



SCHOLARLY PUBLICATIONS

School of Electrical Engineering

KIIT Deemed to be University

Journal Name: Journal of Energy Storage

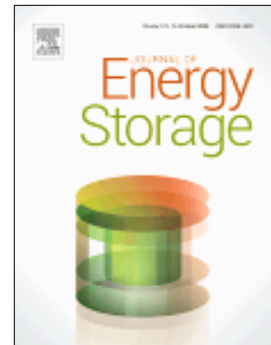
IF: 10.7

Title: Optimal bio-inspired fuzzy adaptive control strategy for frequency and power control of a battery-integrated AC microgrid

Author: Das M.C.; Swain S.C.; Sahu P.C.; Bhatta S.K.; Bassir D.; Tejani G.

Details: Volume-179, November 2026

Abstract: This research manuscript presents a resilient fuzzy adaptive exponent control (FAEC) strategy for managing power distribution among distributed generation (DG) units in an islanded AC microgrid under various loading conditions. The microgrid is basically a hybrid type and incorporates several DGs like wind generator, solar PV system, diesel generator, micro-turbine, thermo-electric system and fuel-cell for the generation of desired electricity. The energy storage systems, such as battery systems and super capacitors, are also integrated with the microgrid system. Since the microgrid incorporates several inertia-less DGs, the system may face huge frequency instability issues under load dynamics. Further, the intrinsic nature of wind fluctuation and solar intensity deviation creates power generation issues in the microgrid system, especially in islanding operations. The typical islanding mode of operation needs more attention in dynamic load scenarios. In different load dynamic situations, the output power management of each individual DG is important for the reliable operation of the microgrid. As per the new load demand, the individual DG unit cordially takes up the additional demand without fluctuating the system frequency. This needs an effective secondary control mechanism to sort out the additional load demand smoothly. In this regard, the study has recommended a fuzzy adaptive exponent controller for energy management of the microgrid system. The controller offers its best effort at the optimal parametric situation. In optimal design concern, the study has anticipated a novel Botox optimization algorithm (BOA) for tuning the gains of the FAEC controller. To justify novelty, the optimal performance of the FAEC controller is compared with basic fuzzy PID and PID controllers. The recommended FAEC approach is able to stabilize the zone1 power ($\Delta PZ1$) faster through 105.24% and > 500% as compared to the fuzzy-PID controller and the conventional PID controller respectively. Further, the optimization and supremacy behaviour of the anticipated BOA approach is evaluated statistically, over gradient search algorithm (GSA), standard SCA and PSO algorithms.



URL: <https://www.sciencedirect.com/science/article/pii/S2352152X2603344X?via%3Dihub>





SCHOLARLY PUBLICATIONS

School of Electrical Engineering

KIIT Deemed to be University

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

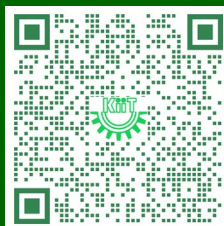
Author: Mishra S.; Swain S.C.; Mayaluri Z.L.; Sahoo P.K.; Samantaray A.K.

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 (R_{int}) 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 $\pm$ SD across cells). These results provide quantitative guidance for selecting compact electro–thermal battery models for real-time applications under dynamic operation.

SCIENTIFIC
REPORTS

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





SCHOLARLY PUBLICATIONS

School of Electrical Engineering

KIIT Deemed to be University

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 nonlinearities 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>

