IEEE STUDENT BRANCH COLLEGE OF ENGINEERING KARUNGAPALLY

PRECON 2021
INTERNATIONAL POWER AND RENEWABLE ENERGY CONFERENCE

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2021 IEEE International Power And Renewable Energy Conference

Dates: 24th - 26th September 2021

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IEEE PES Power & Energy Society

IAS IEEE INDUSTRY APPLICATIONS SOCIETY

IEEE

2021 IEEE International Power And Renewable Energy Conference

About the Conference

2021 IEEE International Power and Renewable Energy Conference (IPRECON) is the 2nd edition of India's first IEEE IAS Club of 6 Technical Paper Conference organized by IEEE Student Branch College of Engineering Karunagappally (IEEE SB CEK), technically sponsored by IEEE IAS, IEEE PES and IEEE PELS. IPRECON provides a platform for students and professionals from all around the world to share their findings in the fields of Power, Renewable Energy and Computing Technologies. With the theme “Engineering the sustainable world with Renewable Energy Resources through ingenious computing technologies”, the conference will be held on the 24th, 25th and 26th of September 2021 in College of Engineering Karunagappally, Kerala, India.

Technical Papers are solicited on subjects pertaining to the scope of the conference that includes, but is not limited to the topics.

Power Electronic Converters and Control Systems
Wide band gap devices
Electric Machines and Drives
Renewable Energy Resources
Distributed Generation and Grid Interconnection
Electric Vehicles
Energy Storage & Battery Charging Techniques
Power Quality issues
Microgrid & Smartgrid
Lighting technologies
Energy Policies & Standards
Artificial intelligence techniques
Cybersecurity
Nature inspired algorithms and Machine Learning
Deep learning
Big data analytics
Surveillance and Monitoring
Fuzzy semantic Web
Swarm intelligence and algorithms for optimising smart cities

Accepted papers will be submitted for inclusion into the IEEE Xplore® Digital Library subject to meeting IEEE Xplore's scopes and quality requirements.

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Speakers

Dr. Peter Magyar

Dr. Kaushik Rajashekara

Dr. Brad Lehman

Special Session

Dr. Peter Magyar

MPP Consult, Germany
IAS Director of Chapter & Membership Development

Topic

The potential of electricity-based fuels for low-emission personal cars – Quo vadis electric car

Dr. Peter Magyar received the Dipl. eng. and the Dr. tech. degrees from the Budapest University of Technology, Hungary, in 1967 and 1975, respectively. From 1967 to 1991, he was with Department of Automation of the same university as an assistant professor and a research associate. In 1981, he was recipient of the Alexander von Humboldt fellowship, Bonn, Germany, and spent a research year at the Braunschweig University of Technology, Germany. From 1991 to 2009, he was with industrial companies in Germany in different positions. His working field has been control of electrical drives, car steering control and automatic car parking manoeuvre systems. He is retired (2009) and working as consultant in the field of transportation electrification, electric cars and renewable energy. He has been expert evaluator of the European Commission since 2001. Dr. Magyar has been IEEE member since 1991 and served as a volunteer in various positions in the Germany Section, R8 Committee, at IEEE TAB and in the Industry Applications Society since 1998. Currently, he is chapter coordinator of the Germany Section, life members coordinator of the R8 Committee and director of chapter development of the IA-Society. Dr. Magyar is recipient of the IAS Distinguished Service Award 2006 and has been elected to the grade of IEEE Fellow for contributions to digital control of electrical drive systems in 2007.

Keynote Session

Dr. Kaushik Rajashekara

Distinguished Professor of Engineering

University of Houston

Keynote Topic

Convergence of Enabling Technologies for Smart Grid

Dr. Kaushik Rajashekara received his BE, ME, and PhD from Indian Institute of Science. He joined Delphi division of General Motors Corporation in Indianapolis, IN, USA as a staff project engineer in 1989. In Delphi and General Motors, he held various lead technical and managerial positions, and was a Technical Fellow and the Chief Scientist for developing electric machines, controllers, and power electronics systems for electric, hybrid, and fuel cell vehicle systems. In 2006, he joined Rolls-Royce Corporation as a Chief Technologist for More Electric Architectures and power conversion/control technologies for Electric, More Electric, and Hybrid Electric Aircrafts. In August 2012, he joined as a Distinguished Professor of Engineering at the University of Texas at Dallas. Since September 2016, he is a Distinguished Professor of Engineering in University of Houston.Prof. Rajashekara was elected as a Member of the US National Academy of Engineering in 2012 and as Fellow of US National Academy of Inventors in 20215. He is also a Fellow of the Indian National Academy of Engineering. He is a recipient of 2021 IEEE Medal on Environmental and Safety Technologies, and 2013 Distinguished Alumnus Award of the Indian Institute of Science. He is a Fellow of IEEE (1999) and a Fellow of SAE International (2006) for contributions to the advancement of power conversion and propulsion systems. He has published more than 250 papers in international journals and conferences, has 35 U.S. and 15 foreign patents; and has written one book, and contributed individual chapters to 8 books. His research interests are in the area of power/energy conversion, Transportation Electrification, Renewable Energy, and Subsea Electrification

Keynote Session

Dr. Brad Lehman

Professor, Department of Electrical & Computer Engineering, Northeastern University, Boston, MA

Keynote Topic

The Future Influence of Artificial Intelligence on Power Electronics, Renewable Energy

Professor Brad Lehman is presently a Professor in the Department of Electrical and Computer Engineering at Northeastern University (Boston, MA) and previously was a Hearin Hess Distinguished Assistant Professor at Mississippi State University. Dr. Lehman was Editor-in- Chief of the IEEE TRANSACTIONS ON POWER ELECTRONICS from 2013-2018 and previously has been the recipient of the 2015 IEEE (PELS) Power Electronics Society Modeling and Control Technical Achievement Award, a 2016 IEEE Standards Medallion, the 2018 IEEE Award for Achievement in Power Electronics Standards, and the 2019 IEEE PELS Harry A. Owen, Jr. Distinguished Service Award.He has been listed in the inaugural edition of the book The 300 Best Professors, Princeton Review, 2012. Dr. Lehman performs research in power electronics and controls, with applications to solar energy, LED lighting, battery energy management systems, and reliability. Before becoming a professor, Brad was the head swimming and diving coach at Georgia Institute of Technology.

AT A GLANCE

The potential of electricity-based fuels for low-emission personal cars – Quo vadis electric car

Dr. Peter Magyar

Distinguished Professor of Engineering
University of Houston

Date : 25th September 2021
Time : 05:30 - 06:30 PM(IST)

Convergence of Enabling Technologies for Smart Grid

Dr. Kaushik Rajashekara

Distinguished Professor of Engineering
University of Houston

Date : 24th September 2021
Time : 07:00 - 08:00 PM(IST)

The Future Influence of Artificial Intelligence on Power Electronics, Renewable Energy

Dr. Brad Lehman

Professor, Department of Electrical & Computer Engineering, Northeastern University, Boston, MA

Date : 25th September 2021
Time : 07:30 - 08:30 PM(IST)

Humanitarian Track

Mercy Chelangat K

IEEE Smart Village Ambassador,
PES WIP Lead for Region 8.

Date : 26th September 2021
Time : 05:00 - 06:00 PM(IST)

Virtual Laboratory Visit To PNNL

Dr. Richard Kouzes

Laboratory Fellow Emeritus Physical & Cmputational Science Pacific Northwest National Laboratory

Date : 25th September 2021
Time : 09:00 - 10:00 PM(IST)

The bridge between Student and Professional Life

Anish M.S

Public Relations Coordinator
IEEE Germany Section,
Coordinator,New Initiative & Projects Subcommittee,
IEEE PES YP

Date : 24th September 2021
Time : 05:00 - 06:00 PM(IST)

Professional Communication

Raneena Raoof

New Initiative & Projects Subcommittee Member, IEEE PES YP.
Content Team Coordinator IEEE PES YP Kerala
Vice Student Activities Coordinator IEEE PES kERALA CHAPTER

Date : 24th September 2021
Time : 06:00 - 07:00 PM(IST)

2021 IEEE International Power And Renewable Energy Conference

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IPRECON 2021 TRACK SCHEDULE

DAY 1 24th September 2021

Track 1: Power Electronic Converters and Control Systems

Session Chair: Nabil Mohammed

Ph.D.Scholar, Monash University Australia

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9:45 AM	47	Merril Lazar Shreelakshmi MP	Efficient Bidirectional DC-DC Converter using Digital Adaptive Frequency Modulation

10:00 AM	52	Rohming tluanga Subir Datta Nidul Sinha	Study of SCADA based Existing Water Treatment Plant- GAWSS Phase-I in Mizoram, India
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10:30 AM	119	Rubell Goopta Avik Bhattacharya	Reduced Switch 13 Level Inverter for Grid-Connected Applications
10:45 AM	169	Mohammad Afkar Seyyed Amin Sadat Sakkak Roghayeh Gavagsaz-Ghoachani Matheepot Phattanasak serge pierfederici	Operation and Analysis of a Modular Converter for Photovoltaic or Fuel cell systems
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Track 2: Electric Machines & Drives and Power Quality Issues

Session Chair 1: Antony Peter

Research Scholar, APJ Abdul Kalam Technological University

Session Chair 2: Vidya Valson

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09:45 AM	50	CATHERINE THOMAS BINDU G R	A Control Strategy for the Mitigation of Rotor Vibration in a Three Phase Induction Motor
10:00 AM	51	Raja Ram Kumar Chandan Chetri PRIYANKA DEVI Ankita Kumari Dr. KUNDAN KUMAR Saket RK	Electromagnetic Feature Study of a Novel Dual-Stator Five-Phase Spoke-Type Permanent Magnet Motor for Electric Vehicles Application

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Track 3: Renewable Energy Resources (24th September 2021

Session Chair 1: Raju Manuel

Ph.D. Scholar, Karpagam University, Coimbatore

Session Chair 2: Robins Anto

Research Scholar, IIT Roorkee

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Session Chair 1: Lallu Mol K Johny

Ph.D Scholar, APJ Abdul Kalam Technological University

Session Chair 2: Sanoop P S

Ph.D Scholar, National Institute Of Technology Calicut

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Track 5 : Distributed Generation and Grid Interconnection

Session Chair 1: Konrad Erich Kork Schmitt

Ph.D.Scholar, TexasTechnical University

Session Chair 2: Ibrahim A Ibrahim

Ph.D.Scholar, Macquarie University, Australia

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Session Chair 1: Jyothi Gupta

Ph.D. Scholar, Sardar Vallabhbhai National Institute of Technology

Session Chair 2: S.-Vimala Gayathri

Ph.D Scholar, Vellore Institute Of Technology Chennai

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Track 8 : Electric Machines & Drives and Power Quality Issues

Session Chair 1: Antony Peter

Ph.D. Scholar, APJ Abdul Kalam Technological University

Session Chair 2: Ruby Vincy

Ph.D. Scholar, Vellore Institute Of Technology Chennai

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Track 10 : Electric Vehicles

Session Chair 1:Lallu Mol K Johny

Ph.D. Scholar, APJ Abdul Kalam Technological University

Session Chair 2: Athul Vijay

Ph.D Scholar National Institute of Technology Surat

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Session Chair 1:Konrad Erich Kork Schmitt

Ph.D. Scholar, Texas Technical University

Session Chair 2:Ibrahim A Ibrahim

Ph.D Scholar Macquarie University, Australia

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Track 12 : Electric Vehicles

Session Chair 1: Ameen Beevi A

Ph.D. Scholar, APJ Abdul Kalam Technological University

Session Chair 2: Chempak Kumar A

Ph.D. Scholar, University Of Kerala

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Session Chair 1: Raju Manuel

Ph.D .Scholar, Karpagam University, Coimbatore

Session Chair 2: Robins Anto

Research Scholar, IIT Roorkee

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Track 14 : Electric Vehicles

Session Chair 1: Lallu Mol K Johny

Ph.D. Scholar APJ Abdul Kalam Technological University

Session Chair 2: Kripalakshmi Thiagarajan

Research Scholar ,Vellore Institute Of Technology, Chennai

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Track 15 Microgrid & SmartGrid and Power Quality Issues

Session Chair 1: Konrad Erich Kork Schmitt

Ph.D. Scholar, Texas Technical University

Session Chair 2: Ibrahim A Ibrahim

Ph.D scholar, Macquarie University Australia

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Session Chair 1: Ameena Beevi

Ph.D. Scholar, APJ Abdul Kalam Technological University

Session Chair 2: Hariharan R L

Ph.D Scholar Scholar, National Institute Of Technology, Surathkal

Session Chair 3: Chempak Kumar A

Ph.D Scholar Scholar, University Of Kerala

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02:15 PM	274	Priya C V	Behavioral Biometrics based Authen-tication System using MLP-NN and MVPA
02:30 PM	219	Binoy Nair Sudheer Dunna Manoj Panda	A Deep Learning based system for fast detection of obstacles using rear-view camera under parking sce-narios
02:45 PM	244	Arya K K R M Vijaya Chan-drakala	Machine Learning Based Prediction and Forecasting of Electricity Price During COVID-19

Track 17: Communications & Allied

Session Chair: Jihas Khan

Ph.D. Scholar, National Institute Of Technology, Calicut

Time	Paper ID	Authors	Paper Title
01:30 PM	104	MANJULA S KOUSHIK RAM C JAYA KANTHAN K MUNISH KARTHICK P	Development Of GPS Based Real Time Dynamic Traffic Management System Using IOT
01:45 PM	54	Ghanishtha Bhatti Raja Singh R	Design of Cubic Dielectric Resonator Antenna
02:00 PM	107	SHARMILA P Brindha Devi V Akshaya YK Mallika Das Anita shalu K R	Power System Harmonics Estimation using R Adaptive Variational Bayesian Kalman Filter

02:15 PM	117	CHAYANIKA SHARMA BABAK MONTAZER UTPAL SARMA	Parameter optimization of a gas sensing chamber for the detection of Volatile Organic Compounds using Finite Element Method
02:30 PM	186	SUVETA YADAV Nivetha K M Rohith Mathew Salman Faris Caroline Ann Sam Sreekumar G	Network of Outdoor Air Purification Systems; Air Quality Measurement Analysis and Display Systems using Mesh Network Topology
02:45 PM	272	Anish M S	WeCare i-Board : A Tangible User Interface for Communication

Track 18: Surveillance and Monitoring

Session Chair 1: Elangovan K

Ph.D. Scholar, Indian Institute Of Space Science And Technology, Trivandrum

Session Chair 2: Sabeena K

Ph.D. Scholar APJ Abdul Kalam Technological University

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01:30 PM	174	sofia banu Teena Johnson Tukaram Moger	A Comparative Study of Bayesian based filters for Dynamic State Estimation in Power Systems

01:45 PM	181	SUBRAMANIAN S V MANJULA S RAHUL T R RAMALINGAM R	INTEGRATED REAL-TIME TRACKING OF CAR PARKING SLOTS
02:00 PM	206	Ravishankar P C Sharmila Suttur C	IoT BASED SYSTEM FOR HOME MONITORING OF HUMAN VITAL SIGNS
02:15 PM	223	Dr. Sheeba R Anoop Kumar Anusree Mohan Arunjith M Joseph Jose AJITH NAIR Aswin U Joys Joseph Nadera Beevi S Amal S	Real-time Monitoring of Energy Meters Using Cloud Storage

Track 01 - Power Electronic Converters and Control Systems

Paper 14

Review and Comparative Study of Bi-Directional DC-DC Converters

Abstract

The bi-directional DC-DC converters are utilized in numerous applications based on their directions power transfer capability. This paper aims to discuss an in-depth literature review and comparative analysis of the various kinds of the bidirectional dc-dc converter. In this paper, each converter is classified according to the characteristics, structure, and voltage boosting techniques. A broad, comprehensive study and complete assessment have been done in this paper to select the converter's suitable applications. Moreover, this study helps to optimize the topologies in the future. Furthermore, the detailed gain comparison analysis of each non-isolated converters is presented. Finally, a detailed summary of each converter is explained with the merits, demerits, power densities, features, efficiencies, and components.

Paper 47

Efficient Bidirectional DC-DC Converter using Digital Adaptive Frequency Modulation

Abstract

A digital adaptive frequency modulated bidirectional dc-dc converter is introduced for an efficient and reliable energy management system. The proposed system achieves zero voltage switching (ZVS) without an additional zero-crossing detector (ZCD) circuit. To achieve the ZVS condition, frequency is calculated adaptively in every cycle. As this method does not involve a ZCD circuit, it can be easily retrofitted to any circuit configuration. The proposed system satisfies ZVS condition for a wide range of voltage (Battery voltage 12V-24V & Bus voltage 28V-36V) and load variations. The proposed digital adaptive frequency control is validated in an interleaved bidirectional dc-dc converter topology. The interleaving technique reduces the effective conduction loss and current ripple, thus increasing the converter performance and overall efficiency. A 200W interleaved bidirectional dc-dc converter for battery charging/discharging is designed and digital adaptive frequency control is validated in a MATLAB/Simulink platform. The results are encouraging.

Paper 52

Study of SCADA based Existing Water Treatment Plant- GAWSS Phase-I in Mizoram, India

Abstract

Mizoram is a hilly state in India and unlike other states most of the water pumping is done through high head pumping, hence providing available drinking water throughout the year is a government priority. Under Public Health Engineering department, there is a Greater Aizawl Water Supply schemes phase I (GAWSS p-I) implemented in 1988 with a capacity of 10.8 MLD of treated water in the clear water reservoir. This water supply scheme consists of four major components :(1) Intake Pump House near Tlawng river, (2) Water Treatment Plant (WTP) with clear water pump house, (3) Intermediate Pumping Station (IPS) at Lawipu & (4) Clear Water Reservoir at Tuikhuahtlang. SCADA system has been implemented in the existing water treatment plant (GAWSS p-I) in 2020 generally for monitoring and improving the plant efficiency. Data such as Water quality (using pH, turbidity and chlorine analyser) and water quantity at each pumping stations (using electromagnetic flowmeter and ultrasonic level and pressure analyser) are collected continuously through programmable logic controller (PLC) and monitored online from the central SCADA station. This paper describes study of the whole utility process of SCADA based WTP in Aizawl and how the backwash scheduling is done using SCADA system.

Paper 59

A Transformerless Two Input Two Output DC-DC Step up Converter

Abstract

This paper introduces a transformerless DC-DC converter that has two inputs and can provide two different voltage levels at the output side. Lower element counts, multiple input and output ports, comparatively lower voltage stress etc., are some of the potential merits of the given converter. Analysis of the topology with detailed circuit operations and necessary equations are presented. The equations for the output voltages and inductor current are derived. Performance validation of the converter has been carried out with the support of simulation and experimental results. Various simulation waveforms including inductor voltage, inductor current, switch voltages, output voltages etc, and hardware waveforms have been included to highlight the efficient operation of the converter.

Paper 119

Reduced Switch 13 Level Inverter for Grid-Connected Applications

Abstract

This work reports reduced switch cross-connected source (CCS) based thirteen level inverter for grid-connected applications. The proposed 13 level inverter is asymmetrically switched, and only eight switches are used to generate 13 level output. Multicarrier pulse width modulation technique (MCPWM) is proposed to control the output voltage and THD of the inverter. The inverter is simulated for resistive and inductive load with improved power quality, i.e., low THD output. The proposed inverter is further investigated for grid-connected applications through a proper grid control strategy. All the simulated results are further verified using a hardware-in-the-loop (HIL) simulation platform to confirm the feasibility of the proposed methods.

Paper 169

Operation and Analysis of a Modular Converter for Photovoltaic or Fuel cell systems

Abstract

Renewable energies are environmentally friendly. Two of the most important of these systems are fuel cell and photovoltaic panel. Both systems generate electricity without pollution, but they have low output voltage levels. Low voltage is not suitable for the consumer and additionally, in this case, can increase losses. By applying a modular converter based on three-level boost converter, the output voltage level and consequently the power can be increased. In this paper, recognition and analysis of a modular converter based on three-level boost converter's behavior are performed. Equivalent circuits during the different intervals of the operation of the studied converter are presented. Operating waveforms of all intervals are given. Possible operating modes are provided. The several operating modes of the modular converter are investigated. The simulation results obtained by using MATLAB/Simulink software are presented and analyzed in the steady-state as well as experimental results.

Paper 177

Non-isolated High Step-up DC-DC Converter with Low Input Current Ripple

Abstract

In this paper, a novel non-isolated high gain DC-DC converter is proposed. The presented high gain converter is synthesized from a coupled inductor (CI) based two-phase interleaved boost converter (IBC) which also uses voltage lift capacitor. Voltage multiplier cells (VMCs) and voltage doubler are connected to enhance the voltage obtained at the primary and secondary of the CIs respectively. The overall voltage gain is obtained by cascading the outputs obtained from the primary and the secondary side of the CIs. Since the voltage gain is enhanced by adopting combinations of gain extension mechanisms, the voltage stress on the switches

and diodes are reduced. Moreover, due to the IBC in Stage 1, the input current ripple is also reduced. To validate the proposed concept, simulation results are presented for a 18V to 380V, 450W converter when it operates with and without feedback.

Track 02 - Electric Machines and Drives and Power Quality issues

Paper 30

Evaluation of Predictive Torque Controlled Two-level and Multi-level Permanent Magnet Synchronous Motor Drive for Electric Vehicles

Abstract

Nowadays, the application of two-level and multi-level Voltage Source Inverter (VSI) in electric drives is well established. However, Multi-Level Inverter (MLI) has several operational advantages such as voltage stress reduction across power electronic switch and power quality improvement. It is also advantageous considering motor operation, such as improved response of flux, torque and current. Hence, proving its suitability for high power Electric Vehicle (EV) application performing smooth operation. Concerning EV application, the particular selection of MLI structure should have features of simple, ready accessible and hybrid source operation. In this paper, dual VSI is selected for multi-level operation supplying to PMSM drive, owing to its operational and structural advantages. Using emerging Predictive Torque Control (PTC) technique, PMSM drive is operated in two-level and multi-level modes. Matlab/Simulink simulations are performed for PMSM drive operation and results are compared for two-level and multi-level PMSM drive. Thus, benefits of MLI operated PMSM drive are validated with regard to flux and torque ripple, voltage and current response over two-level inverter operated PMSM drive.

Paper 50

A Control Strategy for the Mitigation of Rotor Vibration in a Three Phase Induction Motor

Abstract

Vibrations of rotor is a major cause of concern in a three phase induction motor, more so because the air gap in these machines is of the order of only millimetres. One of major reasons for this is electromagnetic in nature. Unbalanced Magnetic Pull(UMP) resulting from rotor eccentricity may lead to vibrations and also to a severe condition like rotor-stator rub contact. This paper proposes a control strategy wherein the potential of Fractional Proportional Integral Derivative(FOPID) controller is put into use to mitigate rotor vibrations due to static eccentricity of the rotor.

Paper 51

Electromagnetic Feature Study of a Novel Dual-Stator Five-Phase Spoke-Type Permanent Magnet Motor for Electric Vehicles Application

Abstract

The electromagnetic feature investigation of a Novel Dual-Stator Five-Phase Spoke-Type Permanent Magnet Motor (NDSFPST-PMM) for application in electric vehicles has been discussed in this paper. For this application, several features such as high fault tolerance ability, high power-density and high reliability are preferred in the motor. The presence of two stators in the motor ensures high power-density, whereas high fault tolerance and reliability is due to the presence of 2-sets of five-phase windings. For the efficient and cost-effective use of magnets, single set of magnets are used for both the inner and outer stator-rotor system. Due to this special arrangement, the rotor of the PMM becomes robust and light in weight. For the analysis of the PMM model, the finite element method (FEM) is chosen as it gives accurate results. Further, results such as the generated back electromotive force (BEMF), torque versus current plot, torque and power versus speed plot, efficiency versus load current plot, etc. are studied for the PMM.

Paper 65

Space Vector PWM Based Vector Control in an Electric Vehicle with Induction Motor Drive

Abstract

The speed of an Induction Motor (IM) can be controlled through various techniques but FOC (Field Oriented Control) being one of the most used speed control technique, under which there are Hysteresis current control technique (a current control technique) and Space Vector Pulse Width Modulation (SVPWM, a voltage control technique). In this paper we are going to discuss briefly about SVPWM based speed control technique and its application in an IM for an Electric Vehicle. Further a detail study of how the model is going to behave in different scenarios such as steady state analysis, transient state analysis, load change, speed change, torque change is given by the use of MATLAB Simulink and experimentally verified with 2.2 kW IM drive

Paper 84

Torque performance in Novel H-type Modular Stator Consequent Pole Permanent Magnet Machine with 3rd harmonic shaped rotor

Abstract

In comparison with surface-mounted permanent magnet synchronous machines (SPMSM), consequent pole SPMSM (CP-SPMSM) reduce permanent magnet volume to half however, magnetic circuit in CP machines are un-balanced between iron pole and PM pole which results significant harmonics in magnetic flux density which contributes to cogging torque (T_cog) and torque ripple (T_rip) leading to acoustic noise and vibration. To over the aforesaid demerits in CP-SPMSM, in this paper a novel H-type modular stator CP machine is proposed, and 3rd order harmonic shaped rotors are thoroughly investigated for average torque (T_avg) improvement and suppression of T_cog and T_rip. For this purpose, sin shape, sin+3rd order harmonic, inverse cosine and inverse cosine with 3rd order harmonic is investigated. Analysis reveals that using 3rd harmonic shaped rotor, harmonic content of back-EMF is curtailed by 15.78%, intensify flux linkage up to 8.1%, increase T_avg up to 12.34%, repressed T_cog up to 75.27% and diminish T_rip up to 73.56% when compare with initial rotor structure.

Paper 101

Co-Simulation of a Surface-Mounted Permanent Magnet Synchronous Motor Drive using Finite Element Method

Abstract

In this paper, a co-simulation of the surface permanent magnet synchronous motor drive is presented. The finite element model of a surface PMSM is designed in the FLUX 2D finite element software. Then, the direct torque control approach of the PMSM motor is designed in MATLAB/SIMULINK software. The finite element model of the surface PMSM is transferred to the control system within an interface block and replaced with the mathematical model of the motor. After tuning the PI ratios manually (trial and error), the motor drive is analyzed in no-load condition. The simulation results prove the accuracy of the drive model and the finite element model of the motor, which makes it possible to study the electrical machine's behavior in a more realistic manner, considering all motor's non-linear characteristics. Finally, the post-processing results of the co-simulation is mentioned including the iso values of various face regions of the motor. The co-simulation technique can be applied before assembling the actual drive system, in order to validate the motor design and its control system.

Paper 110

Design and Electromagnetic Performance Analysis of Linear Hybrid Excited Flux Switching Machine for Long Stroke Applications

Abstract

In this paper, a linear hybrid excited flux switching machine (LHEFSM) with the iron bridge in the mover core is proposed. The iron bridge between the permanent magnet (PM) and field excitation coil (FEC) avoids the leakage of flux through mover, hence the magnetic flux goes through the bridge and converts the leakage flux into flux linkage. This will increase the magnetic flux and hence the thrust

force. The proposed machine has all the excitation sources housed on the mover and the secondary is completely robust, which makes it a good applicant for long stroke applications. Further, the proposed machine uses ferrite magnets in place of the expensive rare-earth PMs which reduces the overall cost of the machine. FECs are used which improves the flux linkage and hence the proposed machine offers enhanced flux regulation capability at different field currents. Parametric optimization is used to optimize the design parameters. Finally, the proposed machine is compared with a conventional machine, 18.97% higher average thrust force (TF_{avg}) was achieved under the same volume of PM and the whole machine.

Paper 53

Harmonic Filtering Scheme Selection Based on Diagnosis with Independent Component Analysis

Abstract

Non-synchronous generation may cause excessive harmonic distortion that flows from generators to consumers. Unfortunately, generator's harmonic contribution and consumer's harmonic contribution cannot be measured independently, which leads to the usual assumption of fully allocating the measured values to consumer's facilities. This paper proposes a methodology to assess the feasibility of installing passive harmonic filters to mitigate harmonic distortion inside facilities by taking into account external harmonic distortion. Excessive external harmonic distortion may cause harmonic current to increase, instead of decrease, when installing passive harmonic filters. To estimate external harmonics, the use of Complex Independent Analysis (CICA) is proposed. CICA is a blind-source separation algorithm used to estimate contributions from different sources to a measured value. In the case where a passive filter solution is deemed unfeasible, an active harmonic filter is recommended.

Track 03 - Renewable Energy Resources

Paper 17

Cascaded PI Controller based Wind Turbine Generator System for Battery Charging Applications

Abstract

Wind turbine generator system is a promising alternative to fossil fuel based sources of energy. In recent decades, this technology has seen rapid developments with respect to efficiency and versatility. This paper proposes a wind turbine-permanent magnet synchronous generator-buck converter system for battery charging applications using MATLAB/Simulink. Various permutations and combinations have been considered in input wind speed and the battery's initial state of charge. It is observed that the dynamic response of the system is robust and time to attain steady state stability is desirously less.

Paper 37

Structural Optimization of a Bismuth Telluride-Based Thermoelectric Generator Using Finite Element Analysis

Abstract

Accurate and effective performance estimation of thermoelectric generators with optimized structure is essential for large-scale energy harvesting applications. This paper aims to study and analyze a bismuth telluride-based thermoelectric generator using finite element analysis. The impact of thermoelements length and area on obtaining an optimal temperature gradient, output voltage generation, and maximum output power is investigated. The proposed thermoelectric generator module, which is consisted of eight pairs of p-type and n-type bismuth telluride thermoelements, produced an optimum temperature gradient and output voltage of 96.6 mV with each thermoelement length of 8 mm and area of 1 mm2. In addition, the effect of varying thermoelements area with optimal length on thermoelectric generator performances is also presented. These outcomes could be utilized to fabricate a bismuth telluride-based thermoelectric generator with optimized thermoelements.

Paper 46

Hybrid Algorithm for Optimal Improvement of a Distribution System Resiliency using Renewable Energy Resources: Case Colombia

Abstract

The service restoration is a multi-objective optimization problem that considers maximization of served critical load while minimizes the required configuration maneuvers within the distribution system (DS). This paper proposes a hybrid optimization-based algorithm based on metaheuristic and real-time simulation techniques to leverage renewable resources in the service restoration tasks. A respective validation is carried out using a Colombian DS serving half a million consumers in one of the main cities in the Andean region. Detailed models for automatization devices, photovoltaic (PV), and two small scale hydro-power plants (SHP) have been included in the studied DS use case. Obtained results show the effectiveness of the proposed algorithm as the times execution in each case and dependence on Renewable Energy Resources (RER). Also, during the restoration process, steady state conditions were being maintained to guarantee a safe and secure operation of DS assets.

Paper 96

PERFORMANCE ENHANCEMENT OF SOLID OXIDE FUEL CELL BY EMPLOYING PI CONTROLLER AND PID CONTROLLER WITH FILTER DERIVATIVE

Abstract

Solid oxide fuel cells (SOFCs) are effective electro-chemical devices that directly convert chemical energy into highly efficient, low-pollution electrical energy. However, high operating voltage and rapid fluctuations of the load disruption of SOFC system addresses challenges in controlling the output voltage. The objective of the paper is to improve the performance of SOFC system by employing PI controller and PID controller with filter derivative (PIDF). PID tuner is used to optimize the controller gains of the PI and PIDF controller. The output of the SOFC system with PI and PIDF controller are being compared. Simulation result shows that output obtained from PIDF controller is superior to PI controller.

Paper 102

A novel technique based smart grid economic dispatch under uncertain environment

Abstract

This article proposes a novel optimization technique “Mutation based Statistically tracked GWO (MSGWO)” for solving, smart grid economic load dispatch problem which includes the uncertainties associated with the wind power generation, solar power generation and Plug-in electric vehicles (PEVs). Such a model incorporating renewable energy resources (RERs) faces an innovative challenge with the inclusion of PEVs, which might act as sources, loads and energy storages. One of the foremost concerns with such a complex model is to control the charging and/or

discharging of these vehicles as per the hourly load demand of the system to such an extent that it can operate with minimum possible stress on the system with reduced overall optimum cost and emission. The extraordinary strength of the proposed optimization technique, which is tested on IEEE 300 bus system, is demonstrated in the results which are superior to those obtained from other optimization techniques: GA, PSO, GWO, Modified GWO and EO.

Paper 120

Mathematical modelling of an OWC device mounted over the shoal bottom

Abstract

The current study analyzes the mechanism of an OWC-WEC located over the shoal bed in the influence of oblique incoming waves. The impact of chamber shape, the draft of the front wall of an OWC-WEC, and the incident angle on the efficiency of an OWC-WEC are examined in a detailed manner. It is revealed that the potential of an OWC-WEC noticeably improved by changing the incident angle.

Track 04 - Electric Vehicles

Paper 23

Techniques to Reduce Voltage Instability of Power System caused due to Charging of EV : A Review

Abstract

With the increasing concern of environmental aspects the world is moving towards the usage of Electric Vehicles (EVs) as load to the power system which results in many problems. Various studies and researches are done to understand the threats caused to the power system due to charging of electric vehicles, as the stability of the power system is necessary to meet operational criteria various techniques are suggested. This work is the study of different techniques proposed to overcome the voltage stability.

Paper 48

Optimal Charging Schedule for Electric Vehicles in a Microgrid with Renewable Energy Sources using DigSilent Power Factory and Matlab

Abstract

Rising atmospheric pollution in developing countries like India has provided a much-needed impetus to Electric Vehicles (EVs) which offer various economic and environmental benefits. Merchant-owned fast charging stations are coming up as the penetration of EVs increases. The fast chargers installed in these facilities draw higher amount of power and may lead to adverse effects especially in a low voltage distribution microgrid with renewable energy sources. Maintaining voltage security for contingencies becomes crucial to prevent power blackouts. As the EVs spend considerable time at charging stations, fluctuations in non-EV load and power injection especially from renewable resources like solar energy and wind energy may be considered to obtain an optimal charging schedule for EVs. This paper presents such a scheduling approach in a microgrid along with elimination of penalties imposed for violating contingency limits applicable to the merchant-owned fast charging stations using real-time bidirectional communication between DigSilent Power Factory and Matlab.

Paper 56

A Multi-Objective Planning for Fast-Charging Station and Distributed Renewable Resource under Environmental Impacts

Abstract

Environmental impact from transportation system has been attracting a lot of attention. As an importation method to mitigate air pollution, the number of electric vehicles (EV) has been increasing in the past decades, which leads to many research works focus on fast-charging station (FCS) planning for drive range limitation of EVs. However, many research works founded that much air pollution is created by EVs with accepting fast-charging services compared with internal combustion engineer vehicles (ICV) if there is not enough renewable energy usage. In this paper, a methodology is implemented on the joint fast-charging stations and distributed renewable resource integration planning coupled on transportation and power distribution networks. The methodology is based on a multi-objective integer planning model that determines the siting and sizing of: 1) FCS; 2) PV distributed generation on the power distribution network and 3) wind turbine distributed generation on power distribution power. Also, several significant factors such as EVs drive range constraints, PDN operation security, reliability, and different kinds of air pollutants are considered. To make sure of the feasibility and practicality of the methodology, numerical experiments are conducted.

Paper 60

Multiphase Bidirectional DC-DC Converter with Phase shedding for BLDC Driven Electric Vehicle

Abstract

Electric Vehicles are seeking more attention in recent days due to pollution concerns and fear of exhausting petroleum products. In battery powered electric vehicle the use of bi-directional converters would support charging of battery during regenerative braking. Use of multiphase converters offer several advantages such as reduced ripple and reduced passive components size and avoid local hotspot creation and improve system efficiency. However, all the phases in multiphase converters would not be required to operate all the time. Hence this paper focuses on operating the number of phases adaptive to load current. Analysis of interleaved soft switching boost converter to minimize the switching losses is also presented. The BLDC motor is considered as a load which makes it a usual choice because of its various advantages.

Paper 80

Electronic Differential Based On Active Disturbance Rejection Control For a Four In-Wheel Drive Electric-Vehicle (Go-Kart)

Abstract

The article deals with the implementation of an electronic differential system (EDS) for a four-wheel drive (4WD) electric vehicle (EV), using in-wheel brushless DC motors. Applying a graph theory analysis, we design a decentralized control

scheme based on active disturbance rejection control (ADRC) for each wheel, with the purpose of all motors work together to follow the angular speed references in a synchronized way when driving in a straight line and at different speeds in a curve. The angular speed of each wheel is calculated from a reference turning angle and speed for the EV using the steering Ackermann model. Simulation results are presented to show the feasibility of the scheme proposed.

Paper 106

Kim-Sul Algorithm Based FOC for Electronic Pole Changing Induction Motor Drive in EV Applications

Abstract

Usage of induction motor drive (IMD) with electronic pole changing (EPC) technique is becoming popular for the electric vehicle application. EPC technique extends operating torque and speed range of the induction motor. It provides high starting torque and wider speed range with lower torque. Ability to change the number of poles during running condition, also eliminates the requirement of the mechanical gear box generally required for getting wider torque and speed range. However, having a wider range of the speed and torque is not enough for the IMD. A proper high-performance control is also required for such electronics pole changing induction motor drive (EPC-IMD). In this paper field-oriented control (FOC) for electronic pole changing induction motor drive (EPC-IMD) is proposed. The given FOC is implemented on EPC-IMD, having three-phase, twelve-pole (3-ph,12-P) and nine-phase, four-pole (9-ph,4-P) operation. The proposed FOC uses Kim-Sul algorithm for the generation of the PWM, which further gives additional degree of freedom for the control. It also provides accurate speed control with improved torque response. All the details with respect to modelling and implementation of FOC are given in the manuscript. MATLAB/Simulink results are also presented to show the performance of the proposed FOC in the given EPC-IMD.

Track 05 - Distributed Generation and Grid Interconnection

Paper 49

Performance Analysis of a Modified Direct Power Controlled Photovoltaic System Connected to a Weak AC Grid

Abstract

A Voltage Source Inverter (VSI) controlled by vector current control is popularly used to integrate distributed energy sources to main grid. However, the interaction between the Phase Locked Loop (PLL) and the controller makes the system unstable when the grid is weak. In this paper a modified direct power control technique is used to integrate a photovoltaic system to a weak AC grid. This control technique does not need a PLL for its operation. The performance of the controller is evaluated using simulation studies done in MATLAB/Simulink. The effect of change in irradiation, temperature and sag in grid voltage is also analyzed. The results show that the controller is able to follow the active and reactive power commands with permissible THD in the current injected to grid.

Paper 58

Intelligent Grid Tie Module for Phase Balancing in Microgrid

Abstract

Promotion of low carbon technology has increased the interconnection of small Photovoltaic (PV) plants and domestic Electric Vehicle (EV) chargers in the grid. However, phase balancing of these single-phase units in a microgrid is difficult to achieve due to their stochastic nature and dynamic characteristics. In view of a better phase balancing, in this paper a grid-tie module for phase selective interconnection of single-phase unit is suggested. It is capable of identifying the connecting unit as source or load and improve phase balancing by intelligent selection of phase lines. The module can also be utilized for quick disconnection of units by remote signaling on fault identification, safety hazards and for commercial reasons.

Paper 113

Renewable Interfaced Active Power Filter for Load Compensation and Real Power Injection

Abstract

Unbalanced and non-linear nature of the loads connected across low voltage utility is liable for distortion of grid side currents. In addition, the ever-increasing consumer energy demands are higher than ever and expected to rise eventually. Generally, shunt Active Power Filter (APF) is employed for compensation of the power quality disturbances associated with the utility grid. In case a Renewable Energy Source (RES) is connected at the DC bus of APF, real power may supply local loads while surplus power may be fed into the grid. Therefore, this article presents a unified control scheme for shunt Active Power Filter (APF) to compensate for unbalanced and non-linear loads as well as to facilitate integration of renewable energy source simultaneously. An advantage of Instantaneous Symmetrical Component algorithm is that no synchronizing process is involved for desired unity power factor at utility grid side. To demonstrate efficacy of the adopted control scheme, all the digital simulations are been worked out in MATLAB/SIMULINK environment and simulation results are compiled.

Paper 222

A Novel MultiObjective Control of Microgrid with Battery Enabled Hybrid Sources.

Abstract

Microgrid (MG) is a small generating system that can work for both islanding and grid-connected mode. With the increasing price and demand of conventional power generation, scientists have switched their attention to extract power from renewable energies. The major challenge of MG operation is its control such that maximum power is delivered under fluctuating generation. In this paper, an optimal power-sharing method is presented for Solar Photovoltaic (PV), wind and Battery Energy Storage System (BESS). The proposed study is free of pollution and greenhouse emission which impacts positively the pollution aspects in nature. The proposed multiobjective function successfully delivers power under varying load condition with cost minimization. The proposed Penguin Search Algorithm (PSA) gives better result in minimization of the economic cost associated with the generation of electricity from the microgrid. Further hierarchical control topology is introduced for each system so that frequency of operation is maintained under uncertain generation and demand conditions. The overall result is compared with other optimization techniques like particle Swarm Optimization (PSO) and Bacteria Foraging Optimization (BFO) and found that PSA gives the best result

Paper 243

Islanding detection for grid integrated distributed generation using adaptive neuro-fuzzy inference system

Abstract

The use of distributed Generation (DG) for power supply and quality improvement is gaining more acceptance. Power Utility Company’s connection standard for DG

requires that islanding be quickly detected and DG sources isolated to prevent damage to power utility equipment, harm to power system operators, maintain power quality and ensure that protective devices do not mal-operate such that the power system security is maintained. Adaptive Neuro-fuzzy Inference System (ANFIS) is proposed for detection of islanding in power distribution networks with DGs connected. The ANFIS technique relies on the passive parameter during islanding for islanding detection. These passive parameters, Voltage, rate of change of frequency (ROCOF) and rate of change of power (ROCOP) forms the inputs for training and validation of the proposed islanding detection method. A segment of the South-East Nigeria 33/11KV power distribution network is used for generating the training data for training the ANFIS network and evaluating the performance of the islanding detection techniques. Performance evaluation was based on Time performance region and Non-detection Zone (NDZ). Results of simulations showed that the ANFIS islanding detection method detected islanding faster and in all case give a smaller NDZ compared with the frequency relay method.

Paper 246

Adaptive Control of PV-WGS-DG Based Grid Interactive Microgrid with Mode Transfer Capability

Abstract

This paper deals with a microgrid consisting of a PV (Photovoltaic) array, a BES (Battery Energy Storage), a WT (Wind Turbine) and DG (Diesel Generator), distributing reliable power for rural electrification. This work presents an AAF-FLL (Advanced Adaptive Filter Frequency Locked Loop) control strategy for optimal functioning of the microgrid in an islanded, the utility tied and DG (Diesel Generator) connected modes. This system uses only one VSC (Voltage Source Converter), which takes power from the solar PV array and wind and feeds nonlinear loads. The BES performs the required power management during the islanded mode of operation. If the utility is available, during high renewable power generation concerning the load requirement, the power is fed to the utility. However, if utility not available and battery is also inaccessible then the system is synchronized to the DG. Test results authenticate the microgrid performance under dynamics and steady-state conditions while experiencing varying wind speeds, solar insolation and nonlinear loads. In all operating modes, the THDs (Total Harmonic Distortion) of the currents and voltages at the common coupling point (CCP) are within the IEEE 1547 and 519 standard limits.

Paper 261

Seamless Transfer with Multi-functional Capabilities of Solar Photovoltaic Based Grid Interactive Microgrid

Abstract

With the increasing number of renewables in a microgrid, synchronization of each source becomes an intricate task. This work deals with a SPV-BES based microgrid working in grid tied mode (GTM) and in islanded mode (ISM) besides, seamless mode shift operation is also presented at constant and variable power modes of the grid along a change in solar insolation. A dual filtered FLL (DF-FLL) is utilized to evaluate the phase angle of the grid and load voltages instead of SRFPLL and comparative results are presented. In GTM, the power conditioning unit works in the current control mode, however, to maintain common point of coupling (CPC) voltage, it works in voltage control in ISM. In order to shift from ISM to GTM, a synchronizing controller is used to track the amplitude of the grid and load voltages, phase difference and frequency. Whenever the signals are found in the range as mentioned in the IEEE 1547-2018 standard, the synchronizing signal goes high. Besides, this work also deals with the mitigation of power quality issues at the CPC. A comparative table of the system with existing microgrid is also presented. Test results depict that the power quality (PQ) index of source current and voltage, are maintained under the IEEE-519 standard.

Track 06 - Energy Storage & Battery Charging Techniques

Paper 33

Minimizing Eddy Current Effects in a Hybrid Thrust Magnetic Bearing

Abstract

Hybrid magnetic bearings are often used to eliminate power losses due to the bias current. However, in dynamic conditions, the bias flux and the control flux vary, thus inducing eddy currents in the iron core which cause power losses and affect the performance of the bearing. These eddy current effects can be reduced by segmenting the stator to break the eddy currents' loop. The model of Hybrid Thrust Magnetic Bearing (HTMB) studied in this paper was cut into 2, 4, and 8 segments, and then a 3D-FEM analysis was performed for each configuration at different frequencies. The results present a maximum reduction in eddy current losses of about 66% between a 2-segment and the uncut HTMB. In addition, the improvement of dynamic force was observed for all bearing configurations. The maximum value of 6.3 N was recorded at 2 kHz on a 2-segment HTMB.

Paper 55

Implementation of Variable Duty Ratio Reflex Charging of Li-ion Batteries

Abstract

In today scenario, a proper battery charging method is vital. There are many methods to charge the lithium battery like constant current(CC), constant current constant voltage(CCCV), Multistage constant current(MS-CC), pulse charging, and Reflex charging. In the Reflex method, a high pulse current is used to decrease the time consumption for charging, and the negative pulse of the reflex method along with rest period reverses the chemical action, thereby decreases the internal pressure as well as the amount of Li-ion saturation at graphite. Different types of reflex method are there, like constant pulse width and variable frequency. A duty cycle varied Reflex charging method is proposed in this paper to charge the Li-ion batteries using a bidirectional converter. The duty ratio of this reflex method will vary according to the charge stored in the battery. The main advantage of the proposed method is, efficient and fast charging of Li-ion batteries. Using this method, the Lithium quantity decreases during the formation of a solid electrolyte interface(SEI). Hence, the life cycles of batteries is increased. This scheme involves, varying the duty cycle of the charging current such that the charge rate is greater than the conventional reflex charge rate. This strategy is simulated and analysed and also compared with the conventional constant pulse width reflex charging method and the CC-CV method.

Paper 63

ZVT Boost Converter Integrated with Charging and Discharging Topologies

Abstract

The paper analyses a ZVT based PV connected PWM boost converter topology with an integrated battery charger circuit exhibiting flexible charging and discharging functions in order to ensure that the load demand is being met under varying input conditions. While both the main and auxiliary switches always operate under soft-switching conditions, battery utilizes the circulating energy in the resonant tank circuit in its charging process, thus effectively minimizing the losses. To further improve the overall system efficiency, the system continuously tracks the maximum power point (MPP) of the photovoltaic supply irrespective of variations in irradiance and temperature. The system flexibility further increases as the system offers a wide variation in choice of the battery irrespective of the load voltage. Furthermore, the discharging current of the battery is continuous which greatly reduces the stresses on the battery. The system is simulated and analyzed in PSIM and the results have been presented to validate the analysis and design.

Paper 76

Analysis the impact of Energy Storage a shared asset between DC Railway Network and Electricity Distribution Nework

Abstract

European distribution networks and light-railway networks have been developed as independent networks, relying on the resilience and robustness of existing power supplies. This paper reports on findings of European Union H2020 funded E-LOBSTER project which in its concept, is proposing an innovative Railway to Grid (R+G) Management system which, combined with advanced power electronics, will be able to make the best use of the available energy on both the grids by increasing their mutual synergies and increasing the whole system efficiency. In this study, a sustainable solution, as a concept, represents a new type of electric infrastructure. In E-LOBSTER, electrical energy storage will play a shared asset between grid and railway. To investigate the solution, a real case study of urban metro line is chosen for simulation study. The challenges that distribution networks are facing with integration of high intake of EV charging facilities is providing an insight on the solution addressed in the paper. The results show the effectiveness of the proposed solution.

Paper 81

CUK Converter Controller Design, Modelling and Tuning for Solar Battery Charger System

Abstract

This paper aims at designing, modelling and tuning of the controller for a DC-DC converter employed in a solar aided battery charging system and thus constructing a simple yet efficient working solar battery charger which focuses on long battery life. CUK single stage DC-DC converter topology is chosen for the application as it enables minimum ripple current at both the solar photo voltaic (PV) cell and battery, with low component count. A detailed analyses of the control scheme employed, which is maximum power point tracking \& battery charge control convoluted with proportional-integral-derivative (PID) control followed by pulse width modulation scheme for generation of the gate pulse, is provided. The controller uses the system model of the CUK converter to find the ratio between the proportionality constants of the PID controller (Kp, Ki, Kd) given the specifications of the solar PV array and the battery. Tuning of a PID controller is often done using hit and trial method for finding three values which is cumbersome and time consuming. In this paper the controller requires tuning of just one parameter which has a direct linear relation with the bandwidth and the settling time of step response. Thus the proposed battery charger system is efficient yet simple. Bode plot is used for stability analysis. Verification of system working is done by thorough simulations of the CUK DC-DC converter with the controller, for charging a 48V lead acid battery on MATLAB/Simulink and results are presented in the paper.

Paper 125

Investigation of Cell to Cell Gap During Onset of Thermal Runaway Within Lithium-ion Battery Pack

Abstract

Thermal runaway in Lithium-ion batteries is a major safety concern in Electric Vehicles. There is a need to establish functional simulation frameworks to investigate thermal runaway. This paper investigates the role of cell to cell gap in a Lithium-ion battery pack composed of 25 cylindrical 18650 cells. The simulation was conducted by selecting the location of a trigger cell, which initiates thermal runaway, within the battery pack. It can be clearly observed that, the arrangement of the cells, cell to cell gap and location of the trigger cell play crucial roles in ensuring safe operation of the pack during dynamic operation.

Paper 131

Analysis and Design of Battery Controller for More Electric Aircraft Application

Abstract

This paper deals with innovative multi-function battery controller with seamless transition between controllers for future MEA platforms. The battery controller performs different functions i.e. providing DC power, maintaining DC bus voltage, controlling battery voltage and battery current for charging and discharging

process purposes. Due to its superiority and simplicity of implementation, the constant current-constant voltage technique is chosen for battery charging. Furthermore, the study provides a detailed analysis of the proposed approach and control challenges then proposes the corresponding solutions. The PI controller is adopted for all controllers and it was designed to provide a robust control system behaviour. Therefore, the battery terminal voltage and charging current are efficiently limited by the corresponding battery controllers. A robust Energy Management Strategy (EMS) to supervise the charging and discharging process is presented as well.The proposed controller can be suitable for different battery types where only the value of reference voltage and current limit are specific for each battery type. The controller is tested in simulation environment and the results confirm its effectiveness.

Paper 227

A Novel Dual-LCC Hybrid Compensation Network for High-Efficiency CC-CV Wireless Charging of an EV Battery considering Weak Communication

Abstract

In this work, a novel dual-LCC hybrid compensation network is proposed which can offer high efficiency in both the Constant Current (CC) and Constant Voltage (CV) charging modes of an Electric Vehicle (EV) battery at a fixed operating frequency. Here, the compensation network is reconfigured as soon as the mode changes from CC to CV using two ac-switches. The proposed technique works well with weak communication, i.e., it doesn't require continuous high-speed real-time feedback signals from the receiver end for current or voltage regulation. Hence, the issue of interference caused by the higher order switching harmonics of the power converter with the wireless communication link is avoided, thus increasing the reliability and minimizing the cost of the wireless communication module. Moreover, this technique can also maintain a load-independent primary-coil current in both the charging modes and puts no constraints on the design of the transmitter and receiver coils, which makes it more practical. The proposed work is well-suited for the static and semi-dynamic wireless EV battery charging application, where the coupling condition can be assumed to be constant and a high efficiency CC-CV battery charging modes are desirable. The claims are verified through simulation of a 3.2 kW charger designed based on Standard SAE J2954.

Paper 241

Microgrid Integrated Charging Infrastructure with PV Array and Seamless Grid-Hydro Generator Synchronization for Rural and Hilly Areas

Abstract

In this paper, a microgrid integrated charging station is developed for electric vehicles (EVs) charging in hilly and rural area by using a photovoltaic (PV) array and a hydro generator with adverse grid conditions. In rural and hilly areas, there is

continuous fluctuation in the distribution grid, which can interrupt the power across the EVs and household loads. Therefore, a microgrid integrated charging station is developed with a hydro power, which seamlessly switched to islanded and grid connected modes as per the accessibility of utility grid. The microgrid integrated charging station, is controlled using an upper threshold sparse identified zero attractor zero-attracting proportionate normalized least mean square (UTSI-ZA-PNLMS) control technique. The initial convergence process of UTSI-ZA-PNLMS technique is quick and also enhances the dynamic performance under nonlinear load perturbation. Moreover, the mean square error (MSE) of load current is improved due to low convergence rate in later period. The adaptation process becomes accurate by introducing the upper threshold limit to truncate the MSE error of load current to converge faster and the dynamic response is further improved. Under peak load demand and outage of the distribution grid, the vehicles at charging station are charged through the PV power and hydro power to support the distribution grid. However, under recovery of distribution grid, the EVs load is switched to the grid under low PV power, load demand and hydro power.

Track 07 - Power Electronic Converters and Control Systems

Paper 196

A Multi-Input Switched Capacitor Bidirectional DC-DC Converter with Triple Closed Loop Control for Electric Vehicle Application

Abstract

Multi input system is best suitable for uninterrupted power supply (UPS) applications. Moreover, it provides increased mileage for electric vehicle applications. Multi input bidirectional switched capacitor (MIBSC) DC-DC converter with reduced number of components for above applications are implemented in this paper. The MIBSC DC-DC converter has the following advantages: a) multi input with reduced number of inductors, b) minimum number of components compared to conventional topologies, c) high voltage gain ratio. d) reduced design complexity. e) synchronous rectification with increased performance f) triple closed loop control with increased system stability g) reduced voltage stress in switches. A 780 W system is implemented in software (MATLAB/Simulink)

Paper 213

PV-Grid Integrated System with Single Stage Switched Boost Inverter for Irrigation Application

Abstract

The objective of any PV inverter connected to grid topology is to increase the efficiency, improve the power quality and reduce cost. The topology used in this paper is a single stage PV grid integrated inverter, where it uses lesser number of stages compared to conventional ones which uses SOGI controller. However the THD content of the output was not promising. In this work the controller is modified to a PR current controller which tracks the reference sine waveform without steady state error in the single stage switched boost converter and supplies the power to the load depending on the availability of grid and solar voltage. The overall simulation is done in MATLAB in order to analyze the performance of inverter with solar grid integration.

Paper 255

Optimized Modulation Scheme for Dual Active Bridge Converter Using Accurate Harmonic Model

Abstract

This paper deals with optimized modulation technique for minimization of rms transformer current in dual active bridge (DAB) converter suitable for offboard electric vehicle(EV) charging application. The inner phase shift ratios are obtained from look up tables optimized for minimizing rms current. The look up tables are deduced by applying firefly algorithm (FA) optimization technique on harmonic state space (HSS) model of DAB converter. The merit of the HSS model avoids labor-intensive derivation of working equations for each modes of operation, thereby increasing the simplicity of this process significantly. The outer phase shift is obtained from PI controller to maintain proper dynamic response. Time domain simulations are conducted in MATLAB/Simulink. The simulation results confirm the validation of the deduced modulation technique.

Paper 262

An overvoltage and undervoltage prevention control for superconducting magnetic energy storage based power converter connected to a weak grid

Abstract

With the growing usage of primary energy resources (PERs), energy storage technologies have been required to fulfill a balance between supply and demand. Therefore, a control scheme combining superconducting magnetic energy storage (SMES) control and overvoltage and under-voltage prevention control is proposed for SMES based inverter connected to utility grid under various grid voltage disturbances. One of the contributions of this paper is to maximize positive voltage sequence and minimize negative voltage sequences to eliminate the voltage and current imbalances. Besides, the control of the SMES has been performed depending on the regulation of the DC-link capacitor voltage. Also, the voltage support guarantees the safe operation of the three phase inverter. Theoretical analysis and PSCAD/EMTDC based results are conducted to show the feasibility of the voltage and power quality improvement.

Paper 266

A Single Stage Three Phase Bidirectional Rectifier With Power Electronic Star-Star Connection Transformer

Abstract

This paper presents a three phase pulse-width modulated rectifier with power electronic star-star connection transformer which offers bidirectional power flow. Power electronic star-star connection transformer proposed requires less switch count and benefit from the reduction in volume and weight . Power electronic star-star connection transformer proposed can be used for utility applications. The following are the main benefits: There is only one stage of conversion, there is no need for an inconsistent midway hefty dc link capacitor, and great power density is attained. To accomplish required voltage at load and to maintain unity power factor , this study utilizes a decoupled d-q reference frame control strategy.

Paper 267

Design and Control of Smart Loads using Improved Adaptive based P-Q Control

Abstract

Smart grid technology offers to monitor grid generation for scheduling the load demands. Smart load is an emerging technology used in demand side management to optimize generation of the grid. This paper proposes control of an electric spring (ES-2) based smart loads using adaptive technique. An adaptive control is used for extracting the fundamental component of load current with an adaptive noise cancellation (ANC) filter. A phase locked loop (PLL) is used to synchronize operation of ES-2 based on adaptive transfer delay ATD-PLL. An instantaneous reference active and reactive power of critical loads are estimated to control the ES-2. A full bridge voltage source converter (VSC) with battery at its DC link is used as an ES-2. Proposed concept of smart loads is modeled and its performance is observed under various dynamic situations.

Paper 273

Improved Droop Control Methods for Load Sharing in a Solar PV Low Voltage DC Microgrid

Abstract

In a DC microgrid, distributed energy resources and energy storage units are connected in parallel through converters. The proportional distribution of the current among parallel converters is the basic requirement of a microgrid and many current sharing methods like centralized control, master−slave control, circular current−chain control, droop control etc. have been proposed. Amongst them, the droop control method is widely adopted as it does not require any interconnections between the converter. However, in the traditional droop control method, there is a compromise between voltage regulation and current sharing. In order to improve the performance of the overall system, two improved droop control methods have been described in this paper.

Track 08 - Electric Machines and Drives and Power Quality issues

Paper 112

Electromagnetic Performance Analysis of Linear Hybrid Excited Flux Switching Machine with Ferrite Magnets

Abstract

Hybrid Excited Linear Flux Switching Machines (HELFSMs) are one of the recently emerging and competitive candidates for long stroke applications due to high thrust force density, low cost and high reliability. Permanent magnet flux switching machines (PMFSM) use rare earth magnets, such as neodymium, which are inherently expensive and obsolete. HELFSM is proposed by reducing the permanent magnet (PM) volume of traditional linear PMFSM and introducing a set of field winding's into the saved space. In order to increase the thrust density and reduce thrust ripple under load conditions, the influence of some main design parameters, including split ratio, AC winding slot area, DC lower winding slot area, DC upper winding slot area, secondary tip width and pole height are investigated through finite element analysis. Within the same volume constraint and electrical loading, a proposed model can achieve the maximum thrust force higher than the optimized conventional model having magnet placed at bottom.

Paper 121

Design and Analysis of Double-Sided Linear Hybrid Excited Flux Switching Machine with Yokeless Mover

Abstract

In this paper, a new yokeless double-sided linear hybrid excitation flux switching machine (DSYLHEFSM) is proposed. A hybrid topology is used to increase thrust force density and speed. The importance of this new machine is to eliminate the mover yoke, which can decrease the size of the machine. The elimination of yoke in the mover also increases thrust force density. Ferrite magnets are used to reduce machine cost. The volume of the magnet is also smaller than the traditional design. Double-sided model is used to cancel the effect of normal force. Several factors such as split ratio (S.R), AC winding slot area (T_{AC}), stator pole alignment, stator pole width (S_{WR}), and stator pole height (S_{HR}) that increases thrust force density are studied through finite element analysis. The electromagnetic analysis is performed using JMAG version 2017. Electromagnetic analysis of DYLHEFSM shows bipolar flux linkages and back electromotive force, reduced detent force and normal force, and increased thrust density and efficiency. Under the same volume constraints and electrical load, the proposed machine accomplished greater average thrust force than the traditional model.

Paper 152

Suppression of Permanent Magnet Eddy Current Loss in High-Speed Machines

Abstract

Computation eddy losses are vital for the highspeed permanent magnet (PM) machines. These losses extensively rise with speed and influence the electromagnetic performance and the temperature of PM, which may cause PM demagnetization. In this article, a simple technique for reducing PM eddy current loss (ECL) is proposed. A novel rotor structure with a retaining enclosure over solid PM and tooth coil winding configuration is proposed. The source of the ECL's, that is, asynchronous harmonics of magnetomotive force (MMF), are analyzed. Utilizing the proposed technique, a significant reduction in PM ECL is observed. The FEA analysis shows that the magnet eddy losses are reduced by 80.3%, cogging torque is diminished by 61.7%, and iron loss by 45.2% compared to the conventional model.

Paper 173

Enhancing Torque performance with Dual Teeth Switched Reluctance Motor: A Novel Approach

Abstract

Among the available Electric traction motors, switched reluctance motor (SRM) because of its robustness, simple structure, and magnet-free construction is becoming a potential candidate for Electric vehicle (EV) traction application. However, they possess several drawbacks such as low torque density, high torque ripple, nonlinear characteristics, and complex control. In this paper, a novel design based on the conventional four-phase 8/6 SRM is proposed to enhance torque density. The stator pole of the 8/6 SRM is divided into two parallel split-poles (dual teeth) and correspondingly the number of rotor poles is increased to arrive at the novel 8/22 SRM configuration. A new formula for the design of stator-rotor poles of the novel SRM is introduced. Static analysis (FEA based) has been carried out to determine the torque output. In order to save computation time, a theoretical method based on Equivalent Magnetic Circuit (EMC) model is developed and its accuracy is verified with FEA results. The proposed design is also compared with its classical counterpart 8/6 SRM on the basis of torque output and torque per ampere ratio which are obtained from Static FEA simulation. The results indicated 8/22 SRM has a better torque performance and higher torque per ampere ratio in comparison to 8/6 SRM due to the increased variation of co-energy of the field with respect to rotor position at a constant current. This makes 8/22 SRM a promising candidate for high torque density applications in EVs and industrial applications.

Paper 189

Performance Analysis of SRM with Two Stage Commutation for Effective Vibration Reduction

Abstract

The simple structure, high fault tolerance capability, and low cost have made Switched Reluctance Motor (SRM), a promising option for many industrial applications. The major challenges SRM drives currently face are the noise and vibration due to radial force variations. It is essential to address these problems to bring them more into the market. The paper presents the analysis of two-stage commutation, a method of Active Vibration cancellation (AVC), by which noise issues can effectively be reduced without compromising much on the other performance parameters. A closed loop model of SRM with two stage commutation is developed and is tested for different speed and load conditions. Active Vibration Cancellation is demonstrated by modelling the vibration signal using radial force data obtained using finite element analysis platform. By two-stage commutation, peak vibration is considerably reduced and hence an effective solution for acoustic noise problems in SRM.

Paper 237

Design of an Energy Efficient Reverse-Saliency Interior PM Motor with Multi-Barriers Based on Flux-Intensifying Effect for Solar Water Pumping

Abstract

The design of an energy efficient reverse-saliency-interior permanent-magnet synchronous motor (RSI-PMSM) consisting of multi-barriers in rotor structure for solar water pumping units (WPU) is provided here. The existing interior PM motor generates reluctance torque which is positive when negative d-axis current is applied. This increases PM demagnetization risk and limits maximum operating speed. These drawbacks are overcome by presented RSI-PMSM, which generates positive reluctance torque upon injection of positive current at direct axis. Rotor with multiple barriers are developed for this purpose. The design of barriers also reduces torque ripples. Besides, the efficiency is increased by reducing the core losses through proper design of stator slots and yoke. The design along with the finite element analysis based simulation results viz., inductance characteristics torque curves, airgap flux density, back electromotive force along with efficiency plots are presented to illustrate the advantages of the RSI-PMSM for solar WPU.

Track 09 - Renewable Energy Resources

Paper 123

Large-signal average modeling of 2-module Converter for renewable energy applications

Abstract

In this paper, a large-signal average model for a modular system is presented. The studied system is a two module structure based on a three-level boost converter. This topology has been used to balance the dc output voltages in renewable systems. To establish the model, the equations of the system, including the stage power and the used indirect sliding mode controller, are considered. The accuracy of the presented model is validated. To verify the accuracy of the large-signal model, the system is simulated using MATLAB/Simulink software. The simulation is performed using the large-signal averaged and switched models. The switched model is simulated in MATLAB/Simscape (Circuit-Oriented Simulation), whereas the averaged model is simulated in a MATLAB function. The accuracy of the averaged model by two simulations is compared in the transient regime for two scenarios. One in which the inductor current reference is changed and another in which the input voltage is changed.

Paper 124

Economic Analysis of a Net Metering Rooftop Solar PV System and Assessment of CO2 Emission Reduction

Abstract

This paper presents the economic analysis of a grid-tied rooftop solar PV system with a net meter for a residential building of a university campus. The proposed PV system shows the capability to fulfill the maximum energy demand by the different flats of the building and supply overplus power to the national grid which contributes to national energy management. The methodology involves collecting the geographical site information, available useable rooftop area, solar energy resources data, load estimation, and energy consumption profile, PV module technical data, PV array sizing, calculate the profit and payback period of the system. The profit and payback period indicate the financial viability of the rooftop solar PV system. This paper also represents the amount of Carbon dioxide (CO2) reduction while generating the same amount of electrical energy from conventional fossil fuel-based power plants. The reduction of CO2 helps to preserve the environment green by reducing the production of greenhouse gases (GHGs) and global warming. The result of this analysis shows the rooftop solar PV system is economically viable and helpful to a clean environment.

Paper 132

Enhanced TOGI Controller for Single-stage Single Phase Grid-tied Solar PV Supply System

Abstract

This paper proposes a single-stage single phase grid-tied photovoltaic (PV) supply system (SPGPSS). An H-bridge voltage source converter (VSC) is controlled using an enhanced third order generalized integrator (ETOGI). The ETOGI is used to extract the grid synchronization signal and an active component of load currents. The ETOGI works efficiently under presence of grid voltage disturbances such as dc-offset, harmonics or sag/swell. The performance of the proposed control scheme is verified on prototype developed in the laboratory and control algorithm is implemented on TMS320F28379D controller. Its effectiveness is validated under dynamic change in solar irradiations and change in loads. Its performance is found satisfactory under standard test conditions.

Paper 138

A New Single-Phase Nine-Level Cascaded Multilevel Inverter for Alleviation of Leakage Current in Grid Connected PV Systems

Abstract

A new topology for a single-phase transformerless nine-level CMLI is proposed in this paper. The operation of the proposed single-phase transformerless nine-level CMLI is discussed along with the mathematical analysis of terminal voltage and common-mode voltage using switching function is presented in this paper. The proposed topology uses only eleven switches to generate nine-level output voltage. A modified PWM switching technique is adopted to maintain a 0 level throughout the entire cycle of the output voltage so that the high frequency switching transitions in the terminal and common-mode voltages are minimized. The reduction in the high frequency switching transitions subsequently minimizes the leakage current flowing through the parasitic capacitance. The simulation waveforms presented in this paper further justifies the operation of the proposed single-phase transformerless nine-level CMLI.

Paper 149

Comparative Study of Genetic Algorithm v/s Genetics Based Harmony Search Algorithm for Short Term Wind Power Forecasting

Abstract

Renewable energy is one of the means by which sustainable development can be achieved. There have been several technological advancements in renewable energy in the past decades. Renewable energy based power generation are not reliable as these resources are variable in nature, Example: solar and wind. Even though there are various solar and wind based power plants in India, thermal power generation is the preferred source. Forecasting wind power will help to increase the reliability of the wind resource. In this study, short term wind forecasting is done using artificial neural network. Two algorithms are used for wind power forecasting i.e. Genetic algorithm and Genetics based Harmony search algorithm. The study is carried out for Bhilai (C.G.), India. The developed algorithm is trained using hourly data for a year and hour ahead power forecasting is achieved. Both the algorithms are compared for execution time and error. The study is done using MATLAB simulation.

Paper 150

Intelligent Control Of Small VAWT Based WECS for Low Wind Speed Regions Using Advanced Hill Climb Search MPPT and BELBIC Controller

Abstract

India gets electricity majorly from thermal power plants utilizing fossil fuels. This has led to India being the third largest CO2 emitter in the world, creating climatic and environmental issues. The electricity needs of a renewable resources rich country like India can be addressed by shifting to renewable energy. The potential of wind energy in India remains largely underutilized as only commercial on shore is focused. Small VAWT based WECS has been simulated and shown to produce considerable amount of power in the wind speed range of 2.0m/s to 6.5m/s. Small WECS can prove to be a game changer as almost 80% of land area in India has wind speeds in the range of 2.0 m/s to 6.5m/s. The study is carried out for Bhilai, (C.G.) India. A 3kW VAWT based WECS is simulated using MATLAB/Simulink. The use of BELBIC Controller in duty ratio control further helps in reducing settling time and maintaining the DC link Voltage. To compensate for the variable nature of wind and generate the maximum power Advanced Hill Climb Search MPPT has been used.

Paper 151

Power Management of Photovoltaic Battery Standalone system using Fractional order PI Controller

Abstract

This paper presents an effective power management technique for a Standalone Photovoltaic(PV) Battery system using a fractional order PI controller (FOPI). The scheme is aimed at meeting the load demand requirement during varying conditions. The FOPI offers an extra extent of liberty for achieving the desired specifications. The particle swarm optimization (PSO) method is adopted to tune the FOPI control parameters. The boost converter (boostmppt) derives maximum

power from the PV panel. The charging and discharging operation of the battery is controlled by buck (buckcharging) converter and boost (boostdischarging) converter respectively. The use of double loop control scheme assures full control over the charging and discharging current. The proposed strategy has been extensively tested using MATLAB simulations.

Paper 155

Maximum Power Point Tracking for Photovoltaic Brushless DC Motor Connected Water Pumping System Based on GBDT-BOA Technique

Abstract

An efficient tracking of maximum power point (MPP) in PV brushless DC (BLDC) motor fed water pumping system using hybrid approach is presented in this paper. The proposed method is a combined implementation of both the Gradient Boost decision tree (GBDT) and Billiards-inspired optimization algorithm (BOA) named as GBDT-BOA technique. The purpose of the proposed method is to monitor the maximal power of the PV brushless DC (BLDC) motor fed water pumping system. Among the various categories of DC-DC converters, SEPIC converter is selected with the aim of maximum power taking out from PV as well as smooth starting of motor. GBDT plays to train the input data set, the trained value of the best parameters is optimized by the BOA in which it calculate the duty ratio of the single-ended primary inductor converter (SEPIC) to accomplish MPP. The duty cycle obtained through the proposed GBDT-BOA technique is applied to the SEPIC. SEPIC is connected to voltage source inverter (VSI) that is employed to power the BLDC motor. In the meantime, the proposed method is performed on MATLAB/ Simulink working platform and implementation is being explored with present methods like Perturb and Observation (P&O), Radial basis Function Neural Network (RBFNN). The performance of the system is assessed in terms of voltage, current, power of PV system and SEPIC voltage, current and the BLDC motor speed, torque, current, emf which shows the performance of the proposed system.

Track 10 - Electric Vehicles

Paper 137

EV Charger Power quality Improvement using Synchronous rectified Bridgeless CUK Converter

Abstract

A two stage Bridgeless CUK Converter is developed and simulated in this paper work. The converter is cost effective and simple with very less elements.The front end Power factor Correction (PFC) unit rectifies the voltage along with the unity power factor which improves the power quality and efficiency of the power given to the Electric vehicle on-board charging unit. The rear end Flyback with synchronous rectification (SR) controls the vehicle battery charging in Constant Current (CC) and Constant Voltage (CV) based on the battery State Of Charge (SoC). The Electric vehicle (EV) charger draws a sinusoidal current waveform keeping Total Harmonic Distortion (THD) is under the guidelines of international regulations standard IEC 61000-3-2. The proposed topology consists of very few components excluding the unwanted capacitor banks as well as conventional diode bridges will be resulting in fewer losses.

Paper 143

PMSM Torque Ripple Reduction in Electric Vehicle using Neural Network

Abstract

For Electric vehicle(EV) application, Permanent Magnet Synchronous Motor (PMSM) is widely used due to high power density and high efficiency. Field Oriented Control (FOC) with feedforward compensation is used predominantly for motor control to give better dynamic performance. With the changing motor parameters due to ageing effect or variation in motor temperature causes torque ripple and EV vibrations. This paper presents the implementation of Neural Network (NN) for PMSM Control to reduce the torque ripples. NN with current feedback works as a feedforward network. Current control PI regulators and feedforward compensation is replaced with NN model. It improves the decoupling accuracy in between d-axis and q-axis currents and also reduces the torque ripples even if motor parameters varied slightly. Vehicle dynamics is taken into consideration during simulation. Matlab/Simulink tool is used for simulation and verified the Motor torque performance with FOC and NN.

Paper 166

Comparative Analysis of Symmetrical and Asymmetrical Phase Shift Control Strategy for Resonant Wireless Inductive Charging System

Abstract

This paper describes the operation and performance analysis of series/series resonant wireless inductive charging system with symmetrical phase shift (SPS) and asymmetrical phase shift (APS) control strategies. The H-bridge inverter switches of the resonant wireless inductive charging system (RWICS) are designed to operate with zero voltage switching. The comparison of the SPS, APS switching strategies are discussed in regulation of output voltage for different loading conditions and step change in the reference voltages. It is found that the system efficiency is higher with APS control strategy. Also, the variation in pulse-width angle required for controlling the output voltage is small for various loading conditions in APS compared to the SPS. The MATLAB/Simulink Simulation results confirmed that APS control strategy provides superior performance than SPS control for different loading and different output desired conditions.

Paper 183

Data Acquisition and Signal Processing System for Electric Powertrain Performance, Mileage and Drive Cycle Analysis for Electric Two and Three Wheelers

Abstract

This paper presents a proposed high speed data acquisition and processing system that can measure electrical power quantity as well as other physical parameters from electric drivetrain of two wheeler and three wheeler electric vehicle and digitally process these captured data to calculate power in real time. Hardware requirements for this proposed system is discussed in this paper with major focus on developed signal processing algorithm which uses DFT (Discrete Fourier Transform) based power calculation algorithm that can calculate inverter's output and input power in real time. Data measured from this acquisition system can be used for electric drivetrain performance analysis, mileage estimation, drive cycle analysis and diagnostic for two wheeler and three wheeler electric drivetrain.

Paper 220

Braking control strategies based on single-pedal regenerative braking and neural network for Electric Vehicles

Abstract

Braking systems and braking control strategies play a vital role in improving the overall vehicle performance like vehicle and passenger safety, overall vehicle efficiency, vehicle stability, and much more. Braking control strategies based on single-pedal regenerative braking and neural network for electric vehicles will ensure braking stability as well as improvement in overall vehicle energy economy to reduce the driver range anxiety to some extent. To better utilize the regenerative braking potential of the motor, to improvise the overall energy recovery characteristic of the vehicle, and to reduce the driving difficulties of the user, the fuzzy logic-controlled algorithm is implemented on a single pedal accelerator electric vehicle. Driving characteristics and driver's intentions can be identified through pedal operations. Releasing the single pedal (acceleration pedal) and Stepping on the brake pedal is the two-braking process of the driver. A single-pedal-based regenerative braking control approach (RBC) is designed to facilitate proper regeneration brake torque to the motor to fulfill the braking needs from the driver all the time, in the first braking process. A neural network-based controller is proposed for the emergency braking operation to optimize the braking stability as well as the energy, in the second braking process.

Track 11 - Microgrid & Smartgrid

Paper 11

A Review on Demand Response Techniques of Load Management in Smart Grid

Abstract

The new realm of a smart grid signifies renovation of the existing power grid to a new version which will incorporate distributed renewable energy sources (DER) and at the same optimize the uses of power at the consumer end during the high price of electricity which is called demand side management. The renewable generation is weather dependent and is incapable of supplying the peak loads which is expected to increase, due to the escalation of demand of both heat and power in residential load. Hence the temporal variability of these new renewable energy sources may degrade the reliability of electricity to its consumers. To extricate this in avoidable constraint , smart grid with the deployment of high speed communication network can introduce demand response as a optimization resource since consumer is not using all the loads for all the times. Demand response optimization programs (DR) are thus dedicated to schedule the energy consumption behavior of end-users in a smart power grid in an optimal fashion. It has been demonstrated in various research works on this problem that the simultaneous use of smart grid communication technologies with DR programs helps utilities to save electricity economically by peak shaving of demand . This paper presents an comprehensive review of various modern techniques of demand response adopted in power industry employing smart power grid and also present possible benefits that demand response can introduce in economic supply of electricity with quality and high standards of reliability in future power grids.

Paper 19

Energy Management Strategy of Micro-grids in Joint Energy, Reserve and Regulation Markets based on Non-intrusive Load Monitoring

Abstract

The heating, ventilation, and air-conditioning (HVAC) units are regarded as major demand response (DR) resources in micro-grids. However, due to the privacy protection, it is difficult for the system operator to obtain complete information of each individual appliance. In this paper, we present a non-intrusive load monitoring (NILM)-based framework for the operation strategy of the micro-grid in the joint energy, reserve, and regulation markets. The NILM technologies enable the operator to disaggregate the power of the HVAC units from the reading of the smart meters. Hence, the operation state of the appliances and the behavior of consumers can be studied without obtaining detailed data of each individual appliance. Based on the NILM result, a novel method to evaluate the upward and

downward reserve capacity of the HVAC units is formulated. The evaluated reserve capacity can help the operator better bid in the joint market based on the proposed optimization model. The proposed framework and methodology are verified through case studies. The simulation result reveals that with NILM, the market operator can save more energy consumption cost and load curtailment cost and earn more revenue in the joint market through selling excessive energy and providing ancillary services.

Paper 36

Energy Consumption Forecasting using a Deep Learning Energy-Level Based Prediction

Abstract

Smart grids benefit the consumers via enabling informed participation. As a result, customers have more choices, which drives a range of buying trends and actions. One such important application is accurate forecasts of energy demands (loads) at individual sites, but load forecasting is still a challenge. Most load forecasting research has used traditional numerical value estimation, which is a regression style prediction; however, energy consumers will not know if the forecasted load is low or high. Level prediction can be performed by performing regression first and then classifying the values into energy levels, or by using a classification model to predict the levels directly. The Random Forest (RF) classification algorithm is shown to have outperformed other machine learning algorithms for level predictions. This paper provides a deep learning-based classification approach. The results of this deep learning-based classification were compared to those of the RF classification algorithm, it was observed that the deep learning method outperformed the RF method, particularly for high numbers of energy levels.

Paper 44

Experimental Validation of Grid-Tied and Standalone Inverters on a Lab-scale Wind-PV Microgrid

Abstract

Power inverters are integral parts of microgrids containing renewable generation units and energy storage devices. In general, two types of inverters are available in power systems including grid-tied and standalone. The hybrid integration of photovoltaic (PV) and wind turbines into distribution power networks has further promoted grid-tied and off-grid applications of inverters to enhance the system reliability. Toward this end, this paper experimentally validates the performance of grid-tied inverter vs. standalone inverter on a lab-scale microgrid located at Southern Illinois University, Carbondale, IL, USA containing two wind turbines and two PV modules. The experimental results verify the advantages of the standalone inverter in operating the lab-scale microgrid when it is disconnected from the grid.

Paper 75

Effect of load sharing between parallel connected Choppers on efficiency of the system for unequal line resistances

Abstract

The usage of renewable energy sources is a promising key solution for the anticipated energy scarcity due to the depletion of conventional energy sources. Increasing energy demand all the time for DC loads can be substantially met by DC MG. Assimilation of the suitable controller with DC Micro Grid can guarantee a continuous energy supply. In this paper, the authors discuss Droop control employing Virtual Output Impedance to properly share the load among parallel-connected choppers in a DC Micro Grid. The control strategy used doesn't mandate communication between various sources. In this paper, the authors investigate the effect of load sharing on the efficiency of the system for unequal cable resistances. MATLAB/Simulink results justify the use of a controller for an increase in system efficiency.

Paper 89

Feasibility of Smart Power Grid in Bangladesh-A Part of Next-Generation Smart City Planning

Abstract

The purpose of this research is to describe the essentialness and investigation of the useful execution of Smart Grid in Bangladesh. Smart-grid alludes to an electric energy framework that upgrades grid quality and effectiveness via consequently reacting to system aggravations. Energy deficiency is a significant issue for a developing nation like Bangladesh. Productive transmission and dissemination of power with mandatory power sources is an essential demand to supply residents and economies. The research investigates the qualities of Smart-Grid and a general examination with a traditional framework. The target of this research article is to introduce a guide that could be utilized as a direction for the improvement of smart-grid networks dependent on innovative difficulties for this south Asian developed nation. This research study consists of a short overview of the idea and elements of the smart grid from the viewpoint of our nation. The main innovative difficulties for the usage of this new insightful grid framework have been sketched and their possible cures are suggested. The highest difficult section is to implement this novel innovation beneficially and to guarantee this, a few major ventures are should have been illustrated. It likewise talks about the proficient transmission and dispersion system which will coordinate the energy frameworks with the sustainable power source and data framework.

Paper 94

Modelling and Analysis of PV array Connections Under Non-Uniform Irradinace Conditions

Abstract

Partial shading is the most significant factor affecting the PV array's maximum power production. Interconnection between PV modules in different styles inside the array is one way to mitigate this issue. The literature reported that PV modules can be connected in simple-series (SS), series-parallel (SP), total-cross-tied (TCT), bridge-link (BL) and honey-comb (HC) ways to reduce partial shadings. Under the influence of shading, however, the modelling and analysis of PV array connections is a difficult task. Therefore, this work presents modelling and analysis of PV array connections under partial shadings. The performance of each PV array connection is analysed under different shading conditions on 9x9 array in this work, and further, comparative study has been performed by obtained global maximum power output (GMPP), fill-factor (FF), efficiency and possible local peaks (PLP). As per the study, it is identified that the TCT and BL PV arrays are showing better results under all considered shading conditions compared to other connections.

Track 12 - Artificial Intelligence Techniques

Paper 83

Diagnosis of COVID-19 from Chest X-Ray Images Using Convolutional Neural Networking with K-Fold Cross Validation

Abstract

SARS COV-2 or Novel Coronavirus known as COVID-19 is the current world's toughest challenge and it has become pandemic and a huge number of people have lost their lives throughout this pandemic period. The death rate is so high compared to any disease of the last hundred years. The proper vaccine for this virus hasn't been discovered yet. The detection of this virus is doing using RT-PCR testing and which is not fully accurate when there is a huge number of people tested there is a chance of slight false negative result and the testing procedure is costly, takes time and there is a shortage of kits for doing tests is some regions. So, in this method, the aim is to detect COVID-19 from Chest X-Ray images using deep learning approach like convolutional neural networking and also higher accuracy and availability. In this method, before implementing images, some preprocessing has done like RGB to gray image conversion, denoising using an anisotropic diffusion filter and resizing the images for computation. A Convolutional Neural Networking method is proposed having 19 sequential layers. The K-fold cross validation is used while training using proposed Convolutional Neural Networking architecture and the folding was done 5 times. A dataset is used having two-class data COVID and Normal x-ray. The dataset has a total of 1621 images where 280 images are of COVID patient and 1341 are of Normal atient. The proposed method's average accuracy is 99.5%.

Paper 129

Performance investigation of SVR for evaluating Voltage Stability Margin in a power utility

Abstract

Voltage stability margin is one of the key parameters to ensure the credibility of the power system in real time. Voltage stability margin indicates the maximum loading capacity of the system i.e, further increase in load will collapse the system voltage, and the system becomes unstable. Hence in real time, the evaluation of voltage stability margin is crucial and requires more significance. In recent times, reinforcement learning algorithms attracts a great deal of interest for determining the voltage stability margin. In this paper, voltage stability analysis on the power system has been accomplished using the Continuous power flow method with Spider SVM regression algorithm. The analysis was carried out in the IEEE 118 bus system, with the help of PSAT software in MATLAB. The result obtained from

SVM regression model satisfies the expected model with the best accuracy for many cases.

Paper 130

Intelligent Fault Diagnosis Mechanism for Industrial Robot Actuators with Digital Twin Technology

Abstract

Intelligent fault detection is a mechanism's competency to distinguish between healthy and faulty machine signals for smart and efficient diagnosis. The modelling and analysis of the parameters that contribute to the system's fundamental operation form the crux of the framework. A heuristic technology to enable real-time intelligent fault detection is digital twin technology. Digital twin technology allows a tandem establishment between real-world machines and the virtual domain, allowing for the inclusion of optimization and maintenance frameworks. Sparsely represented machines in the digital twin domain are linear actuators, which form essential parts of various industrial and commercial machines. Therefore, this study has modelled a data-driven and multi-physics robotic linear actuator digital twin, and integrated it with a custom designed fault detection mechanism using Naïve Bayes classifier. This architecture can autonomously be deployed in tandem to the physical machine to alarm and diagnose electrical faults as soon as they occur in the machine. As compared with conventional diagnostics this will reduce machine down-time and expedite repairs. The resultant model built on MATLAB, Simulink gave an accuracy of 96% and required minimal processing capability to operate. Widespread commercial utilization of the proposed model can pave the path for Industry 4.0 utilization of linear actuators as well as technologies including industrial robots that utilize them.

Paper 135

VOTING BOOTH HELPER SYSTEM USING MACHINE LEARNING

Abstract

Elections are the fundamental defining characteristics of any democracy that is being governed by the people, where in people express their choices or articulate opinions through voting. The existing voting system uses EVM system at polling booths for voting and its main drawback is the manual validation of the voter. In the polling booths, the voting process is organized by few organizers having a count from 5 to 10 or even above. These people are assigned to perform certain tasks, one of such tasks is to validate the voter. With the raising population this consumes a lot of time, which in turn increases the man power and the human error. This project aims to provide an efficient solution to overcome the drawbacks of the existing voting system. We have developed a module using face recognition algorithm, to validate the voter accurately and efficiently within no time. It even reduces the man power, as it alone, performs all the tasks performed by the several organizers at the voting booths. The algorithm made use of, is the Multi-

Task Cascaded Convolutional Neural Networks (MTCNN) which is known for its accuracy and speed. The reduction of man power helps to control the rapid increase of covid cases, which is the most prevailing problem and helps the voters to vote with ease.

Paper 176

Supervised Learning Techniques for Sentiment Analysis

Abstract

Data mining is the process of extracting knowledge from a huge data. Another term for data mining is Knowledge Discovery from Data. For the same, various data mining technologies are available such as statistics (lay the foundation of data mining), Artificial Intelligence (applying human thoughts like processing of data) and Machine Learning (union of statistics and artificial intelligence). In this research work, authors employ natural language processing in order to perform sentiment analysis using feature extraction techniques of NLP viz. bag of words and Term Frequency Inverse Document Frequency. Sentiment analysis is especially important to gain users' feedback and opinion about products. In this paper, authors perform sentiment analysis of twitter data. Each data point (tweets in considered case) will be classified as "positive tweet" or "negative tweet". For this classification, six different techniques i.e., Information Gain, Gini Index, Naive Bayes, K-nearest neighbor, Random Forest and Gradient Boost are used. In the end, classification through all these techniques are compared based on various performance metrics like accuracy, precision, recall, and f1 score. Experimental results suggest that random forest aces the current analysis by yielding an accuracy of 97%.

Paper 199

Allocation of Vehicle Based on the Availability Using Machine Learning

Abstract

Allocation of vehicle Based on the Availability using Machine Learning can track/estimate the movement of people and provides real time location to the transportation department enabling them to understand the demand and based on this they might take necessary steps to mitigate the load on their system. This idea leads to better cost efficiency and maintains a constant balance between supply and demand of the transportation system and it also reduces discomfort to the end user. We propose to consider the prediction of buses demand for pick-up as related tasks, and we constructed a feature extraction component based on Time series algorithm, multi-task learning and SARIMA Algorithm to extract spatiotemporal features concurrently. We have considered the previous data record and in addition to that we have included another mobile application wherein we can get the information of the pickup location predicted. We combined external factors, such as weather, day of the week and public transport conditions, to simultaneously predict bus demand for pick-up location.

Paper 218

An End to End Learning based Ego Vehicle Speed Estimation System

Abstract

Estimating speed of a vehicle from only the video captured from within the vehicle without relying on any other supplementary information such as GPS coordinates or LIDAR data, is a challenging task. A deep neural network-based technique is proposed in this work that uses only the recordings from onboard dash camera, to estimate speed of the ego car. Three models are designed using various combinations of LSTM and CNN and evaluated on two benchmark datasets. From the results, it is observed that the proposed systems are well capable of generating estimates of the ego vehicle speeds with good accuracy.

Track 13 - Renewable Energy Resources

Paper 156

Investigation of three-module converter structure in photovoltaic systems

Abstract

DC voltage imbalance is a significant challenge in photovoltaic systems. These systems can consider as a current source. Therefore, a capacitor is parallel to the interface converter to meet the limitations of this source. By using the proposed modular structure, the voltage balance can establish. Perturb and observe (P&O) algorithm is used to obtain the maximum power point (MPP) of this system. This algorithm generates the reference currents of the inductors for the converter. A sliding-mode controller is considered to control these currents and balance the voltage at the output capacitors of the system. The three-module system with photovoltaic sources has been simulated using MATLAB/ Simulink software.

Paper 178

Fault Detection and Classification of Grid Connected Wind Farm (DFIG) Using Fuzzy Logic Controller

Abstract

Wind farms employing DFIG are the most important and budding source of renewable energy because of their low maintenance cost and high efficiency. Limited research works are available to monitor fault detection and classification. This paper deals with a 9MW wind power plant implementing a doubly-fed induction generator that feeds power to 120 kV, 50Hz utility grid. A doubly feded 30 km transmission line connects the wind park and grid. The simulation results for different short circuit faults using a pi block in the MATLAB Simulink are obtained. Here we develop a fuzzy system from the short circuit fault analysis and also identify the evolving fault, and classifies the fault phases.

Paper 191

Solar Energy based EV Charging Station With Added Battery Storage System

Abstract

The concern of environmental pollution pushes to go for the electrification of vehicles. Certainly, the conversion of fossil fuels to electric energy and fed it to electric vehicles (EV) will not help to reduce air pollution, rather it's just the conversion of energy from one form to another. So, it’s better to fed energies (in form of electricity) to EV which are environment-friendly, sustainable, and renewable. The main idea behind this project is to use Solar Photo-Voltaic (PV) panel to convert solar energy into electric energy and fed it to a DC microgrid-based EV charging station. Integration of an additional battery is proposed as a buffer to store or deliver the generated energy. It is also suggested that the charging station will be grid-connected so that energy can be imported for or exported according to the demand because all day will not be sunny.

Paper 194

Real-Time Simulation of Wind Turbine Driven Grid-Connected Induction Generator on DSP Platform

Abstract

Induction generator based wind turbines are increasingly being integrated to power system networks. Power converters required for the integration can be tested using power hardware in loop simulation and power electronic based emulation. Real-time simulation constitutes an important part of these testing methods. This paper presents the real-time simulation of a mechanically-coupled wind turbine and squirrel cage induction generator system connected to the grid. Dynamic models of wind turbine and induction machine are detailed. The responses obtained using real-time and off-line simulations based on these models are presented. The same are benchmarked against the responses obtained through MATLAB simulink library blocks for cases pertaining to the start-up transients when the system is connected to the grid, and the transients resulting from a grid fault. Close agreement among the three sets of responses validates the mathematical model as well as the real-time simulation of the system. The real-time simulation is performed on a digital signal processor which is much more cost effective solution as compared to commercial simulators. Low execution time observed affirms the suitability of the DSP as a real-time simulator.

Paper 264

Comparison of Photovoltaic Generation Uncertainty Models for Power System Planning Using Regression Framework

Abstract

Probabilistic photovoltaic (PV) generation forecasting is essential for the planning of a PV integrated power system. Compared to deterministic forecasting, probabilistic PV generation forecast results are more realistic in making critical decisions during the planning stage of power systems. Since its inspection, regression frameworks have gained enormous credit in the prediction literature owing to their decent prediction performance. The selection of a reduced but

sensible theoretical relevant regressor set is an essential task for a befitting model. This paper elucidates various regression-based PV generation uncertainty models, mainly compares the forecasting result of two quantile regression models suitable for planning applications. Each model's merits and demerits in the power system planning application are deeply analyzed. Historically collected PV generation time-series data from three different places in the USA are used for forecast performance comparison through suitable metrics. The suitability of a model out of the considered two with various choices of regressor(s) is critically analyzed through detailed result analysis.

Paper 265

A Simple Approach to Model Photovoltaic Module using Solver Utility of Microsoft Excel

Abstract

Photovoltaic (PV) modules are used to extract electrical energy from the solar energy efficiently. The relationship between the output voltage and current of a PV module being nonlinear, development of a proper model is a complex task. Due to very limited PV module models available in many simulation tools, studies that use such models are therefore constrained. This paper proposes a simple yet effective method to extract the parameters of the PV module by exploiting the solver utility of Microsoft's Excel. These extracted parameters are then used to construct the model. The correctness of the model is verified by carrying out simulation in the spice environment. The data points required to extract the parameters can be taken either from the datasheet or from the experiment. Use of a common and well-known tool like Excel makes the implementation of proposed method not only easy but also simple.

Paper 268

Frequency Regulation of Solar-Wind integrated multi Area System with SMES and SSSC

Abstract

The proposed study illustrated the design and control of load frequency control of a two area power system. The system is modeled with conventional as well as non-conventional energy sources like wind, solar and diesel power plants. Apart from energy sources, energy storage and Flexible AC Transmission (FACT) system equipment like Superconducting Magnetic Energy storage (SMES) and static synchronous series compensator (SSSC) is also incorporated for realization of recent power system configuration. with inclusion of FACT devices not only improves the reliability of the system but also reduces the large frequency oscillations present in the transmission line. An effective and efficient controller named as Tilt Integral Derivative controller with filter is employed in this study. For tuning of controller parameters, a simple yet proficient optimization method called Jaya algorithm is used. The performance analysis with various controller schemes

are done to validate the efficiency of the proposed system. Lastly, the effect of a storage system and FACT device with the interconnected system is analyzed.

Track 14 - Electric Vehicles

Paper 240

Ultracapacitor based constant torque regenerative braking system for a brushless DC motor

Abstract

In this paper a low cost and efficient ultracapacitor based constant torque regenerative braking system for a BLDC motor is proposed, which is very much suitable for electric vehicles with lead acid batteries. The proposed regenerative braking system is designed such that, the inertial energy associated with the BLDC motor at the time of braking is used to charge an ultracapacitor through a buck converter so as to get constant braking torque. By varying the charging current of the ultracapacitor any constant braking torque can be produced for the motor. Thus a characteristics similar to mechanical braking is achieved. The proposed braking system can be implemented even in sensorless bldc motors since sensors are not used with this technique. To validate the dynamic performance at different load conditions the proposed system simulated and tested using MATLAB/Simulink model. The results confirm the high capability of the proposed system. Finally it is verified that the proposed technique is very much suitable for practical implementation.

Paper 253

SMO Based Position Sensorless BLDC Motor Drive Employing Canonical Switching Cell Converter For Light Electric Vehicle

Abstract

In this paper, a sliding mode observer (SMO) based rotor position sensorless brushless DC (BLDC) motor drive for light electric vehicle (LEV) is designed employing canonical switching cell (CSC) converter, which optimizes the MPPT performance and soft starting of the motor is assured during sensorless start-up. The CSC converter provides ripple free current in the output to the VSI and minimizes the losses. For sensorless commutation of the BLDC motor drive, SMO technique is used, which estimates rotor angular position and speed. This sliding mode technique reduces switching spikes due to the trapezoidal commutation of the BLDC motor and provides smooth transition between sensored and sensorless mode as required. To ensure green mobility, a pulse-width modulated regenerative braking algorithm is also integrated using the same VSI, which avoids any additional converter. This system performance is simulated and analyzed in the MATLAB environment.

Paper 254

Dual-Input Single-Stage Isolated Charger for Light Electric Vehicles

Abstract

Aiming towards reducing the size and cost of light electric vehicle (LEV) charger powered from solar photovoltaic (PV) panel and the grid, this paper deals an isolated dual-input single-stage power factor corrected (PFC) converter configuration. This LEV charger is realized by modifying the single input Cuk converter. It utilizes both inputs simultaneously to charge the battery. Both inputs are operated in buck as-well-as boost mode. Power quality at an AC input is maintained according to guidelines provided by the IEC 61000-3-2 standard in constant voltage (CV) mode as-well-as in constant current (CC) mode. The PV array input is always operated at maximum power point (MPP). The reduction in component counts, is the major novelty of this LEV charger. MATLAB environment is used to design and simulate this LEV charger for an 1-kW rated output.

Paper 256

A 20kW Three Phase Off-Board Charging System with Multiple Outputs for Wide Variety of EVs

Abstract

For wide variety of EVs, there is a need to provide multiple charging points as per charging standards. This paper gives a solution for off-board charging system design. The charging system uses three different isolated DC-DC converters as per their charging rates for different charging terminals whereas all converters sharing single DC-link. The three phase AC to DC power conversion is made through a Vienna rectifier, which maintains both DC link voltage and PFC (Power Factor Correction). For super-fast charging (250-450V charging range), a DAB (Dual Active Bridge) DC-DC converter (15kW) is used. For fast charging (250-500V), a reconfigurable-type isolated resonant DC-DC converter (3.5 kW) is used while for e-moped charging, a half bridge isolated LLC converter (1.5kW) is used. For all isolated DC-DC converters, turn ratio of HF isolation transformer is decided to make sure that during whole charging range, the peak series inductor current is not increasing too much for maintaining minimum level of current stress during whole charging range at each charging port. The Vienna converter is controlled through digital DQ control approach while DAB is controlled through SPS control and half bridge converter is controlled through frequency modulation approach. Simulated results are presented in different charging modes.

Paper 258

Energy Management and Hybridization of Nissan Leaf using Switched Capacitor Converter and Ultra-Capacitor

Abstract

This paper proposes a new hybrid energy storage system(HESS) incorporating a battery and ultracapacitor(UC). The proposed system uses separate energy sources to use their characteristics at their best, which reduces the size, efficiency, or cost of the embedded source. Electric Vehicle power onver sion system is implemented with Hybrid Energy Storage Sys tem(HESS), consisting of a battery and UC.The simulink model of the proposed system with Nissan Electric Vehicle model is implemented and the results validated the theoretical studies.The electric vehicle(EV) operates in various modes depending on acceleration, deceleration, and State of Charge (SoC) of the HESS. The choice of energy storage device for vehicle propulsion is taken based on voltage, SoC, and other parameters. The proposed system is more precise and reliable, and the final results showed improvement in the overall performance, resulting in the extension of the range. The system allows one to utilize batteries optimized for energy density seeing that the system was able to actively limit the power drawn from the battery while providing the required power to the load by utilizing the UC bank.

Paper 270

A Single-Stage Sepic and Buck-Boost Converter based Isolated Charging Systems for Electric Vehicles

Abstract

In the present article, a single-stage, isolated, nonbridged charging scheme is filed for the charging of LEVs (light electric vehicles) with enhanced power actor. A linear voltage to current profile is achieved on the supply side with the proposed scheme for EV charger, so that the criteria of IEC-61000-3-2 is not violated. The charger consists of an AC-DC converter with two electrically isolated separate paths for both half of input voltages. In the presented work, an isolated buck-boost and sepic converter based non bridged EV charger is introduced with ability of power factor (PFP) preregulation at the supply end. The charger is reached by combination of buck-boost and sepic converter which works as sepic and buck-boost converter based charger in positive and negative half of input voltages respectively. The nobility in this article is the elimination of back feeding diodes. However, the same task is performed by antiparallel body diodes of the switches which results in reduction in components counting and increase in efficiency. The converter designed in the filed scheme is operated in discontinuous conduction mode (DCM) and the proposed electric vehicle charger topology is validated using the MATLAB simulation results.

Track 15 - Microgrid & SmatGrid and Power Quality Issues

Paper 115

Pre-Feasibility Study: Microgrid Solar Solution for Indigenous Village (Kampung Adat) Ubu Oleta in Sumba Island, Indonesia

Abstract

While the Indonesian grid continues to expand toward off-grid communities, Sumba kept its unique challenge of scattered communities living between valleys and rolling hills, making the national grid expansion financially expensive. Hence, this condition is not unique to Sumba, but Indonesia in general. In this study, we investigate the need of clean energy for indigenous villages of the frontier, outermost and disadvantaged communities. We also provide the local community and government with a sustainable photovoltaic management learning that suitable for the village. We conducted literatures review, field work, small group discussion with relevant stakeholders, and the development and implementation of photovoltaic. After the data were collected, it was coded in order to uniquely organize the file and for an easy access of the data. The result shows that the community is willing to improve their livelihood through the use of renewable energy and photovoltaic microgrid is the best solution to offer.

Paper 133

Control Strategies for energy management of MMC-MTDC smartgrid

Abstract

The introduction of renewable energy sources in remote island regions is difficult due to the small capacity. To improve this issue, grid expansion and control of energy storage systems are needed. This paper proposes a MMC-MTDC smart grid and control strategy for it to expand remote island areas grid. Multiple remote islands are linked by HVDC transmission lines to form a smart grid with renewable energy sources and energy storage systems. Depending on the power balance, recharge/discharge of storage batteries, MPPT control and output suppression of renewable energy sources are performed. Simulation results under power imbalance and fault conditions show that the proposed system operates stably.

Paper 134

A Fuzzy Logic Based Load Shedding Approach for Islanding Mode of Microgrid

Abstract

Overloading is usually faced by the microgrid operated in islanded mode of operation because of no contribution of power from the main grid to the loads and total load demand must be fulfilled by the microgrid. The scenario of overloading will cause decrease in frequency. Load shedding technique is most common way to overcome this under frequency problem. Conventional techniques for under frequency load shedding are inefficient for complex microgrid and microgrid operating in islanding mode. In this paper, a fuzzy logic controller is designed to determine the optimum amount of load shed required. System frequency and its rate of variation are design parameters of the fuzzy logic controller. Priority of the load is also considered before load detaches. The proposed method is simulated on MATLAB (Simulink) model and tested for various loads. The designed fuzzy logic controller has determined the optimum load to be shed and successfully resolved the overloading problem of the microgrid.

Paper 136

Utility/DG Set Synchronization Capability of Wind-PV-BES Supported 3Ph-4Wire AC Microgrid

Abstract

The supply and demand gap is bridged by interconnecting utility to the microgrid. The utilization of renewables generation units in the microgrid have improved the power surety and the energy storage as the buffer power unit enhances the power reliability. In operation of these resources, a pertinent situation can arise when the loss of generation from renewable power units is observed and energy storage gets completely discharged. As a solution, this work focuses in bringing the generation of diesel generator (DG) for the instances of generation shortage from renewable resources and completely drained battery storage. The seamless operating modes namely current control and voltage control are enabled in accordance to the availability of the utility grid/DG set. On the existence and exclusion of the faults, the static transfer switches (STS-1-2) isolate/reconnect the three phase four wire based microgrid to the utility/DG set. The microgrid is modelled in MATLAB and the investigations in accordance to the practical operating conditions are perceived satisfactory.

Paper 158

Seamless Mode Shifting of Double-Stage Solar PV System Interfaced to the Utility Grid

Abstract

A double stage solar photovoltaic (PV) system with grid connection and disconnection ability is presented here. With the requirement of energy surety and improved power quality, several steps are being undertaken to incorporate distributed energy resources (DERs) based on renewable power. Therefore, the need of an efficient control is paramount, which allows seamless transfer of power between grid connection and disconnection. In order to obtain a coordinated control, a subband adaptive filter is utilized, which improves power quality (PQ), power transfer proficiency along with reduced intermittency. Moreover, in conformity with the switching state of static transfer switches (STS), the changeover between grid connection and disconnection state is obtained. In accordance with IEEE-1547 and IEEE-519 standards, the results validate the system performance during weak grid conditions and transition between the grid connected mode and grid outage mode of operation.

Paper 251

Water Cycle Algorithm based Intelligent Controller for Frequency Regulation of Dual Area Hybrid System with Time Delays

Abstract

In this paper, the functioning of water cycle algorithm (WCA) optimized fuzzy PID controller for regulating the frequency of dual area hybrid power system is analyzed for a disturbance of 10% step load (SLP) on area-1. However, supremacy of fuzzy PID performance is showcased up on comparing with other traditional regulators of PI and PID optimized with WCA. Controller optimization is accomplished by the criterion of time multiplied by absolute error over integral (ITAE) index. Time delays (TDs) have been considered with power system as parameters of non-linearity to set out the research work close to realistic nature. Finally, the essence of taking time delays with the system during controller design is revealed and their impact on system performance is demonstrated.

Paper 252

Determination of appropriate GRC Modelling for Optimal LFC of Multi Area Thermal System

Abstract

This paper deliberates the selection of appropriate generation rate constraint (GRC) modeling for obtaining load frequency control (LFC) of multi area thermal system optimally. The different models of GRC investigated for obtaining optimal LFC has been named as GRC open loop model and GRC closed loop model. However, these GRC models have been extensively utilized in the literature without affording any description of its suitability and selection. This paper addresses the GRC model selection to obtain the optimal control of three area thermal system with reheat type turbine structure. Three area thermal system has been analyzed with different models of GRC under the control of Two Degree of

freedom (DOF)-PID (2DOFPID) regulator optimized with water cycle algorithm (WCA) based on the constraint of integral square error (ISE) index. Further, robustness test reveals the validity of suggested structure of GRC model to attain LFC of thermal units optimally.

Paper 257

Microgrid Integrating Hybrid Power Generation and Energy Storage

Abstract

This paper presents the hybrid power generating renewable sources combined with energy storage to function as microgrid (MG). APMBLDCG (Permanent Magnet Brushless DC Generator) based pico-hydro variable power generation unit along with intermittent nature of photovoltaic (PV) source is used in this MG. A battery energy storage (BES) is combined with the system to improve reliability while managing power balance between sources and loads. A voltage source converter is controlled in such a way that it provides harmonics mitigation, reactive power compensation and regulates the voltage under perturbations in the generation and loads. A PMBLDCG based pico-hydro power is rectified and boosted to a reference DC link voltage. The maximum PV array power is extracted using reliable perturb and observe MPPT (Maximum Power Point Tracking) technique. Performance of the system is evaluated using the MATLAB platform and developing a hardware prototype. In both steady state and dynamic conditions, the system is found to be efficient and robust.

Track 16 - Artificial Intelligence Techniques

Paper 219

A Deep Learning based system for fast detection of obstacles using rear-view camera under parking scenarios

Abstract

Rear-end collision warning system is an important component of Advanced Driver Assistance Systems (ADAS). Main objective is to warn the host vehicle driver about the rear-end situation while host vehicle is reversing, for example, in a parking environment. A typical rear-end collision warning system uses short range Radar or ultra-sonic sensors which either have high cost or suffer from limited performance. To overcome these limitations, a deep learning based system that employs the existing rear-view camera to detect vehicles and non-vehicles (obstacles) close to the rear of the ego vehicle, is presented. To overcome the unavailability of real-world data for training deep learning models for the above scenario, synthetic data for training has been generated. The trained model is validated on examples of real-world videos. It is observed that the proposed system is capable of identifying possible stationary and moving obstacles and generate warnings well in advance for the user to take evasive actions.

Paper 225

Digital Image Forgery Detection Using Local Binary Pattern (LBP) and Harlick Transform with classification

Abstract

Images are a natural carrier of information.Images are used in an immense range of applications nowadays, including military purposes, surveillance systems, insurance processing, the internet, television, advertising media, forensic investigation, and so on. However, because powerful, low-cost image editing tools are readily available, these images can be easily tampered with. Therefore, the authenticity of images has become questionable. In this age of advanced PC innovation, digital picture and video have high significance in our everyday life. For editing or modifying the original multimedia contents, a range of low-cost multimedia content handling tools, techniques, and applications with various advanced features are available on the Internet, such as Adobe Photoshop. To handle this issue, numerous investigations have been centered around how to identify, this kind of controlled media. Existing computerized fraud identification techniques are grouped into two significant classes: active and passive. This paper proposes a technique of copy-move forgery detection in which feature extraction is done by Local Binary Patterns (LBP) and Harlick features. For the verification of the authenticity of the image various supervised machine learning classifiers like

Support Vector Machine (SVM), Random Forest (RF) & Gradient Boost classifiers are usedmand the performance of forgery detection is based on these classifiers are analyzed.

Paper 244

Machine Learning Based Prediction and Forecasting of Electricity Price During COVID-19

Abstract

During COVID-19 impact especially on energy markets, reliable electricity pricing has now become unpredictable and it becomes a challenging task to get prepared for the future price forecasting. The pandemic has mostly affected energy markets and efficient operation of the restructured electricity market effectively all over the world. In this work, the analysis of electricity price and forecasting is carried out on the wholesale market of United States namely MISO electricity market. Due to uncertainty of demand occurring during the pandemic period, the market price data is analyzed. And, using statistical learning and deep learning method day ahead price is forecasted which would prepare the electricity market to operate in an efficient manner to face such pandemics in the future. In this study, three methods are proposed namely Auto Regressive Integrated Moving Average (ARIMA), decision-tree-based ensemble Machine Learning algorithm namely Extreme Gradient Boosting (XGboost) and Recurrent Neural Network (RNN) for forecasting the electricity price. Depending upon the electricity price data attributes, the electricity price of MISO electricity market is predicted and forecasted. The performance of the methods to predict and forecast the electricity price is compared based on the processing speed and error.

Paper 263

Probabilistic Ambient Temperature Forecasting Using Quantile Regression Averaging Model

Abstract

Probabilistic ambient temperature forecasting is fascinating research in recent times. Rejuvenating the existing models with hybridization to improve forecast accuracy has a broad research interest. The nonparametric forecast combination technique, such as quantile regression averaging, is powerful enough with various scopes for improvements. The choice of different number and types of point forecasters as regressors is studied here. Two similar quantile regression averaging approaches are compared with a diverse selection of individual models, and the use of theoretically proposed regressors is the main highlight of the study. They are compared by using simulations with real-world ambient temperature data collected from different places in India. The proposed quantile regression approach is potentially better than the one that doesn’t use the theoretical regressors.

Paper 271

Water quality prediction system using LSTM NN and IoT

Abstract

Drinking water that is both clean and safe is critical to one's well-being. About a billion people around the world do not have access to safe drinking water. Many diseases are being spread by drinking contaminated water. In this scenario, pure water supply and better sanitation measures could help to reduce the incidence of waterborne diseases in humans. Checking the quality of water regularly can be an initial step in ensuring pure drinking water. The existing system is time consuming and monotonous manual system. Therefore, we propose a system based on Machine Learning (ML) and Internet of Things(IoT) that can measure and forecast future water quality parameters. For this, the daily water quality data was taken from one station of the Muvattupuzha River in Kerala. Long Short-Term Memory Neural Network (LSTM NN) was used to bring out the time- series pattern in the data. The sensors like pH sensor, turbidity sensor and total dissolved solids (TDS) sensor were used to read the current water quality parameters and this data was used to predict the future parameter values. The IoT module which includes the sensors, Arduino and NodeMCU can be installed in the water source to monitor the parameters regularly. The main benefit of this system is that users can be notified ahead of time if there is a risk of pollution, allowing them to disinfect the water before it becomes polluted. Therefore, this proposed system prevents the users from drinking contaminated water and helps to keep the water resources clean.

Paper 274

Behavioral Biometrics based Authentication System using MLP-NN and MVPA

Abstract

In this age of information, mechanisms to ensure data and system security are of paramount importance. Password is one of the most widely used authentication mechanism, which also makes it prone to attacks. Methods to improve password authentication is a hot topic of research, in which biometric authentication offers new possibilities. Behavioral biometrics is a branch of science that studies the patterns of human activities that are uniquely recognisable and measurable. Behavioral biometrics which employs mechanisms like keystroke dynamics offers to improve password authentication without using additional hardware. This paper proposes an improvement in the existing authentication mechanism using Keystroke Dynamics (KD), Multilayer Perceptron Neural Network (MLP-NN) and Most Valuable Player Algorithm (MVPA). To overcome the drawbacks in the conventional training process, MLP-NN is trained using MVPA.Using MATLAB software, the proposed biometric authentication system is developed and validated on different users. Comparison with different authentication performance measures such FAR & FRR are also discussed.

Track 17 - Communications & Allied

Paper 54

Design of Cubic Dielectric Resonator Antenna

Abstract

This paper describes the simple design of a dielectric resonator antenna for Bluetooth applications using a regular cubic resonator. Dielectric resonator antennas (DRAs) are used at microwave and millimeter frequencies and consist of materials having a high dielectric constant that have high gain and directivity. The resonator is mounted on a grounded dielectric substrate of lower permittivity. The selected dielectric resonator has a resonant frequency fr = 2.4 GHz and dielectric constant εr = 9.8. Computer Simulation Technology (CST) Microwave Studio was used to perform the simulation and analysis. The gain of the proposed antenna is 1.633 dBi and the directivity is 2.205 dBi.

Paper 104

Development Of GPS Based Real Time Dynamic Traffic Management System Using IOT

Abstract

In recent years, there is an extreme increase in road vehicle usage which in turn a challenge to manage the traffic system. The current traffic system is not based on the vehicle density level and a pre-established time is distributed to the traffic lights for every lane crossing which had an issue like traffic congestion & wastage of time and this condition turns out to be worse in the peak hours, and it also increases the emission of CO2 in the environment. In this paper, an IoT-based real-time dynamic traffic management system based on density level on each junction with the help of approximate geo-density information is developed. The density level on each junction is then updated to the real-time database. Then, this real-time data is computed with an exclusive priority-based algorithm where the crossing with high density is prioritized over the other (emergency vehicles are given the maximum priority) while maintaining the congestion around the junction under control. The prototype of GPS based real-time traffic management system is implemented.

Paper 107

Power System Harmonics Estimation using R Adaptive Variational Bayesian Kalman Filter

Abstract

For the power quality improvement, rapid and precise harmonics estimation of a power signal is very much recommendable. This paper demonstrates the performance of Variational Bayesian Kalman Filter for the first time in harmonics estimation of a power signal during a critical situation with unknown noise statistics. VBKF principle is based on the conjugate prior distribution for estimating the probability density function of both the states and measurements. This method is also effective one when noise statistics is unknown and time-varying as may be observed during harmonics estimation. A detailed simulation study reveals the superiority of VBKF over conventional Kalman Filter when process noise covariance and measurement noise covariance are unknown and non-stationary. Monte Carlo simulation indicates the consistency and better convergence of VBKF over conventional Kalman Filter. It is also found suitable for harmonics estimation with real measurement data.

Paper 117

Parameter optimization of a gas sensing chamber for the detection of Volatile Organic Compounds using Finite Element Method

Abstract

Several parameters of a gas sensing chamber influence the overall response of the system. These parameters are related to the dimensions of the chamber and the placements of the sensors inside it. In this work, a gas sensing system with two similar gas sensors along with two well designed orifice plates was designed, and simulated utilizing Finite Element Method. Various models of gas chamber with fixed boundary conditions were simulated to optimize the sensing system. The simulation was performed in three different ways and for eighteen unique arrangements. The angle between the gas sensors with z-axis was varied to calculate the optimised angle of the sensors inside the chamber. The optimised distance between the gas sensors and the optimised dimensions of the orifice plates were also calculated. The optimised model was fabricated and tested for different leaf samples.

Paper 186

Network of Outdoor Air Purification Systems; Air Quality Measurement Analysis and Display Systems using Mesh Network Topology

Abstract

Air pollution is being addressed in a number of ways by countries around the world. Despite the fact that numerous different policies have been implemented to reduce the effects of pollution, it is clear that an end is not in sight. This can only be solved by a series of parallel-running solutions that work independently but achieve the desired result. The solution proposed in the paper is a widely

disseminated outdoor air filtration device that fits on electrical lamp posts and filters the surrounding polluted air with high-efficiency particulate air filters and carbon-activated filters. These devices are connected together using a mesh topology, which monitors the surrounding air quality index with industry-grade sensors and uploads live data to the cloud using Message Queuing Telemetry Transport protocol. End users can view their city's live pollution data on a dashboard and take the appropriate precautions.

Paper 272

WeCare i-Board : A Tangible User Interface for Communication

Abstract

The idea of this work is to create an interaction between people to keep them connected emotionally during the COVID crisis. The goal is to provide two interactive boards(i-Boards) and to let people communicate using it wireless. The device embodies digital information in physical space and aims to go beyond the limits of graphical user interfaces. It also expands the affordances of simple physical objects (e.g cubes) and surfaces (board). It provides a tangible interface and also has its own elements of fun to keep the interaction as intuitive and as fun as possible. The user interface design choices and the limitations were also investigated.

Track 18 - Surveillance and Monitoring

Paper 174

A Comparative Study of Bayesian based filters for Dynamic State Estimation in Power Systems

Abstract

Dynamic state estimation of a power system is the first prerequisite for control and stability prediction under transient conditions. Among the states of synchronous machine, precise, accurate, and timely information about rotor angle and speed deviation can be useful to enhance power system reliability and stability. In this paper, the popular variants of Kalman filter are used to estimate these main states of synchronous generators of an SMIB and IEEE 3-generators 9-bus test systems. A case study using a simple power system model is presented to illustrate the comparison between effectiveness of proposed approaches.

Paper 181

INTEGRATED REAL-TIME TRACKING OF CAR PARKING SLOTS

Abstract

One of the greatest starts for smart City was High-tech Parking by integrating IoT technology and the Web Application. This job seems easy on side streets and interior lanes, but it has become difficult to locate a parking space in malls, multi-story complexes, IT parks, and other parking facilities where hundreds of cars were parked. Parking was a time-consuming process wherever even on multi-story buildings. This proposed system tracks the slots in real-time which is updated to the cloud. Thus Driver can view the availability via the website. For security purpose, OTP system has been introduced which send OTP for vehicle owner Authorization. This System has reduced the Man Power and it was Cost – Effective. The system's main function is to detect parking slots using sensors that are put on each one, making information more accessible. This method not only improves accessibility, but it also helps to control traffic congestion, reducing the need for lengthy searches and wait periods. The user's smartphone will be used to retrieve the slot occupancy in selected locations at the end of the process.

Paper 206

IoT BASED SYSTEM FOR HOME MONITORING OF HUMAN VITAL SIGNS

Abstract

Due to current pandemic situation it is difficult for old/aged people to go out to hospitals for consulting the doctor. The people in rural areas cannot obtain professional healthcare services or emergency medical facilities due to long distance to hospital from their home, and lack of doctors, hospitals and also lack of specialist doctor. The people in urban areas cannot find time to go to hospitals for their monthly checkup or for any small health issues. Hence the solution for all these issues or problems is, health care monitoring system using technology called IoT. As we are in the generation of industry 4.0, technologies such as IoT, big data, machine learning, artificial intelligence, play a vital role in our day- to-day life. As the technology is growing day by day, life is also becoming much simpler, better, faster, smart with the use of these technologies. Also by the application of these technologies, we can reduce the human efforts, where by sitting at one place we can perform many tasks. Health care being a global issue especially in India with more population, where most of who stay in rural areas deprived of health care services. With industry 4.0 technology, we can build a IoT based device for monitoring the human vital signs, Using which, we can communicate between networked devices wirelessly, which would help the patient to get better treatment or better consultation from doctor without consulting the doctor physically. In the current situation, this system can also be effectively used for constantly monitoring covid patients requiring home isolation

Paper 223

Real-time Monitoring of Energy Meters Using Cloud Storage

Abstract

The trends and technologies in power systems are rapidly changing. There is an increased demand for an efficient and reliable Automatic Meter Reading (AMR) system. Smart energy meters are widely employing in developed countries where there are Smart grids. This paper presents the design of an energy meter suitable for our traditional power grids, and its associated web interface based on cloud computing, for automating billing and managing the collected data. Here the proposed design converts the conventional digital electronic energy meters into smart meters, capable of communicating with the utility and the consumers. A Long Range (LoRa)-WiFi-based wireless communication module is integrated with an electronic energy meter through a gateway and Raspberry pi module. An optocoupler is used to compute the meter readings from the pulses of LED of the energy meter. A LoRa receiver at the other end, with a cloud database, acts as the billing point. A responsive, user-friendly graphical user interface has developed using Microsoft visual studio and angular. With proper authentication, users can access the developed web page from anywhere in the world. The total energy consumption and due bill of the customers can be obtained from this webpage. The cloud storage used is Firebase. The proposed system neglects the regular digital metering system and allows remote access to the electronic meter.

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