Abstract Proceedings of

ESDA2025

8th International Conference on

Energy Systems Drives and Automation

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27th (Offline) to 28th (Online) December, 2025

Organizer:
Applied Computer Technology, Kolkata, West Bengal, India.

Venue:
Hotel Pushpak, Kalpana Square, Buddha Nagar, Bhubaneswar, Odisha, India.

Technical Sponsor:
C. V. Raman Global University Bhubaneswar, Odisha, India.

In Association with:
International Association of Science, Technology and Management, Kolkata, West Bengal, India.

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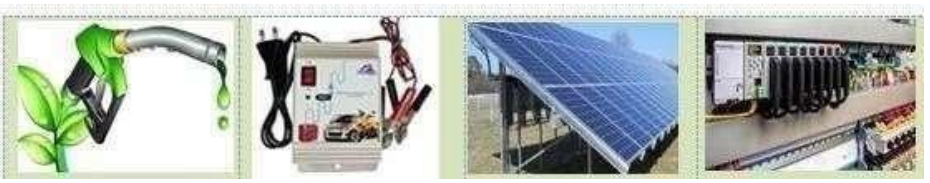

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Inaugural Song:

Prayer

Translated in English
By
Hillol Ray
http://www.iwvpa.net/rayh
http://www.iwvpa.net/rayh/index-hra.php

Desires are all yours, you are the universal star-
You do your own works, God,People say, I do them from a far!!

You stuck elephant into clay, And push a handicap to ascend hill-
To some, you offer "Brahmo" feet,
And make others descenddownhill!!

I am a machine, you are the machinist, Iam the home, you are the homemaker-

I am the chariot, you are the charioteer, You drive as you like, and I am a happy taker!!

"Milestone"
June 25, 2019
Garland, Texas, USA

Editorial

About 112 papers are received and about 50% of the papers are selected for presentations in ESDA2025 and rest of the paper has not passed the quality parameters. Abstracts of registered papers and summary of invited talks are included in this book. Most of the papers are in the areas of: energy systems, automations, control systems, Solar Energy, Bio Mass Energy, Electrical Vehicle Systems, Fuel Cells, Smart Grid Technologies, Micro Grid Technologies, Electric Conversion Systems, soft computing and optimization techniques, Energy Conservation and Auditing, Energy Storage and Battery Management, Conventional and Special Electrical Machines, Industrial Drives, High Voltage Engineering, memory-storage circuits etc. Some papers are in the areas of AI tools and applications, IOT based application, algorithms, medical electronics,

With due thanks and best wishes to all our team members including the Chief Guest, Keynote Speakers, invited speakers, Chair persons, Authors, participants etc. for sparing their valuable time for preparing the papers for this abstract book.

These abstract proceedings are prepared with the abstracts of all papers for the delegates of the conference and for listing the abstracts only either in offline/online. As most of the revised and extended versions of the papers will go for either SCIE Journal or Scopus indexed Book chapters or journals. We have not given any ISBN number to this book as because; these papers will go for further online publications.

The Editors of ESDA2025

Dr. Mukku Pavan Kumar(Dept. of ECE, Associate Professor & RnD Coordinator, Lendi Institute of Engineering and Technology (Autonomous), Vizianagaram, Andhra Pradesh, India.)

Dr. Aditi Chatterjee (Associate Professor and Head Department of Electrical Engineering, C.V. Raman Global University, Bhubaneswar, Odisha, India.)

Mr. Arup Halder (Scientist, Applied Computer Technology, Kolkata, West Bengal, India)

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Message from the Hon'ble Vice-Chancellor

I would like to take this opportunity to greet all of the participants, researchers, academicians, and business people attending this prestigious conference Energy Systems Drives and Automation (ESDA) 2025. This conference offers a great venue for the sharing of cutting-edge concepts, current research results, and cutting-edge technology on energy systems, drives and automation that support both technological advancement and academic success.

The joint efforts of researchers dedicated to expanding knowledge in their respective domains are reflected in the abstract proceedings. I applaud the organizing team for their commitment to bringing together young researchers, scientists and specialists in one forum. I have no doubt that the conference's deliberations and discussions will spark significant partnerships and new lines of inquiry.
I hope the ESDA 2025 is a huge success and that everyone who attends finds it to be both intellectually and professionally gratifying.

Prof. Bansidhar Majhi
Vice Chancellor,
C.V. Raman Global University,
Bhubaneswar, Odisha, India.

Speech of: **Prof. Dulal Acharjee**
Executive Chairman, ESDA2025 and
Director, Applied Computer Technology, Kolkata, West Bengal, India.

Today, we are here to inaugurate the 08th International Conference on 'Energy Systems Drives and Automation', in short ESDA2025. To promote research works in these particular fields, for continuous improvement of the research works and to give a good platform for presenting recent research works- are the main motto and objective of this conference.

Harvesting natural resources to produce required energy is one of the main themes of this conference. So fast we can minimize the uses of coal, oil and gas is the best for the next generation. Simultaneously we should accelerate the uses of Wind, Sunlight, Tide, Water flows, pressure, and vibrations etc. which are the physical properties of the nature and should be converted to power. The philosophy of generating of energy should be that the required energy to run a device should be collected from the adjacent surroundings of the device by conversion of adjacent natural properties to energy. For that, architecture and design of all electrical instruments should be made accordingly. Next concept of uses of energy should be of using hybrid sources of energy for running any fuel or battery based machine. Machine shouldrun by hybrid sources of energy.

Next generation of automations will be controlled with the help of brain of machine where Artificial Intelligence based programming will make the system more and more intelligent to take decision about the situation. Controlling of heavy machines like Crane, motor of Ship and rock cutting drilling machines etc. will be able to work with more efficiently with the combinations of proper hardware and software. Slogan should be 'more brain, less labor'.

Through our long observations, we feel that many areas related to research works yet to be explored which are: research supporting staff, Scientist and technicians should be recruited in each department who will support technical works of the research projects. Some points are mentioned here: data collection, data file preparation for reusing, keeping data in repository for other researchers. Another important issue is: creating video of research flow or output flow. Video is the best way of presenting any work to the audiences, animations of figures, exploring and expanding the inner components visually can explain the concept in a better way. We need to develop separate manpower that will be associated with the research fellows. Making a model is more important than writing a thesis. Our company, Applied Computer Technology, ACT, provides these services and in future we shall expand these types of supports and extend our services for the research fellows. Our company also supports publications to SCI/SCOPUS indexed journals after revising and improving the qualities of the papers.

All presented papers will be graded as A or B or C as per evaluation of three experts. Accordingly, papers will be invited for SCI/SCOPUS publications. A good publication takes sufficient time to make a final decision which is made by the reviewer comments of those publications.

Hope, by your active participation, researchers will be able to make a network with the related professors which may help you to furnish your research projects. In future, these inventions, as presented papers, would be patented and then as models these would be implemented within the machines and the World would be a better sustainable and peaceful space for the human being.

With warm wishes and kind regards,

Prof. Dulal Acharjee.
Kolkata, WB, India.
Date: 20/12/2025

Keynote Talk

Hybrid charging system for e- vehicles which allows charging instatic as well as dynamic condition

Prof. Pradip Kumar Sadhu
Professor, department of Electrical Engineering
Indian Institute of Technology (ISM)Dhanbad, Jharkhand, India

Abstract:

Governments all across the world are planning to build carbon-neutral infrastructures to reduce dependency on fossil fuels in the transport sector following the sustainable development goals (SDGs). India is one of the largest vehicle markets in the world, with around 40 million customers needing mobility solutions. The major problem in utilizing EVs is the lack of reliable, accessible, and affordable commercial charging infrastructure, proving to be a hurdle in adopting electric vehicles as the principal mode of road transport. Electric vehicles (EVs) are emerging as a method of utilizing clean energy with a considerable reduction in greenhouse gas emissions and air pollution. However, the widespread adoption of EVs is impeded by lack of charging facilities, range anxiety, longer charging time and higher prices due to the requirement for larger batteries. The penetration of EVs in the market can be increased by creating an infrastructure that enables EV charging in dynamic as well as static conditions of the car. To provide maximum degree of freedom, the conventional plug-in charging facilities should be upgraded to wireless charging. While the utilization of renewable energy will make the transport sector more sustainable, bidirectional power flow will enable car owners to sell excess electricity from vehicle to grid (V2G). A working model of a hybrid renewable energy- driven bidirectional wireless charging system has been developed by a research group in the Department of Electrical Engineering, IIT (ISM) Dhanbad. In the proposed model, the inductive power transfer occurs between two mutually coupled coils through the air gap and asphalt. The charging coil can be kept under the road, parking lot, or garage. The proposed system works in cars with low, mid, and high ground clearance and therefore can be utilized for charging a wide variety of passenger automobiles, SUVs, and light trucks. The system underwent a trial at a laboratory scale and demonstrated satisfactory power transfer efficiency. The charging of vehicles is propelled by renewable sources of energy, including solar and wind energy and simultaneously allows electric charging of vehicles through power grids.

The IIT (ISM) Dhanbad funded project began on February 17, 2020 and after 30 months of rigorous experimentation, the working model was developed. A patent has been filed for the same with some added features of adjustable height for vehicles with different ground clearances. The researchers further plan to make the technology adjustable to the length of the vehicle.

Keynote Talk

Perovskite Solar Cells: Redefining the Next Generation of Photovoltaic Technologies

Dr. Abhijit Biswas
Institute of Radio Physics and Electronics,
University of Calcutta, Kolkata, India.

Abstract:

Perovskite solar cells (PSCs) have rapidly progressed as leading candidates for next- generation photovoltaic technologies, driven by their tunable bandgap, high absorption coefficient, low-temperature processability, and continuously improving power conversion efficiencies (PCEs), reaching the state-of-the value of 27%. These attributes make PSCs strong alternatives to conventional silicon photovoltaics while offering additional flexibility for advanced device architectures. This article presents a comprehensive and physics-oriented assessment of recent advances in PSCs, with particular emphasis on two-dimensional (2D) and all-inorganic perovskite cells aimed at achieving high efficiency, improved stability, and long-term sustainability.

The fundamental PSC device architecture, consisting of a perovskite absorber layer sandwiched between electron and hole transport layers (ETL/HTL), is analyzed in terms of photo generation, carrier transport, recombination, and charge extraction. Key fabrication routes, including solution-based deposition, spin-coating, and post-deposition thermal annealing, are discussed with respect to their impact on film morphology, crystallinity, and interfacial properties. Recent advances in compositional engineering and interface optimization are shown to play a decisive role in enhancing device efficiency and operational stability.
A physics-based analytical framework is developed to evaluate the photo generated current density and current–voltage (J–V) characteristics of PSCs by coupling optical absorption with carrier transport and recombination mechanisms. The model is applied to optimize 2D Ruddlesden–Popper PSCs in both n–i–p and p–i–n configurations, considering absorber thickness scaling and alternative ETL/HTL material selections. The results provide quantitative insight into the interplay between optical confinement, carrier transport, and recombination losses governing device performance.

To mitigate the stability and toxicity challenges associated with Pb-based perovskites, this study further investigates lead-free all-inorganic PSCs employing a 2D Cs 3 Sb 2 I 9 absorber. Systematic optimization of ETL–HTL band alignment, layer thicknesses, interface defect densities, and metal back-contact work function results in a champion FTO/SnO 2 / Cs 3 Sb 2 I 9 /NiO/Ni device delivering a PCE of 17.91% along with excellent thermal robustness, exhibiting only ~0.06% efficiency degradation over a wide temperature range of 200 °C–400 °C. In addition, advanced light-management strategies based on three-dimensional finite- difference time-domain simulations demonstrate that the incorporation of metallic nanostructures, particularly pyramidal Ni nanostructures, significantly enhances optical absorption and carrier generation in all-inorganic CsPbI 3 PSCs, leading to a PCE of 23.32%.

Collectively, these results highlight the critical role of material innovation, device-level modeling, and nanoscale optical engineering in advancing perovskite photovoltaics toward practical, high-performance, and sustainable next generation energy solutions.

Keynote Talk

Integration of VSG-Augmented Renewables into Social Welfare Optimization Framework for Stability-Constrained Power Dispatch

Dr. Sandip Chanda
Associate Professor & Former Dean (SW &FW), Former Head Department of Electrical Engineering
Ghani Khan Choudhury Institute of Engineering and Technology
A CFTI under Ministry Education. Govt. of India Narayanpur, Malda, West Bengal, India.

Abstract:

The accelerating penetration of renewable energy sources has significantly altered the dynamic characteristics of modern power systems. While solar and wind generation contribute to sustainability, their converter-interfaced nature drastically reduces system inertia, making grids more vulnerable to transient instability, frequency excursions, and reduced fault ride-through capability. Conventional planning tools such as Optimal Power Flow and demand-response-based Social Welfare Maximization (SWM) effectively address economic dispatch, but they remain largely static and are unable to manage fast electromechanical disturbances. This lecture presents a unified techno-economic framework that addresses this limitation by integrating Virtual Synchronous Generator (VSG)–augmented renewables within a stability-constrained SWM formulation.

The primary technical contribution of this work is the development of a closed-loop adaptive VSG architecture that extends the controllability of conventional VSGs. Traditional VSG implementations rely on fixed or limited adaptive inertia settings constrained by inverter ratings and control bandwidth, often resulting in sluggish or unstable responses under severe disturbances. To overcome this, the proposed approach employs a Hardware-in-the-Loop–inspired concept using a virtual DC motor–synchronous generator pair. By dynamically regulating a virtual load torque, the system effectively enhances synthetic inertia and damping in real time, allowing renewable generators to emulate the dynamic behavior of conventional synchronous machines without requiring additional physical storage. A second major contribution is the integration of VSG-augmented renewable dynamics into the Social Welfare Maximization framework. SWM balances generation costs with consumer willingness-to-pay and enables controlled demand response. However, incorporating transient stability constraints directly into SWM is computationally challenging. To address this, the work introduces an LSTM-based load-flow surrogate model trained on time-series data from VSG-supported renewable systems. This data-driven model accurately captures nonlinear dynamic interactions and enables fast evaluation of system states, making stability-aware economic dispatch feasible in near real time. The resulting nonlinear, multi-constraint optimization problem is solved using a Differential Evolution–Quantum Particle Swarm Optimization (DE-QPSO) algorithm. This hybrid metaheuristic efficiently handles the combined economic and dynamic constraints, yielding optimal schedules for generation, renewable utilization, and controllable loads while minimizing load curtailment and maintaining stability margins.

The framework is validated on a modified IEEE 30-bus system with solar and wind generators supported by VSGs. Simulation results under severe fault conditions demonstrate significant improvements in rotor-angle damping, voltage recovery, and fault ride-through capability. The Transient Stability Margin improves by approximately 8°–12°, and Critical Clearing Time increases across all generators, confirming enhanced resilience. Additionally, improved voltage profiles reduce congestion and load curtailment, reinforcing the economic benefits of the proposed approach.

In summary, this work delivers a first-of-its-kind integrated solution that jointly addresses transient stability and economic optimality, offering a scalable pathway for secure operation of future low-inertia, renewable-dominated power systems.

Keynote Talk

Moving Toward Electrical Nanogrids: The Future of Local Energy

Prof. Dr. Arabinda Das
Professor, Department of Electrical Engineering, Jadavpur University,
Kolkata, West Bengal, India.

The way of getting and sharing electricity around the world is changing a lot. It is moving away from big central power systems from the last century to smaller, spread-out systems called 'distributed energy'. At the center of this change is the electrical nanogrid — a small, local power setup that can make electricity smarter, cleaner, and more focused on nearby use.

In the past, electricity came from a few huge power plants — like big coal, gas, or nuclear ones — far away from people. These plants send power over long, high-voltage lines called 'super grids'. This worked well for making a lot of power cheaply, but it had problems: a lot of energy was lost during travel, and if one big plant or line broke, many people could lose power at once.

Spread-out systems are different. They use small sources like solar panels on roofs, small wind turbines, and home batteries. By making power close to where it's used, these systems waste less energy and are harder to break down completely.

A nanogrid is the smallest part of this new power setup.

- A minigrid might power a whole village (often 50 kW to 1 MW).
- A microgrid might power a school campus or business area.
- A nanogrid usually powers just one home or building. It typically has a power level under 10–20 kW (or sometimes up to 100 kW when connected to the main grid).

It smartly combines clean energy sources (like solar) and batteries in a small space.

Key features of nanogrids include:

- ✓ DC Power Setup: Many use direct current (DC) at around 380 volts. This avoids wasting energy by changing between AC and DC many times, like in old grids.
- ✓ Smart Controls: They use advanced methods (like "adaptive droop control") to balance power use and keep voltage steady based on battery levels, often without needing outside signals.
- ✓ Easy to Add On: The design is modular, so you can grow it or fix it easily, even if you're not an expert.

Nanogrids let people control their own energy and rely less on far-away, unreliable main grids. For homes, this means lower power bills — sometimes cutting costs by up to 45% in rural areas. In places like India, people can become 'prosumers' (producers + consumers). They make extra solar power and sell it back to local companies (called DISCOMs) through net metering to get money or credits. Government programs like the PM KUSUM Scheme help farmers install solar systems to make and sell power, boosting their income.

Nanogrids have great potential, but there are hurdles. Solar panels and batteries cost a lot upfront. Clean energy like solar and wind depends on the weather, which can cause power ups and downs. In far-away areas, it's hard to find skilled workers or spare parts.

Looking ahead to 2050, nanogrids could be fully connected everywhere. By 2030–2040, they might be normal in new homes and for charging electric cars. The big dream is an 'EnergyNet' with smart routers and blockchain for people to trade power directly with each other, like sharing data on the internet.

Switching to electrical nanogrids is a big rethink of how we share power. By using clean energy, smart controls, and local production, they offer a strong way to fix energy shortages around the world while giving power back to everyday people. As tech gets better and cheaper, these small grids will be the key parts of a cleaner, spread-out energy world.

Keynote Talk

Municipal Water Supply Pumping Station Microgrid Energy Efficiency Improvement using Batteries and Photovoltaic Power Systems

Dr. sc. Danijel Pavković,
Full Professor, University of Zagreb, Croatia
Faculty of Mechanical Engineering and Naval Architecture.

Abstract:

Electrical power distribution networks are vulnerable to service interruptions, making reliable backup power essential for critical infrastructure. Battery Energy Storage Systems (BESS), combined with Uninterruptible Power Supply (UPS) functionality, can also support energy arbitrage to reduce electricity costs.

This study evaluates the feasibility of integrating commercial BESS and photovoltaic (PV) systems to enable autonomous operation of a water pumping station. Using 16 years of historical municipal water consumption data from the Cres–Lošinj archipelago, system performance is simulated with and without BESS–PV integration. The analysis quantifies potential energy savings, cost reductions, and return on investment (ROI).

The Cres–Lošinj archipelago, located in Croatia's Kvarner Bay, consists of 36 islands, with Cres and Lošinj as the main islands. The concept builds on insights gained during the five-year Horizon 2020 INSULAE project, which focused on improving energy and water autonomy on maritime islands, highlighting the need to reduce the water supply system's dependence on the main electricity grid.

Keynote Talk

The Emerging Future of Electric Vehicles (EVs) and Lithium-IonBatteries in India

Dr. Rajesh Dey
Associate Professor, Gopal Narayan Singh University,
Sasaram, Bihar, India.

Abstract:

The transportation landscape in India is undergoing a transformative shift with the increasing adoption of electric vehicles (EVs). This change is driven by the urgent need to reduce greenhouse gas emissions, decrease dependency on fossil fuels, and improve urban air quality. The core technology enabling this revolution is the lithium-ion (Li-ion) battery, which powers EVs with high efficiency and reliability. At ESDA2025, this talk delves into the advancements, challenges, and future prospects of EVs and Li-ion batteries in India.

India's EV market has experienced exponential growth in recent years, fueled by favorable government policies, technological advancements, and increased consumer awareness. The Government of India has launched several initiatives to promote EV adoption, including the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, which provides incentives for purchasing electric vehicles and setting up charging infrastructure.

This surge in EV adoption is also driven by urbanization and the need for sustainable mobility solutions in cities plagued by pollution and traffic congestion. Major Indian cities like Delhi, Mumbai, and Bangalore are witnessing a rise in electric two-wheelers and electric buses, which offer a cleaner and quieter alternative to conventional internal combustion engine vehicles.

The heart of any EV is its battery, and the development of advanced battery technologies is crucial for the success of EVs. Li-ion batteries are currently the most popular choice due to their high energy density, long cycle life, and relatively low self-discharge rates. However, researchers and manufacturers are continually striving to enhance these batteries to meet the growing demands of the EV market.

Recent advancements in battery chemistry have led to the development of Lithium Iron Phosphate (LFP) and solid-state batteries. LFP batteries are gaining popularity due to their safety, longevity, and cost-effectiveness. They are less prone to overheating and thermal runaway, making them a safer option for EVs. Solid-state batteries, on the other hand, promise even higher energy densities and faster charging times, which could significantly improve the range and convenience of EVs.

Final Remarks

The future of EVs and Li-ion batteries in India is bright, with immense potential to transform the transportation sector. Continued research and development, coupled with supportive policies, will ensure that India remains at the forefront of this technological revolution. By addressing the challenges and leveraging opportunities, India can achieve its vision of becoming a leader in electric mobility and sustainable transportation.

Keynote Talk

Hydrogen Technologies as the Foundation of Economy Decarbonization

Dr. Marta Zurek-Mortka
Department of Control Systems
Lukasiewicz Research Network – Institute for Sustainable Technologies, Poland

Abstract:

Hydrogen is one of the most promising energy sources in the fight against climate change because its combustion produces only water, with no carbon dioxide emissions. Decarbonizing the economy requires a shift from fossil fuels to clean energy sources, and hydrogen, thanks to its versatility, can be used in energy production, transportation, industry, and heating. A key role in this process is played by green hydrogen, produced through water electrolysis using renewable energy, which enables significant reductions in greenhouse gas emissions. Additionally, hydrogen can serve as an effective energy storage solution, allowing surplus energy from intermittent renewable sources, such as wind or solar, to be stored.

In the transportation sector, hydrogen presents an intriguing alternative to electric vehicles, particularly in areas where batteries are not efficient enough, such as heavy-duty transport, shipping, and aviation. In heavy industry, hydrogen can be used to reduce emissions in processes like steelmaking and chemical production, which are challenging to decarbonize through other means. One of the challenges related to hydrogen's widespread adoption is the development of infrastructure, including fueling stations and transmission networks, which are essential for its widespread use.

This presentation will delve into these innovations, highlighting their potential torevolutionize industry and the broader transportation ecosystem, while addressing the challenges and opportunities on the road to fully sustainable solutions. Also climate policies and regulations, such as those introduced in the European Union, play a crucial role in supporting the large-scale implementation of hydrogen technologies. Ultimately, adopting hydrogen technologies could not only accelerate the decarbonization process but also drive innovation, create new jobs, and contribute to transforming economies toward more sustainable development.

Keynote Talk

How AI is Transforming Software Engineering Today

Mr. Dhairya Bimal,
Software Engineer, Vanguard, USA.

Abstract:

Artificial intelligence is rapidly reshaping how software is designed, developed, tested, and maintained. This talk explores the practical impact of AI on everyday engineering tasks and the broader software lifecycle. It highlights how modern AI tools assist with coding, debugging, documentation, DevOps automation, cloud optimization, and large-scale data workloads. The session also discusses how AI is improving developer productivity, reducing repetitive work, and enabling engineers to focus on architecture and innovation. Real examples and experiences will be shared to demonstrate how AI can be integrated into professional workflows, along with insights into the skills software engineers need as AI continues to evolve.

Prof. Pradip Kumar Sadhu

Professor, department of Electrical Engineering,Indian Institute of Technology (ISM)
Dhanbad, Jharkhand, India.

He received his Bachelor, Post-Graduate and Ph.D. (Engineering) degrees from Department of Electrical Engineering, Jadavpur University, Kolkata, West Bengal, India. Currently, he is working as a Professor (HAG) & Ex- Head of Electrical Engineering Department of Indian Institute of Technology (ISM), Dhanbad, India. Also, He served B.I.T., Mesra, Ranchi as faculty member of Electrical & Electronics Engg. Department. Prior to join B.I.T. Mesra, also he served the different industries for twelve years. He has total experience of 35 years, out of which 23 years in teaching and 12 years in industry. He has eighteen (18) Granted Patents. In addition, fourteen (14) more patents in his name are under process. He has several journal and conference publications in National and International level including IEEE Transactions on INDUSTRIAL ELECTRONICS, IEEE transactions on POWER SYSTEMS, IEEE Transactions on Instrumentation and Measurement, IEEE SENSORS JOURNAL, IEEE Access, Solar Energy, Renewable Energy, Building and Environment, Renewable and Sustainable Energy Reviews, IET Generation, Transmission & Distribution, IET Science Measurement & Technology, IET Smart Grid. He is principal investigator of a few Govt. funded projects. He has developed Hybrid charging system for e- vehicles that allows charging in static as wellas dynamic condition; Technology for which the patent application has been filed can herald a new era for adoption of electric vehicles as principal mode of road transport. He is reviewer of various international journals like IEEE Transaction on Power Electronics, IEEE Transactions on INDUSTRIAL ELECTRONICS, Solar Energy, Renewable Energy, etc. He has guided 22 Nos. of doctoral candidates and a large no. of M. Tech students. Moreover, He has published four text books entitled, "Elements of Power Systems" under CRC Press, Taylor & Francis Group, "Modern Utilizationof Electrical Power", "Elements of Electrical Machines", "Basic Electrical Engineering" under CBS Publication, with his co-author research scholar Soumya Das. His current areas of interest are Power Electronics Applications, Application of High Frequency Converter, Energy Efficient Devices, EnergyEfficient Drives, Computer Aided Power System Analysis, Condition Monitoring, Solar Energy, Renewable and Sustainable Energy and Lighting& Communication Systems for Underground Coal Mines.

Dr. Abhijit Biswas

Institute of Radio Physics and Electronics,
University of Calcutta, Kolkata, India.

Abhijit Biswas earned his B.Tech., M.Tech., and Ph. D. (Tech.) degrees from the University of Calcutta. He is currently a Professor in the Department of Radio Physics and Electronics at the University of Calcutta, where he also served as Head of the Department from 2020 to 2022. Prior to this, he was a Reader in the Department of Electronics and Telecommunication Engineering at Jadavpur University from 2006 to 2008. Additionally, he worked at the Interuniversity Microelectronics Centre (IMEC) in Belgium in 2007.

His research interests include semiconductor physics, as well as the modeling, simulation, and characterization of electronic and optoelectronic devices, including CMOS devices and circuits, LEDs, laser diodes, photovoltaics, and optical fiber communications. He has published 100 technical papers in SCI-indexed journals, contributed a book chapter to Nova Science Publications, USA, and presented over 150 papers at international conferences and workshops. His research excellence has been recognized with seven Best Paper Awards at international conferences. Since 2016, he has served as a Guest Editor for Microsystem Technologies and currently acting as a Lead Guest Editor for the S. I. of IET Circuits, Devices and Systems (U. K.). He is an active reviewer for numerous peer-reviewed journals, including IEEE Transactions on Electron Devices, IEEE Transactions on Nanotechnology, Microelectronics Reliability, Optical Engineering, Solar Energy, and many more.

Dr. Sandip Chanda

Associate Professor & Former Dean (SW &FW), Former Head Department of Electrical Engineering
Ghani Khan Choudhury Institute of Engineering and TechnologyA CFTI under Ministry Education. Govt. of India Narayanpur,
Malda, West Bengal, India.

He is a B.E from Jadavpur University in Electrical Engineering. He completed his M. Tech Degree in Electrical Engineering from Applied Physics Department of Science College, Kolkata and he was awarded Ph.D. (Engineering) form IIEST, Shibpur (Formerly Shibpur B.E. College) in 2015. Dr. Chanda has 20 years of teaching experience including 15 years of research experience in the field of Electrical Power System. He has worked 2.5 years as Principal, 6 years as Dean and 8 years as head of Electrical Engineering Department of reputed Engineering colleges. He has published 80 journals and conference papers in Elsevier, springer, IEEE and in other reputed publications. He has also published 4 books on Smart Grid Research and 10 book chapters available in IET digital library and other reputed publications. He has published 6 Patents so far and among which 3 are granted by Govt. of India and UK patent offices. Dr. Chanda is a Fellow of Institute of Engineers (India) and Institute of Electronics and Tele Communication Engineering, and he is also a Senior Member of IEEE. Currently he is working as Associate Professor of Electrical Engineering Department in Ghani Khan Choudhury Institute of Engineering and Technology, Malda, a CFTI under Ministry of Education, Govt. of India. His research area include Power system Optimisation, Smart Gird, Renewable Energy Sources, Charging infrastructure of EV and Micro Grid.

Prof. Dr. Arabinda Das

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Arabinda Das obtained his B. Tech., M. Tech. degrees in Electrical Machines and Power System and Ph.D. (Tech.) degree from the University of Calcutta, India. He has received Junior Research Fellowship from the Department of Science and Technology, Government of West Bengal and Senior Research Fellowship from Council of Scientific and Industrial Research, Government of India for conducting his research. Presently, he is Professor in the Department of Electrical Engineering, Jadavpur University, India. Before joining Jadavpur University in 1999, he worked as a Lecturer in Regional Engineering College, Durgapur, India (presently National Institute of Technology, Durgapur) since 1996. His field of interest includes Electrical Machines and Drives, Power quality, Power system fault diagnosis, protection and signal analysis. He has published more than 100 research articles in National and International journals and conferences including IEEE, IET, Elsevier, Springer and Taylor & Francis. Ten students have awarded PhD degree under his supervision. Also he has published three books 'Overhead Electric Power Lines: Theory and practice' in The Institution of Engineering and Technology, UK, 'Design of 3-phase 3-winding transformer: An Optimization Approach' and 'Modeling of Electrical Machines: Synchronous and Induction' in LAP Lambert Academic Publishing, UK. Dr. Das is the Fellow of 'The Institution of Engineers (India)' and 'The Institution of Electronics and Telecommunication Engineers'.He is working as a board member in different selection committee in Directorate of Electricity, Government of West Bengal and in Public Service Commission, West Bengal. Dr. Das worked for vetting of (i) Electrical Documents-Highway Lighting cum Electrical project, and (ii) Vetting of the Facade Illumination for the project 'Construction of Extradosed PSC Bridge over River Brahmaputra connecting Guwahati and North Guwahati including viaduct and approaches, etc. on EPC mode' designed by Surya Roshni Ltd.For a long time Dr. Das worked as the Course Coordinator of the skill development program 'Electrical Installation, Repairing, Maintenance & Safety Practices' organized by the Electrical Engineering Department, Jadavpur University, for the unprivileged and orphan students residing at different Homes under the Department of Women and Child Development and Social Welfare, Govt. of West Bengal. Dr. Das is the recipient of Railway Board Prize, The Union Ministry of Energy --- Department of Power Medal, The Corps of Electrical and Mechanical Engineers Medal, Tata Rao Prize and The Pandit Madan Mohan Malaviya Memorial Prize from The Institution of Engineers (India), Best Paper presentation award at the International Conference at Amsterdam, The Netherlands, from World Academy of Science, Engineering and Technology.

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B.Sc. and M.Sc. degrees in Electrical Engineering, and Ph.D. degree in Mechanical Engineering, all from the University of Zagreb, Croatia. Currently holding the position of Full Professor at the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, teaching subjects in the field of electrical machines, electrical servodrive control, and digital control systems. Participated on 20 research and technology projects supported by the Ministry of Science of the Republic of Croatia, Croatian Science Foundation, Ford Motor Company, Jaguar Cars Ltd., CROSCO Integrated Drilling & Well Services Company, and European Commission (FP7 and Horizon). Research interests include estimation and control of electrical servodrive systems with automotive and deep-drilling applications, mechatronics systems, adaptive and optimal control, and energy storage systems modeling, estimation and control.

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She is a young researcher, which works as a specialist in the Institute for Sustainable Technologies in Radom in the Department of Control Systems. The institute belongs to the third largest research network in Europe called Lukasiewicz Research Network (https://lukasiewicz.gov.pl/en/). She obtained a Doctor degree at the Faculty of Transport, Electrical Engineering and Computer Science at the University of Technology and Humanities Kazimierz Pulaski in Radom in the field of Electrical Engineering. She was an Erasmus Ph.D. Student at the Faculty of Electrical Engineering at the University of Ljubljana in Slovenia in 2019-2020. She is a Member of the Mazovia ICT Cluster, the Polish Association of Electrical Engineers, and a Member of the Expert Board of the European Commission and National Centre for Research and Development in Poland. She is also a Member of the Organizing Committees of International Conferences in Poland and India. The scientific interest includes among others electromobility, renewable energy, power electronic converters for electromobility and Renewable Energy Sources (RES), minimizing electromagnetic disturbances generated by power electronic converters, hydrogen technology. At the present, she is working on an innovative solution related to the use of thermoelectric generators for the production of electricity from waste heat. She is an author and co-author of over 25 publications in English and Polish language in Energies, ASTES Journal, elektro.info, and Springer, and also co- author of 4 patent applications. She participates in many national and international conferences and seminars, mainly organized in Asia.

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Dhairya Chandarana is a software engineer with more than six years of experience in building and maintaining applications and working across data, cloud, and AI technologies. He is currently working at Vanguard, where he contributes to developing scalable solutions and improving engineering processes through the use of modern AI tools. Dhairya is continually learning and leveraging AI to enhance productivity, optimize development workflows, and support cloud-based systems. He holds a Master's degree in Computer Science from the University of Texas at Arlington.

Paper ID: 16

Greenhouse Gas for use in Electricity Generation

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Abstract- The increasing demand for sustainable energy solutions has prompted exploration into unconventional sources for electricity generation. This study investigates the potential utilization of greenhouse gases primarily methane (CH4) and carbon dioxide (CO2) as feed stocks or catalysts in electricity production systems. Methane, a potent greenhouse gas, is examined for its viability in combustion based power generation and fuel cell technologies, while CO2 is assessed for its role in enhanced geothermal systems and emerging electrochemical conversion methods. The research evaluates the thermodynamic efficiency, environmental impact, and economic feasibility of these approaches, highlighting innovations in carbon capture and utilization (CCU) that transform harmful emissions into energy assets. Findings suggest that strategic integration of greenhouse gas-based technologies could contribute to decarbonizing the energy sector while mitigating climate change. However, challenges remain in scalability, infrastructure adaptation, and lifecycle emissions. This paper provides a comprehensive overview of current methodologies and proposes future directions for harnessing greenhouse gases in electricity generation.

Keywords: Electrochemical CO2 reduction, Carbon dioxide conversion, Greenhouse gas mitigation, Value-added chemicals, Renewable energy, Electro catalysis

Paper ID: 22

Autonomous Chess Play Using Stockfish AI and Vision-Based Robotic Arm

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Abstract- The fusion of artificial intelligence (AI) and robotics has opened doors to autonomous systems capable of handling complex, decision-driven tasks. In this work, we present a Chess Playing Robotic Arm that brings together three powerful components: the Stockfish AI engine, computer vision via OpenCV, and robotic manipulation. Together, these elements enable a machine to not only understand the game of chess but also physically play it on a real board. At the core, OpenCV is employed to capture and interpret the state of the chessboard, accurately detecting the positions and identities of the pieces. Stockfish, a world-class open-source chess engine, drives the decision-making process by calculating and recommending the most strategic moves. These moves are then translated into physical actions through a robotic arm, which executes them with programmed precision. This seamless interaction between vision, intelligence, and mechanical control bridges the gap between digital chess algorithms and tangible, real-world gameplay. The system also tackles several challenges, such as ensuring reliable recognition of pieces under varying lighting conditions, achieving fine-grained motion control to avoid misplacements, and making decisions in real time without disrupting the natural flow of a match. Beyond simply demonstrating a machine that "plays chess," this project highlights the potential of AI-powered robotics in enhancing human-robot interaction, particularly in settings that demand both strategy and physical execution. Initial experiments validate the system's ability to correctly interpret board states and carry out legal moves, marking a promising step toward more advanced robotic gaming applications. Future work could extend this foundation toward multi-modal interaction, adaptive difficulty, or even educational tools where robots can train players by explaining strategies as they play.

Keywords- Chess Playing Robot, Stockfish AI, OpenCV, Computer Vision, Robotic Arm, Autonomous Gameplay, Piece Recognition.

Paper ID: 23

Earthquake Induced Landslides Detection: Monitoring for Early Warning

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Abstract- Earthquakes often trigger landslides in mountainous or unstable terrain, causing severe damage to infrastructure, disrupting transportation, and endangering human lives. Detecting such landslides early—ideally even before or immediately following an earthquake—can greatly reduce losses by allowing timely warnings and mitigations. This project develops a system for Earthquake-Induced Landslide Detection and Monitoring for Early Warning, integrating multiple data sources: seismic sensors to detect ground motion, remote sensing (e.g. InSAR, optical imagery) to map slope deformation, and machine learning classification to distinguish between landslide precursor signals and background noise. Real-time data is processed to identify ground vibrations, slope instability, and soil saturation conditions. The system further employs GPS and GSM modules to provide precise location tracking and instant SMS alerts, ensuring timely communication even in remote areas without internet connectivity.

Keywords: Seismic sensor;Tilt Sensor;Microcontroller;IoT; InSAR;.Geospatial analysis.

Paper ID: 26

A Multi-Source DC-DC Converter for Renewable Energy Applications with Enhanced Load Transient Suppression

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Abstract- Recent research works carried out using the renewable energy as a source which connected to DC loads are mainly focused on designing the DC-DC multi-source converters with unique topology has simple structure and significant features. In line with this, designing a unique DC-DC converter that supports to connect multiple renewable energy sources with isolation facility is attempted in this article. A well-defined power management scheme is adopted to ensure the required power delivery in the load using MPPT. In which, transient compensation technique is achieved with fewer solid-state power electronic devices. In order to validate this unique converter along with its subsystem components, a hardware set up is prepared and tested its performance. The results are evidenced that the overall efficiency of the system is superior than the other recent topologies.

Keywords: DC-DC converter, multiport converter, multi input converters, renewable energy integration.

Paper ID: 28

Real-World Validation of a Regenerative Braking-Enabled BLDC E-Bike with an Adaptive Battery Management in an Urban Environment

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Abstract- The present study develops and tests the electric bike (e- bike) system equipped with a 48V,20 Ah battery and a 1.5kW Permanent Magnet BLDC motor, along with other components. MATLAB/Simulink is used to model and test the proposed e-bike model under a modified urban drive cycle model and then validated through real-world environments. Key metrics, including battery State of Charge (SoC), voltage, discharge current, cell temperature, and regenerative braking efficiency, were tracked over a 30 km range. A Battery Management System (BMS) with active balancing and Bluetooth was integrated for real-time data monitoring. The designed system under the simulation platform provides a range of about 35km, and a motor efficiency of 91% and the regenerative recovery of energy is about 12.4%. But, in real-time validation, a slightly shorter distance of 32.2km and energy recovery of about 10.3% is obtained. The strong alignment between simulation and experimental results is a significant accuracy of the proposed model. The system demonstrates a stable operation and effective energy and thermal management, which shows its suitability for urban e-bike mobility.

Keywords: Regenerative Braking, MATLAB/Simulink Simulation, Energy Efficiency, Cell Balancing, Battery Management System (BMS).

Paper ID: 31

Hardware Implementation of A Modified Brushless Isolated Sepic Converter Fed With HB-LLC Resonant Converter For Power Factor Correction

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Abstract- This paper introduces a high-efficiency, power factor corrected converter architecture that combines a modified bridgeless isolated SEPIC and a Half-Bridge LLC resonant converter. Designed for applications such as renewable energy systems and electric vehicle charging, the proposed system achieves a peak efficiency of 92%, with simulation results confirming stable voltage regulation and near-unity power factor. The hybrid approach integrates soft-switching techniques to reduce switching losses, making it particularly suitable for modern high-performance power electronics.

Keywords: Bridgeless SEPIC, HB-LLC resonant converter, Power Factor Correction (PFC), soft switching, renewable energy, electric vehicles, efficiency.

Paper ID: 32

Drift-Robust Anomaly Detection in Building & Industrial Energy Streams via EVT Calibration and SHAP-Logic

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Abstract- We present DRIFT-X, a deployable framework for detecting and explaining anomalies in building and industrial energy streams under non-stationary operating conditions (weather, occupancy, schedules). DRIFT-X combines self-supervised time-series pretraining for label-scarce settings, context-aware representations that fuse exogenous variables, and online drift sensing that triggers peaks-over-threshold (EVT) recalibration. To enhance operator trust, we introduce SHAP-logic, which aggregates feature attributions into concise temporal rules. Evaluated on multiple public building/industrial datasets against strong baselines (Isolation Forest, LSTM-AE, TranAD, Anomaly Transformer), DRIFT-X achieves +8–15 percentage-point F1 gains and 30–40% false-alarm reduction, with markedly improved stability across seasonal and occupancy shifts. We release code and an edge-profile suitable for BMS/EMS gateways, enabling practical, explainable anomaly analytics at the point of measurement.

Keywords: anomaly detection; energy analytics; concept drift; EVT; self-supervised learning; explainable AI; SHAP.

Paper ID: 38

High-Frequency PLCC Channel Modeling and FSK Detection under AWGN and Impulsive Noise

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Abstract- A fully developed MATLAB-based model was introduced in this paper to model power line carrier communication (PLCC) for high-voltage transmission performance at a long-range. A distributed-parameter line model is applied to determine frequency-dependent attenuation and phase characteristics of PLCC channels in the 30–500 kHz band. A binary Frequency Shift Keying (FSK) signal coupling and non-coherent detection is implemented to assess the tele-protection performance for realistic noise conditions such as Additive White Gaussian Noise (AWGN), 1/f noise, and impulsive disturbances. The simulation findings indicate that impulsive noise was the major impairment responsible for extensive symbol-energy separation and Bit Error Rate (BER) degradation, whereas mid-band carrier frequencies (150–250 kHz) improved robustness by minimizing both low-frequency pink-noise effects and high-frequency attenuation. BER sensitivity is even more significant for long distance PLCC communication; thus, it is necessary to optimize coupling and channel design. The framework offers a robust reference for frequency planning, equipment selection, and performance evaluation of PLCC-based protection signalling.

Keywords: PLCC, FSK signalling, impulsive noise, distributed-parameter line model, tele-protection, BER analysis, high-frequency attenuation, power transmission communication.

Paper ID: 41

A Comprehensive Analysis on Underwater Object Detection Using Enhanced YOLO Pre-Trained Models

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Abstract- Natural resources underwater have precious living and non-living substances that are found under marine Ecosystem. Most of the resources are Biotic resources like coral fish, seaweeds and reefs. In reality there are lot of obstacles in detecting underwater images because it has the low visibility, blurry and the presence of small object. To mitigate this issue, the paper presents a study on enhanced YOLOv8 and YOLOv11 model for under water object detection using the deep learning techniques. There are lot of marine species and objects from the custom data set has been evaluated using both the model. The detection of small and low contrast targets is improved by the mechanism of YOLOv11 where it has the YOLOv8 which act as baseline. The real-time inference capability maintains the higher mean Average Precision(mAP) in YOLOv11 by the experimental result using URPC2020 dataset. These advancements maintain real time efficiency to enhance the multiscale feature extraction, spatial detection and attention accuracy. It is mainly designed for underwater image enhancement and object detection for the efficient evaluation of the architecture modification and performance strategy. This study paper enlightens the underwater object detection under challenging visual conditions where YOLO11 provides a more efficient and robust framework.

Keywords: Underwater object detection, Image enhancement and YOLOv8, YOLOv11, URPC2020

Paper ID: 46

Bayesian Deep Learning–Based Transmission Line Fault Classification with Uncertainty-Aware Protection

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Abstract- Accurate classification of transmission line faults is critical for secure power system operation, especially as modern grids exhibit increasingly nonstationary and noise-prone behavior. This paper presents a hybrid machine-learning and Bayesian deep learning framework for identifying single-phase line-to-ground (LG) faults using multi- domain electrical features derived from a high-fidelity three-phase system model. Voltage and current waveforms were processed using dq0 transformation, spectrogram- based time–frequency analysis, harmonic characterization, and instantaneous power dynamics, and then segmented into multi-channel samples for learning. A Bayesian convolutional neural network employing Monte Carlo Dropout was developed to jointly estimate fault probabilities and epistemic uncertainty through predictive entropy and mutual information. The model achieved perfect classification performance on the test set (accuracy, precision, recall, and F1-score of 1.0), while calibration curves and uncertainty histograms confirmed well- behaved probabilistic outputs. Furthermore, the false-trip- rate surface remained flat under harmonic distortion, demonstrating strong robustness of the proposed Bayesian protection strategy. These results show that integrating engineered fault features with uncertainty-aware Bayesian deep learning offers a reliable pathway toward intelligent and dependable transmission line protection.

Keywords: Transmission line protection, Line-to-ground faults, Bayesian deep learning, Monte Carlo Dropout, Uncertainty quantification, Machine learning, Power system fault classification, False-trip-rate analysis.

Paper ID: 47

An Enhanced Advance Encryption Standard for Resource Environments

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Abstract- The current IoT industry ecosystem interconnected smart tools equipped with sensors, software, electronics, and wireless networking that allow them to exchange and gather information autonomously. Today, IoT devices are transforming everyday life by offering flexible features and real-time communication capabilities. However, despite their advanced functionality, these devices are typically compact, highly sophisticated, and reliant on limited battery reserves. Their dependence on unpredictable wireless connections exposes them to numerous operational challenges and vulnerabilities.

Among the various issues facing IoT, energy efficiency has emerged as a crucial requirement. Traditionally, most research has targeted hardware optimization, focusing on reducing chip area and reinforcing security measures. Yet, as the use of IoT continues to accelerate, there is a notable shift toward balancing adequate security with improved energy savings. In response to this evolving need, we introduce MAES, a streamlined alternative to the Advanced Encryption Standard (AES), crafted specifically for environments where energy conservation is paramount. Our approach integrates AES with the Cipher-based Message Authentication Code (CMAC) and presents a new method for secure and efficient data transmission using MAES, aiming to address both security and energy concerns in IoT applications.

Keywords: Advanced Encryption Standard (AES), Cipher authentication code, Energy Optimization, Secure Data Transmission, Low Power Consumption.

Paper ID: 49

Enhancing RUL Prediction Accuracy using CNN-LSTM via CAN-FD Data Transmission

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Abstract- The adoption of electric vehicles has made Battery Management System (BMS) the most important part of the car. The difficult challenge BMS must overcome is determining how much of its life is left and the state of the battery, since batteries lose capacity and life in unique and unpredictable ways depending on use and ambient temperature or humidity. Still, the old communication cables that are in use in vehicles (referred to as a Controller Area Network (CAN) bus) are too slow to transfer the necessary batch of data that the Artificial Intelligence relies on, and as such, we are stuck. In this research paper, we explore a potential approach to resolve this challenge that integrates two different technologies. This is the upgrade to a new class of communication cables, Controller Area Network with Flexible Data-Rate (CAN-FD), and a new class of Artificial Intelligence designed to create Hybrid models built to manage programs of very high complexity. Research shows that CAN-FD cables fabricated for automotive communication are more efficient on average than their counterparts for the standard communication process. To serve this purpose, if the right Hybrid Artificial Intelligence models are used, we have a strong chance of determining the battery life of the Electric vehicles. This represents new and significant value to electric vehicles and batteries used in such vehicles.

Keywords: AI Models, CAN, CAN-FD, Electric Vehicles, Remaining Useful Life.

Paper ID: 50

Voltaic Efficiency of a PKL Electrochemical Module Using CO_2 Gas

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Abstract- The efficiency of a PKL (Pathor Kuchi Leaf) module is an important parameter to design and fabricate an electrochemical cell. Due to load shading, renewable energy may play an important to meet up the power crisis. In this research work, we have studied the voltaic efficiency for electrochemical cell. The study time was for 1500 minutes. It is shown that the Change of voltaic efficiency, ηV(%) has increased almost linearly up to 70 minutes and then decreases 500 minutes. Then after the voltaic efficiency was almost constant up to 1500 minutes. The maximum value of Voc is 5.87 V and the minimum value of Voc is 4.95 V for with CO2. The maximum value of Voc is 6.05 V and the minimum value of Voc is 5.96 V for without CO2. The maximum value of Voltaic efficiency, ηV (%) is 92.66% and the minimum value of voltaic efficiency, ηV(%) is 74.45%. for with CO2. The maximum value of Voltaic efficiency, ηV(%) is 96.03 % and the minimum value of voltaic efficiency, ηV(%) is 85.57 % for without CO2.Themaximum value of change of voltaic efficiency, ηV(%) is 11.12% and the minimum change of voltaic efficiency, ηV(%) is 4.63%. So that in this case, the voltage difference is 6.49 %.

Keywords: Voltaic efficiency, PKL module, Greenhouse gas, Open circuit voltage, Load voltage, Short circuit current

Paper ID: 51

Black-Winged Kite Algorithm Optimized Nonlinear PID Control for Enhanced Frequency Regulation in isolated Microgrid

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Abstract- Modern power grids face a serious problem with frequency instability, particularly when variable renewable energy sources (RES) are integrated. Since conventional PID controllers are insufficient for these nonlinear dynamics, this paper introduces a Nonlinear PID (NPID) controller. The NPID's parameters are optimally tuned using the Black-Winged Kite Algorithm (BKA) and applied to multi-zone Load Frequency Control (LFC). The resulting BKA-NPID approach demonstrates superior frequency restoration speed, enhanced transient behavior, and stronger robustness against disturbances, making it a reliable solution for advanced frequency regulation.

Paper ID: 53

Hate Speech Detection Using NLP With Deep Learning in Online Social Network

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Abstract- The rapid growth of social media platforms has changed how we communicate and share information. However, it has also increased the spread of hate speech, which poses serious risks to social unity and individual well-being. Detecting hate speech is still a complex challenge because it depends on context, can be implicit, and evolves over time. Traditional methods like keyword- based and rule-based systems often do not effectively handle these complexities. In recent years, artificial intelligence (AI) has become a strong option for automating hate speech detection. This paper reviews AI- based methods for identifying hateful content, focusing on techniques such as deep learning, neural networks, and hybrid AI frameworks. We examine how effective these methods are at capturing meaning and context while also addressing issues like dataset imbalance, subjective annotation, and algorithmic bias. By compiling existing research, this review offers insights into the recent developments in AI-driven hate speech detection and suggests future paths for creating more accurate, reliable, and fair systems.

Keywords: Hate speech detection, Artificial Intelligence (AI), Deep learning, Neural networks, Hybrid AI frameworks, Contextual analysis, Dataset imbalance, Annotation subjectivity, Algorithmic bias.

Paper ID: 55

Optimization of Coverage in Underwater Wireless Sensor Networks Under Real-World Constraints

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Abstract- The problem of Coverage Optimization in Underwater Wireless Sensor Networks (UWSNs) suffers from real-world practical constraints which are largely ignored by theoretical studies. Overview In this work, we consider coverage optimization under practical constraints such as water currents, energy constraints and acoustic distortion, localization errors and deployment issues. The survey systematically studied mathematical optimization, meta-heuristic algorithms and AI/ML methods on how they solve constraint handling problem. A comparative analysis of over fifty algorithms uncovers essential insights regarding computational complexity, convergence speed, and Realistic possibility. Some of the main problems that have been pointed out are real-time adaptability, scalability, multi constraint optimization, and robustness under uncertainty. Some things that might happen in the future are explainable AI, digital twins, the Internet of Underwater Things, and federated learning for distributed optimization. This survey can be used as a detailed guide for researchers and professionals who work on UWSN coverage solutions that work.

Keywords: Underwater wireless sensor networks, coverage optimization, real-world constraints, energy efficiency, eta-heuristic algorithms, machine learning, acoustic communication, localization.

Paper ID: 56

A Hybrid PubMedBERT-Based NER and Knowledge Alignment Framework for Reliable Drug–Food Interaction Detect

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Abstract- Medicines, play crucial role in disease prevention however inappropriate medications can put patients at serious risk. Drug interactions could be one of the reason, as it defines how a drug acts on body once it's engulfed caused by another drug or food and beverages. People often take care of drug-drug intake in order to avoid counter drugs and overlook the other cause, drug-food. Drug–food interactions (DFIs) pose significant challenges to patient safety and therapeutic efficacy. In this work, we present a hybrid pipeline combining a transformer-based Named Entity Recognition (NER) model with a curated drug knowledge base to identify drug and food entities in textual input and predict possible interactions. The NER model is fine-tuned over biomedical collection of drug and food entity for its recognition, where its predictions are normalized against a DrugBank-derived knowledge base alignment using fuzzy string matching. The evaluation on the test set demonstrates high entity recognition performance including Precision, Recall, F1-score and accuracy detection of known drug–food interactions. The NER model achieved an overall F1 score of 95, which were described by Single-token entities like (B-FOOD) are predicted with higher precision and recall, while multi-token drug entities (I-DRUG) are slightly more challenging, resulting in a lower F1 score. Accuracy is high for the non-entity label (O) as expected. The pipeline is designed for modular deployment and can be extended to prescription processing and other biomedical entities in the future including the pharmacodynamics and pharmacokinetics features of each drug-food interaction.

Keywords: Drug–food interaction, NER, PubMedBERT, Knowledge base, Biomedical NLP.

Paper ID: 57

Financial Sentiment Analysis Using FinBERT and XGBOOST: A Hybrid Deep Learning Approach for Equity Markets

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Abstract- Financial sentiment analysis (FSA) is important for understanding market dynamics and informing investment decisions, but faces challenges from the technical vocabulary of the domain and imbalanced data. Models of sentiment analysis trained on general vocabulary data sets cannot extract the implicit meaning from news articles for which only those informed by finance would recognize. This paper presents a hybrid deep learning framework that integrates FinBERT and XGBoost for predicting sentiment for financial news. To address imbalance in data, we will implement SMOTE (Synthetic Minority Oversampling Technique). We detail experimental results on a curated dataset of 2099 Livemint news articles (2016-2017) from which we achieved accuracy of 89.77% with FinBERT and 85.54% accuracy when employing XGBoost trained on FinBERT logits. Together these findings highlight the complementary viewpoints of utilizing contextual and ensemble learner methods, as well as confirm that transfer from domain-specific language is substantially better than machine learning trained on general vocabulary for financial NLP applications.

Keywords: Financial Sentiment Analysis, FinBERT, XG- Boost, Ensemble Learning, Deep Learning, SMOTE, Data Augmentation, Transfer Learning.

Paper ID: 59

Performance Investigation of OLED using Silvaco Software

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Abstract- This study evaluates the performance and quality of a seven-layer organic light- emitting diode (OLED) using software simulations. The device structure is modeled in the Silvaco ATLAS platform. Each layer in the OLED plays a specific role in controlling how charges move and how light is produced. The simulations use mobility and recombination models suited for organic materials, which naturally show strong dependence on electric fields. The results display typical OLED behavior, including nonlinear charge movement and changes in light output with applied voltage. Overall, the findings help clarify how charges travel and interact inside multilayer OLED.

Keywords: Organic light-emitting diode (OLED), Silvaco ATLAS, multilayered OLED, Luminance

Paper ID: 60

Generation and Evaluation of Reliable Dataset for PowerShell Based Fileless Malware Detection: A Machine Learning Approach

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Abstract- In windows environment PowerShell becomes an integral part whose responsible for system automation, management and configuration tasks. It is very flexible to helps in performing all the operations which makes it more popular among developers and users. Yet, this flexibility also the reason of being targeted for criminal activities by implanting PowerShell scripts in the form of Fileless malware as it doesn't leave any trace in memory. So detecting these script before execution is the best way to counter the fileless attacks. For that an authentic and reliable dataset with advanced Machine Learning(ML) and Deep Learning(DL) models were required with most useful feature sets for better detection. This paper implemented a generalized workflow to create a reliable dataset by collecting PowerShell scripts from different repositories and cleaning the obfuscated script by implementing a deobfuscation technique. Then evaluated them with a well-known Antivirus(AV) platform VirusTotal to label those scripts. The extracted meaningful features from those clean and labelled script to pass the inputs to ML models for evaluation of those models. Among defined models Trigonometric Functional Link Artificial Neural Network (TFLANN) performed outstandingly with an accuracy of 97.68%. The proposed reliable dataset offers effective support to future research in PowerShell-based fileless malware detection and can be used to create more effective machine learning-based cybersecurity mechanisms.

Keywords: PowerShell, Fileless Malware, Deobfuscation, RBFNN, Machine Learning

Paper ID: 76

Advanced-Switched-Capacitor Boost Multilevel Inverter for Stand-Alone PV Systems

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Abstract- Due to the rapid growth of world, it is now emphasizing the renewable power generation which has led to a considerable high implementation of several inverters. Inverter technology is required to integrate renewable sources mainly Photovoltaic system for utilization in charging station, electric vehicles, electric vehicles, high frequency power system and motor drives. Because of its small design and capacity to meet a variety of operating needs, multilevel inverters (MLIs) are the recommended option for these applications. However, traditional MLIs often face limitations, including the lack of voltage-boosting capability and the necessity for multiple DC sources. To overcome these challenges, Switched-capacitor (SC) based MLIs are being utilized. This paper introduces a novel 7-level SC-based MLI designed to enhance solar PV systems. A key feature of this topology is its ability to use a single DC input or a single PV link while achieving a three-times boosted AC output voltage at the load side. The paper provides a detailed operational analysis for each mode of the proposed structure. Its advantages are substantiated through a comparison with recent topologies. The effectiveness of the structure is further confirmed by both simulation results under varying operating conditions and experimental validation using a laboratory prototype across different working scenarios.

Keywords: Self-boosting multilevel inverter, Seven-level, Reduced Switch, Switched capacitor, Voltage

balancing, Photovoltaic system(PV).

Paper ID: 77

A Two-Phase Liver Disease Classification with Stacking Ensemble Models, SHAP Analysis, and Robust Statistical Testing

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Abstract- Abstract—Liver Disease (DT) is a life-threatening disease for humanity. Its early detection is important for on-time inter- vention and improved patient survival. Its traditional diagnosis requires manual interpretation by medical experts. They can be time-consuming and are prone to human-error. Machine Learning came into play as an alternative to the latter effort- intensive approach. However, relying on a single ML algorithm for diagnosis is subject to limitations due to its architectural level limitations. In addition, the black-box nature of Artificial Intelligence (AI) limits its real-life adoption. To address these limitations, this work presents an eXplainable AI-based strategic ensembling approach for efficient detection of LD disorders. A two-level learning approach is used that analyzes the performance of various individual models and then ensembles them later. A stacking ensemble approach is used that combines base learners through an interpretable logistic regression meta-learner. It focuses on classification as well as identification of the severity of the diseases for efficient treatment decisions. Experimental analysis on a publicly available dataset presented that the proposed ensemble model achieved F1-Macro score of 0.8600 on the test set. This presents a reliable nature of the approach. Its lightweight and interpretable nature enables ease in deployment and adoption in other domains.

Keywords: Liver Disease Prediction, Machine Learning, Artificial Intelligence, Ensemble Learning, LR, SMOTE, SHAP.

Paper ID: 84

Comparative Analysis of Sense Amplifier Designs at 45nm, 32nm, and 22nm Technology Nodes

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Abstract-This paper presents a comparative analysis of Decoupled Sense Amplifiers implemented across three different semiconductor technology nodes: 22 nm, 32 nm, and 45 nm. It analyses how variations in supply voltage influence four critical performance parameters: power consumption, operational speed, bitline capacitance, and leakage current. The result shows that smaller technologies like 22nm and 32nm work faster and use less energy at high voltage, but also use more power and leak more as voltage rises. The 45nm technology is slower but saves more energy and leaks less at low voltage. Also, higher bitline capacitance slows down the circuits, so it should be kept low. This paper helps designers pick the best technology for faster and more efficient sense amplifiers.

Keywords: Low Voltage SRAM, Sense Amplifier, Sensing Delay, Transient Analysis.

Paper ID: 85

A machine learning based framework for predictive maintenance of solar panels

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Abstract- The abundance, adaptability, and continually declining installation costs of solar photovoltaic (PV) technology have made it a prominent renewable energy source. However, environmental variability, component deterioration, power-electronic failures, and aging effects continue to have a major impact on the long-term performance and dependability of PV systems. These difficulties show that in order to maintain optimal system output and operational safety, effective monitoring, early fault identification, and prompt repair techniques are essential. There are some drawbacks to the conventional maintenance techniques employed in PV installations, such as routine manual inspections and corrective actions. In order to improve the performance and operational efficiency of solar PV systems, this work presents a predictive maintenance framework driven by machine learning techniques. Four different machine learning models linear regression, decision tree, random forest and XGboost has been implemented for predictive maintenance of solar panels. A comparative assessment of the machine learning models is presented to find the optimal model in terms of accuracy and speed of prediction.

Keywords: Machine learning, Solar panels, predictive maintenance, Error metrics.

Paper ID: 87

Bent topological optical fibers for medical and photovoltaic applications

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Abstract- Topological band structure engineering enables the development of robust light propagation states known as topological interface states, across various media. These light states emerge at the interface between two topologically distinct lattices and are characterized by their remarkable stability, resistance to scattering, and robustness against structural imperfections. In this study, we investigate the propagation of light for two wavelength regimes through a bent 3-channel topological optical fiber featuring a one-dimensional periodic lattice geometry. First, we develop a simulation for a 90-degree bent topological fiber and investigate its light propagation characteristics using the Finite Element Method. For medical applications we evaluate the key performance metrics of the bent fiber including dispersion and confinement loss. The 90-degree bent configuration exhibits low chromatic dispersion (9.7 ps/nm·km) and minimal confinement loss (~0.42 dB/km), indicating efficient light guidance. Remarkably, the bent 3-channel fiber geometry is also capable of photovoltaic applications for the transmission of solar light when structurally modified. Finally, the obtained results are compared with previously published reports on bent fibers. The superior optical performance demonstrated by the bent topological fiber underscores its potential to surpass conventional optical fibers, especially in scenarios where resilience to structural imperfections is essential. This makes it a suitable alternative for next-generation optical fiber technologies.

Keywords: Bent topological fiber, medical applications, periodic lattice, photovoltaic applications, light propagation, structural imperfections.

Paper ID: 96

Economical Load Dispatch Through Flower Polliation Algorithm

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Abstract-This work presents the application of the flower polliation algorithm (FPA) for solving economical load dispatch (ELD) problems. The working of FPA is based on the reproduction procedure of flowering plants. The nonlinear and non-convex nature of generating plants due to valve point effects, prohibited operating region and transmission loss are taken into consideration for solving ELD problems. The simulation results obtained from FPA are compared with other metaheuristic algorithms such as GA [22], GASPO [22], NSOA [22], PSO [22], MSGHPA [22], FPSOGSA [22], MSG-HS [32], GA-APO [32], SADE ALM [32] and TS [32], which confirm the ability of FPA algorithm in solving non-linear ELD problem in terms of its computational efficiency and robustness.

Paper ID: 97

Watermarking Framework Against AI-Powered Removal Attacks

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Abstract- Digital watermarking has widely been used to guarantee copyrighting of images and authenticity, however it arises that sometimes watermarks need to be removed like in old archives restoration, forensic investigations or in a research database where they may wish to reuse a given image. The traditional watermark removal algorithms have the tendency to destroy the clarity and structure of the image causing visible distortions or blurriness. To address these inefficiencies, this paper suggests an effective watermark removal framework that is based on IMPRINTS (Image Processing and Restoration Techniques). The proposed solution applies better inpainting algorithms to reconstruct the missing regions of the image after either watermark erase and preserves the texture, color consistency and edge continuity. The scheme has stages of preprocessing, watermark detection, generation of mask and mask repair to create the least visual artifacts. Experimental results conducted on different image sets with watermarks prove that IMPRINTS becomes much better than the conventional interpolation and CNN-based watermarking in terms of Peak Signal to Noise Ratio (PSNR) and Structural Similarity Index Measure (SSIM). The results portray that the IMPRINTS process is capable of eliminating high quality of watermarks in visual images and structural integrity, therefore, the process is reliable in image restoration processes in reality.

Keywords: Image Restoration Image Inpainting Digital Image processing Edge Detection Image Restoration IMPRINTS Image Restoration Watermark Removal PSNR SSIM.

AOI: Applied Object Indexing – A new Paradigm of Unique Identification

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Abstract(extended): indexing of any digital or material object is important for unique identification. There are different organizations that provide unique numbers to digital objects and these are DOI, ISSN, ISBN etc. This article proposes a new indexing technique, AOI(ACT Object Indexing) which is based on single platform and easy to generate and all numbers are link based object identifier.

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	Keynote Speaker **Prof. Abhijit Biswas** Professor, Institute of Radio Physics and Electronics, University of Calcutta, Kolkata, India.
	Keynote Speaker: **Dr. Sandip Chanda,** General Chair, ESDA2025 Professor, Department of Electrical Engineering, Ganni Khan Chowdhury Institute of Engineering and Technology (GKCIET), Maldah, West Bengal, India.
	Keynote Speaker **Prof. Arabinda Das** Professor, Department of Electrical Engineering, Jadavpur University, 188, Raja S. C. Mullick Road, Kolkata 700032, West Bengal, India.
	Keynote Speaker: **Prof. Danijel Pavkovic** Full Professor, University of Zagreb, Croatia Faculty of Mechanical Engineering and Naval Architecture.
	Invited Speaker**:** **Dr. Rajesh Dey** Associate Professor, Gopal Narayan Singh University, Sasaram-Tilauthu Road, Jamuhar, Rohtas, Bihar, India
	Invited Speaker: **Dr. Marta Zurek-Mortka** General Chair, ESDA2025 Senior Researcher, Lukasiewicz Research Network - Institute for Sustainable Technologies, Radom, Poland,
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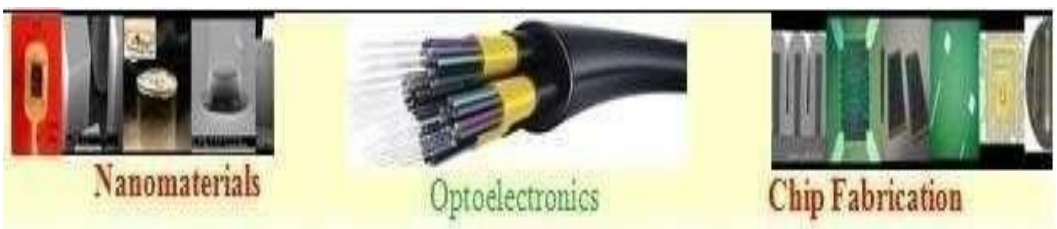

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