculty during A.Y. 2022-23:

S. no.	Name of the Faculty	Title	Name of the Conference
1	Dr. D. Rakesh Chandra	Short-Term Load Forecasting in DSO Substation Networks with Dimensionality Reduction Techniques, *IEEE international Conference on Environment and Electrical Engineering* (CPS Europe), pp.1-6, July 2022.	IEEE international Conference on Environment and Electrical Engineering
2	Dr. G. Rajender	Design and development of Mini electric bike, *AIP Conference Proceedings*, October 2022.	AIP Conference Proceedings
3	Dr. C. Venkatesh, Dr. Y. Manjusree	ANFIS Based VSC Drive Solar Fed Water Pump with Zeta Converter", AIP Conference Proceedings 2418, 040031 (2022); https://doi.org/10.1063/5.0083115.	AIP Conference Proceedings
4	Dr. C. Venkatesh	"Single-Input Dual-Output Three-Level DC–DC Converter", *National Conference on Electric Vehicle Charging Infrastructure*, 9th & 10th May 2022, ISSN 2347 – 3258.	National Conference on EV
5	A. V. V. Sudhakar, Manjusree Y. and Venkatesh C.	SVC compensated transmission line protection using wavelet approach Cite as: AIP Conference Proceedings 2418, 040027 (2022); https://doi.org/10.1063/5.0083112 Published Online: 24 May 2022	AIP Conference Proceedings

2022 IEEE International Conference on Environment and Electrical Engineering and 2022 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe) | 978-1-6654-8537-1/22/$31.00 ©2022 IEEE | DOI: 10.1109/EEEIC/ICPSEUROPE54979.2022.9854749

Short-Term Load Forecasting in DSO Substation Networks with Dimensionality Reduction Techniques

Francesco Grimaccia
Department of Energy
Politecnico di Milano
Via Lambruschini 4, Milan, Italy
francesco.grimaccia@polimi.it

Marco Mussetta
Department of Energy
Politecnico di Milano
Via Lambruschini 4, Milan, Italy
marco.mussetta@polimi.it

Alessandro Niccolai
Department of Energy
Politecnico di Milano
Via Lambruschini 4, Milan, Italy
alessandro.niccolai@polimi.it

Venkataramana Veeramsetty
Center for AI and Deep Learning, Dept. of EEE
SR University
Warangal, India
dr.vvr.research@gmail.com

Dongari Rakesh Chandra
Department of Electrical and Electronics Engineering
Kakatiya Institute of Technology and Science (KITS)
Warangal, India
drc.eee@kitsw.ac.in

***Abstract*—Electric load forecasting is a crucial task for Distribution System Operators (DSOs) in power system for many applications to face future RES increasing penetration with respect to different time horizons related to optimal operations, congestion prevention or future planning. In this field, neural computing and proper reduction techniques can be used to implement useful management tools to cope with uncertainty and future smart grid services. In this manuscript the combined use of Recurrent Neural Networks and Principal Component Analysis techniques is validated to guarantee the forecasting capability of electrical loads related to a grid substation. A historical series of measured Medium Voltage data is considered with the aims to demonstrate the efficiency of the designed procedure. Following all reported numerical results, the authors discuss a novel approach to be extended also to real end user loads in LV network including also thermal consumption, with a reduced dimension of the input dataset. A comparative analysis with the SoA is reported to support the proposed methodology.**

***Index Terms*—dimensionality reduction, load forecasting, recurrent neural networks, principal component analysis**

I. Introduction

Electrical power load forecasting is required for the utilities in order to optimize the operation and maintenance costs, the demand and supply management, improve the reliability, for proper planning for future investments and for effective energy trading [1], [2]. Based on time of forecasting, electric power load forecasting is classified as very-short, short, medium and long-term load forecasting [3], [4].

A lot of work has been done on demand side forecasting problem for accurate prediction using artificial intelligence (AI) techniques as shown in Table I. However, most of these approaches have issues like model complexity and accuracy. So there is a need to build a less weight and more accurately predicting AI model [5].

TABLE I: Literature survey

Reference	AI Model
[6]	Stacking ensemble-based algorithm
[7]	Multi-temporalspatial- scale technique
[8]	k-Medoid based algorithm
[9]	Markov-chain distribution model
[10]	Fusion forecasting
[11]	Bi-directional GRU and LSTM
[12]	Deep Residual Network with convolution layer
[13]	Regression Models
[14]	LSTM & Factor Analysis
[15]	ANN
[16]	ANN with Ensemble Methods
[17]	Random Forest & GRU

In this paper, a combination of principal components analysis(PCA) and Recurrent Neural Network (RNN) is used to build a more accurate light weight model to predict load for day-ahead energy market (DEM) and hourly-ahead energy market (HEM) . In this article, two approaches are used to predict the load for each market.

- Predict the load P(T) using previous three hours P(T-1), P(T-2), P(T-3) (only for hourly-ahead market), load on previous three days but at same time P(T-24), P(T-48), P(T-72) and load on previous three weeks but at same time P(T-168), P(T-336), P(T-504) in order to incorporate the weekends impact.
- Predict the load P(T) based on proper number of principal components (PCs) extracted using PCA which covers 90% variance available in original data

Based on these two approaches, four AI models are developed to predict load for both markets and details about these four models presented below.

- Model-1: RNN model to forecast the consumption for HEM based on input features P(T-1), P(T-2), P(T-3), P(T-24), P(T-48), P(T-72), P(T-168), P(T-336), P(T-504)

978-1-6654-8537-1/22/$31.00 ©2022 IEEE

Design and Development of Mini Electric Bike

Dhiyaneswaran Jaganathan[1,a)], Rajender Gogu[2,b)], Balakumar Subramanian[3,c)], Harikumar Pallathadka[4, d)], Nithya Sabtharishi[5, e)]

[1]*Department of Mechanical Engineering, Sri Krishna College of Engineering and Technology, Coimbatore - 641008, Tamil Nadu, India.*

[2]*Department of EEE, Kakatiya Institute of Technology and Science , Warangal, Telangana*

[3]*Electrical and Computer Engineering, Arba Minch University, Arba Minch, Ethiopia*

[4]*Manipur International University, Imphal, Manipur, India*

[5]*Department of Information Technology, P.S.N.A College of Engineering and Technology, Dindigul, Tamilnadu*

Corresponding author: a)dhiyaneswaranj@skcet.ac.in, b)gr.eee@kitsw.ac.in, c)balakumar25dec@gmail.com, d)harikumar@miu.edu.in, e)snithya@psnacet.edu

Abstract. The Concept and idea behind our E-bike is that due to the increase in usage of automobiles in the world, in turn it increases global warming and heat in our world. On behalf of this, the Indian government took a mission that by 2030, the nation will be transformed to a 100 percent e-mobility country. To achieve this humongous mission, first we need to achieve the factors like customers acceptability and desirability and the major factor cost-efficiency. In 2021, 15.2 million units of engine-based bikes were sold in India and the previous year 21 million units were sold. So, these bike owners tend to use these bikes around 10 years from the purchase, this shatters India's 2030 mission. To overcome this, we come up with an idea that if we can convert the conventional engine bikes to electric bikes then we can displace the engines into e-bikes, which can make stupendous improvement in e-mobility usage in our country. Our bike is totally built and designed using old bikes, which makes it cost efficient as well as it retains every grain feature of bikes.

INTRODUCTION

The principle motivation to plan the mini electric bike is to defeated the issue with the environment pollutions and with the economy. In the past twenty years the fuel price in India is in upward trend only. Even every month the price is increasing around 1.15% to 3.39% in metro cities [1]. Future E bicycle is the best specialized application as an answer for the better world and forthcoming age. The E bikes is a battery worked vehicle that is efficient with low support cost and less pollutions. E bikes are an appealing option in contrast to both regular bikes and customary autos, giving a harmless to the ecosystem, fun, effective and advantageous approach to travel. E-bikes are driven with the assistance of motor and battery. Our E-Bike is the adapter electrical vehicles with two wheels. The entire system gets the power from the stored rechargeable battery. Currently these E-Bikes are fabricated at an enormous scope. Common parts utilized in E-bicycle are BLDC engine, battery, regulator, choke, chain set, etc. Many of the E-Bick are designed for single seated only [2] [3].

TABLE I. E-BIKE DETAILS IN DIFFERENT COUNTRY

S. No	Name of the Country	E- Bike Types	Speed limit in km/hr	Rang of Weights in kgs	Age in Years require
1.	India	Hand	25 - 30	NA	16
2.	US	Hand	25 -30	40	12
3.	China	Pedal / Hand	30 -35	20	14
4.	Australia	Pedal	25 -30	NA	None
5.	Canada	Hand	27 -32	NA	Various
6.	UK	Hand	27	NA	14

International Conference on Advancements in Materials and Manufacturing Engineering – ICAMME 2021
AIP Conf. Proc. 2527, 030001-1–030001-6; https://doi.org/10.1063/5.0108141
Published by AIP Publishing. 978-0-7354-4202-3/$30.00

ANFIS Based VSC Drive Solar Fed Water Pump with Zeta Converter

Sudhakar A V V[1, a)], **Manjusree Y**[2, b)], and **Venkatesh C**[2, c)]

[1]*Centre for Emerging Energy Technologies, SR University Warangal, Telangana, India - 506371*
[2]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology & Science, Warangal, Telangana, India - 506 015*

[c)]*Corresponding author: challacvs@yahoo.com*
[a)]*sudheavv@gmail.com*
[b)]*manju547sree@gmail.com*

Abstract. This paper implements a new strategy for a bidirectional power stream between the Renewable Energy Source (RES) and the load. The usage of Solar Photovoltaic (SPV) cells, as RES makes the generation eco-friendly, and Brush Less DC (BLDC) motor load is connected to run the water pump through a series of chopper and Voltage Source Inverter (VSI) in the grid. This strategy implements the Adaptive Neuro Fuzzy Interface System (ANFIS) in the solar generative framework. The proposed system extracts the maximum power, decreases the power loss of the grid, and allows the consumer to operate the motor and the loads at the maximum efficiency throughout the 24hours time. The use of Fuzzy Logic Control in the PV system allows the system to diminish the values of the switching losses, THD, and maintains the power factor, power quality, stability of the system.

Keywords: BLDC motor, SPV array, water pump, Zeta converter, VSI, MPPT

INTRODUCTION

The thermal use in the power generative plants had destroyed the environment of the only human habitat planet with its continuous emission of greenhouse gases and making the fossil fuels to extinct in future. These constraints had led to idea of trending usage of solar in multi purposes in electric power as a best alternative of renewable source. In this regard, solar power has found one of its best applications in water pumping in the irrigation sector and many sections of the present technology. Due to high efficiency, low power loss, low maintenance cost, etc. a permanent magnet motor is being used from the past decade by many scientists in their research to further improve its efficiency and operating conditions.

Ingrid isolated systems the BLDC motors completely rely on the solar power for its operation of water feeding pumps [2]. Due to this reason, it emerges with a major drawback of unreliable BLDC motor drive and pump operations under partial concealing conditions of PV array or unsupportive climatic condition to extract the maximum power from the solar PV plant. Besides this due to the absence of solar power in the night and shades the motor drives and water pumps fail to operate due to lack of sunlight.

To avoid such imperfections in the grid system several research have carried out to install the battery storage systems within the framework, to provide the power to the motor drives and pumps continuously even in the absence of solar power at the cost of expenses, maintenance, service life, etc. Even at the expense of such drawbacks, storage system not even last for long time making them to be replaced each time of its failure.

In reference papers [3-6] the proposed connection of the grid system clearly explains the interconnection of solar PV system to extract quality solar power and supply through DC-DC converter [1] and DC-AC converter to a water pumping mechanism which is a unidirectional power flow with a drawback of energy storage absence in the grid

International Conference on Research in Sciences, Engineering & Technology
AIP Conf. Proc. 2418, 040031-1–040031-12; https://doi.org/10.1063/5.0083115
Published by AIP Publishing. 978-0-7354-4368-6/$30.00

Single-Input Dual-Output Three-Level DC–DC Converter

Gatla Vaishnavi, C. Venkatesh, Madikonda Rumitha, Abhishek Shanmukhan, D. Nikhil, A. Shanmukhan
Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology & Science,
Warangal, India
b18ee006@kitsw.ac.in, cv.eee@kitsw.ac.in, b18ee012@kitsw.ac.in, b18ee009@kitsw.ac.in, b18ee023@kitsw.ac.in

***Abstract*— This paper presents the development of a non-isolated single-input dual-output three-level dc–dc converter (SIDO-TLC) appropriate for medium- and high-voltage applications. 3 level Buck-Boost converter is used in order to achieve the controllable output voltages. The main merits of this project include reducing voltage stress across semiconductor devices, improving efficiency, and reducing passive components size. This converter shows very good stability, even under simultaneous step changes of the loads and input voltage. Simulation analysis of converter output voltages for various duty cycles is presented for three cases of duty cycle control range.**

Keywords- Multiple converter, single input dual-output dc-dc converter (SIDOC), single-input dual-output three-level dc-dc converter (SIDO-TLC), buck-boost converter

I. INTRODUCTION

Multi-Output DC-DC converters have attracted increasing interest due to the high demand for energy in many fields and for different applications, such as supplying different loads at the same time and the integration of renewable energy sources (photovoltaic panels, wind turbine, etc.) in micro-grids. At higher voltages, switches voltage stress is a major challenge for multiport dc–dc converters. The reason for that are the issues such as the cost and the inaccessibility of high-voltage switches, which could also have a negative effect on overall efficiency. The project is about designing a high-efficiency multiport dc–dc converter with reduced voltage stress across semiconductor devices and shrunken passive components size. K. Filsoof and P. W. Lehn [2] proposed a bidirectional multiple-input multiple-output modular multilevel DC–DC converter and its control design. In this converter, the voltage stress on switches is shared among the levels. In addition to its complex control system, the converter is not capable of generating buck and boost output voltages at the same time. As a result, it requires two separate circuits with different topologies to generate each voltage separately. O. Ray, A. P. Josyula, S. Mishra, and A. Joshi [3] proposed integrated dual-output converter. Proposed converter which one of its outputs is boost and the other one is buck at the same time. The converter is appropriate for low-voltage applications. Meanwhile, because of high voltage stress on the diode and the series added switches, and also due to the lack of proper high input current distribution among the switches, the converter's both conduction and switching losses are high, which can lead to a fairly low system efficiency. SEPIC based dual output DC-DC converter for solar applications is proposed in [4]. The converter which is a combination of the SEPIC and five-level boost converters is composed of one switch and ten diodes. The voltage stress on the switch is reduced to one-fifth of the high voltage side. Yet, high number of diodes may effect the reliability of the system. Moreover, reducing the passive components size, which is one of the advantages of the multilevel structures, has not been achieved through the proposed converter.

This paper presents the modeling and performance of single-input dual-output DC-DC converter. Simulation results are presented to demonstrate the buck and boost utput voltage ranges under three cases of duty cycle control range.

II. SINGLE- INPUT DUAL- OUTPUT THREE- LEVEL DC- DC CONVERTER

Fig. 1 shows the circuit diagram of the Single- Input Dual-Output Three- Level DC-DC Converter. In Fig. 1, V_{in} is the input voltage, V_{o1} is the step-up output voltage, V_{o2} is the step- down output voltage. The series capacitors C_{11} and C_{12} are the filter capacitors of the step-up output, while C_2 is that the filter capacitor of the step-down output. The converter consists of 4 power switches: S_1, S_2, S_3, and S_4, with antiparallel diodes, and two power diodes: D_{11} and D_{12}. V_{ab} is that the unfiltered step-down output voltage, V_{L1} and V_{L2} are the instantaneous voltages of inductors, i_{C11} and i_{C12} are the currents of the series capacitors, i_{C2} is the current through the step-down capacitor C_2, and V_{C11}, V_{C22} are the voltages of the series capacitors and V_{C2} is the voltage of the step-down capacitor.

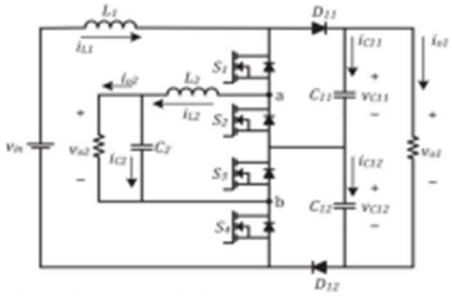

Fig. 1. Circuit Diagram of SIDO-TLC

A. Switching States of Single- Input Dual-Output Three-Level DC-DC Converter

Table I shows the switching states, the unfiltered step-down output voltage V_{ab}, the instantaneous voltages of inductors V_{L1} and V_{L2}, the currents of series capacitors i_{C11} and i_{C12}, and also the voltage change (direction) of capacitors.

B. Operating Range of Single-Input Dual-Output Three-Level DC-DC Converter

Regarding the duty cycles of the switches, there are three possible operating cases named A, B, and C for the SIDO-TLC. In the ideal situation, the control signals of S_1 and S_4 have the same duty cycles ($d_{S1} = d_{S4} = d_1$) and are 180° phase shifted. In the same way, the control signals of S_2 and S_3 have the same duty cycles ($d_{S2} = d_{S3} = d_2$) and are 180° phase shifted. Depending on d_1 and d_2 values, the operating cases can be expressed as follows:

Case A: $(1/2 < d_1$ and $d_2 < 1)$ and $(d_1 > d_2)$
Case B: $(1/2 < d_1$ and $d_2 < 1)$ and $(d_1 < d_2)$
Case C: $(d_2 + 1/2 < d_1 < 1)$ and $(0 < d_2 < 1/2)$.

SVC Compensated Transmission Line Protection using Wavelet Approach

Sudhakar A V V[1, a)], **Manjusree Y**[2, b)] and **Venkatesh C** [2, c)]

[1]*Centre for Emerging Energy Technologies, SR University Warangal, Telangana, India - 506371*
[2]*Department of Electrical and Electronics Engineering, Kakatiya Institute of Technology & Science, Warangal, Telangana, India - 506 015*

[c)]*Corresponding author:challacvs@yahoo.com*
[a)]*sudheavv@gmail.com*
[b)]*manju547sree@gmail.com*

Abstract. In modern power systems, protection of transmission line is one of the challenging issues. It is found that in a power system approximately two thirds of faults occur on transmission lines. The protection of transmission lines usually consists of a primary and a backup protection scheme. In power system multiterminal transmission protection scheme is the most quite challenging task. In the presence of PV and wind energy sources, this article implements a routine algorithm for detection, classification of faults with SVC compensated six-terminal transmission system. To calculate the fault index using detailed coefficients of the signals a multiresolution analysis is done with wavelet approach. The detailed coefficients of the fault current signals are analysed with bior1.5 wavelet to find the fault indices of short circuit faults. The algorithm is validated for multiple types of faults in a six terminal transmission network in the presence of solar PV system and wind energy sources connected. Further, algorithm is tested for various faults occurring at various inception angles and distances. Results for the protection scheme are presented showing the variation of fault index calculated at terminals near the fault and away from the fault. The algorithm is found effective in fault detection for with and without static VAr compensation in the system as the threshold value set is not affected and faults are detected correctly.

INTRODUCTION

Since transmission network is exposed to the environment it has maximum fault incidence rate. Proper design, good maintenance and operating procedures can minimize the severity of occurrence of faults, but cannot suddenly eliminate them. The objective of the protection is to reduce the effect of fault on the power system network[1]. Faults may have very serious consequences. Faults must be removed from the system as quickly as possible. Fault conditions are monitored at each step of current signals and every critical points in the system are identified. The aim of protecting a power system is to identify and classify faults so that other equipment is not harmed while the faults in the system are reduced.

The protection system for the transmission lines can be achieved by over-current protection, distance protection and pilot protection. Over-current relays are quite suitable for the protection of radial lines, but for mesh systems they coordinate very poorly. Even though over-current relays are simple and least expensive, it is difficult to change their coordination characteristics for the change in the network configuration. Distance protection protects the line by means of three zones with three different fault impedance[2]. Flexible protection scheme for multiterminal tapped transmission line using distance relay with conventional carrier assistance is implemented but these relays allows a short time-delay in clearing end-zone faults. Synchronized positive sequence voltage and current phasor

International Conference on Research in Sciences, Engineering & Technology
AIP Conf. Proc. 2418, 040027-1–040027-8; https://doi.org/10.1063/5.0083112
Published by AIP Publishing. 978-0-7354-4368-6/$30.00