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2018 IEEMA Engineer Infinite Conference (eTechNxT)

March 13th–14th, 2018

India Expo Mart, Greater Noida, Gautam Budh Nagar Uttar Pradesh 201306, INDIA

SOUVENIR

Editors

Prof. (Dr.) Subrata Mukhopadhyay

Dr. Shabana Urooj

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First Impression: March 2018

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Typeset by
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Printed by
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MESSAGE FROM CONVENOR

MR. MUSTAFA WAJID
Convenor
eTechNxt–ELECRAMA 2018, Noida-NCR, India

The IEEMA IEEE Engineer Infinite Conference held under the umbrella of eTechNxT at ELECRAMA 2018 has come about due to the combination of key leadership. hard work & dedicated efforts by IEEE Delhi Section, IEEE Uttar Pradesh Section, IEEE Power and Energy Society, and IEEE Industry Applications Society.

This conference is a platform for students, teachers, researchers & practicing engineers to come together and share thoughts and ideas in the emerging areas of Digital Transformation of Power Delivery, Energy Storage Systems and Solutions, IoT, AI and Electricity, and e-Transportation as well as engage with the startup community and industry leaders.

I would strongly suggest to all participants that they must utilise the advantages of the conference co-location with ELECRAMA 2018, within which there are also many important events, to interact with thought leaders, exhibitors and corporate entities from India and across the world. This will add considerable value & enhance perspectives for all. Given that the focus of the Conference is emerging technologies, it is indeed a matter of great satisfaction that the Conference has received overwhelming response.

I also place on record my deep appreciation of all staff members of IEEMA & IEEE for their dedicated efforts in organizing the Conference.

I wish Engineer Infinite Conference all the best for its success with the cooperation of all concerned Authors, Reviewers, and Volunteers.

Mr. Mustafa Wajid

MESSAGE FROM GENERAL CHAIR

PROF. (DR.) SUBRATA MUKHOPADHYAY

General Chair
2018 IEEMA Engineer Infinite Conference (eTechNxT)

I am glad that IEEE Delhi Section, IEEE Uttar Pradesh Section, IEEE Power and Energy Society, and IEEE Industry Applications Society have come together to hold the two-day 2018 IEEMA Engineer Infinite Conference (eTechNxT) at Greater Noida in Uttar Pradesh with as many as 4 tracks in the emerging areas of technology, namely, Power Electronics & Digital Transformation of Power Delivery, Energy Storage Systems and Solutions, IoT, AI and Electricity, e-Transportation. Side by side to the Mega Event ELECRAMA 2018 when this Conference is being held, just following World Utility Summit 2018, it has added a flavor to the whole atmosphere in the complex. The prime objective of this International Conference is to connect the Electrical &Electronics Industries to Research, Academia and bring out New Technologies / Products &Markets that are "NxT".

The central theme of the Conference is **"Showcase of Technology Next"** focused on the above-mentioned four tracks. It is indeed a moment of pride and joy to note that the Conference has received overwhelming response from researchers in India and abroad as 116 papers upon acceptance after peer review are likely to be presented in the Conference. As General Chair of the Conference I wish to remind authors to see that the papers presented are truly as per IEEE format. This is on account of the fact that these are to be sent for publication in IEEE Xplore. The deadline for submission to IEEE Conference Publications being April 13, 2018 in this context, I seek cooperation of all involved in the process for meeting the target.

Last but not the least on this occasion I will like to congratulate all concerned with the Conference for their hard and sincere works towards organizing the Conference and hope that this Conference shall create new grounds in the role played by Engineering community in the progress and sustainability of Electric Power and Energy Systems.

I wish Engineer Infinite Conference all the best for its success with the cooperation of all concerned Authors, Reviewers, and Volunteers.

SUBRATA MUKHOPADHYAY

MAHESH BUNDELE

Registration Chair
2018 IEEMA Engineer Infinite Conference (eTechNxT)

It gives me immense pleasure to write about IEEE Delhi Section, IEEE UP Section and IEEMA's Two days IEEE International Conference Engineer Infinite e-TechNxt-2018 being organized in conjunction with ELECRAMA during 13-14 March 2018. Being a registration chair and the participating in planning about the conference since more than a year, I would like to say that this has been an important addition to the event ELECRAMA providing a separate platform for showcasing the current research in the Power delivery sector. The themes of the conference have been rightly chosen by team IEEMA that shall provide a good connect between Industries and Academia, bridging the gap.

The most of the authors of accepted paper have registered and those selected for exhibit has submitted their posters. I hope that this conference would benefit the researchers in the area and the Industry in time to come leading to success of its objectives.

Mahesh Bundele

DR. SHABANA UROOJ

Logistics Chair
2018 IEEMA Engineer Infinite Conference (eTechNxT)

I'm feeling fortunate to address all the contributors and readers of the International Conference "2018 IEEMA Engineer Infinite Conference (eTechNxT)"; being organized during March 13th-14th, 2018 under the umbrella of the mega event ELECRAMA. On behalf of IEEE Delhi Section I'm thankful to IEEMA for providing the networking opportunity and to be a part of this prestigious amalgam of reputed organizations. This conference is being organized with an aim to provide a platform to eminent academicians, scientists, researchers, manufacturers and above all young students to present and share their views on new evolving engineering tools and technological trends. It was an enriching experience to work with eminent officers from distinct organisations. Being the Logistics Chair, I must mention few names and thank Mr. Ravindra Desai from IEEE Standards Association KA, Mr. Seetharaman K from IEEMA KA, Mr. Srikanth Chandrasekaran from Standards & Technology IEEE India, Mr. Mustafa Wajid, CEO of Meher KA, my friend Prof. Bundele from Rajasthan Sub-section and my mentor Prof. Subrata for their continuous support to commute the tasks successfully. I wish all the best to all organizers and participants.

Dr. Shabana Urooj

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Contents

Paper ID: 1570407974

Robust State Feedback Current Controller with Harmonic Compensation for Single Stage Grid Connected PV Inverter with LCL Filter

Rishi Kant Sharma[1], Sukumar Mishra[2] and Shivraman Mudliyar[3]
[1,2,3]*Student Member IEEE, Indian Institute of Technology, New Delhi, India*

***Abstract*—The paper presents the robust state feedback output current controller for single stage grid connected photovoltaicarray (PV) inverter interfaced to grid through LCL filter. The robust state feedback current controller is based on mixed H2/H∞ with regional pole placement constraints approach. The controller enhances the system performance and robustness to grid disturbances as well as also enhances the power quality with the help of robust harmonic compensator utilizing resonant controller tuned for fundamental, 5th and 7th harmonics. It also mitigates the need of passive damping for LCL resonance. The state feedback current control is formulated in stationary reference frame and obtained by solving linear matrix inequalities (LMI). Simulation results tests the controller performance under different solar irradiance and linear load conditions as well as grid voltage disturbances.**

Keywords: State Feedback, Mixed H2/H∞, Photovoltaic Array, LCL Filter, Harmonic Compensation, LMI

Paper ID: 1570408934

Low Speed Sensorless Model Predictive Current Control of a Three Phase Induction Motor from a Single Phase Supply

Tabish Mir[1], Bhim Singh[2] and Abdul Bhat[3]
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[3]*National Institute of Technology, Srinagar, India*

***Abstract*—The three phase induction motor (3_ IM) is arguably most popular owing to its rugged and robust nature. However in single phase systems, it becomes almost mandatory to use motors other than the 3_ IM. To operate it from a single phase supply, a 3_ IM conventionally requires AC to DC conversion, followed by conversion from DC to three phase AC, which calls for energy storage in the DC link, resulting in a larger footprint of such 1_-3_ motor drives. An effective solution for running a 3_ IM from a single phase supply, can be the use of single phase to three phase Matrix Converter (1_-3_ MC). This paper proposes a predictive current control strategy that employs Finite Control Set Model Predictive Control (FCS-MPC) for theodulation of 1_-3_ MC and subsequent control of 3_ IM. Predictive model of the motor is also used in estimating the motor speed. Sensor requirements are significantly reduced as stator currents and voltages are appropriately predicted. The entire control algorithm uses only one voltage sensor to sense the 1_ input voltage. The converter delivers a superior quality of motor current as ompared to its thyristor based counter part, i.e. the 1_-3_ cyclo-converter. However best results are achieved at low output to input voltage ratios and low frequency, hence making it particularly suitable for low speed applications such as home appliances and treadmills. The converter being inherently bi-directional can be of particular interest in lift systems.**

Keywords: 1_-3_ power Conversion, Matrix Converter (MC), Finite Control Set Model Redictive Control (FCS-MPC), Induction Motor Drive (IMD), Sensorless

Paper ID: 1570414100

Comparative Analysis of Permanent Magnet Motors and Switched Reluctance Motors Capabilities for Electric and Hybrid Electric Vehicles

R.M. Pindoriya[1], B.S. Rajpurohit[2], R. Kumar[3] and K.N. Srivastava[4]
[1]*Student Member, IEEE*
[2]*Senior Member, IEEE*
[3,4]*Indian Institute of Technology Mandi, Himachal Pradesh, India*

***Abstract*—This paper discusses about the relative analysis of permanent magnet motors and switched reluctance motors (SRM) capability of electric vehicles (EVs) and hybrid electric vehicles (HEVs) system. Nowadays the pollution of the environment is increasing due to conventional vehicles. Hence, to reduce the pollution electric motors are very beneficial. Presently use of high power density magnetic motors like, brushless DC (BLDC) motors and permanent magnet synchronous motors (PMSM) have been the primary choice in the EVs and HEVs. But these motors have problems with demagnetization, high cost and fault tolerance. Therefore, in future permanent magnet motors are replaced with SRM for EVs and HEVs. Because of SRM have no permanent magnets on the rotor, higher torque to power ratio, low losses and low acoustic noise compare to BLDC motors and PMSM. This paper is based on the properties of the special electric motors for example performance analysis, power density control, torque ripple control, vibration control, noise and efficiency. In this paper, special aspects of the BLDC motors, PMSM and SRM based drive systems for the EVs and HEVs are offered and reviewed. Also explained why permanent magnet motors are replaced with SRM for applications in EVs and HEVs.**

Keywords: Brushless DC (BLDC) Motors, Electric Vehicles (EVs), Hybrid Electric Vehicles (HEVs), Power Electronics Converters (PEC), Permanent Magnet Synchronous Motors (PMSM), Switched Reluctance Motors (SRM) and Special Electric Motors (SEM)

Paper ID: 1570414865

Adaptive Wide Area Damping Control for Renewable Integrated System

Abhishek Nayak[1], Sukumar Mishra[2] and S.R. Mudaliyar[3]
[1,2,3]*Electrical Engineering Department, Indian Institute of Technology Delhi, New Delhi, India*

***Abstract*—Renewable energy penetration has been consistently increasing in power systems across the world. Renewable energy systems are integrated into the powergrid by essentially a power electronics converter system, these power electronic converters act as an inertialess interface. Now, large power injection to the grid from an inertialess system leads to an effective reduction in the overall system inertia thus affecting overall system damping. In this paper, the impact of integrating renewable energy on damping of the system is first examined by eigen value analysis, then a supplementary adaptive wide-area damping controller is implemented to improve the system damping of low-frequency oscillation. Two different approaches for implementation of damping controller has been carried out. In the first approach, the damping controller is implemented by giving control action to the excitation system of synchronous generator and in seconds approach the control action is provided through the power electronics converter**

using power modulation technique. It is observed from the simulation results that the power system damping is better improved by control action through converters than the excitation control.

Keywords: Wide Area Damping Control (WADC), Adaptive PID, Power Modulation, Voltage Source Converter (VSC)

Paper ID: 1570415373

Assessment of 48 Volts DC for Homes

Anukram Mishra[1], Rajeev K.K.[2] and Vaibhav Garg[3]
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***Abstract*—There is a compelling need to reduce carbon footprints. With the pollution bringing the capital of India to a stand still in November 2017, this is being emphatically reiterated. This paper aims to investigate the use of DC in homes and also the use of solar energy to reduce electricity demand drastically. Renewable energy in homes comes from solar panels in its DC form. Similarly, most of the electronic gadgets used in homes today consume DC. Brush Less DC (BLDC) motors and inverter technology have enabled other appliances to operate on DC. Mainly due to unavailability of power and inefficiency of power distribution, '24x7' uninterrupted electricity remains a dream even for most of the urban population today. Rural scenario is still worse. To remain powered during outages, most houses store energy in DC batteries, which is again inefficiently converted to AC by inverters. Because of these compelling reasons, DC power replacing AC in homes is gaining momentum. Some projects are also in progress. Focus of this paper is to answer the pertinent questions; what are the main drivers of DC power in homes and how this initiative could be supported by working on Indian standards and promoting an eco-system of DC appliances. Based on experiments and quantitative analysis, a safe and power efficient AC-DC hybrid solution is proposed for fulfilling the basic needs of uninterrupted power and integration of renewable energy for essential functions of homes in rural as well as urban scenarios.**

Keywords: DC in Homes, BLDC Motors, Bureau of Indian Standards, Supporting Standards, Carbon Footprints

Paper ID: 1570415534

PFC based Bridgeless Cuk Converter for SRM Drive

Aniket Anand[1] and Bhim Singh[2]
[1]*Member IEEE*
[2]*Fellow, IEEE*

***Abstract*—A bridgeless PFC (Power Factor Correction) converter is proposed to feed a switched reluctance motor(SRM) drive in this work. The new Cuk converter generates two symmetrical voltages with no extra voltage loop. The new converter eliminates diode bridge rectifier (DBR) thus reducing the semiconductor switches incurrent path. A double cell structure utilizes two Cuk converters, which operates for two half cycles of the AC mains, separately. The proposed topology operates in discontinuous conduction mode (DCM), which reduces the size, weight and cost of the proposed drive. The speed control of proposed drive is obtained by regulating converter output voltage over a wide range. However DC link voltage based control, eliminates speed sensor requirement, which makes the drive cost effective. Test results are presented for proposed converter converting universal AC input voltage (90V -270V) to varying DC voltage for speed control of SRM. Test results demonstrate the power factor close to unity with input current THD(Total Harmonic Distortion) below 5% as per the given IEEE-519 standard.**

Keywords: Cuk, Mid-point Converter, DBR, DCM, Power Quality, THD, SRM

Paper ID: 1570415561

Standalone and Grid Connected Operations of a SynRG based WECS with BESS

Deepu Vijay M.[1], Bhim Singh[2] and G. Bhuvaneswari[3]
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[2,3]*Fellow, IEEE Dept. of Electrical Engineering, IIT Delhi, New Delhi–110016, India*

***Abstract*—This work advocates an effective way of energy management in a microgrid consisting of asynchronous reluctance generator (SynRG) based wind energy conversion system (WECS) connected to a DC bus, which voltage is maintained by a battery energy storage system (BESS). The system is capable of feeding a fairly constant value of power to the grid apart from supplying the local loads. Apart from maintaining the DC link voltage, the BESS compensates for the fluctuations in the wind power by channelizing the power in and out of the BESS as per the power generation and power demand. The SynRG is operated in direct torque control (DTC) mode corresponding to maximum power point (MPP) of the WECS by adjusting the control inputs to the machine side converter. The battery in BESS, is integrated to the DC bus using a bidirectional converter (BDC), which helps in charging and discharging of the battery. A voltage source converter (VSC) connected on the grid side evacuates the power from the common DC link and feeds it to the three-phase grid. This VSC is controlled in such away as to maintain the required power factor on the grid side as per the reference values of the direct and quadrature axes components of currents specified. The proposed system is designed, modeled and simulated in Simulink/ MATLAB environment.**

Keywords: BDC, BESS, PCC, Power Quality and WECS

Paper ID: 1570415668

Effect of Different De-ion Plate Surface Finishes on Arc Mobility at Higher Voltages and Fault Currents

Virender Singh Bura[1] and Richa Diptisikha[2]
[1,2]*Switchgear Design and Development Center Larsen and Toubro Ltd., Powai, Mumbai, India*

***Abstract*—This paper discusses various methodologies to evaluate and enhance the performance of breaking capacity of Miniature Circuit Breaker at higher voltages and fault currents. The experimental investigation is carried out to examine the effect of using different kind of plating on de-ion plates in order to achieve higher breaking capacity at higher voltages. At higher voltages, the performance of the MCB becomes a challenge based upon the efficiency of arc quenching system. The influence of different plating on De-ion plate materials has been studied to enhance the performance at higher voltages. The overall arc mobility and the arc quenching in the system gets enhanced with the Nickel and Copper plating on the Deion plates. The performance improvement has been evaluated on the basis of parameters like operating time and let through energy which determines the behavior of a switchgear device at fault conditions.**

Keywords: De-ion Plates, Mild Steel, Miniature Circuit Breaker, EU

Paper ID: 1570415725

Tariff Calculation using Hybrid Smart Energy Meter and Fuzzy Inference System

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***Abstract*—In the modern scenario various load forecasting techniques are used by which commercial and residential loads are known. It could be maintained through forecasted data in relation with supply and demand. In case the demand is less than the supply the unit needs to be shut down or kept in standby mode, resulting in an increase of total cost of generation. Thus, it is important to divide the load in various time intervals such that the congestion on the generating unit can be reduced. The proposed hybrid smart energy meter (HSEM) scheme focuses on encouraging the consumers by providing low unit price during the non-peak hours and high price at peak hours. The presented scheme also aims to reduce the tariff amount at consumer ends. The FIS based proposed scheme has been validated and compared with conventional scheme.**

Keywords: Hybrid Smart Energy Meter (HSEM), Tariff, Price, Mamdani-FIS, Sugeno-FIS, Forecasting

Paper ID: 1570415730

Design Architecture and Optimization of Multi Agent based Smart Grid

Devendra Somwanshi[1], Arvind Kumar[2] and Lokesh Tiwari[3]
[1]*Poornima University, Jaipur*
[2,3]*Research Scholar, Poornima University, Jaipur*

***Abstract*—Smart Grid is a modern electric grid infrastructure for improved electrical system efficiency, reliability, precise fault detection and safety with smooth integration of renewable and alternative energy source through automated control and modern communication technology. In the proposed work design of architecture for multi agent based smart grid is selected with 10kW wind power plant, 10kW solar power source and 15KVA Diesel Generator and Main grid. Finally results from these experiments are observed and analyzed for Control agent, DER agent and Load agent. It also includes the Architecture of MAS based smart grid. And a control panel with Supervisory Control And Data Acquisition environment where agents were assigned function then to justify features of multi agent based smart grid experiments related to load balancing and load shedding.**

Keywords: Solar, DG, PLC, SCADA, DDS, OPC, Microgrid

Paper ID: 1570415755

Simulation of Partial Discharge Caused by Cavity in Solid Dielectric Material

S.H. Cuong Nguyen[1] and V.N. Chuong Ho[2]
[1]*Southern Power Company - Electric Testing Company, Vietnam*
[2]*Ho Chi Minh City University of Technology, Vietnam*

***Abstract*—Partial discharge (PD) is a phenomenon where partial conducting bridges are formed inside the insulation system. In order to study about partial discharge, several models are presented to simulate the behavior of this phenomenon. In this work, the three-capacitance model, which was introduced by Gemant and Philippoff, is modified in an attempt to produce a more accurate simulation. The results will be compared with that of similar research to prove that the modified model is suitable for partial discharge simulation.**

Keywords: Solid Insulation, Partial Discharge, Three-Capacitance Model, Finite Element Analysis, Induced Charge Concept

Paper ID: 1570415758

Experiment of Partial Discharge in Cast Resin Instrument Transformer

S.H. Cuong Nguyen[1] and V.N. Chuong Ho[2]
[1]*Southern Power Company - Electric Testing Company, Vietnam*
[2]*Ho Chi Minh City University of Technology, Vietnam*

***Abstract*—Partial discharge (PD) measurement is listed as a factory routine test of Instrument Transformer. While the quantitative analysis of PD apparent charge is clearly stated in the international standards, the qualitative analysis to find the PD source has yet been mentioned. In this paper, the topic of diagnostic experiments in the laboratory and qualitative analysis of Partial Discharge in Cast Resin Instrument Transformers during factory test will be addressed.**

Keywords: Solid Insulation, Partial Discharge, Void, Cast Resin Instrument Transformer

Paper ID: 1570415861

Encoder-less Speed Control of PMSM Drive using Adaptive Observer

S. Padhy[1], R.M. Pindoriya[2], C. Subramanian[3] and Z. Husain[4]
[1]*Student Member, IEEE, National Institute of Technology Hamirpur,*
[2]*Student Member, IEEE, Indian Institute of Technology Mandi, Himachal Pradesh, India*

***Abstract*—This paper mainly focuses on the full order state observer for the vector control (field-oriented control) of a surface mounted Permanent Magnet Synchronous Motor(PMSM) without the use of a speed sensor. Space Vector Pulse Width Modulation (SVPWM) technique has been used to generate three phase voltages from the dc link source. The inverter switches are designed here with no dead time compensation. The rotor speed is treated as an unknown parameter and the adaptation law for driving the estimated rotor speed is being carried out by the use of Popov's Hyper stability criteria. The proposed observer and the whole other system except the PWM generation block and the PMSM has been discretized i.e., the whole system is running at a variable sampling rate and rate transitions blocks have been used to make the bridges between the continuous and discrete subsystems. For making the observer to become dynamically faster the observer poles are fixed proportionally to its motor poles using pole placement technique. The whole system is being verified using MATLAB/ Simulink environment.**

Keywords: Permanent Magnet Synchronous Motor (PMSM), Space Vector Pulse Width Modulation (SVPWM), Clamping, Popov Hyperstability and Model Reference Adaptive Control (MRAC)

Paper ID: 1570417007

SMART Motor for Industry 4.0

Swapnil Do[1] and Raunak Bhinge[2]
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***Abstract*—With the world moving towards the era of Artificial Intelligence (AI), Internet of Things (IoT) and Industrial Internet of Things (IIoT) there is a need for technologies that align with the customer expectation of making their plants more intelligent and communicative in a wireless manner. The currently trending concept of Industry 4.0introduces what has been called the "smart factory," in which cyber-physical systems monitor the physical processes of the factory and make decentralized decisions. The physical systems become Internet of Things, communicating and cooperating both with each other and with humans in real time via the wireless web. The paper introduces SMART Electric Motors, the future of Electric Motors. A SMART Motor can perform its own condition monitoring, 24X7, and predicts failures much in advance, which allows corrective actions to be taken to avoid premature equipment & process breakdowns in the industry. SMART motors coupled with various equipments also act as a pattern learning device to gather the, much needed, hidden, equipment productivity and efficiency related information. This information can be a very useful MIS data to improve the productivity, efficiency and Overall Equipment Effectiveness (OEE) for the industry.**

Keywords: IIOT, IOT, Industry 4.0, SMART Motor, Condition Monitoring, Smart Factory

Paper ID: 1570417373

SRM Driven Solar Irrigation Pumping System Utilizing Modified Dual Output SEPIC Converter

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***Abstract*—This paper presents a modified SEPIC (Single Ended Primary Inductance Converter) suitable for solar PV based irrigation water pumping system using SRM (Switched Reluctance Motor) drive. The modified converter has two inductors in the output section for dual output configuration. It has all the merits of the conventional SEPIC converter with balanced dual outputs feeding the DC link capacitors of the mid-point converter. Inherent voltage balancing feature, eliminates the need of extra control architecture to balance the voltages across the DC link capacitors, thereby reducing the cost and complexity of the system. An IC (incremental conductance) MPPT algorithm is used to make the photovoltaic array operate at MPP (maximum power point) without oscillations and to increase the efficiency of the system. A proper selection of step size in MPPT algorithm, helps in achieving the smooth starting of SRM drive. The performance of the system is validated both by simulation in MATLAB/Simulink and by experimental results on a developed prototype of 8/6 SRM. The response of the system obtained under dynamic conditions, shows its aptness towards water pumping application.**

Keywords: Dual Output Converter, Incremental Conductance, Modified SEPIC Converter, Solar Water Pump, Switched Reluctance Motor Drive

Paper ID: 1570417575

Modeling and Design of Solid State Smart Transformer for Microgrid

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***Abstract*—While the techno-economic feasibility of solid state transformer (SST) is constantly under question, some of the leaders in power sector have recognized the potential of the technology and have started efforts of commercialization. One of the important advantages of SST is its ability to integrate to low voltage dc grids and vehicle-to-grid (V2G) technology. One of the key area of research in this field is to develop an accurate model for the SST to demonstrate the control capabilities and perform the dynamic analysis of the system. Although detailed model shave been proposed for individual components of SST, only lower order averaged models are used for modelling the composite system. In this article, an accurate composite model of SST that incorporates high switching frequency is developed. The model is controlled using a conventional voltage control technique and a with a newly proposed power control technique. The control methods are then used accordingly to develop applications to integrate electric vehicles with its battery charging station in adc microgrid.**

Keywords: DC Microgrid, Dual Active Bridge, DQ Control, Solid State Transformer

Paper ID: 1570418596

IOT based Controlling of Hybrid Energy System using ESP8266

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***Abstract*—In this paper, authors have focused on controlling of hybrid energy system using IOT. There is various combination of energy and all of them are alternative to each other like solar energy, wind energy, biofuel, fuel cell, etc. But the need of controlling of hybrid energy system arises when it is installed for domestic or commercial purpose. At this point IOT plays an important role in controlling system. The main criteria being switching between the two sources of energy i.e. solar and wind energy without any inconvenience through a website using ESP8266 Wi-Fi module. The data is transmitted wirelessly through website to ESP8266 module which controls the sources of energy. The transmitted data is controlled remotely using IOT. This enables user to have flexible control mechanism remotely through a secured internet web connection. This system helps the user to control the sources of energy, manually and remotely using smart phone or personal computer. This system is very efficient, cheaper and flexible in operation.**

Keywords: IOT, Controlling of Hybrid System, Home Automation, ESP8266, Router, Arduino IDE

Paper ID: 1570418664

Performance Optimization of UPFC Assisted Hybrid Power System

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***Abstract*—This paper focuses on the development of approaches to design hybrid power systems for the needs of energy management and power quality. It develops an algorithm for determining an optimal structure of power supply system taking into account technical, environmental and social aspects. This research aims at achieving a regulatory for power management in a PV Wind hybrid power system based on simulated intellect practices. To safe guard efficient optimization of sources, Fuzzy Inference System approach is engaged to accomplish the Maximum PowerPoint for photovoltaic panels and wind turbine. In addition, the power quality aspects are studied and with the use of UPFC which improves the voltage and current regulations. The Total Harmonic Distortions of the Voltages and currents in the simulated system under different load conditions were analysed with IEEE Standards 519–2014. The whole system is analysed through simulation in MATLAB/ Simulink environment.**

Keywords: Fuzzy Inference System (FIS), Hybrid Power System (HPS), Maximum Power Point Tracking (MPPT), Unified Powerflow Controller (UPFC), Photovoltaic (PV), Permanent Magnetic Synchronous Machine (PMSM), Battery Management System (BMS).

Paper ID: 1570418775

An Advanced Disturbance Reduction Field-Oriented Control for Six-phase Induction Machine

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***Abstract*—These days multiphase induction machines are being considered for various applications in transportation and power sector. This is because of their capability to achieve enhanced power when compared to its three-phase counterparts. In addition to this, a multiphase drive improves the reliability at the system level, thus contributing to overall system efficiency. An efficient control strategy is necessary to operate a multiphase induction motor drive in variable speed. Variation in load torque causes speed disturbance to any machine drive operating in closed loop, consequently affecting the system performance. This paper, therefore, proposes a simple and elegant rotor field oriented control (RFOC) methodology for a six-phase induction motor(SPIM) with 30°phase displacement between the two three-phase winding sets. Proposed RFOC consists of an additional loop for the resilient speed control under input load disturbances without any additional PI controllers. A detailed dynamic modeling of SPIM with vector space decomposition (VSD) SVPWM is presented in the paper. In order to verify the effectiveness proposed RFOC, necessary simulation results are provided using MATLAB/SIMULINK software and experimental analysis is performed on 1.5 hp induction machine.**

Keywords: Multiphase Induction Machine, Space Vectorpulse Width Modulation (SVPWM), Rotor Field Oriented Control (RFOC), Load Disturbance Reduction Technique

Paper ID: 1570418832

Power Electronic Circuit based Implementation of a Solar PV Emulator using a Power Factor Corrected Buck Converter

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***Abstract*—This paper presents an approach to design and implement a power electronic circuit based photovoltaic (PV) simulator which emulates the output characteristics of PV modules. The characteristics are obtained based on the lookup tables corresponding to an array of ten SunPower SPR-X20-250-BLK photovoltaic modules connected in series. Based on that data, a power factor corrected buck converter circuit is presented here which is able to mimic the panel behaviour at different temperature and irradiance conditions. The designed circuit has been modeled and simulated in Simulink/MATLAB environment. The simulation results show that the output characteristics of the proposed circuit coincide with those of actual PV modules and hence are promising. Thus, the proposed circuit can be used in laboratory environments for research purposes when actual modules are not available or if the environmental conditions are not conducive.**

Keywords: Photovoltaic, Buck Converter, Emulator, Power Electronics, Rectifier

Paper ID: 1570418863

Performance of Modified-Leaky LMS Control Algorithm for Super Capacitor based SAPF

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***Abstract*—The next generation of power system is expected to be more complex and sensitive. Therefore, controllers implemented for a custom power device must be efficient and adaptive. In order to mitigate the power quality problems, a Modified Leaky Least Mean Square (MLLMS) control algorithm for a three-phase Super capacitor based Shunt Active Power Filter (SSAPF) is proposed in this paper. Especially, the efficient control algorithm meant for power quality improvement by compensating source current harmonics, load unbalancing and reactive power flow in the system. Suitable switching pulses required for Voltage Source Converter (VSC) of the SSAPF are generated followed by the reference current generation and extraction of fundamental active and reactive power components from harmonic rich three-phase load currents. The super capacitor is coupled with the VSC to make the DC-link voltage constant and ripple free during faults in the system. The performance of the SSAPF using a MLLMS control algorithm is conducted in the MATLAB software.**

Keywords: Modified Leaky Least Mean Square (MLLMS) Control Algorithm, Shunt Active Power Filter (SAPF), Power Quality, Super Capacitor

Paper ID: 1570419066

Power Quality Refinement by Executing IcosΘ Control Algorithm in Fuel Cell based DSTATCOM

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***Abstract*—In this paper, a fuel cell is integrated into a voltage source inverter (VSI) based DSTATCOM for power quality improvement in a distribution system. An efficient control technique called "icos-theta" (IcosΘ) control algorithm is chosen to make the distribution system stable and harmonics free even under unbalanced load (single phase fault) condition. The fuel cell is intended to maintain the DC-link voltage of the VSI-DSTATCOM so that excess switching losses and conduction loss of the DSTATCOM due to a single phase fault, can be eradicated. The DC-link voltage is almost constant during steady-state operation, and even an acceptable voltage regulation of 3.35% is achieved during fault conditions. Further, the system supply current is maintained balance, and has the total harmonic distortion (THD) well-below 5%, thus it is satisfying the IEEE-519 standard on the harmonic limit. Moreover, simulation of the proposed system has been performed in Sim Power System (SPS)/MATLAB Simulink software.**

Keywords: Power Quality, Distributed STATicCOM pensator (DSTATCOM), Fuel Cell, IcosΘ Control Algorithm

Paper ID: 1570419365

An Improved Setting-free Power Swing Blocking Scheme using Local End Information

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***Abstract*—A distance relay mal-operating during power swing has been very frequently attributed to triggering the events leading to a power system blackout. The existing methods rely on settings being proposed by the operators, which in turn are calculated from exhaustive offline simulation studies. Apart from being cumbersome, these methods are not adaptable to the changes in the power system. As such, the requirement of an algorithm to identify power swings based on local measurements and without settings cannot be emphasized enough. This paper examines the effectiveness of one such method to detect power swings based on continuous impedance measurements, and identifies the cases where the same is found to be lacking. Necessary modifications are suggested to make the algorithm overcome the identified shortcomings. The benefit of this method is that it employs a very simplistic approach in analyzing the locus of the impedance trajectory to identify power swings and the suggested improvements do not require any additional functional blocks to improve its effectiveness. The effectiveness of the suggested approach is validated on Western Systems Coordinating Council (WSCC) 9-bus system. The results show improved performance in terms of power swing identification over wide range of swing frequency.**

Keywords: Distance Relay, Power Swing Detection, Setting Free Algorithm

Paper ID: 1570419384

Minimization in the Price of Electricity Bills of Consumers using MILP

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***Abstract*—Intensive efforts done on the modernization of power grid lead to smartness in the power grid where integration of large amount of renewable energy generation is done. This transformation is motivated due to global climate change, carbon emission and increasing demand of electricity. In the paper, an investigation is done to minimize the energy demand of a locality from the grid and how to reduce the total energy cost. The problem has been mathematically formulated and solved by using Mixed Integer Linear Programming (MILP). Results illustrate that using the optimal points lead to significant saving, both commercial and environmental.**

Keywords: Smart Grid, Mixed Integer Programming, Renewable Energy Generation

Paper ID: 1570419389

Low Voltage Ride-Through of a Synchronous Reluctance Generator based Variable Speed Wind Energy Conversion System

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***Abstract*—Grid codes want the wind energy conversion systems (WECS) to stay connected even when low voltage occurs at the point of common coupling (PCC) for a short-while. This paper is an attempt to propose a control strategy to achieve low voltage ride through (LVRT) for a variable speed grid-connected WECS based on Synchronous reluctance machine (SyRM) as a generator. The SyRM is controlled by field oriented control technique and grid side-converter is controlled by grid voltage oriented control. Hill climbing algorithm is used to implement maximum power point tracking in the WECS. The LVRT capability of the system under three-phase grid fault condition is achieved using three different control techniques namely, modulation index control, de-loading and crowbar protection. These methods have been simulated in Simulink/MATLAB environment and the results obtained show that these techniques work very effectively for realizing LVRT in a SyRM based WECS.**

Keywords: Grid Side Converter (GSC), Low Voltage Ride Through (LVRT), Machine Side Converter (MSC), Synchronous Reluctance Machine (SyRM), Wind Energy Conversion System (WECS)

Paper ID: 1570419486

Sampling based Motion Planning of Ackermann Steering System using Transformation

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***Abstract*—The objective of this work is to apply sampling based algorithm to generate a path to Ackermann steering system with given constraints based on its Kinematics model. Rapidly-exploring Random Tree (RRT) is used with uniform sampling for path exploration. The configuration space is transformed and will be used for path formulation. This paper presents Gaussian sampling based strategy, path formulation meeting system kinematics, and trajectories creation over the sample points.**

Keywords: RRT, RRT*, PRM, RRT-Connect, Lazy RRT

Paper ID: 1570419667

Experimental Validation of a Cascaded Multilevel Inverter with Single Excited DC Source

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***Abstract*—In this paper, Pulse width modulation techniques for multi-level inverter are compared, evaluating their performance for various converter parameters. The study has been applied for a seven-level cascaded H-bridge multi-level inverter with a single dc source employing single phase transformer. There are several techniques for modulation of multilevel converters. But their performance is not similar under various inverter topologies and from different applications prospective. Moreover, they differ from each other by their ease of real time implementation. Therefore, an optimization has to be made considering all the abovementioned features. The simulation and experimental results demonstrate the effectiveness of the proposed configuration with level shifted PWM, phase shifted PWM and space vector PWM.**

Keywords: CHBMLI, Space Vector Modulation, Multi Carrier Modulation, Power Quality

Paper ID: 1570419706

Control of Vehicle-to-Home Operation of Electric Vehicle with Seamless Transition Capabilities

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***Abstract*—This work demonstrates the vehicle-to-home (V2H) capability of a bi-directional electrical vehicle (EV) charger. This proposed intelligent EV charger, detects the grid outage, isolates a home load from the grid, works in the V2H mode, detects the grid recovery, synchronizes and re-establishes connection to the grid, without load power interruptions. Its control is designed to have smooth and seamless transition among different modes of operation. However, to address the realistic conditions, the charger performance and its synchronizing capability are tested under grid abnormalities such as voltage fluctuations, voltage distortion both at linear and nonlinear loads. Additionally, the system operates at unity power factor (UPF) and makes the grid current sinusoidal even when the grid voltage is distorted. The second order generalized integrator (SOGI) based phase locked loop (PLL) is used to estimate the phase angle of grid voltage and point of common interconnection (PCI) voltage, and it offers the added advantage of fast dynamic response and reduced computational burden. The charger is designed to operate with a single phase, 230V, 50 Hz AC mains installation. The performance under grid disturbances and various loading conditions, validates the design and control of proposed charger.**

Keywords: V2H, G2V, Synchronization, Power Quality, De-synchronization, Bi-directional Charger

Paper ID: 1570419711

Grid Synchronization Control for an Autonomous PV-Wind-Battery based Microgrid

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***Abstract*—This paper deals with the control of PWB (Photovoltaic-Wind-Battery) based MG (Micro-Grid) in standalone and grid connected modes. The proposed MG works in standalone mode and during peak load condition of the utility it is able to synchronize with the grid and it operates in the grid connected mode. In WECS (Wind Energy Conversion System), a SCIG (Squirrel Cage Induction Generator) is used to convert the wind energy into electrical energy. An INC (Incremental Conductance) based MPPT (Maximum Power Point Tracking) approach is used to extract a maximum power from solar PV (Photovoltaic) array. The battery is connected at the DC-link of load/grid side VSC (Voltage Source Converter) for balancing the power flow in dynamic conditions of the system. In grid connected mode, PL-EPLL (Pseudo-Linear-Enhanced Phase Locked Loop) based grid control algorithm is proposed to extract fundamental components of load currents. Along with grid synchronization and desynchronization, some ancillary services are also provided by the grid/load side VSC such as harmonics mitigation, load balancing and regulation of PCI (Point of Common Interconnection) voltages. The proposed MG is modeled and its performance is simulated in MATLAB/ SIMULINK to verify the features of PWB based MG.**

Keywords: PV, WECS, MPPT, Microgrid, Battery, Synchronization, Power Quality

Paper Id: 1570419823

A Simplified Carrier based PWM Method for Five-level Inverter Fed Five-Phase Induction Motor

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***Abstract*—This paper presents a simplified SVPWM signal generation technique for a five phase induction motor fed by cascaded H-bridge five-level inverter. This technique directly calculates the switching time of inverter switches using only the sampled amplitude of reference phase voltages making the carrier based PWM technique easy to implement for higher levels of inverter. The proposed algorithm is derived for different modulation region (i.e. m < 0.433 and m < 0.866) and their respective variation in voltage waveform is observed. Also, there sponse of five level inverter fed five phase induction motor is observed in terms of electromagnetic torque, speed and stator current. The simulation analysis is carried out using MATLAB/ Simulink.**

Keywords: SVPWM, Modulation Index (MI), MLI, THD, CHB, VSI

Paper ID: 1570419886

Comparative Analysis of 3-phase 3-wire Shunt Active Power Filters using Various Control Strategies

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***Abstract*—This paper describes three-phase three-wire Shunt active power filter (SAPF) using conventional three leg voltage source converter. In this paper three control strategies are compared. These strategies are Constant Instantaneous Power Theory, Generalized Fryze Current Control Theory and Synchronous Reference Frame Method. The performance analysis of SAPF for Different Loads and for Different Supply (Balanced as well as Unbalanced) condition are simulated using MATLAB/SIMULINK™.**

Keyword: Shunt Active Power Filter (SAPF), Constant Power Control (CP) Theory, Generalized Fryze Current Control Theory (FRYZE), Unity Power Factor (UPF), Zero Voltage Regulation (ZVR)

Paper ID: 1570419903

Comparison of Different Control Strategies for Shunt Active Power Filter

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***Abstract*—This paper deals with comparison of different techniques for shunt active power filters. Three techniques are considered, first constant instantaneous power control, second sinusoidal current control technique using phase locked loop control, third Fryze current control technique. For each techniques different operating conditions are discussed. Only resistive-inductive load with three phase three wire system has been considered. Using MATLAB Simulink TM simulation results are obtained with wave forms for different parameters. All THD data in tabular form also obtained and discussed. By performing this simulation, it comes out that Sinusoidal Current Control method gives good results.**

Keywords: Constant Instantaneous Power Method (CIP), Shunt Active Power Filter (SAPF), Sinusoidal Current Control Strategy with Phase Locked Loop (SCC), Total Harmonic Distortion (THD), Point of Common Coupling (PCC), Voltage Source Inverter (VSI), Positive Sequence Detector (PSD)

Paper ID: 1570419964

Impacts of System Non-linearities on Communication Delay Margin for Power Systems Having Open Channel Communication based Automatic Generation Control

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***Abstract*—This paper presents an analysis of impacts of various non-linearities on communication delay margin for stability of Automatic Generation Control (AGC) of hydro power systems using open channel communication which introduces time delay in the AGC loop. This delay may lead to system instability. The delay margin depends not only on the secondary controller gains but also on the various non-linearities inherently presently in the AGC loop. To study their impact, these non-linearities are one by one introduced in the AGC of a hydro system and their impacts on critical delay (delay margin) is studied by simulating the system in MATLAB / Simulink by keeping the secondary controller gains constant at a random value to observe the effect only of communication delay and the non-linearities. The non-linearities considered are frequency of AGC execution and governor intentional dead band and governor backlash.**

***Keywords:** Automatic Generation Control, Communication Delay Margin, Governor Intentional Dead Band*

Paper ID: 1570420048

Autonomous Power Management in a Wind/ Fuel Cell/ Ultracapacitor Hybrid Power System

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Abstract*—This paper presents a dynamic modeling and simulation of a small wind–fuel cell-ultra capacitor based hybrid isolated power system. A hybrid system is formulated using a wind turbine, a proton exchange membrane fuel cell (PEMFC) with an electrolyzer, and an ultra capacitor (UC) for storing the energy. The power fluctuation of the wind turbine, because of wind speed variation, is decreased by using fuel cell as well as UC. The surplus of wind power is being converted and stored as hydrogen by the help of an electrolyzer. Ultra capacitors, PID and 2-DOFPID controllers are being incorporated into the hybrid system for improving the voltage variations. The hybrid system responses is studied for step variation in load current and wind speed. Simulation results reflect that voltage variation is found to be within the acceptable limits by the use of above proposed controllers. The proposed controller 2-DOFPID controller is observed to show better results as compared to that of conventional PID controller. The hybrid power system is modeled in MATLAB/SIMULINK environments.

***Keywords:** Dynamic Modeling and Simulation, Fuel Cell, Hybrid System, PID and 2-DOFPID Controllers*

Paper ID: 1570420070

Intelligent Control Scheme for SPV-Wind-BESS based Microgrid

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***Abstract*—This article proposes a novel control scheme for efficient control of solar photovoltaic (SPV), wind energy system (WES) and battery energy storage system (BESS) based microgrid. Using this control scheme the voltage in the main DC bus is kept constant irrespective of the load or weather condition. When power requirement at load side is less than the energy produced by both SPV and WES combined, the batteries are charged and in case of any imbalance or excess energy required in case of peak load conditions the BESS provides the remaining energy. The dc voltage thus obtained is converted into ac voltage by using a three-phase inverter, which is operated with sinusoidal pulse width modulation (PWM) technique. The system is designed and tested in MATLAB-SIMULINK and simulated results are demonstrated to validate the concept and design. On account of simulation results, it has been established that the performance of the controllers is quite satisfactory in both transient and steady states.**

Keywords: Solar Power Generation, BESS, Wind Energy Generation, Microgrid

Paper ID: 1570420072

Different Fast Charging Methods and Topologies for EV Charging

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***Abstract*—In order to promote clean and green environment and to reduce carbon emission, the Government of India aspires for a nation with 100 percent electric vehicle mobility by the year2030. For such a large number of electric vehicles to be running on Indian roads, there is a critical need for fast charging stations and infrastructure. This paper presents different fast charging schemes along with different power converter topologies for electric vehicles. Simulation results of different topologies of power converter are presented and compared. To charge battery of electric vehicle, the safety and charging time of battery must be considered.**

Keywords: Fast Charging, Electric Vehicle, Charging Methods

Paper ID: 1570420099

Power Quality Enhancement in a Distribution Network using PSO Assisted Kalman Filter-based Shunt Active Power Filter

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***Abstract*—The increased usage of non-linear loads in the distribution system network imposes the need of power quality enhancement in the distribution side. In this regards, a Kalman filter (KF) based proportional integral (PI) current control strategy for controlling the shunt active power filter (SAPF) is proposed in this paper. To achieve accuracy in the KF performance, Particle Swarm Optimization (PSO) algorithm is adopted for tuning parameters. The KF estimates the source reference current quickly and adaptively. So, the tuning and parallel resonance problems are eliminated associated with the existing proportional integral (PI) technique. To validate the performance of the controller, the system is tested under steady state and dynamic load conditions. Also, the proposed control algorithm working performance is compared with the existing p-q(reactive power compensation) theory based PI controller using *MATLAB/Simulink*.**

Keywords: Active Power Filter, Current Control, Kalman Filter, Power Quality, Proportional Integral

Paper ID: 1570420207

A Review on Recent MPPT Techniques for Photovoltaic System

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***Abstract*—Solar energy is an abundant renewable energy source (RES) which is available without any price from the Sun to the earth. It can be a good alternative of energy source in place of nonrenewable sources (NRES) of energy like as fossil fuels and petroleum articles. Sun light can be utilized through solar cells which fulfills the need of energy of the utilizer instead of energy generation by NRES. The development of solar cells has crossed by a number of modifications from one age to another. The cost and efficiency of solar cells are the obstacles in the advancement. In order to select suitable solar photovoltaic (PV) cells for a particular area, operators are needed to sense the basic mechanisms and topologies of diverse solar PV with maximum power point tracking(MPPT) methodologies that are checked to a great degree. In this article, authors reviewed and analyzed a successive growth in the solar PV cell research from one decade to other, and explained about their coming fashions and behaviors. This article also attempts to emphasize on many experiments and technologies to contribute the perks of solar energy.**

Keywords: Energy Sources, Renewable, Solar Cell, Photovoltaic, MPPT Techniques

Paper ID: 1570420243

Sensorless Speed Control of Brushless Doubly-Fed Reluctance Machine for Pump Storage and Wind Power Application

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***Abstract*—A sensorless speed control technique for brushless doubly-fed reluctance machine (BDFRM) drive using fictitious quantity (X= vs∗ × is) based model reference adaptive system (MRAS) is proposed in the present work which is suitable for pump storage and wind power generation applications. The proposed MRAS (X-MRAS) shows stable operation in all the four quadrants of BDFRM drive. In this context, the performance analysis of the complete BDFRM drive, is done under maximum torque per inverter ampere (MTPIA) condition for both motoring and generating modes of operation using MATLAB/SIMULINK.A study on stability and sensitivity analysis of the complete drive system is also included to confirm the efficacy of the scheme.**

Keywords: Brushless Doubly-fed Reluctance Machine, MRAS, Primary Field Orientation, Sensitivity, Speed Estimation, Stability

Paper ID: 1570420249

Vector Control of Permanent Magnet Synchronous Motor Drive using a Reduced Switch Five-level Inverter

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***Abstract*—This paper presents one of the most popular closed-loop control techniques namely the Vector Control for the control of a Permanent Magnet Synchronous Motor (PMSM) drive using a reduced switch five-level inverter. A SIMULINK model for the vector control of a surface mounted PMSM drive system is implemented using two different inverters, namely, a conventional sinusoidal pulse width modulated (SPWM) two-level voltage source inverter (VSI) and a reduced switch five-level PWM VSI. A comparative performance analysis of the two topologies is presented, for various dynamic operating conditions like load torque perturbations and different reference speed conditions, keeping the DC link voltage and carrier frequency the same for both topologies. The simulation results of the proposed drive system using a reduced switch five-level inverter validate the relevance of the rising popularity of multilevel inverters for adjustable speed drive applications and also emphasize the fact that a five-level inverter offers an advantageous choice of working with lower switching frequencies, maintaining a low and consistent value of current THD, thereby reducing switching losses, unlike SPWM technique for the two-level VSI which needs to be implemented at higher switching frequencies in order to maintain a low value of current THD.**

Keywords: Vector Control, Surface Mounted PMSM, SPWM, Multilevel Inverters

Paper ID: 1570420273

Implementation of Improved PQ Theory in Shunt Active Filter based on Cascaded Multilevel Inverter with Single Excited DC Source

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***Abstract*—In this paper, a Cascaded H-Bridge Multilevel Inverter (CHBMLI) is proposed and designed with single dc source employing single-phase transformers to operate as a shunt active filter for harmonic reduction. The paper studies the complete architecture and control logic of the proposed multilevel inverter. For harmonic current extraction an improved instantaneous active and reactive power control technique is used for reference current generation. Phase shifted PWM technique is used for the modulation of CHBMLI. Finally a seven level CHBMLI is developed to operate as a shunt active filter. The proposal and performance are validated through simulation results.**

Keywords: CHBMLI, Shunt Active Filter, Multi Carrier Modulation, Power Quality

Paper ID: 1570420282

Gradient Descent in Sample-based Single-querypath Planning Algorithm

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***Abstract*—Rapidly-exploring random tree (RRT) is a sampling based single query algorithm that is used to generate a path. This papers describes RRT algorithm, modifies RRT algorithm by applying gradient descent method for generating the path. Simulations are run in iterations and the results are compared with and without gradient descent. Finally this paper concludes with advantages and limitations of the gradient approach.**

Keywords: RRT, PRM, RRT*, RRT-Connect, LazyRRT

Paper ID: 1570420283

PHIL Experimentation on Fault Ride through Behavior of Doubly Fed Induction Generator based Wind System in the Presence of Fault Current Limiter

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***Abstract*—In recent years, the large-scale coal fired thermal power plants are facing serious setback to meet the growing electricity need of the planet. In addition to this, the increased environmental concern of the mankind has paved the path for alternate energy sources to satisfy the thirst of global energy need. Currently, the doubly fed induction generator (DFIG) based wind system has got lot of attention due to its inherent benefits of reduced converter size and independent control of back to back converters. The main drawback of the DFIG wind system is its poor fault ride through (FRT) capabilities. Most of the FRT studies in the literature consider fault to take place after the fault current limiter (FCL) with respect to the DFIG wind system. However, in this paper, the power hardware in loop (PHIL) experimentation is conducted in order to study the transient behavior when fault occurs before the FCL with respect to DFIG system. The system under study mainly consists of a 2 KW rated DFIG wind system. This is connected to the modified IEEE 33 bus distribution system simulated in the real time digital simulator (RTDS) platform via power amplifier. The PHIL experimental results convey an important message that the occurrence of fault before FCL may worsen the FRT of the DFIG wind system and hence a combination of different FRT techniques would be recommended under such cases.**

Keywords: DFIG Wind System, Fault Ride Through, Fault Current Limiter, Power Amplifier, Renewables, RTDS

Paper ID: 1570420289

A Unity Power Factor Converter with Isolation for Electric Vehicle Battery Charger

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***Abstract*—This paper deals with a unity power factor (UPF) Cuk converter EV (Electric Vehicle) battery charger having a high frequency transformer isolation instead of only a single phase front end converter used in vehicle's conventional battery chargers. The operation of the proposed converter is defined in various modes of the converter components i.e. DCM (Discontinuous Conduction Mode) or CCM (Continuous Conduction Mode) along with the optimum design equations. In this way, this isolated PFC converter makes the input current sinusoidal in shape and improves input power factor to unity. Simulation results for the proposed converter are shown for charging a lead acid EV battery in constant current constant voltage (CC-CV) mode. The rated full load and varying input supply conditions have been considered to show the improved power quality indices as compared to conventional battery chargers. These indices follow the international IEC 61000-3-2 standard to give harmonic free input parameters for the proposed circuit.**

Keywords: UPF Cuk Converter, Battery Charger, Front End Converter, CC-CV Mode, IEC 61000-3-2 Standard

Paper ID: 1570420337

Physical Relocation of PV Panel for Optimization of Power Under PSC in PV Array

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***Abstract*—This paper implements a solar photovoltaic (PV) array based on Global Maximum Power Point (GMPP), Power loss and Fill Factor. It shows the effect of Partial Shading Condition (PSC) on a PV array which certainly diminishes the output power. A reconfiguration scheme has been tested with a 4×4 PV array in which the array is relocated to deliver optimized power. Some of the existing configurations such as Total Cross Tied (TCT), Honey Comb (HC), Bridge Link (BL) and Series-Parallel (SP) are compared with Rearrange Square (RS) method based on three performance indices. MATLAB/Simulink modeling of all configurations has been done to achieve PV characteristics and analyze their bar graphs. This work delve into performance based on different shading patterns like short wide, long wide, short and narrow. The novelty of this paper is to present that physical relocation can be the best choice for array reconfiguration in terms of cost to disperse the shade in PV array.**

Keywords: PV Array, Rearranged Square Method, Optimized Array Power, Fill Factor, MATLAB

Paper ID: 1570420532

Power Quality Enhancement and Renewable Energy Integration in Ship's Distribution Grid

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***Abstract*—This paper discusses about power quality improvement in a ship's distribution grid consisting of nonlinear and linear loads. Due to large scale introduction of power electronic equipment onboard, there is a detrimental effect on the quality of power available. In order to ensure safe and efficient operation of various sensitive equipment, it is utmost important to ensure a power supply of impeccable quality. Further more, importance of fuel economy needs attention in ever increasing naval vessels operations. Till date no such efforts have been undertaken in any of Indian Naval vessels other than introduction of standalone PV panel only for lighting requirement onboard a survey vessel in2016. Integration of Solar PV array with main distribution grid has been proposed mainly for battery charging in this paper. Towards power quality improvement, a shunt connected hybrid filter consisting passive and shunt active filter has been proposed. The proposed configuration can be further expanded depending on the vessel class and space availability. It is observed that power quality has been considerably improved to the satisfactory Naval requirement as per IEEE 519 and NES 532 standards.**

Keywords: Hybrid Power Filter (HPF), Power Quality (PQ), Photovoltaic (PV), Bi-directional Battery Charger (BDBC), State of Charge (SoC)

Paper ID: 1570420569

A Review on Stability Enhancement in SMIB System using Artificial Intelligence based Techniques

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***Abstract*—The growing interest towards the stability issues in the modern day power system is a matter of concern for every power utility. As the power system is highly complex in nature therefore it is not possible to predict its behavior at every point of time. Modern power system is heavily loaded and is been operated close to their stability limits therefore issues related to small signal stability results in low frequency oscillations (0.2-3) Hz. These problems are generally related to the compensation of reactive power in the power system and may lead to blackouts and outages in the power system. Therefore reactive power is compensated through FACTS controllers and these devices operate efficiently if their parameters are optimally tuned. So this paper focuses on the survey of various artificial intelligence based techniques been applied for the proper tuning of various controller parameters applied in a single machine infinite bus (SMIB)system.**

Keywords: Artificial Intelligence, Low Frequency Oscillations, Stability, Single Machine Infinite Bus System

Paper ID: 1570420944

Optimization of Railway Tractive Energy using Conventional and Evolutionary Optimization Techniques

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***Abstract*—The energy optimization in modern railway electric traction system is the need of the day. In this paper, tractive energy consumed in railway electric locomotive is optimized and corresponding optimized parameters of interest i.e. acceleration, acceleration period and free run period are determined. Speed-time curve of the locomotive is used to formulate the optimization problem. Conventional and evolutionary optimization methods viz. pattern search and particle swarm optimization techniques are used to optimize the tractive energy and their results are compared. MATLAB toolbox is used to solve the optimization problem.**

Keywords: Tractive Energy, Speed-time Curve, Conventional and Evolutionary Optimization Techniques, Pattern Search Method, Particle Swarm Optimization

Paper ID: 1570422196

Evolving Metering Solutions for Determining the Grid Support Received from Utilities by Captive Power Plants Under Parallel Operation

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***Abstract*—The bulk of consumers require reliable, quality and uninterrupted power supply from utilities as industrial plants do not want any power cuts. Utilities try their best to give uninterrupted power supply to the bulk consumers and also invest money for installing new generation. However, there is a gap between generation and demand in India which encourages the bulk consumers to have their own generation. Industrial plants are installing new power-generating facilities (Captive Power Plants) to meet the increased demands for electric power. Above generated power is cheaper than the grid power supply. The potential for significant increase in the number of captive power plant facilities will grow as energy costs continue to increase. In some industrial plants, where low-cost by-product fuel is available or where demands for process steam are high, the initial investment required to install apparatus for power generation can be repaid by savings in plant operating costs within 2 to 3 years of operation – an attractive return on any investment. Most of the CPPs intend to operate their plants in parallel with the grid supply. Parallel operation provides for both utility and industry export of the surplus electricity and a source of imported power in emergency. Consumers operate their plant in parallel with the grid support for the sake of the slack power requirement. Also they can operate their plant in absence of utility supply. This results in saving of loss of production. Also the bulk consumers can have higher fault level, lower voltage dips, provision of very high instantaneous peak demand from grid, improvement in plant load factor etc. if these consumers connect with the grid supply. For Parallel Operation of a CPP, plant load factor plays an important role & provides salient information to utility of the support extracted by CPP from the utility. In order to get meaningful information, it is desirable to record the data in an energy meter every minutes, this will help to realize the support extracted by CPP from utility for starting their plant machines. Thus the time block setting & meter configuration are the important aspects as far as the metering is concerned to determine the support gained by CPP from grid.**

Paper ID: 1570422536

A Double Derivative based Droop Controller for Improved Power Sharing in Inverter based Autonomous Microgrid

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***Abstract*—This work proposes a double derivative based droop controller for autonomous inverter based microgrids. In multi inverter based microgrids, accurate power sharing requires higher value of droop parameters but increasing the droop coefficient will degrade the microgrid stability. Therefore, one should compromise between system stability and accurate power sharing. The proposed modified controller is designed such that it will improve the power sharing as well as system stability even at higher values of droop coefficient. A double derivative term is added to the**

frequency loop that results in the improved sharing between the inverters as well as it increases the stability limit of the microgrid. The suggested controller is implemented in a three inverter microgrid. MATLAB/Simulink environment is used to obtained time domain simulation results which shows the fruitfulness of the given controller in improving the damping of low frequency modes and thus, improving the system stability.

Keywords: Active Power Sharing, Double Derivative Controller, Droop Control, Inverter Microgrid

Paper ID: 1570423138

A Wide Range Constant Current LED Driver with Improved Power Quality and Zero Standby

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***Abstract*—This paper presents a high power factor low THD (total harmonic distortion) constant current LED (light emittingdiode) driver for wide range input voltage application (90V-300VAC). LED driver is regulated for wide range LED string voltage (60V-105V) and constant LED current (0.7A) for entire load and line cycle. This design is suitable for 50W-90W LED driver for outdoor street lighting application. The power factor and THD meet IEC61000-3-2 Class C regulation for lighting. The overall power conversion efficiency, standby and no-load power consumption of LED driver meet ENERGYSTAR® norms. This solution is useful for smart city applications for LED street lighting in wide voltage range. The board is compact in size so as to fit into existing commercially available LED extrusions for LED streetlights. All protection features like LED open and short are present in the proposed solution.**

Keywords: LED Streetlight, Light Emitted Diode Driver, Power Factor Correction, Power Quality, Quasi Resonant Converter, Zero Standby Power, Smart Cities, Energy Efficiency

Paper ID: 1570423331

Validation of Autopilot Controller for Marine Surface Vessels with Six DoF Model

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***Abstract*—A marine vessels at sea experiences rotational as well as translational motions under the influence of diverse nature of forces and moments originating due to external and internal nature of dynamics including uncertainties and disturbances. For the purpose of design of autopilot controller, use of these modeling becomes too tedious and complex and therefore, controllers are usually designed based on simplified models which depict complex nature of ship motion at sea. In this paper, Extended State Observer (ESO) based Input-Output Linearisation (IOL) controller and Generalised Extended State Observer (GESO) based Output tracking controllers, developed based on simplified Nomoto model have been implemented with six Degree of Freedom model for validating their efficacy. The notable features of the proposed controllers are they neither requires accurate plant model nor any information about the uncertainties and disturbances while achieving robustness and desired performances. It has been demonstrated with the help simulation results how these controllers are effective under various practical scenarios.**

Keywords: Marine Propulsion, Extended State Observer, Six DoF Model, Ship, Autopilot Controller

Paper ID: 1570424758

Intelligent Transformers Keep the Plant Running and Reduce Maintenance Expenditures

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***Abstract*—Electrical utility operators face a growing number of challenges every day for the reliable operation of the transmission grid. These challenges range from managing aging infrastructure to meeting compliance requirements as the transmission operators focus more and more on achieving performance and safety targets. The average age of operating power transformers in North America is around 40 years, which well beyond the projected operating life of the asset. Age is an important factor to be considered when analyzing the failure mechanisms. Although age by itself could be meaningless as a risk factor, its combination with other parameters could play an important role in the analysis of the failure mechanisms and statistics. In addition to the age of the entire installation, other factors including protection devices and gauges, availability of spare parts, expert knowledge and information about a given outdated design, lack of historical operational data and test results, cumulative effects of external stresses such as through faults, lightning and overloads, among others, must be considered. Combined, all the above aspects certainly increase the risk of failure, particularly in the regions where demand growth and power quality play a leading role, as additional constraints to an already aged infrastructure. In addition to aging, the increasingly complex nature of the interconnectivity in the multi-area networks, along with the trending loss of power transformers' expert knowledge, originated from non-replacements of retirees or even from a professional migration of the engineering workforce into other fields of work, has been continuously changing the face of the electricity market. The industry is responding to those challenges in a number of ways. In the power transformer sector, one can engage multiple activities such as the introduction of online smart sensors (gas in oil, moisture, bushing condition, etc.), design analysis, integration of transformer operational data, use of new on-site diagnostic techniques such as Dielectric Frequency Response (DFR) Test, Sweep Frequency Response Analysis (SFRA), Partial Discharge Tests, just to mention a few. In addition, traditional methods such as low-voltage electrical tests and oil chemistry and DGA analysis are key pieces of information that helps determine the readiness of continued reliable operation. Having 24/7 access to updated information related to the condition of each transformer will help to better plan actions needed to increase the availability of the fleet, while reducing total cost of ownership. This also allows planned changes in operation to support maintenance activities when they will have minimal impact on the plant's operation.**

Paper ID: 1570425019

Seamless Operation and Control of Hybrid PVBES-Utility Synchronized System

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***Abstract*—This papers presents the control of a single phase photovoltaic (PV)-battery energy storage (BES) based hybrid system with seamless transfer and power quality (PQ) improvement features. The PV-BES based single phase system provides uninterruptable power to the dedicated nonlinear loads even under utility outage, by transferring**

smoothly to the islanding. Therefore, the smooth transfer from the grid integrated operation to the islanding and vice-versa, provides high reliability of the system than the conventional system. To control the proposed synchronized system in grid integrated mode, a learning quantization (LQ) based current control with PV feed forward (PVFF) loop, is used. The LQ current control extracts the net active component of the load current. Moreover, PVFF is included in LQ control to reflect the PV power contribution in the utility, which also increases the fast tracking ability of proposed control at variable climate conditions. In islanding operation, the load voltage is regulated by the voltage control. The effectiveness of LQ based current control for single phase PV-BES-Utility synchronized system is demonstrated through the experimental results.

Keyword: Photovoltaic, Power Quality, Utility Grid, Seamless Transfer and Single Phase PV-BES-Utility Synchronized System

Paper ID: 1570428076

A Simple Modeling & Working with Wind Power Production

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***Abstract*—The paper address that theoretical and practical model for the wind power conversions plays a significant status to slaughter the power tragedy. A simple model is proposed to prefigure the improved performance for the maximum power extractions from the wind speed and to hurl on the power grids as a substantial green power. Here, the productive postulations are envisaged to the horizontal and vertical axis turbine to ply prying presumption of the wind power mining. The data mining of the wind power may only be hauled out from the track of torrent as a viable landscape of the power farming and accomplishment of the power quality.**

Keywords: Modeling, Simulations, Wind Power Productions, Power Utilization

Paper ID: 1570428243

BLDC Motor Specific PCOTLC Converter with Active Current Wave Shaping for Torque Ripple Minimization

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***Abstract*—In this paper a new converter configuration has been proposed for the active wave shaping of phase currents in BLDC motors without PWM generators. Current wave shaping has been achieved without the implementation of rectangular current generators, comparators, hysteresis and PI controllers. Also the sensing of phase currents is not**

required for feedback to current comparators. In proposed BLDC specific converter, a new concept of Phase Current Overlap Time Limiting Cell(PCOTLC) converter topology, comprised of three sets of Free wheeling Phase Current Limiting (FPCL) transformer has been introduced, which results into tremendous reduction in phase current overlap time i.e. rise and fall time of the currents in switches of incoming and outgoing phases. Together, proposed converter also reduces freewheeling time, which is generally large due to the effect of load and inductance of motor. The proposed topology minimizes the torque ripple without any switching operation. The resulting phase current wave shape is purely rectangular at steady state with very low speed and torque ripple. The speed of the BLDC motor with proposed converter configuration is DC link switch controlled. The dynamic response of the proposed BLDC motor drive system has been investigated using the MATLAB/Simulink.

Keywords: PCOTLC, Phase Current Overlap Time Limiting Cell, FPCL, BLDC, Brushless Motor, Active Current Wave Shaping

Paper ID: 1570428321

Investigations on Flux Estimation Methods for Stator Current based MRAS Speed Estimator for Induction Motor Drive

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***Abstract*—In this paper, a detailed comparative study on the performance of an encoder-less vector control induction motor drive is presented. The performance is compared using two types of rotor flux vector estimation models: voltage model and current model. Speed information of the estimators is used for speed control of motor. MATLAB software is used to model the complete system and to perform the analysis.**

Keywords: Induction Motor, MRAS, Speed Estimation, Stator Current Based

Paper ID: 1570428880

A Bridgeless Boost PFC Converter Fed LED Driver for High Power Factor and Low THD

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***Abstract*—This paper deals with multi-string light emitting diode (LED) driver using a bridgeless (BL) boost converter. This converter is designed for large area LED lighting with illumination control. A multi-mode LED dimming technique is used for lighting control. The BL-boost PFC converter feeds power to an isolated flyback DC-DC converter. The regulated low voltage from the flyback converter is a source of power to the synchronous buck converters for multi-string LED driver and forced cooling system for LED junction. The BL-boost PFC converter inductor is designed based on discontinuous inductor current mode (DICM) which provides good PFC at low cost. The performance of the LED driver is evaluated for a full brightness control capability with low THD at universal**

input supply (90V-265 V). The power quality parameters observed at AC mains are found within an IEC 61000-3-2 Class C standard.

Keywords: PFC, BL-boost Converter, Power Quality, Flyback Converter, LED Light

Paper ID: 1570428987

Single Phase Symmetrical and Asymmetrical Design of Multilevel Inverter Topology with Reduced Number of Switches

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***Abstract*—Multilevel Inverters have shaped a new trend of importance in industry and research. A new topology of multilevel inverter is proposed in this paper which can be operated in symmetrical and asymmetrical modes. The proposed topology produces 7-level and 13-level staircase output voltage waveform for symmetrical and asymmetrical configuration respectively using only 10 switches. The gate signals for the different switches are produced employing the fundamental frequency switching technique. The topology achieves better performance using a lower minimum number of components in comparison to conventional inverters. These improvements result in reduced system cost and size. Simulations are carried out using MATLAB/SIMULINK environment and experimental implementation using laboratory prototype module have ascertained the performance and operation of the proposed topology.**

Keywords: Multilevel Inverter, Symmetrical, Asymmetrical, H-bridge, Fundamental Frequency Switching, Total Harmonic Distortion

Paper ID: 1570429079

A Novel Notch Filter using Wavelet Transform and Statistical Curve Fitting

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***Abstract*—A filtering technique based on wavelet transform and statistical curve fitting is proposed in this paper, to denoise the notches from the variable frequency non stationary synchronizing signal. Rapid processing of the proposed filter in the detection of the notches and removing them from the signal is justified by the results obtained from MATLAB/Simulink. Further, an experimental study is carried out to validate the performance of the proposed filter on a real-time signal.**

Keywords: Curve Fitting, Notch Filter, Power Quality, Wavelet Transform

Paper ID: 1570429300

Space Vector Based PWM Sequences for Z-Source Principal Derived Inverter Topologies

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***Abstract*—A digital implementation of various pulse width modulation sequences based on space vector approach for the case of Z-source inverter is presented in this paper. Each PWM sequence is studied with respect to two main control techniques, namely maximum boost and maximum constant boost. It is observed that when maximum boost control technique is applied, the number of switching in a sample is reduced as compared to the normal situation when there is no shoot through state inserted in the inverter states. Also, maximum boost control causes 120 degree clamping of each phase to positive dc bus for every sequence. Double switching sequences (advanced bus clamping PWM) are being explored first time in this paper for the case of Z-source inverter. The constraints on number and position of samples in a sector are highlighted in order to achieve symmetry in output voltage waveform. Experimental results have been presented to verify the concept.**

Keywords: Z Source Inverter (ZSI), Space Vector Pulse Width Modulation (SVPWM), Voltage Source Inverter (VSI), Maximum Boost Control (MBC), Maximum Constant Boost Control (MCBC), ST State (ST).

Paper ID: 1570429321

Zero-dimensional Modelling of Helical Flux Compression Generator in Matlab Simulink using Radius Matrix Concept

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***Abstract*—Helical flux compression generator (HFCG) is a pulse power source that uses high explosive to convert the energy present in the explosive to the mechanical energy which is again converted to electrical pulse. In this paper a zero dimensional model is implemented in MATLAB-Simulink using the radius matrix concept which determines the radius of the armature of HFCG at each and every axial position with respect to time. This approach enables to increase the accuracy of simulation results and its analysis by increasing the number of time steps and number of axial positions. The results obtained are compared and verified with the experimental and simulation data available in literature**

Keywords: Helical Flux Compression Generator, Radius Matrix, Pulse Power Generation

Paper ID: 1570429341

Fuzzy Logic Fault Diagnostic System for Power Transformers using Roger's Ratio Method

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***Abstract*—It is well known that generation of certain gases within transformer is an excellent indicator of the fault. Dissolved Gas Analysis (DGA) is a widely used method to identify the incipient fault in oil filled power transformer and is based on dissolved gases in oil. Since starting the work is being done to enhance its ability to detect incipient fault in transformer with higher accuracy. Different DGA techniques have been developed and interpretation techniques are shifting from ratio methods to graphical methods and offline to online. Although conventional methods are most promising but they fail in some cases. In this paper roger's ratio method is implemented using fuzzy logic to identify fault and fault level in transformer.**

Keywords: Dissolved Gas Analysis, Roger's Ratio Method, Fault Interpretation, Artificial Intelligence, Fuzzylogic

Paper ID: 1570429356

Evaluation of Input Harmonic Characteristics of LED Lamps Connected to Utility Grid

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***Abstract*—In this paper an attempt is being made to explore the harmonic currents exchanged with the utility-grid by the various types of LED lamps which are commercially available in the Indian consumer market. Total harmonic distortion in input current (THDI) and input power factor (IPF) are identified as critical performance indices. Various types of LED Lamps are investigated for the above performance indices at different power levels and are compared with the IEC 61000-3-2 guidelines. The investigation has not only resulted in the identification of good products available in the market and improved understanding of their electrical characteristics, but it has also culminated in providing us a way to enhance the performance of an individual LED lamp when used in cluster with other variants.**

Keywords: Light Emitting Diode, Fluorescent Lighting, Incandescent Lamp, Total Harmonic Distortion, Power Factor, Power Quality, Displacement Factor and Distortion Factor

Paper ID: 1570429370

A Linear Quadratic Regulator for Small Signal Stability Improvement of Grid Connected PMSG

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***Abstract*—The PMSG wind turbine with grid connectivity has been getting attention as it has the low maintenance requirements and also greater power extraction. Since the rating of PMSG available till now is of medium power ratings it is mostly integrated into medium voltage level in the transmission system. The reactance at this voltage level is different compare to the high voltage transmission system. This paper presents the analysis of PMSG based wind turbine when connected to weak grid scenario. Also, an LQR based control is proposed for making the systems table in varying grid strength. A mathematical model of the grid-connected PMSG system is presented. A differential algebraic based linearization for eigen value analysis is also presented to give the clear distinction of system stability. An ODE-based coding has been carried out in MATLAB to carried out the proposed control verification.**

Keywords: Differential Algebraic Equations (DAE), Ordinary Differential Equation (ODE), Linear Quadratic Control (LQR)

Paper ID: 1570429378

VSC Control of Grid Connected PV for Maintaining Power Supply during Open Phase Condition in Distribution Network

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***Abstract*—The grid-connected PV system with BESS has been in use for many demand-related issues. This paper discusses the use of grid-connected PV in case of open phase condition in the distribution system. An Open phase condition at medium voltage (11 kV) will result in the reduced voltage at low tension (LT) voltage level (400 V) which may be detrimental to constant power loads connected to it. This paper presents an approach to mitigate such scenario by using VSC terminal of grid-connected PV with the distribution transformer (DT). The usefulness of the proposed configuration is validated by restoring the voltage in all phases at the LT level during an open phase at MV level. AMATLAB/SIMULINK model is developed and results obtained for a different mode of operation has been presented.**

Keywords: Point of Common Coupling (PCC), Low Tension (LT), Medium Voltage (MV), Distribution Transformer (DT), Voltage Source Converter (VSC), Phase Locked Loop (PLL)

Paper ID: 1570429430

Analysis and Current Control of Fourth-order DC-DC Bidirectional Converter

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***Abstract*—This paper describes the current control of a non-isolated bidirectional dc-dc converter. It is a switched capacitor type fourth-order bidirectional converter (FOBDC). This converter is modeled using state-space modeling technique, and duty ratio -to- inductor current transfer functions is then derived. Two different compensators are designed using the respective transfer functions to achieve an average current mode control (ACMC) during the charging and discharging modes. The compensator(s) performance is evaluated by introducing perturbations. A technique is also developed for smooth mode transitions, charging to discharging and vice-versa, with minimum delay time. A 12 - 48 V converter is designed, simulated, and experimentally verified for low power applications.**

Keywords: Non-isolated Bidirectional Converter, State-space Model, Average Current Mode Control, Mode Transition Technique

Paper ID: 1570429451

Significance of Reactive Power Loss and its Application to System Voltage Stability

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***Abstract*—In this paper, the significance of reactive power loss and its application to system voltage stability is presented. There active power loss allocation at the load-buses is computed from the reactive power support and loss allocation algorithm using modified Y-bus approach. Further, it is computed for the various load conditions in the system upto the maximum load ability point. The proposed approach is illustrated on a sample 5-bussystem and also tested on a 11-bus practical equivalent system of Indian southern region power grid. A comparative analysis is also carried out with the continuation power flow method to highlight the features of the proposed approach. It can be observed from the simulation results that the reactive power loss allocation at load-buses give the clear indication about the system reactive power issues, which in-turn give an indication about the system voltage instability/collapse problem.**

Keywords: Reactive Power Loss, Voltage Stability, Modified Y-bus Method, Weak Buses

Paper ID: 1570429477

An Approach to Minimize the VA Size of UPQC-S and its Performance Comparison

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***Abstract*—The unified power quality conditioner (UPQC) with injection of voltage with respect to supply current at definite angle (UPQC-S) exhibits unique characteristics as opposed to the injection of voltage in-phase (UPQC-P) or in-quadrature (UPQC-Q) of the supply current. The UPQC-S comprises series and shunt converters. The series converter shares the reactive powers of shunt converter and reduces burden of UPQC under normal operating conditions. The reactive power sharing of a series converter depends on phase angle and, therefore, it has been optimized to minimize the VA size of the UPQC-S. In this work an algorithm is proposed to minimize the VA size of the UPQC-S. The optimized angle is verified using graphical approach under different power factor of the load and also under different voltage sag. Moreover, optimized VA size of UPQC-S is compared with the UPQC-Q and UPQC-P for 0% to 50% of the voltage sag. A comparative analysis is presented to understand the worth of various control approaches of the UPQC. A comprehensive mathematical evaluation is also presented under normal and voltage sag/swell conditions of the AC mains.**

Keywords: AC Mains, Control Algorithm, Optimization, Voltage Sag/ Swell, VA Size

Paper ID: 1570429770

Design and Implementation of Digital Energy Meter with Power Factor Measurement and Load Indicating Feature

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***Abstract*—The technology is developing at a faster pace, and so is the energy consumption. There is an immediate need for us to transcend from electromechanical meters which measure the energy to digital meters which calibrate it efficiently. The widely used electro mechanical meters are susceptible to changes in temperature and time as a consequence of the mechanical components present in the meter. There are problems associated with the meter reading collection and generation of the bill. The primary objective is to build an energy meter which is able to calibrate the energy accurately, able to determine whether the load is leading or lagging without any human interference and also to make it serve as an communication interface between the consumer and producer. The power factor is measured using XOR logic and the type of load is determined by the micro controller based on the XOR logic. This helps the consumer gain an insight on what kind of load he/she is consuming, how much reactive power and real power are they paying for and help them control their energy expenses.**

Keywords: Energy Meter, Power, Power Factor, Voltage, Current

Paper ID: 1570429775

A Home Energy Management Incorporating Energy Storage Systems with Utility under Demand Response using PSO

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***Abstract*—Home energy management (HEM) is important for utility as well as environment. This paper presents an incorporation of energy storage systems (ESSs) as electric vehicle (EV) and uninterruptible power supply (UPS) with utility with the help of demand response (DR) for electricity bill reduction of a home. Heating, ventilating, and air conditioning (HVAC), electric water heater (EWH), and electric water pump (EWP) are taken as loads of a house. ESSs operate as loads as well as energy sources. These home devices are scheduled using particle swarm optimization (PSO) algorithm in MATLAB environment including curtailment. The proposed scheme results in a significant bill reduction while maintaining the users requirement.**

Keywords: Home Energy Management System, Demand Response, Energy Storage Systems, Particle Swarm Optimization, Demand-side Management, Demand-side Resource

Paper ID: 1570429787

A Global Maximum Power Point Tracking Technique based on Current Source Region Detection of I-V Curve

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***Abstract*—This paper proposes a new global MPPT method for PV array under uniform as well as non-uniform insolation. The proposed method first finds out whether the operating voltage lies in the current source region (CSR) or voltage source region (VSR). If the operating voltage lies in CSR, the method skips the settling of PV voltage at the reference voltage and moves to next operating voltage. This reduces the tracking time as PV voltage takes more time to settle when operating voltage lies in CSR. Moreover, the method applies P&O to find the peak whenever operating voltage moves from VSR to CSR as a peak always lies in between them. Finally, it compares the measured power at various local peaks to find the global peak. The performance of the proposed algorithm is further verified in MATLAB/Simulink.**

Keywords: PV System, Boost Converter, Maximum Power Point Tracking (MPPT), I-V Curve, Partially Shaded Conditions (PSCs), Settling Time

Paper ID: 1570429845

Smart Heart Rate Monitoring System

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***Abstract*—Heart rate that is given by the number of times heart beats per minute is a crucial health parameter that indicates the soundness of the human health. In this project, areal-time heart rate measurement technique called Photo-Plethysmography (PPG) is implemented using simple infrared transmitter and receiver circuit. Arduino Uno board has been used for calculating the heart rate from the fingertip. The obtained heart rate values are initially displayed on a Liquid Crystal Display (LCD) and sent serially to Raspberry Pi which is used as an Internet of Things (IoT) gateway. The values are then sent to the cloud through Message Queuing Telemetry Transport (MQTT) protocol. The designed system updates the user with their heart rate through electronic mail (email), Short Message Service (SMS) and real-time plots and provides name and address of a nearby prominent hospital in case of an emergency.**

Keywords: MQTT, PPG, IoT, Raspberry Pi

Paper ID: 1570429914

A New 5L-UHPFC with Reduced Part Count for High Speed Gen-Set Applications

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***Abstract*—In this paper, a new three phase 5-level unidirectional high-power factor converter (5L-UHPFC) for high speed gen-set applications is proposed. The proposed converter has an advantage of reduced device count along with reduced maximum device stress. Nobidirectional switches or clamping devises are used. However, the converter can be modeled and modulated similar to multi-point clamped (MPC) structured converters like diode clamped topology. The validation of the new 5L-UHPFC with phase disposition pulse width modulation (PD-PWM) scheme is verified by simulation and a downscaled experimental setup.**

Keywords: AC-DC Converters, Multi Point Clamped Converters, Multi-level Converters, High Power Factor Converters

Paper ID: 1570429946

Hybrid DERs Enabled Residential Microgrid System with MVDC and LVDC Bus Layout Facilities

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***Abstract*—In last few decades, the environmental, social and technical reforms have undoubtedly changed the way energy is produced and consumed. World eco-forum regulations have pressurized the government agencies to initiate and promote renewable energy. A consistent support is offered by the Ministry of New and Renewable Energy (MNRE), India, to install distributed energy resources (DERs) within the residential consumer premises. Integration of multiple DERs within the premises raises various technical issues related to voltage control and power balancing of hybrid DC/AC residential micro grid system. This paper proposes the hybrid solar and wind energy DERs integrated residential premises. A sophisticated multi-terminal converter controller helps in integrating hybrid DERs along with the battery storage stack for operation in both grid connected and islanded modes. Proposed controllers are self-adaptive to the frequent islanding situations and ensure system stability during such transients. Further, medium voltage DC(MVDC) = 380.0 V and Low Voltage DC (LVDC) = 48.0 V, bus layouts are proposed for hassle free rectifier-less DC load integrations, in addition to the single phase AC buses lying within the residential premises.**

Keywords: Distributed Energy Resource, Grid Connected, Islanded, Hybrid Microgrid, Power Management, Solar and Wind

Paper ID: 1570429995

Detecting Symmetrical Faults during Power Swing for Deblocking Distance Relays

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***Abstract*—In order to avoid relay mal operations during power swings, a power swing blocking feature is incorporated in the distance relays. In order to preserve the security of the system, it is desirable that if any fault occurs during power swing while the relay is blocked, the system operator should be able to deblock the relay. It is not an issue with unsymmetrical faults. However, owing to its symmetrical nature sometimes during power swing when asymmetrical fault occurs the relay remains blocked. With an aim to detect a symmetrical fault during power swing, this paper proposes a technique based on Hilbert transform that monitors three-phase active power on the transmission line. The technique was implemented and verified on WSCC 9 bus system built on Dig SILENT Power Factory. The results justify immunity of the technique towards the location of the fault and fault inception time. The proposed technique successfully sends a deblocking signal to the relay on the occurrence of a symmetrical fault during power swing thus ensuring the Secured operation of the relay.**

Keywords: Power Swing Blocking, Symmetrical Fault, Deblocking Distance Relay

Paper ID: 1570430010

Power Management and Economic Load Dispatch based Control of Hybrid PV-Battery-Diesel Stand alone AC System

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***Abstract*—This paper presents a power management strategy with consideration to the economical operation of a hybrid photovoltaic (PV), battery (BESS) and diesel generator (DG) system. The components of a hybrid system complements the characteristics of each other and tends to improve the reliability of the system. However, a coordinated power management strategy among the individual components is crucial for reliable system operation under load and source power imbalances. In this work, a DC synchronization of DG with PV-BESS is proposed to achieve improved power sharing and coordination as compared to a typical ac synchronization approach. The DG is connected to the common DC link through a controlled VSC while the PV & BESS system is connected through DC-DC converters respectively. The decentralized power sharing among the DG, PV & BESS is achieved through DC droop approach while the remote end AC loads are fed through a voltage source inverter (VSI) operating in the grid-forming mode. The proposed power management strategy incorporates off-MPPT operation of PV as well as efficient operation of DG, under critical powerim balances. Further a secondary control based on Economic Load Dispatch (ELD) is proposed for the optimal operation of the hybrid system taking BESS's State of Charge (SoC) into account. The proposed power management and ELD based control scheme is verified though real-time simulation carried out under wide variations in system condition.**

Keywords: Battery Energy Storage, Droop Control, Economic Load Dispatch (ELD), Hybrid System, Power Management, Secondary Control

Paper ID: 1570430014

Isolated Bidirectional Battery Converter Control for Standalone Solar PV Applications

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***Abstract*—This paper focuses on the efficient use of battery storage system for overcoming the intermittency conditions in the standalone solar PV applications. A dual-active bridge (DAB) based isolated DC-DC converter has been used for the high power transfer efficiency, bidirectional power flow, fast dynamic control, and smaller size. However for energy storage applications, the circulating power of the DAB based DC-DC converter at the input and output ends are the major concern. This paper uses a modified phase-shift control algorithm for DAB converter in order to reduce the back power flow/ circulating power and improve the battery performance overlong time. The operation of the standalone solar PV system with the proposed battery converter control has been verified through the PSCAD based simulation results in both the charging and discharging mode.**

Keywords: Battery Energy Storage, Dual Active Bridge, Phaseshift Modulation, Power Management, Solar PV

Paper ID: 1570430035

Detection and Classification of Faults on Transmission Line using Time-Frequency Approach of Current Transients

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***Abstract*—This paper presents an algorithm for detection and classification of transmission line faults using time-frequency analysis (Stock-Well Transform) on current signal obtained from both the ends of transmission line. The current samples are synchronized with GPS clock and their absolute values are added at each end, to obtained resultant current signal. The cumulative differential sum of the resultant signal over a moving window of half-cycle is compared with the disturbance threshold, to detect a disturbance. Subsequently energy of the signal over a half-cycle prior to the detection of disturbance is computed based on (Stock-Well Transform) and compared with fault threshold, to classify the disturbance into faulty and non-faulty transients. Finally, the faults are classified by computing energy of three-phase currents and zero sequence current in comparing with fault threshold. The proposed algorithm has been successfully tested for types of fault, fault impedance, fault incidence angle and fault location.**

Keywords: Transmission Line Protection, Cumulative-Differential Sum and Energy

Paper ID: 1570430121

Breast Cancer Diagnosis using Adaptive Voting Ensemble Machine Learning Algorithm

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***Abstract*—This paper proposes a new global MPPT method for PV array under uniform as well as non-uniform insolation. The proposed method first finds out whether the operating voltage lies in the current source region (CSR) or voltage source region (VSR). If the operating voltage lies in CSR, the method skips the settling of PV voltage at the reference voltage and moves to next operating voltage. This reduces the tracking time as PV voltage takes more time to settle when operating voltage lies in CSR. Moreover, the method applies P&O to find the peak whenever operating voltage moves from VSR to CSR as a peak always lies in between them. Finally, it compares the measured power at various local peaks to find the global peak. The performance of the proposed algorithm is further verified in MATLAB/Simulink.**

Keywords: Breast Cancer, Neural Network, Logistic, Machine Learning Algorithm, WDBC Dataset

Paper ID: 1570430134

Probabilistic Power Flow using Point Estimate Methods in Mesh and Radial Power Networks

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***Abstract*—Present trend in power system steady state analysis is to account for the existing uncertainties in the system parameters. With the increased installations of renewable energy resources, robust analysis methodologies and techniques are needed to counter the power system operation and planning challenges. Probabilistic power flow (PPF) has been identified as an efficient tool for power system analysis under uncertainty. This paper commemorates the PPF using point estimate methods(PEM).Two schemes of PEM (2 and m) are presented and their performance in solving PPF is evaluated by comparing it to the Monte-Carlo based PPF. PEM-PPF has been tested in both meshed transmission system (30-Bus) and radial distribution system (33-Bus) for its performance. Results have been discussed and PEM is shown to be better performing for radial networks. A new probability density function (PDF) recovery method of Johnson distribution system is used to approximate the PDF of output random variables.**

Keywords: Probabilistic Power Flow, Uncertainty Modeling, Point Estimate Methods, Uncertain Power System Operation

Paper ID: 1570430152

A Resonant Gate Driver Circuit with Turn-On and Turn-Off dv/dt Control

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***Abstract*—At high speed operation of SiC MOSFETs, significant gate losses are present with conventional resistive gate driver circuits. Besides, excessive electromagnetic interference may be generated when they are hard-switched and hence dv/dt control is desired in certain applications. A modified resonant gate driver circuit with separate turn-on and turn-off resonant transfer path is proposed in order to have a decoupled passive dv/dt control of a MOSFET for both turn-on and turn-off process. Further it has been demonstrated using the proposed circuit that dv/dt can be effectively adjusted by proper selection of resonant inductance in each path.**

Keywords: Silicon Carbide (SiC), Gallium Nitride (GaN), dv/dt, Resonant Gate Driver, EMI, High Frequency, Metal-oxide Semiconductor Field Effect Transistor (MOSFET)

Paper ID: 1570430175

Efficient Global Peak Tracking of PV System under Mismatching Conditions using Searching Technique and Bisection Method

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***Abstract*—Rapidly increasing energy demand is leading to increase in installation of photovoltaic (PV) plants across the globe. The PV modules are subjected to various conditions like shading, soiling and degradation because of which the performance of PV panels deteriorates. This will affect the characteristics of PV module which may lead to several stairs in I-V curves and several peaks in P-V curve. In this paper the various causes of occurrences of mismatching conditions are analyzed. An efficient two stage algorithm that tracks global maximum power point (GMPP) accurately under such mismatching conditions is proposed in the paper. In the first stage, a simple searching technique and bisection method are used to bring the operating point to the proximity of global maximum. In the second stage, hill climbing method maintains the operating point at global peak. MATLAB Simulations and experimental verifications are performed for validating the proposed approach.**

Keywords: Maximum Power Point Tracking, Photovoltaic, Partial Shading, Global Peak, Searching Based, Bisection Method

Paper ID: 1570430225

Average Current Mode Control of Battery/ Ultracapacitor Hybrid Energy System & its Microcontroller based Implementation

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***Abstract*—Battery has good energy density but poor power density. Although it can store sufficient energy for the required driving range, but it lacks to provide the acceleration performance of the drive train. Since Ultra Capacitors (UC) have good power density, it is used along with the battery as an auxiliary storage device to form Hybrid Energy Storage System (HESS). Battery and UC should provide the low and high frequency components of the load current demand respectively. This paper presents the Average Current Mode Control (ACMC) for frequency based load current demand arbitration between battery/UC HESS, and its microcontroller based implementation. Since the use digital platform like microcontroller would introduce sampling and computational delay in the control loop, same has been considered for controller design. An UC voltage control loop has also been designed so to keep UC sufficiently charged for providing/ absorbing loads acceleration and regeneration demand.**

Keywords: Bidirectional dc-dc Converter, Electric Vehicle (EV), Frequency Sharing based Control, Sampling and Computational Delay

Paper ID: 1570430268

Direct Torque Controlled Synchronous Reluctance Motor Drive for PV Array Fed Water Pumping

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***Abstract*—This study presents a two stage solar water synchronous reluctance motor (SynRM) driven water pumping system. In this system, to optimize the output of solar PV (photovoltaic) array, a DC/DC converter is used. An incremental conductance based maximum power point technique (MPPT) is used for controlling the DC-DC converter to attain soft starting of the three phase SynRM. In this work, a SynRM is used because of its some inherent characteristics. The simple structure of SynRM makes it ideal for industrial drive arena, especially at low power. The SynRM is substantially highly efficient than other conventional drives used for water pumping. A direct torque control (DTC) technique is used for controlling the SynRM drive. DTC technique is used in this work, because of its simple implementation, less sensitive to parameters variation and no need of co-ordinate transformation. The proposed system is designed, modelled and simulated in MATLAB/Simulink platform. The design and control of the proposed system are validated by simulated results.**

Keywords: Direct Torque Control, Solar Photovoltaic, Synchronous Reluctance Motor, MPPT, Water Pumping

Paper ID: 1570430276

Voltage Stability Assessment using Artificial Neural Network

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***Abstract*—In deregulated environment voltage stability has become very important factor for the purpose of analysis. In this paper some important features associated with voltage stability use in power system have discussed. Line Stability index is used for estimation of the maximum load ability and in other words index is used to recognise the weak bus in electrical power system. In this paper Artificial Neural Networks (ANNs) are used for assessment of voltage stability or to confirm secure and insecure mode of the power system. The input data of neural network are yield from the Newton-Raphson (NR) load flow analysis in the platform of MATLAB R2015b. The result obtained from the N-R method also validates through Feed-Forward Back Propagation (FFBP) Layer Recurrent (LR) and Radial Basis Function Network (RBFN) in terms of accuracy to foresee the status of the power system. The effectiveness of the analysed methods is validated through IEEE 14 test system and IEEE 30 test bus system, using Fast Voltage Stability Index (FVSI).**

Keywords: ANN, FVSI, FFBPN, LR, RBFN, IEEE Bus Test System, MSE, Regression

Paper ID: 1570430295

Direct Torque Controlled Synchronous Reluctance Motor Drive for PV Array Fed Water Pumping

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***Abstract*—In this paper multi-pulse AC-DC converter fed 5-level neutral point clamped (NPC), connected in cascaded manner is used to improve the power quality invector controlled induction motor drive (VCIMD). To meet an IEEE-519 standard at the utility end of the proposed drive, a thirty six pulse AC-DC converter is used. Two isolated eighteen-pulse AC-DC converters are used at the utility end, with the help of the primary phase shift, these two eighteen-pulse AC-DC converters are configured as a thirty six pulse AC-DC converter. A 5-level NPC inverter is used at the drive end to improve the steady state, dynamic and power quality performances of the proposed IMD. To ensure the low switching losses, 5-level NPC inverter is switched at very low switching frequency. The proposed variable speed induction motor drive is modelled and its performance is simulated in Simulink/MATLAB environment to demonstrate its effectiveness for the medium rating applications.**

Keywords: Multi-Pulse AC-DC Converter, Multilevel Inverter, Induction Motor, Power Quality

Paper ID: 1570430305

Dual P-Q Theory based Energy Optimized Dynamic Voltage Restorer with Battery Management Features

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***Abstract*—This paper deals with the protection of sensitive and critical loads from voltage related power quality issues by using Dynamic Voltage Restorer (DVR). A generalized control algorithm based on dual P-Q theory has been proposed to generate the instantaneous reference voltages to compensate the load voltages by the DVR. This suggested algorithm adapts energy optimized series voltage compensation, which results in a reduction of energy storage requirement. A DVR battery management scheme, as a part of this control algorithm has been included for better battery utilization. Each leg of the three-phase three-leg split capacitor inverter is used to inject series compensation voltage explicitly in each phase of the system. Model-based computer simulation studies validate the effectiveness of the proposed control algorithm.**

Keywords: Active Power Filter, Battery Management, Brownout, Dual P-Q Theory, Dynamic Voltage Restorer (DVR), Load Voltage Compensation, Power Quality, Sag, Swell

Paper ID: 1570430315

Application of ANN for Stability Assessment of Large Power System by Post-fault Rotor Angle Measurements

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***Abstract*—Dynamic Stability Assessment (DSA) of power system is a primary requirement in operation and control. Various methods of stability assessment have been reported in the past. In this paper, an Artificial Neural Network (ANN) based supervised learning architecture is presented to assess system stability. The architecture employs the post-fault values of generator rotor angle trajectory as input and predicts the final value of the rotor angle trajectory and time at which the critical generator will cross the system stability criteria. This supervised architecture assesses the radial basis function values of the input features and train the net for a large number of operating conditions with random duration fault at all bus and lines of the system. The results are validated on IEEE 10 Generator 39 bus test system. It is observed that the results obtained from this architecture are aligned with nonlinear simulation studies. The proposed method can be a beneficial tool for decision making at energy management centre.**

Keywords: Artificial Neural Network, Coherent Generator, Dynamic Security Assessment, Preventive Control, Radial Basis Function, Rotor Angle Trajectory

Paper ID: 1570430340

Modeling and Design of Virtual Inertia based Rooftop PV

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***Abstract*—With ever increasing Photovoltaic (PV) penetration in distribution level, they expected to respond for voltage and frequency deviations. It is also necessary to provide an uninterrupted supply to the local loads during grid interruption. In this paper, virtual inertia based single phase rooftop PV which responds to changes in the grid state, grid voltage and frequency is described, using instantaneous real and reactive power components. As the instantaneous real and reactive power components are used in controller, it is embedded with power limiters to avoid over currents and to safe guard inverter switches. The Small signal model analysis is carried out for the system developed to observe its stability under both isolated and grid connected modes. The performance of PV-battery system with proposed controller is tested by considering various operating points and perturbations in digital simulation environment.**

Keywords: Linearised System Model, Power System, Roof Top Photovoltaic, Virtual Inertia

Paper ID: 1570430369

Voltage Stability Assessment using Artificial Neural Network

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***Abstract*—Multilevel inverters have an important place in industries because of its features and importance in many industrial process. Cascaded multilevel inverters have many advantages over other multilevel inverters as low stress across the switches, simple control techniques and high power quality. But, the main drawback of cascaded inverter is requirement of high number of power electronics switches for its operation. This paper presents anew topology for cascaded multilevel inverter with reduced number of switching devices, voltage sources and driver circuits. As the number of switches are less, this topology has lower switching losses, cost, weight and requires less space for installation as compared to conventional inverters. In the presented topology only12 switching devices and four voltage sources are required to generate 31-level in output phase voltage. To verify the performance of the proposed topology in generating all voltage levels, simulation results are carried out using MATLAB for31-level inverter.**

Keywords: Asymmetric Multilevel Inverters, Cascaded Multilevel Inverter, Basic Unit

Paper ID: 1570430473

Linear OPF with Linearization of Quadratic Branch Flow Limits

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***Abstract*—This paper presents a linear optimal power flow (LOPF) formulation which is developed based on recent advancements in linear flow for analyzing various aspects of piecewise linearization of quadratic branch flow limits. Ananalytical expression for obtaining the required number of segments for linearization is developed using the geometry of the circle. The expression gives the number of linear constraints to replace the quadratic constraint for a specific error value without introducing any sub-optimization problem. This makes the LOPF solvable without iterations through efficient linear solvers. The variation of linear constraint set size with different line limits for different errors has been shown. Further, a recent method of area reduction in thermal limit linearization is analyzed, and adverse effects of it have been shown using standard test systems. A modified approach for area reduction is also proposed which excludes the problems associated with the present one. Results of LOPF with the linearization strategy obtained for IEEE 30 Bus are promising and motivate further investigations.**

Keywords: Linear Optimal Power Flow (LOPF), Piecewise Linearization, Thermal Limit Constraints

Paper ID: 1570430521

Survey on Model Order Reduction for Single-input Single-output Systems

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***Abstract*—This paper is a collection of some popular model order reduction techniques. The purpose of this paper is to provide different techniques in a paper with some detail explanation. These techniques has been discussed by many investigators. That includes time domain and frequency domain techniques, which help to reduce the complex higher order system into lower order. These techniques are used in single input single output (SISO). That can be work on continuous and discrete system.**

Keywords: Model Order Reduction, Continuous, Discrete

Paper ID: 1570430686

Voltage Stability Assessment using Artificial Neural Network

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***Abstract*—In practice, sensitivity matrixes were generated through multiple load-flow analysis, though some literature shows the sensitivity like GSF (Generator Shift Factors) can be calculated through conventional numerical method without using load flow analysis. This paper presents the comparative results of locational marginal pricing on IEEE 7 bus system using both PTDF (Power Transfer Distribution Factors) based on DC load flow and Numerical conventional GSF matrix. The analysis shows the effect of GSF on congestion charges and the losses in the system and their formulation and formation of total locational pricing scheme. This paper further gives a combined pricing based on LMP (Locational Marginal Pricing). The prime goal of this paper is to get a better line flow and less locational marginal pricing.**

Keywords: Locational Marginal Pricing (LMP), Generation Shift Factor (GSF), Optimal Power Flow (OPF), Congestion and Power Loss

Paper ID: 1570430707

Implementation of Solar Photovoltaic System with Universal Active Filtering Capability

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***Abstract*—In this work, a novel technique based on second order sequence filter and proportional resonant controller is proposed for control of universal active power filter integrated with PV array system (UAPF-PV). Using a second order sequence filter and sampling it at zero crossing of instant of the load voltage, the active component of distorted load current is estimated which is further used to generate reference signal for shunt active filter. The proposed method has good accuracy in extracting fundamental active component of distorted and unbalanced load currents with reduced mathematical computations. Along with power quality improvement, the system also generates clean energy through the PV array system integrated to its DC-bus. The UAPF-PV system integrates benefits of power quality improvement and distributed generation. The system performance is experimentally evaluated on an experimental prototype in the laboratory under a variety of disturbance conditions such as PCC voltage fall/rise, load unbalancing and variation in solar irradiation.**

Keywords: Power Quality, Universal Active Power Filter, Adaptive Filtering, Photovoltaic System, Maximum Power Point Tracking, Sequence Filter

Paper ID: 1570430714

Linear Quadratic Estimation Control for Single Stage PV System Integrated to Single Phase Utility

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***Abstract*—A linear quadratic estimation (LQE) based control for single stage single-phase grid integrated solar photovoltaic (PV) system is proposed in this paper. The mathematical approach minimizes the mean-squared estimation error and replaces the phase locked loop (PLL) and its associated problems to synchronize the PV converter system to the single-phase grid. The PV converter system uses a voltage source converter (VSC), which harvests the peak power generated from the PV array and injects it into the single-phase grid. The harmonics analysis of grid current is meeting an IEEE-519 power quality standard. In addition, VSC mitigates nonlinear load current harmonics, improves power factor of the system even when PV generation is not available. It also improves dynamic response on sudden connection and disconnection of nonlinear load and under varying irradiance. The reference VSC input voltage is determined by incremental conductance (INC) based maximum power point tracking. The proportional integral (PI) controller sustains VSC input voltage at the set point voltage, and the loading on the PI controller is reduced by using feed-forward loop, thus transient response of the solar system is enhanced. This control algorithm for the solar PV system, is authenticated by experimental results.**

Keywords: Linear Quadratic Estimator (LQE), Solar Photovoltaic (SPV), Low Pass Filters (LPFs), Voltage Source Converter (VSC), Single-Stage, Power Quality

Paper ID: 1570430783

Implementation of Recurrent Neurocontrol Algorithm for Two Stage Solar Energy Conversion System

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***Abstract*—A grid interactive photovoltaic generation system is developed in this work. A boost converter forms the initial stage and is used to obtain the maximum power from the PV array. It is controlled using an incremental conductance (INC) based algorithm. The second stage is a voltage source converter (VSC), which interfaces the PV system to the grid. A recurrent neuro control based algorithm is used to generate the switching pulses for the VSC. The solar energy conversion system (SECS) has the capabilities of harmonics reduction, reactive power compensation, unity power factor operation and grid currents balancing. The proposed system is validated under various operating conditions using simulation as well as experimental results.**

Keywords: Recurrent Neuro Controller, Solar Energy Conversion System, Power Quality, Incremental Conductance Based MPPT

Paper ID: 1570430954

Demand Side Load Management, and its Impact on Bus Parameters

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***Abstract*—Power systems are faced with continuously varying loads. These varying loads, when they rise, can bring the generation to the verge of breach of capacity. Usually during peak load hours of the grid, the sequence of events to happen is loss of quality of power, then loss of stability, and then system collapse. This paper looks at voltage stability, at a bus, and proposes a demand side load management scheme for improvement of system performance, during peak load hours, of particularly high demand season. The proposed demand side load management works in event of an anticipated stress on the power system. The scheme employs fuzzy logic principles to effect direct control of deferrable loads in the consumer premises. The deferrable typically include heating ventilation, air conditioning (HVAC), battery charging, etc. The authors have used modelling and simulation to evaluate the performance of the scheme.**

Keywords: Demand Side Load Management, Fuzzylogic Control, Voltage Stability, Peak Management, Reactive Power Management

Paper ID: 1570431091

Standalone Solar PV Array Fed SMC based PMSM Driven Water Pumping System

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***Abstract*—A sliding mode control (SMC) based vector control of permanent magnet synchronous motor (PMSM) drive used in solar water pumping system is presented in this paper. The SMC gives good performance for motor-drive system under system parameter variations, load disturbances and sudden change in reference speed. The solar PV array is operated at maximum power point through a boost converter. The DC bus voltage of the system is held constant through the DC link voltage proportional-integral (PI) controller. The output of DC link voltage PI controller and the PV array feed forward term are used to generate reference speed command. The speed of PMSM is controlled through vector control. Switching signals for voltage source inverter (VSI) are generated using the hysteresis current controller. The proposed system is designed, modeled and simulated on MATLAB/Simulink platform. The starting, steady-state and dynamic performances of the system are examined for variable environmental conditions. A prototype of the system is also developed in the laboratory.**

Keywords: Permanent Magnet Synchronous Motor (PMSM), Sliding Mode Control (SMC), Solar Photovoltaic (PV) Array, Solar Water Pumping System

Paper ID: 1570431124

A Consensus based Solution to the Classic Economic Dispatch Problem on a Multi-Agent System Framework

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***Abstract*—Smart grids are a modernized type of present-day electric grid. It is a cyber-physical network that employs a advanced level of monitoring, control which can combat the technological difficulties faced today. With the help of this innovative framework, the fundamental problem of economic dispatch needs to be revisited. In this paper, a consensus based approach is presented to solve the Economic Load Dispatch (ELD) problem in smart grid. A multi-agent based intelligent system framework is created by co-simulation of MATLAB and JADE to implement the proposed approach in a distributed manner. The mathematical formulation of the proposed approach is presented in this paper. Simulation results on various case studies are presented to demonstrate the effectiveness of the approach.**

Keywords: Economic Load Dispatch, Smart Grid, Consensus Protocol, JADE, Multi-agent Systems, Graph Theory

Paper ID: 1570431138

Control of a 12/8 Switched Reluctance Motor with Saturation Characteristics for Light Electric Vehicle

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***Abstract*—This paper deals with the modeling and control of a three phase, low voltage switched reluctance motor (SRM)for light electric vehicle (LEV). An improved method of modeling and control of the SRM is implemented, which is fast and accurate. The flux versus current characteristics at different rotor position and torque versus rotor position for various values of currents are achieved for the SRM. Themodeling is done using current and voltage measurements of a SRM and the saturation characteristics are estimated offline over MATLAB/Simulink platform. The control of SRM is implemented using asymmetric bridge converter. The switching is implemented using a hysteresis current control. Simulation results for the starting and steady state performance of the SRM are discussed in detail.**

Keywords: SRM, Flux Characteristics, Torque Characteristics, Asymmetric Bridge Converter, Hysteresis Current Control, SRM Drive

Paper ID: 1570431193

State Feedback with Integral Control for Boost Converter & its Microcontroller Implementation

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***Abstract*—Boost converter has a right-half plane zero (RHPZ) in the "duty cycle control to output voltage" transfer function. Presence of RHPZ deteriorates the performance of the system and causes stability issues. RHPZ should limits the bandwidth of the system while designing PI controller for voltage mode control (VMC) and current mode control (CMC) for boost converter. State feedback control design offers much flexibility in terms of placing poles according to time domain specifications and its implementation is less difficult than VMC or CMC for boost converter. This paper presents modeling, simulation and microcontroller based implementation of the state feedback design with integral control for a boost converter system. The experimental and simulation results verify the system design and specification.**

Keywords: dc-dc Converter, State Feedback, Small Signal Model, Integral Control

Paper ID: 1570431202

Effect of Optocoupler Feedback Dynamics on Peak Current Mode Controlled Active Clamp Forward Converter

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***Abstract*—Forward converter has been used in low and medium power applications due to the cost effectiveness, simplicity, wide input and output variation. Many reset techniques are developed to reset the transformer magnetizing current and increase the duty cycle range of the switch. Active clamp reset technique has the advantage of both increased operating duty cycle and zero voltage switching resulting in increased efficiency. Since it is an isolated converter, optocoupler feedback has been used to isolate input and output. Due to the design simplicity it is being widely used in telecommunications and military applications over magnetic feedback. This paper presents the comparative study of type-II controller realization with Operational Amplifier and optocoupler isolation for 48Wpeak current mode controlled active clamp forward converter with self-driven synchronous rectification. The effect of optocoupler dynamics is investigated for the closed loop active clamp forward converter with the PSPICE simulation.**

Keywords: Forward Converter, Synchronous Rectification Resetting, Optocoupler Feedback, Magnetic Feedback

Paper ID: 1570431218

Capacitor Voltage Balancing and THD Analysis in ANPC Multilevel Inverter

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***Abstract*—The comparative analysis of active neutral point clamped (ANPC) multilevel inverters (MLIs) with classical MLIs such as neutral point clamped (NPC) MLI, and flying capacitor (FC) MLI is presented in this paper. The natural voltage balancing across dc link capacitor is achieved in steady state using ANPC MLI. The redundant switching sequence logic is generated using phase-shifted pulse-width modulation (PS-PWM) strategy. Total harmonic distortion is presented at different modulation indices for 3-level and 5-level inverter voltage output. The simulation results are presented for the verification.**

Keywords: Active Neutral Point Clamped (ANPC), Neutralpoint Clamped (NPC), Multilevel Inverters (MLIs), Phase-shifted Pulse-width Modulation (PS-PWM)

Paper ID: 1570431453

A Comparison of Bayesian and HMM based Approaches in Machine Learning for Emotion Detection in Native Kannada Speaker

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***Abstract*—We build an emotion detection system based on Bayesian multivariate modeling and compare the same with the one based upon Hidden Markov Modeling (HMM) scheme. Both the systems were built upon probabilistic pattern recognition and acoustic phonetic recognition. Since our native language is Kannada, one of very rich South Indian language, we have used 4Emotions uttered in Kannada to train and test the schemes. Since Mel-Frequency Cepstral Coefficients (MFCC) are well known acoustic features of speech [1][2][4], we have used the same in speech feature extraction. Finally performance analysis of these models in terms of Emotion Error Rate (EER) justifies the fact that Dynamic modeling using HMM yields better results over other modeling schemes and can be used in developing Automatic Speech Recognition systems.**

Keywords: Emotion, Phoneme, Bayesian Multivariate Model:HMM, Speech Recognition, MFCC, EER, Kannada

Paper ID: 1570433293

Cause based Analysis of Power Quality Disturbances in a Three Phase System

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***Abstract*—The massive increment towards the activities in the area of power quality (PQ) is due to switching events, faults, nonlinear loads and increased usage of power electronic converters. These are causing PQ disturbances like voltage sag, voltage swell, interruption, harmonics, and waveform distortion etc. Overheating of electronic components, corrupted data and equipment failure are some of the common symptoms of poor PQ in the distribution system. The various types of the voltage sags are the main PQ disturbances which need attention and their respective mitigation. Different types of voltage sags have been investigated on the transmission side and as well on the distribution side due to occurring of the various types of line faults. All these voltage sags has been simulated and analysed with MATLAB software. Furthermore, underlying causes of this PQ disturbance analysis has been simulated and discussed with the need of linking these with the respective PQ disturbances.**

Keywords: Power Quality, Power Quality Disturbances, Voltagesag Classification, Underlying Cause

Paper ID: 1570434372

Dual Mode Operational Control of Single Stage PV-Battery based Microgrid

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***Abstract*—This paper presents a single stage solar photovoltaic (PV)-battery based three-phase microgrid in grid connected and isolated modes. The PV-battery system feeds nonlinear load through a voltage source converter (VSC).The battery energy storage (BES) is connected at the DC-link of the VSC through a bidirectional DC-DC buck-boost converter. The proposed control scheme operates the single stage PV system at maximum power point tracking (MPPT) in grid-connected as well as standalone modes. The dual objectives of battery charging and power quality control is implemented through VSC. An adaptive least mean square (LMS) control is used so that grid currents are always maintained balanced and free of harmonics, as per IEEE 519 standards. BES charging, in case of low state of charge (SOC), is implemented by VSC in grid connected mode by using droop based control. Simple and effective perturb & observe (P&O)control for MPPT is executed through the bidirectional DC-DC converter control. The proposed control algorithm is simulated on MATLAB/Simulink with Simscape toolbox and its satisfactory performance is demonstrated in various scenarios.**

Keywords: Battery, Microgrid, Power Quality, PV Array

Paper ID: 1570434373

Grid Integration of Three-Phase Single-Stage PV System using Adaptive Laguerre Filter based Control Algorithm under Non-Ideal Distribution System

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***Abstract*—This paper presents a single stage, three phase gridconnected solar PV (Photovoltaic) system. The MPPT (Maximum Power Point Tracking) based on P&O (Perturb and Observe) technique is used to obtain maximum power of the PV array. Anadaptive Laguerre filter based control algorithm is used for the control of VSC (Voltage Source Converter). For sustaining the voltage of DC link with the reference value, a PI (Proportional Integral) controller is used. The behavior of the grid connected solar PV system is studied on a laboratory prototype. The performance of this system is demonstrated under non-ideal conditions where it performs satisfactorily for wide range of variations of load.**

Keywords: Distribution Static Synchronous Compensator (DSTATCOM), Laguerre Filter, Solar Photovoltaic (SPV), Power Quality

Paper ID: 1570434380

Analysis of Battery Integrated Second Order Two Switch Boost Converter

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***Abstract*—In this paper, large-signal and small-signal models, with phase portrait, is developed for battery integrated second order boost converter in continuous-conduction mode (CCM) of operation. This models help to investigate the steady state and transient behavior of converter. Large-signal model using controlled current and voltage source is proposed to show the non-linear behavior of the converter under different battery voltage and duty ratio in open loop which is not clear in the switch diode model used in simulation due to inclusion of ripples in voltage and current. Finally, phase portrait is provided under input current and output voltage control to have full insight on its steady state and transient response of battery integrated converter. This paper highlights that the inclusion of battery within the converter changes the dynamics of the converter in open and closed loop system and also range of operating point of the converter increases.**

Keywords: Small Signal Model, Large Signal Model, Phase Portrait, Limit Cycle

Paper ID: 1570434397

PV-Battery based Single Phase Microgrid with Grid Synchronization and De-synchronization Capabilities

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***Abstract*—In this paper presents an integration of battery with a PV grid tied based single phase microgrid with multifaceted facilities. The proposed PV-battery grid tied system has capability to perform in dual mode i.e. grid integrated mode and islanded mode, according to the availability of grid. The proposed system has multipurpose control for VSC (Voltage Source Converter), for power transfer, harmonic elimination and provides power balance to the microgrid. The purpose of this system is to supply uninterrupted power to the load at less PV generation orgrid fault condition or at peak load condition by using a battery. This system is modeled in MATLAB and developed model is used to simulate its performance. Simulation results are analyzed the performance and the response of microgrid with an adaptive algorithm with frequency and voltage control under mode transition condition.**

Keywords: Solar PV Array, Photovoltaic Power Generating System, Battery, Power Quality and Synchronization Control

Paper ID: 1570434429

Discrete Noise-Eliminating Second Order Generalized Integrator based Control Strategy Applied to Grid-Integrated Solar PV Synchronization Converter

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***Abstract*—This work introduces a novel discrete noise-eliminating second order generalized integrator(DNSOGI) based control technique for synchronization converter of single phase two stage grid-connected solarphotovoltaic (PV) system. The role of DNSOGI in control technique is fundamental component extraction from the grid voltage for unit template generation and fundamental component extraction from the load current, which enhances the performances of the control technique. In this work, DNSOGI based control technique is tested for nonlinear loading, unbalanced load condition as well as for solar insolation variation condition. The satisfactory dynamic, as well as the steady-state performance of DNSOGI, shows that the energy management is successfully implemented in all conditions. Moreover, the total harmonic distortion of grid current satisfies the objective of the proposed system and an IEEE-519 standard.**

Keywords: Solar PV, DNSOGI, IEEE-519, Single Phase Two Stage Grid Connected Solar PV System, Power Quality

Paper ID: 1570434480

Flux Optimization of PV Fed Induction Motor Drive with ANN based Current Control for Water Pumping

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***Abstract*—This paper deals with the implementation of an induction motor based single stage solar PV fed water pumping system using vector control. The most popular and widely known perturb and observe (P&O) algorithm is used in the system to operate the PV array at peak point. The system aims at loss minimization and flux optimization of induction motor using P&O algorithm. This utilizes the stator flux component as a control variables fed to MPPT block. The reference speed is generated from the MPPT block itself and it serves as input to the vector control. The losses in the induction motor are minimized by the control of the flux producing component of current and thus the efficiency of the motor is improved by integrating the fluxoptimization algorithm with the P&O MPPT block. The modeling of the proposed work is done in MATLAB environment and is validated experimentally by developing aprototype. The results obtained show the suitability of the system for solar water pumping application.**

Keywords: Sensor-less Speed Control, P&O MPPT, Induction Motor Drive (IMD), Flux Optimization, ANN based Current Control, Solar Water Pump

Paper ID: 1570434483

A Single Phase Double Stage Grid Interfaced Photovoltaic System based on Improved Least Mean Square Algorithm

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***Abstract*—This paper proposes an improved variable step sizekwong least mean square algorithm based single phase double stage solar photovoltaic (SPV) grid interactive system. The interconnection of the distribution system with the SPV system and the load invariability introduces harmonics in the grid current and voltages at the point of interconnection (POI).The double stage topology includes two power stages, the maximum power point tracking (MPPT) power stage where the peak solar power is extricated with subsistence of a boost converter. However, the voltage source converter in the second power stage aids feeding of active power in to the grid and improves the harmonic profile of the system. This control scheme is applied for the adaptive noise cancellation with faster convergence rate and harmonic suppression features. A hardware prototype is developed for the proposed system configuration and is tested under various abnormal conditions to validate system performance. Moreover, the test results conform well to the IEEE standard 519.**

Keywords: Solar PV, Kwong LMS, VSC, MPPT, Power Quality

Paper ID: 1570434485

Single Phase Multifunctional Grid Integrated Synchronous Generator based Wind Energy Generating System

Farheen Chishti[1], Shadab Murshid[2] and Bhim Singh[3]
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***Abstract*—The wind energy is considered to be clean and no waste producing renewable energy resource, but the lack of utilization techniques, restrict its use to full swing. The paper suggests an effective technique of single phase grid interfaced variable speed wind energy generating system (VSWEGS) using a wind turbine driven salient pole synchronous generator (SG).The proposed system has the ability to extract the maximum power of the wind energy generating system (WEGS) and even under sudden voltage changes such as voltage swell and sag the system performance remains intact. The generated power from the VSWEGS, is fed into the grid at unity power factor. The variable wind speed operation is realized effectively by using two power electronic converters (PEC) connected back to back at the intermediate DC link. The proportional integral (PI) controller maintains the DC link voltage at its reference value. The dynamic response of the proposed system is enhanced by including a wind-feed forward term. The performance of the system is verified by the experimental results. The grid current total harmonic distortion (THD) is found to be less than 5%, which meets anIEEE-519 standard.**

Keywords: Salient Pole Synchronous Generator, VSWEGS, Voltage Sag, Voltage Swell and Power Quality

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