Journal Name: Scientific Reports **IF: 4.9**

Title: Electro-thermal benchmarking of low-order lithium-ion battery equivalent circuit models under constant-current and dynamic loading

Author: Mishra S.; Swain S.C.; Mayaluri Z.L.; Sahoo P.K.; Samantaray A.K.

Details: Volume16, Issue-1, December 2026

Abstract: Low-order equivalent circuit models (ECMs) are widely used in battery management systems (BMSs) because they balance accuracy with computational efficiency. Here we present a harmonised electro–thermal benchmark to evaluate voltage accuracy, heat-generation consistency, and temperature prediction under both constant-current and dynamic loading conditions. Three low-order model structures are assessed: the internal-resistance (Rint) model, the first-order Thevenin (1RC) model, and a compact hybrid electro–thermal 1RC model that incorporates bounded electrical adaptation and a two-node thermal network. Model parameters are identified using standard open-circuit-voltage and pulse-based experiments, while thermal parameters are obtained independently from heating–cooling tests and held fixed during validation. Performance is evaluated using commercial 18650 lithium-ion cells across ambient temperatures of 0C,25C and 40C under both laboratory and drive-cycle-inspired load profiles. The results show that increasing electrical model fidelity substantially improves voltage tracking under dynamic conditions and leads to more consistent heat-generation pathways when coupled to a fixed thermal model. Under the strict hold-out profile inspired by the Worldwide Harmonized Light Vehicles Test Cycle (WLTC) at 25C, the hybrid electro–thermal 1RC model delivers a voltage root mean square error (RMSE) of mV, a surface-temperature RMSE of C, and a heat-generation consistency mismatch of (mean ± SD across cells). These results provide quantitative guidance for selecting compact electro–thermal battery models for real-time applications under dynamic operation.

URL: https://www.nature.com/articles/s41598-026-44025-2

Journal Name: Scientific Reports **IF: 4.9**

Title: Adaptive long short term memory-PI based control for load frequency regulation in electric vehicle integrated two area power systems

Author: Das S.K.; Swain S.C.; Nayak B.; Dash R.; Osumanu F.; Mohapatra B.; Al Bustanji S.; Rubanenko O.

Details: Volume-16, Issue-1, December 2026

Abstract: The growing penetration of electric vehicles (EVs) and renewable energy sources has introduced significant nonlinear and stochastic disturbances in modern power systems, posing major challenges to conventional load frequency control (LFC) strategies. To address these issues, a Long Short-Term Memory-based Proportional Integral (LSTM-PI) controller is proposed to enable adaptive frequency regulation in a two-area EV-integrated system. The LSTM network dynamically tunes the proportional and integral gains in response to temporal variations in frequency and tie-line states. The learning module is trained using an Integral of Time weighted Absolute Error (ITAE) objective. Practical non-linearities such as governor deadband, generation-rate constraints, valve saturation, and EV state-of-charge limits are incorporated into both the training dataset and the online control evaluation. A constrained Model Predictive Control (CMPC-PI) is developed as a modern benchmark to compare the proposed technique under identical sampling rates and actuator limits. The proposed method shows better performance under dynamic conditions. Statistical performance analysis has been carried out through 30 runs of Monte Carlo analysis with a mean of 95% confidence intervals. Stability analysis under time-varying gains is supported by a bounded-gain Lyapunov Framework and a delay-margin analysis that addresses sensing and actuation delays. The result analysis confirms that the LSTM-PI controller provides a scalable intelligent solution for modern EV-integrated smart grid frequency regulation. The proposed intelligent adaptive controller provides a scalable, low-complexity, and stability-assured solution for robust load-frequency regulation in nonlinear, EV-integrated smart power grids.

URL: https://www.nature.com/articles/s41598-026-49840-1

SCHOLARLY PUBLICATIONS
School of Electrical Engineering
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Journal Name: IEEE Journal of Emerging and Selected Topics in Industrial Electronics **IF: 4.9**

Title: Intelligent Level-Shifted PWM Controlled PV-Fed Multilevel Inverter with Advanced Partial Shading Detection and GMPP Tracking Capability

Author: Soni A.K.; Jana K.C.; Gupta D.K.

Details: 30th June, 2026

Abstract: This paper presents a fast and accurate hybrid Global Maximum Power Point (GMPP) Tracking technique for solar photovoltaic (PV) systems operating under Partial Shading Conditions (PSCs). The proposed method enables precise detection of PSCs and reliable tracking of the GMPP, overcoming the limitations of conventional MPPT algorithms that often struggle with multiple local maxima in the P–V characteristics. The GMPPT algorithm is integrated with a PV-fed multilevel inverter (MLI) for AC load applications. A novel Intelligent Level Shifted Pulse Width Modulation (I-LSPWM) strategy is employed to optimize the inverter's output waveform, effectively reducing Total Harmonic Distortion (THD) and mitigating the adverse impact of shading on power quality. The proposed approach achieves approximately 26–36 % reduction in THD compared to conventional LSPWM under PSC scenarios. In addition, the hybrid intelligent optimization technique (HIOT) attains faster GMPP convergence within 0.49–0.57 s, compared to 0.83–2.37 s for existing algorithms, with transient efficiency exceeding 95%. The proposed system is further evaluated using an extended version of EN 50530 dynamic MPPT test under dynamic irradiance and PSCs. Validation is carried out through MATLAB/Simulink simulations and experimental implementation using a dSPACE DS1104 controller. Results demonstrate enhanced tracking performance, reduced steady state oscillations, and improved power quality, confirming the effectiveness of the proposed method for PV-fed MLI systems under dynamic shading conditions.


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URL: https://ieeexplore.ieee.org/document/11588780

SCHOLARLY PUBLICATIONS
School of Electrical Engineering
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Journal Name: IEEE Access **IF: 4.2**

Title: Hybrid Renewable Energy System Incorporated With Shunt Active Power Filter with Improved Control Technique for Power Quality Mitigation

Author: Mishra P.K.; Samal S.; Jena C.; Barik P.K.; Jha A.V.; Appasani B.; Bizon N.

Details: Volume-14, 29th June, 2026

Abstract: This work investigates integrating a shunt active power filter (SAPF) with renewable energy sources (RESs) to enhance harmonic mitigation and overall power system performance. Hybrid renewable energy sources (HRES) combine RESs and manage them with smart strategies aimed at maximizing power point tracking in wind and PV energy setups. This research, therefore, proposes a new solution: an HRES carefully combined with a SAPF for the efficient mitigation of power quality. The performance of the SAPF largely depends on its control loops, as these determine its ability to generate sufficient compensating current. Fluctuations in the dc link voltage can disrupt the system's operation. Normally, this voltage is kept high and steady, influenced by the power demand, but under light load conditions, it may rise excessively, causing switching noise and higher losses. To overcome this issue and keep the dc link voltage stable while also reducing total harmonic distortion from both balanced and unbalanced nonlinear loads, RES is integrated on the dc side of the SAPF, which offers better voltage regulation than conventional methods. The anticipated tactic is tested further down both ideal and distorted grid situations, with varying load patterns, and its performance is benchmarked against other existing control strategies.

URL: https://ieeexplore.ieee.org/document/11585761

SCHOLARLY PUBLICATIONS
School of Electrical Engineering
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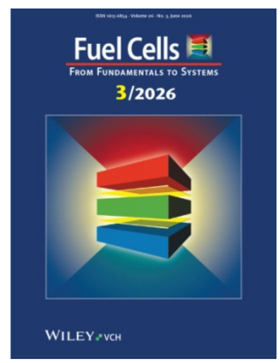
Journal Name: Fuel Cells **IF: 3.1**

Title: A Review Study on Optimization of Load Frequency Control in Marine Microgrid Systems Using Advanced Controllers and Algorithms

Author: Prusty C.; Rout B.; Mohapatra S.S.

Details: Volume-26, Issue-3, June 2026

Abstract: Marine microgrids are gradually adopted in modern shipboard power systems; however, maintaining frequency stability under varying load conditions and operational uncertainties remains a main challenge. The objective of this study is to systematically review and examine the optimization of load frequency control (LFC) in marine microgrid systems using advanced controllers and intelligent optimization algorithms. The methodology includes a comprehensive review of literature on classical and modern LFC techniques, dynamic modeling approaches, innovative control strategies, metaheuristic optimization methods, and machine learning-based solutions for frequency regulation. The key results specify that conventional PI/PID controllers provide basic frequency control but exhibit limitations under highly dynamic marine conditions. Advanced controllers, including adaptive, robust, optimal, and intelligent control strategies, validate improved frequency regulation, stability, and disturbance rejection capabilities. Also, optimization algorithms such as particle swarm optimization, genetic algorithms, and machine learning techniques enhance controller tuning, system robustness, and dynamic response. Comparative analysis shows that hybrid approaches combining advanced control methods with optimization algorithms offer superior performance compared to standalone techniques. In conclusion, optimized LFC is vital for reliable marine microgrid operation, and hybrid intelligent control frameworks signify the most promising solution. Future research should focus on lightweight, real-time adaptive models to overcome computational and implementation challenges while confirming sustainable and resilient marine power system performance.



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