

# IEI Epitome

Volume 8 | Issue 5 | May 2023

*A Century of Service to the Nation*

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**Published by:**

**The Institution of Engineers (India)**

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# Notification for IEI R&D Grant-in-Aid

Volume 8 | Issue 5 | May 2023

To promote appropriate technology, assist in building up design & research talents and, most importantly, to help in nurturing potential R&D venture amongst engineering students pursuing Diploma/UG/PG/PhD courses. The Institution of Engineers (India) had instituted the R&D Grant-in-Aid program way back in 2001.

Every year, the Institution invites applications for funding industry-oriented R&D projects and research initiatives aimed at improving the life-style of common people from engineering students pursuing full time Diploma/UG/PG/PhD engineering program in AICTE/UGC/NAAC approved Institutions / Colleges / Universities. The application form and guidelines are available in our website <https://www.ieindia.org>. The projects should be carried out under the guidance of faculty members who are Corporate Members of IEI. Membership criteria for student(s), guide(s) and institution(s) are as follows:

| Project Category             | Student/Applicant Membership                          | Guide(s) Membership | Institutional Membership  |
|------------------------------|---|---------------------|---|
| 1. Diploma                   | Exempted [Membership of Student Chapter is desirable] | AMIE/MIE/FIE        | Not Mandatory   |
| 2. UG (BE/BTech/ Equivalent) | 'Student Member' (SMIE)                               | AMIE/MIE/FIE        | Applicant's Institute should preferably be an Institutional Member with NBA/NAAC Accreditation or valid NIRF Rank |
| 3. PG (ME/MTech/ Equivalent) | AMIE/MIE/FIE  | MIE/FIE             | Applicant's Institute should preferably be an Institutional Member with NBA/NAAC Accreditation or valid NIRF Rank |
| 4. PhD                       | AMIE/MIE/FIE  | MIE/FIE             | Applicant's Institute should preferably be an Institutional Member with NBA/NAAC Accreditation or valid NIRF Rank |

The soft copy of the duly filled-up applications (in editable format), as per the pro-forma available in our website [www.ieindia.org](http://www.ieindia.org), should be sent through email to [research@ieindia.org](mailto:research@ieindia.org) and one printed copy of the same should reach the following address:

**Director (Technical)**  
The Institution of Engineers (India)  
8 Gokhale Road, Kolkata 700 020

Kindly go through the guidelines (visit link: <https://www.ieindia.org/webui/IEI-Activities.aspx#RnD-Initiative>) before filling up the application.

# Members in the News

Volume 8 | Issue 5 | May 2023



## Er Divya Gudapati, MIE

Assistant Professor

Bapatla Women's Engineering College, Bapatla, Andhra Pradesh

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Er Gudapati was granted **Patent** for her invention of “**Dual Polarized Sub-GHz 5G Base Station Antenna For Low Mobility n-urban Applications**”.

Patent Number : 427472  
Application Number : 202141045273  
Date of Filing : 05/10/2021  
Date of Publication : 05/11/2021  
Date of Grant : 29/03/2023  
Post Grant Journal Date : 31/03/2023  
Field of Invention : Electronics  
Issuing Authority : Indian Patent Office



## Er Ashok Kumar Panda, MIE

Executive Engineer

Military College of Electronics and Mechanical Engineering, Secunderabad, Telangana

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Er Panda presented the research paper titled “**Sustainable Engineering Solutions and Economic Growth Related to Environmental Issues in Indian Context**” in **4th International Conference on “Emerging Trends in Multi Disciplinary Research ‘ETMDR-23’** organised by Advanced Studies & Research Centre, Poornima University, Jaipur, Rajasthan, held during 2-4 March 2023.



## Er Anand K Joshi, AMIE

Research Scholar

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Er Joshi delivered the **Invited Lecture** on “**BTMS for 18650 LIB using Fin and Organic PCM for Preheating of Battery**” in 37th National Convention of Mechanical Engineers and National Seminar on “Advances in Battery Technologies for Electric and Hybrid Vehicle” organised by The Institution of Engineers (India), Telangana State Centre, Hyderabad under aegis of Mechanical Engineering Division Board held during 9-10 December 2022.



**Er Harish Devrani, AMIE**

Lab Assistant

University of Petroleum & Energy Studies, Dehradun, Uttarakhand

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Er Devrani received the **Academic Excellence Award 2022** from **University of Petroleum and Energy Studies (UPES)** in recognition of outstanding performance.



## Project Management Associates Weekend Programme



### International Project Management Association

IPMA is a federation of about 72 Member Associations (MAs) who develop project management competences in their geographic areas of influence. Through IPMA, project management practitioners from all parts of the world can network, share ideas through effective collaboration and cooperation.

#### Who / Why to Attend

Professionals across all levels who want to understand the intricacies of Project Management and want to excel in managing projects to advance their career.

#### Discounted Program Registration Fee for IEI Members (15% discount from the published fee)

Participation Fee for Level C: Rs. 47,090 per person plus GST @ 18%

Participation Fee for Level D: Rs. 24,650/- per person plus GST @ 18%

- Registration fee is non refundable. However, alternate persons can be nominated.
- Cheque / draft or NEFT is payable to "**Project Management Associates**" at Delhi.
- The registration fee does not include travel and hotel accommodation.

Next batch of on-line learning sessions on Project Management Competence Building (PMCB) based on ICB Version 4, knowledge base for IPMA Level C and Level D by our Learning partner PMA is from **2, 3, 9 & 10 June 2023**. The relevant material is available in the link <https://www.pma-india.org/brochures>.

**Exam Dates for Level C: 17, 23 & 24 June 2023**

**Exam Dates for Level D: 17 June 2023**

**Exam Venue: Secure and Seamless Online Exam & Assessment**

**For more details, please contact :**

**Arvind Agarwal**, Head, PMA Cert (Certification Body)

Project Management Associates

FC-33, Plot No. 1 & 2, Periyar Centre, 3rd Floor, Institutional Area, Jasola, New Delhi – 110025

Tel: 011 41421511 Mob: +91 9711631534-35/39, 9840432229, Website: [www.pma-india.org](http://www.pma-india.org), Email: [info@pma-india.org](mailto:info@pma-india.org)

## Book Chapters



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### **Book Chapter: A Study of Four Types of Neural Networks with an Error Correction Approach Applied to Predict Wind Speed**

The 16th International Conference Interdisciplinarity in Engineering, Inter-Eng 2022 Conference Proceedings, Lecture Notes in Networks and Systems series, Springer, Cham, 605, 2022, pp 682–695, Online ISBN: 978-3-031-22375-4, Print ISBN: 978-3-031-22374-7, Series E-ISSN: 2367-3389, Series ISSN: 2367-3370

**DOI:** [https://doi.org/10.1007/978-3-031-22375-4\\_54](https://doi.org/10.1007/978-3-031-22375-4_54)

**Co-authors:** Mohamed Louzazni & Brahim Belmahdi

**Abstract:** Nowadays, renewable energy resources receive attention to meet the Kyoto Protocol and are environmentally friendly. Wind farm and power system planning, maintenance, and control obligate the prediction of wind speeds. Based on four inputs such as wind speed, temperature, relative humidity, and wind direction, this paper studies a set of artificial neural networks that include the Elman Network (EN), Multilayer Perceptron Network (MLPN), Improved Back Propagation Network (IBPN), and Recursive Radial Basis Function Network (RRBFN) associated with the Error Correction (EC) approach based prediction of wind speed. We perform various hidden neuron-based analyses regarding the wind speed prediction using the proposed four inputs based on a different artificial neural network with an error correction approach. The presented prediction model experimental outcome-based study confirms that compared to the EN-EC, MLPN-EC, and IBPN-EC-based prediction models, the minimal performance metrics achieved concerning the proposed four inputs associated prediction model using Recursive Radial Basis Function Network (RRBFN) with an error correction approach.

### **Book Chapter: Modeling and Analysis of the Effect of Current-Voltage in the Solar Cell Dynamic Parameters**

The 16th International Conference Interdisciplinarity in Engineering, Inter-Eng 2022 Conference Proceedings, Lecture Notes in Networks and Systems series, Springer, Cham, 605, 2022, pp 696–705, Online ISBN: 978-3-031-22375-4, Print ISBN: 978-3-031-22374-7, Series E-ISSN: 2367-3389, Series ISSN: 2367-3370

**DOI:** [https://doi.org/10.1007/978-3-031-22375-4\\_55](https://doi.org/10.1007/978-3-031-22375-4_55)

**Co-authors:** Mohamed Louzazni & Brahim Belmahdi

**Abstract:** The new type of solar cells such as thin-film, dye-sensitized, organic, and multi-junction solar cells are increasingly being used in various fields. The current-voltage, capacitance-voltage characteristics, transition, and diffusion capacitance parameters under conditions of reverse and forward bias are reported in modern technologies. Furthermore, the knowledge of AC parameters behavior of solar cells in dynamic regime differs from one of the monocrystalline or polycrystalline solar cells. The dynamic equivalent circuit model of the solar cell is required to describe the impedance for AC through the solar cell. In the present study, we analyze the transition and diffusion capacitance of solar cell parameters in a dynamic model. Moreover, the experimental values of diffusion and transition capacitance will be compared with the theoretical expression of each parameter. The equivalent impedance of the electric circuit will be determined and discussed. In the end, the obtained results of BSR, BSFR silicon solar cell, and GaAs/Ge solar cell is dominant up to 0.9 V, and beyond 0.9 V diffusion capacitance is significant.

### **Book Chapter: Forecasting Solar Radiation Using Machine Learning Method: New Optimization Algorithm**

The 16th International Conference Interdisciplinarity in Engineering, Inter-Eng 2022 Conference Proceedings, Lecture Notes in Networks and Systems series, Springer, Cham, 605, 2022, pp 706–717, Online ISBN: 978-3-031-

22375-4, Print ISBN: 978-3-031-22374-7, Series E-ISSN: 2367-3389, Series ISSN: 2367-3370

DOI: [https://doi.org/10.1007/978-3-031-22375-4\\_56](https://doi.org/10.1007/978-3-031-22375-4_56)

**Co-authors:** Brahim Belmahdi, Mohamed Louzazni & Abdelmajid El Bouardi

**Abstract:** This paper presents a new algorithm approach for global solar radiation (GSR) forecasting based on multiple machine learning techniques. The accuracy of forecasting models is essential to promote clean energy sustainability and optimize the energy performance of photovoltaic power systems. Specifically, in this work, we develop a new optimization algorithm method to forecast hourly global solar radiation (GSR), which includes Autoregressive Integrated Moving Average (ARIMA), Feed Forward Neural Network with Back Propagation algorithm (ANN), k-Nearest Neighbor (k-NN), Support Vector Machine (SVM) and persistence model. In the training algorithm, the clearness index ( $K_t$ ), top of atmosphere (TOA), maximum temperature ( $T_{max}$ ), the difference of temperature ( $\Delta T$ ), temperature ratio ( $T_{ratio}$ ), and average temperature ( $T_{Average}$ ) are used. To decide on the success of the optimization methodology, five computational statistical metrics are discussed in this work. By analyzing the optimization performance of the forecasted models, all five machine-learning algorithms exhibit excellent performance in the forecasting of Hourly GSR.

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[https://www.ieindia.org/webui/IEI\\_PE\\_Certification.aspx](https://www.ieindia.org/webui/IEI_PE_Certification.aspx)

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- Seven years or more professional experiences
- Minimum two years professional experience in significant engineering activity
- Membership of recognised professional engineering institution/ association
- Maintained Continued Professional Development (CPD) at a satisfactory level

For details please visit the following link:

[https://www.ieindia.org/webui/IEI\\_IntPE\\_Certification.aspx](https://www.ieindia.org/webui/IEI_IntPE_Certification.aspx)

The eligible candidate can submit application in the prescribed format to:  
The PE Cell, The Institution of Engineers (India), 8 Gokhale Road, Kolkata 700020  
For any query and assistance, please send email to: [pe@ieindia.org](mailto:pe@ieindia.org)

## Papers published in the Journals / Proceedings



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#### Title of Paper: High Voltage DC Power Supply with Input Parallel and Output Series Connected DC-DC Converters

IEEE Transactions on Power Electronics, 38(6), 2023, pp 6764-6768, Electronic ISSN: 1941-0107, Print ISSN: 0885-8993

DOI: <http://doi.org/10.1109/TPEL.2022.3233257>

Co-authors: Akhilesh Tripathi, Rinki Upadhyay & Mahendra Lad

**Abstract:** A modular 36 kV, 24 A crowbarless dc power supply with input parallel and output series connected 500 V, 24 A dc-dc converters is employed for biasing high power RF amplifiers. Control system having both feed-forward and feedback control is implemented for fine regulation of its output voltage. An optimized control strategy having unique output ripple free capability is adopted. Active redundancy is incorporated to improve the reliability of this power supply significantly. Input section and output section are independent of each other, so the variations in input line voltage and control of output voltage do not affect input and output performances of this power supply. The adopted scheme neither needs any line filter nor needs any crowbar for biasing RF amplifiers. This power supply achieves input power factor  $\geq 0.97$ , current THD  $\leq 6\%$ , output ripple  $\leq 0.25\%$  and output voltage stability  $\leq 0.4\%$ .

**Keywords:** HVDC Converters; DC-DC Power Conversion; Soft-switching Converters; Voltage Control; Redundancy



### Dr Raj Kumar Goswami, FIE

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#### Title of Paper: Performance Analysis of Autoencoders in Wireless Communication Systems with Deep Learning Techniques

Journal of Survey in Fisheries Sciences, 10, Special Issue 4, 2023, pp 1567-1579, ISSN: 2368-7487

URL: <http://sifisheressciences.com/journal/index.php/journal/article/view/1294/1325>

Co-authors: K Srinivasa Rao, S V Rama Rao & Koteswararao Seelam

**Abstract:** Wireless experts worldwide have become interested in using Autoencoders (AEs) for modelling communication systems as an end-to-end reconstruction task. This approach optimizes both the transmitter and receiver components simultaneously, offering flexibility and convenience for representing complex channel models. Traditional communication systems rely on conventional models and assumptions that limit their utilization of limited frequency resources and hinder their ability to adapt to new wireless applications. However, with the rise of Artificial Intelligence, new wireless systems are capable of learning from wireless spectrum data and optimizing their performance. In this paper, the use of deep learning with autoencoders is explored to create an end-to-end communication system that replaces traditional transmitter and receiver activities. The autoencoder architecture effectively addresses channel impairments and enhances overall performance. Simulation results indicate that autoencoders surpass conventional communication systems in terms of Block Error Rate performance, even when facing impairments in the autoencoder's channel layer and using different neural network optimization algorithms.

**Keywords:** Deep Learning; Autoencoders; Wireless Systems; Physical Layer; Channel Estimation



## Dr Kudiyarasan Swamynathan, FIE

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### **Title of Paper: Minimization of Torque Pulsations by using a Novel Fuzzy Controller in SRM Drives for EV Applications**

Heliyon, Elsevier, 9(3), 2023, ISSN: 2405 8440

DOI: <https://doi.org/10.1016/j.heliyon.2023.e14437>

**Co-authors:** N Sthalasayanam & Vijayalakshmi Karunakaran

**Abstract:** In recent years, the applications of Changed Reluctance Motors have expanded, from control system stepping motors to high torque e-vehicle applications. High-speed operation and a light weight driving motor are required for an effective electric vehicle design. Switched reluctance motor (SRM) is ideal for use in electric vehicles due to its low torque-to-weight ratio and magnet free rotor design. The increased torque ripple is the most serious issue with switching reluctance motors. The optimization technique is used to optimize switching controllers in this study, and a comparison is made between a sliding mode controller (SMC) with a modified reaching law and anew fuzzy controller (FC). The magnitude of torque ripple is simulated and compared for both controllers using a MATLAB simulink model. The proposed innovative fuzzy controller model significantly improved torque performance and reduced torque ripples based on simulation results.

**Keywords:** Electric Vehicle; Fuzzy Controller; Switched Reluctance Motor, Sliding Mode Control; Torque Pulsations



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### **Title of Paper: An Extensive Study Using the Beetle Swarm Method to Optimize Single and Multiple Objectives of Various Optimal Power Flow Problems**

International Transactions on Electrical Energy Systems, Wiley-Hindawi, 2023, pp 1-33, Online ISSN: 2050-7038

DOI: <https://doi.org/10.1155/2023/5779700>

**Co-authors:** K Sriram, S P Mangaiyarkarasi & S Sakthivel

**Abstract:** An electric energy generation system, under the economic operation mode, is an imperative mission in the power system function. This article deals with the use of beetle swarm optimization algorithm (BSOA), for optimal power flow (OPF) solution, in an effective approach. BSOA is a competent optimization technique, to handle multimodal, nonlinear, and non-differentiable objective functions. The proposed OPF is modeled by numerous objective functions, formulations with constraints, examined with thirty-one different cases, on the three distinguished test systems (IEEE 30, 57, and 118-bus), using single and weighted sum multi-objectives. Six new multi-objective cases are also studied. The control variables, such as real generation of power, tap setting ratio of transformers, bus voltages magnitudes, and the values of shunt capacitor, are also optimized. Potency and robustness of this proposed method were investigated and evaluated with more recent findings reported in the literature. This extensive study revealed the preeminence of the presented technique, applied to OPF problem, with intricate and non-smooth objective functions.

**Keywords:** Beetle Swarm Optimization; Optimal Power Flow; Voltage Profile; Fuel Rate; Transmission Loss; Stability Index





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**Title of Paper: Numerical Investigation of Power Conversion Efficiency of Sustainable Perovskite Solar Cells**

Electronics, MDPI, 12(8), Special Issue Advances in Optimization and Control of Electronic Devices for Renewable and Clean Energy Systems and Applications, 2023, Electronic ISSN: 2079-9292

DOI: <https://doi.org/10.3390/electronics12081762>

**Co-authors:** Praveen K Jain, Deepak Bhatia, Shashi Kant Dargar, Michał Jasinski, Radomir Gono & Zbigniew Leonowicz

**Abstract:** Perovskite solar cells have been researched for high efficiency only in the last few years. These cells could offer an efficiency increase of about 3% to more than 15%. However, lead-based perovskite materials are very harmful to the environment. So, it is imperative to find lead-free materials and use them in designing solar cells. This research investigates the potential for using a lead-free double-perovskite material,  $\text{La}_2\text{NiMnO}_6$ , as an absorbing layer in perovskite solar cells to enhance power conversion efficiency (PCE). Given the urgent need for environmentally friendly energy sources, the study addresses the problem of developing alternative materials to replace lead-based perovskite materials. Compared to single-perovskite materials, double perovskites offer several advantages, such as improved stability, higher efficiency, and broader absorption spectra. In this research work, we have simulated and analyzed a double-perovskite  $\text{La}_2\text{NiMnO}_6$  as an absorbing material in a variety of electron transport layers (ETLs) and hole transport layers (HTLs) to maximize the capacity for high-efficiency power conversion (PCE). It has been observed that for a perovskite solar cells with  $\text{La}_2\text{NiMnO}_6$  absorbing layer,  $\text{C}_{60}$  and  $\text{Cu}_2\text{O}$  provide good ETLs and HTLs, respectively. Therefore, the achieved power conversion efficiency (PCE) is improved. The study demonstrates that  $\text{La}_2\text{NiMnO}_6$ , as a lead-free double-perovskite material can serve as an effective absorbing layer in perovskite solar cells. The findings of this study contribute to the growing body of research on developing high-efficiency, eco-friendly perovskite solar cell technologies and have important implications for the advancement of renewable energy production.

**Keywords:** Perovskite Solar Cell; Power Conversion Efficiency; Material Optimization; LMNO

**Title of Paper: Investigation of Photocurrent Efficiency of  $\text{Cs}_2\text{TiBr}_6$  Double Perovskite Solar Cell**

Materials Today: Proceedings, Elsevier, 66(8), 2022, pp 3692-3697, ISSN: 2214-7853

DOI: <https://doi.org/10.1016/j.matpr.2022.07.443>

**Co-authors:** Deepak Bhatia & Praveen K Jain

**Abstract:** Perovskite photovoltaics are becoming a more popular alternative to traditional solar cells. Perovskites made of lead have the highest power conversion efficiency, but they are harmful to the environment. Various lead-free perovskite structures have recently been suggested. Although the tin-based lead-free perovskite ( $\text{CH}_3\text{NH}_3\text{SnI}_3$ ) garners the most interest due to its broad absorption, it suffers from temperature instability. Due to their interesting characteristics and potential uses, double perovskite compounds have recently drawn a growing amount of attention as a potential replacement for tin-based perovskite photovoltaic cells. However, there are limited studies dedicated to the characterization of these materials as an absorbent layers. In this research, the SCAPS modeling software was used to investigate the lead-free double perovskite perovskites halides ( $\text{Cs}_2\text{TiBr}_6$ ) as an absorbent material in this work. This research models several ETLs and HTLs to attain high power conversion efficiency (PCE). Parameters of absorber layer such as thickness and defect density are varied to test the influence of absorber's characteristics on device performance. Following the rigorous simulation, we discovered that.  $\text{Cs}_2\text{TiBr}_6$  is a promising material for lead-free perovskite solar cells.

**Keywords:** Perovskite Solar Cell; Double Perovskite; SCAPS;  $\text{Cs}_2\text{TiBr}_6$ ; Power; Conversion Efficiency



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**Title of Paper: Black Widow Optimization Algorithm Used to Extract the Parameters of Photovoltaic Cells and Panels**

Mathematics, MDPI, 11(4), 2023, EISSN: 2227-7390

DOI: <https://doi.org/10.3390/math11040967>

Co-authors: Daniel T Cotfas & Petru A Cotfas

**Abstract:** The metaheuristic algorithms and their hybridization have been utilized successfully in the past to extract the parameters of photovoltaic (PV) cells and panels. The novelty of the paper consists of proposing the black widow optimization algorithm (BWOA) for the first time to identify the parameters of the two photovoltaic cells RTC France, amorphous silicon (aSi), and two photovoltaic panels PWP201, PVM 752 GaAs. The single-diode model (SDM) and double-diode model (DDM) for analyzing the PVs are considered. The performance of the BWOA is verified using four statistical tests: the root mean square error, which is the primary tool, the mean relative error, the mean bias error, and the coefficient of determination. The research results of this study are as follows: BWOA gave the same results, or very slightly better, for RTC and PWP201 for SDM in comparison with the best algorithms from the specialized literature; for all the other cases, BWOA has substantially better results, especially for PVM 752 GaAs, where the improvements in RMSE are: 16.5%, for PWP201: 6.25%, and for aSi: 5.3%, all for the DDM; the computing time is around 2 s, which is one of the lowest durations. A consistent study is made to optimize the accuracy and computational time in function of the number of iterations and population.

**Keywords:** Optimization Algorithm; Photovoltaic; Extraction; Parameters; Modeling

**Title of Paper: Statistical Analysis of Novel Ensemble Recursive Radial Basis Function Neural Network Performance on Global Solar Irradiance Forecasting**

Journal of Electrical and Computer Engineering, Hindawi, 2023, Online ISSN: 2090-0155, Print ISSN: 2090-0147

DOI: <https://doi.org/10.1155/2023/2554355>

Co-authors: Mohamed Louzazni & Brahim Belmahdi

**Abstract:** Reliable operation of energy management systems, grid stability, and managing energy demand responses are becoming challenging because of the flickering nature of solar irradiance. Accurate forecasting of global solar irradiance, i.e., global horizontal irradiance (GHI), plays a significant role in energy policy-making and the energy market. This paper proposes a novel global solar irradiance forecasting model based on the ensemble recursive radial basis function neural networks (ERRBFNNs). The various atmospheric inputs based on the built ensemble recursive radial basis function neural networks make the network more stable and robust to climatic uncertainty. This paper statistically investigates the performance of novel feed-forward neural networks based on forecasting models with various hidden nodes for global solar irradiance forecasting applications. We validated the proposed ERRBFNN global solar irradiance forecasting model using real-time data sets. The simulation results confirm that the proposed ensemble recursive radial basis function neural network based on global solar irradiance forecasting improves the accuracy, generalization, and network stability. Furthermore, the proposed ERRBFNN lowers the forecasting error to the least compared to other state-of-the-art forecasting models.

**Keywords:** NA

# Publication by Members

Volume 8 | Issue 5 | May 2023



**Er Somnath Mahato, AMIE**

Research Associated III

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**Title of Paper:** Galileo-NavIC Hybrid Operation towards Improved Performance and User Benefits

Journal of the Indian Society of Remote Sensing, Springer, 51, 2023, pp 757–769, Electronic ISSN: 0974-3006, Print ISSN: 0255-660X

**DOI:** <https://doi.org/10.1007/s12524-022-01660-2>

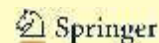
**Co-authors:** Debipriya Dutta, Sukabya Dan, Atanu Santra, Sumit Dey & Anindya Bose

**Abstract:** Galileo and NavIC, respectively, are two operational global and regional satellite-based navigation systems maintained by civilian authorities. Hybrid operation of a global and a regional system offers advantages for the user community within the service area of the regional system. In view of the signal structure similarity of Galileo and NavIC, hybrid operation of the two systems has been studied from India and surrounding regions to explore the possible complimentary benefits. Based on long-term, real-time observations from two locations within the NavIC central region and validated simulations, Galileo and NavIC constellations were found to supplement each other. In the central region, relatively poor Galileo availability is supplemented by NavIC and in the boundary areas Galileo supports inferior NavIC visibility. The time- and location-dependent low-elevation angle problem for the Galileo satellites is supplemented by NavIC signals transmitted from GEO and GSOs for seamless and improved operation. In terms of typical satellite visibility within the constrained satellite visibility conditions, satellite geometry and signal strength, the Galileo–NavIC hybrid operation offers user benefits over the Indian region as well as over the entire NavIC service area extending from east Africa to west Australia. Real-time data collected from survey grade GNSS receivers and compact GNSS module clearly indicates the improved solution quality of the hybrid operation compared to each of the individual constellations. The results would be beneficial for the user community in exploiting the benefits of the Galileo and NavIC concurrent operation.

**Keywords:** GNSS; Galileo; NavIC; DOP; Satellite Visibility; Solution Quality



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### Title of Paper: Design Optimization and Characterization with Fabrication of Nanomaterials-Based Photo Diode Cell for Subretinal Implant Application

Nanomaterials, MDPI, 13(5), 2023, ISSN: 2079-4991

DOI: <https://doi.org/10.3390/nano13050934>

Co-authors: Joseph D Rathnasami & Viranjay M Srivastava

**Abstract:** An ultrathin nano photodiode array fabricated in a flexible substrate can be an ideal therapeutic replacement for degenerated photoreceptor cells damaged by Age-related Macula Degeneration (AMD) and Retinitis Pigmentosa (RP), such as retinal infections. Silicon-based photodiode arrays have been attempted as artificial retinas. Considering the difficulties caused by hard silicon subretinal implants, researchers have diverted their attention towards organic photovoltaic cells-based subretinal implants. Indium-Tin Oxide (ITO) has been a favorite choice as an anode electrode. A mix of poly(3-hexylthiophene) and [6,6]-phenyl C61-butyric acid methyleste (P3HT: PCBM) has been utilized as an active layer in such nanomaterial-based subretinal implants. Though encouraging results have been obtained during the trial of such retinal implants, the need to replace ITO with a suitable transparent conductive electrode will be a suitable substitute. Further, conjugated polymers have been used as active layers in such photodiodes and have shown delamination in the retinal space over time despite their biocompatibility. This research attempted to fabricate and characterize Bulk Hetero Junction (BHJ) based Nano Photo Diode (NPD) utilizing Graphene-polyethylene terephthalate (G-PET)/semiconducting Single-Wall Carbon Nano Tubes (s-SWCNT): fullerene (C60) blend/aluminium (Al) structure to determine the issues in the development of subretinal prosthesis. An effective design approach adopted in this analysis has resulted in developing an NPD with an Efficiency of 10.1% in a non-ITO-driven NPD structure. Additionally, the results show that the efficiency can be further improved by increasing active layer thickness.

**Keywords:** Flexible Substrate; Graphene; Subretinal Prostheses; Nanomaterials; Carbon Nano Tube; Nanotechnology

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**Er Sai Sarath Kruthiventi, AMIE**

Assistant Professor

Koneru Lakshmaiah Education Foundation, Vijayawada, Andhra Pradesh

✉: [satyasai222@gmail.com](mailto:satyasai222@gmail.com)

**Title of Paper: Theoretical Performance Studies on Environment Friendly Refrigerants used in Refrigeration Units**

Environmental Science and Pollution Research, Springer, 30(16), 2023, pp 63065-63083, Electronic ISSN: 1614-7499

DOI: <https://doi.org/10.1007/s11356-023-26409-3>

**Co-authors:** Nagarjuna Kumma, Gokul Sai Seethala, Yatna Bhagat & Satya Sai Harish Kruthiventi

**Abstract:** European Union regulations stipulate that household refrigeration systems must operate with fluid refrigerants that possess low global warming potential (GWPs). In this work, theoretical performance of six binary and one ternary mixture (which consists of R131I, R290, R161, R32, R1234yf, and R1234ze(E)) was investigated. The performance parameters such as coefficient of performance (COP), refrigeration effect (RE), volumetric cooling capacity (VCC), discharge temperature, pressure ratio, and specific power consumption of all considered refrigerant mixtures is studied with respect to the evaporator temperature range of -18 to 18°C and the condenser temperature range of 40 to 55°C. The properties corresponding to different operating conditions for the refrigerants considered in this study are estimated using REFPROP 10. The findings demonstrated that, when compared to R134a, all the investigated refrigerants exhibited very low specific power consumption (apart from M9, M10, and M14-M16), and high volumetric cooling capacity (VCC) (apart from M11 and M13) under the operating conditions of evaporator temperature -18°C and condenser temperature 40°C. M1-M3 and M11-M13 gave similar and within 10% deviation in coefficient of performance, while M3 and M11-M13 refrigerant mixtures offer significantly low discharge temperatures when compared to R134a. Refrigerant mixtures M2 and M11 consistently exhibited a better performance in comparison to R134a in the aspect of majority of the performance parameters considered in this study. Finally, it is understood that M2 and M11 are two possible alternative refrigerants to conventional refrigerants used in small refrigeration units (R134a and R22). Further, it is also identified that these mixtures are non-flammable, possess zero ODP and low GWP values.

**Keywords:** Exergy; Flammability; Eco-Friendly; Minimum Inert Concentration; Domestic Refrigeration Unit

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Volume 8 | Issue 5 | May 2023

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