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SHORT BIO

Ravita Lamba, having 6+ & 10+ years of teaching and research experiences respectively, is currently working as Assistant Professor in the Department of Hydro and Renewable Energy at IIT Roorkee. Prior to this, she worked as Assistant Professor in the Department of Electrical Engineering at MNIT Jaipur and in Department of Electrical and Electronics Engineering at NIT Delhi and as Project Engineer at NISE, Gurugram. She has been awarded the SGSITS National Award for Best Research Work done by Young Teachers of Engineering Colleges for 2024 by Indian Society for Technical Education. She has also been awarded Distinction in Doctoral Research Award for the PhD research work for the year 2018 by IIT Delhi and Research Excellence Award by the International Organizing Committee under the Research Foundation of Kolkata, India in 2021. She was a visiting fellow at the University of Exeter, United Kingdom through the SERB International Research Experience (SIRE) fellowship for year 2022-2023 awarded by SERB, DST. She was also a visiting researcher at the University of South Florida, FL, USA through BHAVAN Fellowship for year 2017-2018 awarded by DST, GoI and IUSSTF. She is the member of APEN Young Editorial Board, Applied Energy Journal, Elsevier and Editorial Board Member of Scientific Reports Journal, Nature. She has carried out research projects funded by DST and SPARC of worth almost 1 Cr. She is actively involved in the research fields including Solar Photovoltaic & Thermal Systems, Thermoelectric Devices, Modeling & Optimization of Energy Systems, Battery Thermal Management, Building Integrated PV Systems and Radiative Cooling Systems. She has published more than 90+ research papers in peer reviewed journals including 5 book chapters & international conference proceedings and one book titled “Thermoelectrics Energy Systems: Modeling and Applications”. She has been awarded best research paper/poster awards twice in international conferences. She is having international exposure of presenting her research work in Florida, (USA), California, (USA), United Kingdom, Croatia etc. She is the member of editorial board in the Journal of Modern Mechanical Engineering and Technology, Zeal Press, Editorial Board Member & Review Editor of Solar Energy in the Frontiers in Energy Research Journal, Associate Editorial

Board Member/Section Editor in Material Science Section of the Current Indian Science Journal. She is the Senior Member of IEEE (USA) society, member of The Institution of Electronics & Telecommunication Engineers (IETE), The Institution of Engineers India (IEI) and member & mentor of Global Women's Network for the Energy Transition (GWNET) and the life member of Soft Computing Research Society, Indian Desalination Association & Solar Energy Society of India (SESI), and Advisory Board Member of Renewable Energy Society of India (RESI).

Award:

Best Poster Award for the research work titled "Attention based mechanism for State-of-Health estimation of Li-ion batteries" during the IEEE 4th International Conference on Sustainable Energy and Future Electric transportation (SEFET) 2024 held on 31 July-03 Aug 2024 at Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, India.

DL Topics

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Topic # 1 Energy Management of Data Center Microgrid with Waste Heat Recovery

In the 21st century, data is considered as the new oil or gold. Increased global digitization has led to vast data generation that needs to be stored in data centers. A data center serves as the backbone of the digital economy by providing necessary infrastructures for storage, computing and networking that powers big data analytics, cloud services, and enterprise applications. With the exponential progress in internet usage, AI workloads and IoT devices, the modern data centers experience several challenges including the increased demands for scalability, efficiency, and reliability. Further, the rapid proliferation of data center infrastructures has made the energy consumption and thermal waste as the critical concerns. These prompt the need for sustainable and efficient energy solutions. The utmost priority of a data center service provider is to provide a reliable and flexible services to its end users. To meet these services, a continuous operation of data center is required. Data center microgrids are explored as an effective choice to enhance reliability and energy efficiency. However, the large energy consumption in the data center produces a significant amount of heat and instead of wasting this heat, it can be further utilized to meet the heating demand in data center microgrids. Therefore, a waste heat recovery based energy management of data center microgrid has been proposed using different metaheuristic approaches including LSHADE algorithm as well. The main aim of this analysis is to reduce the operational cost of data center microgrid subject to the constraints considering onsite diesel generators and renewable energy sources, both heat and electrical energy storage systems. It has been observed that the LSHADE algorithm obtained an optimized operational cost and outperforms among different algorithms in terms of convergence speed, statistical, and boxplot analysis. This study analyses the potential of waste heat recovery as a key enabler for green and self-sustaining data center operations in the context of different data center microgrids.

Topic # 2: Development of distributed economic model predictive control for PV/Hydrogen DC microgrid

The increasing integration of renewable energy sources into microgrids present substantial challenges in ensuring optimal performance, reliability, and economic efficiency. The integration of hydrogen energy into a photovoltaic (PV)-based DC microgrid is now becoming a promising approach to enhance the operating reliability and to improve the conversion efficiency. However, the power regulation and energy management of PV/Hydrogen DC microgrid face challenges due to the intermittency of PV power generation and the randomness of load. Therefore, this study proposes a novel control scheme for a PV/hydrogen-based DC microgrid using distributed economic model predictive control (DEMPC). This scheme integrates the energy management and economic optimization. The system architecture leverages PV generation, hydrogen energy storage (via fuel cells and electrolyzers), and DC loads within a unified microgrid framework. Three local controllers are developed to achieve the economic targets of PV, electrolyzer and fuel cell subsystems using the mathematical model of the developed distributed converter. The subsystems coordinate with each other through the communication network to realize the DC bus voltage stability, power supply–demand balance and economic optimization. A mixed integer nonlinear programming (MINLP) algorithm with the finite converter switching states is embedded into the DEMPC to effectively solve the non-convex local optimization problems. DEMPC permits decentralized controllers to coordinate in real time, optimizing local objectives such as cost minimization, power balance, and hydrogen production efficiency while maintaining global system constraints. The control strategy being predictive allows the system to anticipate fluctuations in load demand and solar irradiance, thus, enhancing robustness and dynamic response. The superiority and effectiveness of the proposed DEMPC scheme are verified by simulations under varying load conditions and irradiances. It indicates that the DEMPC has better overall dynamic economic performance as compared to the centralized economic model predictive control (CEMPC). The proposed DEMPC approach reduces the operational costs, improves the energy management and supports scalability as compared to centralized and heuristic-based control methods. This work highlights the potential of distributed predictive control as a key enabler for flexible, intelligent and sustainable DC microgrids.

Topic # 3: Floating Photovoltaic Solar Power Plants in India: Challenges and Opportunities

Floating Solar Photovoltaic (FSPV) systems have emerged as a promising technology to expand renewable energy capacity by leveraging underutilized water bodies while minimizing land use. In the FSPV systems, the PV modules are installed on buoyant platforms atop reservoirs, lakes, and other bodies of water. In India, FSPV technology offers a transformative opportunity by escalating its renewable energy capacity and simultaneously mitigating the land scarcity issues. India, having huge water bodies, stands at better position by leveraging FSPV systems to achieve its ambitious renewable energy target and thus ensuring a strong commitment to clean energy. The FSPV systems can achieve higher energy yields and improved panel efficiency due to the cooling effect of

water. This study explores the unique challenges and opportunities associated with the deployment of FSPV technology in the Indian context. The key challenges include technical issues such as structural design to withstand wind and wave loads, water-induced corrosion, anchoring and mooring stability, water encapsulation prevention, system stability under monsoon conditions, long-term durability of materials in humid and corrosive environments, maintenance accessibility, limited local expertise as well as regulatory hurdles. Further, the environmental considerations concerns related to aquatic ecosystem impacts, water temperature stratification, water quality and compatibility with existing water use must be addressed. At one hand, FSPV systems offer significant benefits, including higher panel efficiency due to natural cooling, reduced water evaporation from reservoirs, reduced land competition, potential synergies with hydropower facilities (reduced evaporation and shared infrastructure), and faster permitting on existing reservoirs and optimal land conservation in densely populated areas. Additionally, advancements in corrosion-resistant coatings, flexible float design, and dynamic array configurations further enhance feasibility of FSPV systems. The integration of FSPV technology with the existing hydroelectric dams also opens avenues for hybrid energy solutions. The economic analysis of the FSPV plants recommend that these systems can achieve competitive levelized costs of electricity (LCOE) in regions with high land prices or extensive water resources despite their higher installation costs. With several pilot projects already underway in states like Madhya Pradesh, Kerala, Tamil Nadu, Kolkata, Punjab, this study highlights the need for policy support, robust technical standards, and investment incentives to accelerate FSPV technology adoption in India. Overall, FSPV technology represents a promising solution for sustainable energy development in water-rich regions of the country.