Intern. J. Fuzzy Mathematical Archive
Vol. 24, No. 2, 2025, 71-87
ISSN: 2320 –3242 (P), 2320 –3250 (online)
Published on 24 December 2025
www.researchmathsci.org
DOI: http://doi.org/10.22457/ijfma.v24n2a06258

International Journal of Fuzzy Mathematical Archive

Fuzzy-Logic–Based Thermal Management and Performance Regulation of EV Battery Systems Using Integrated Modelling and MATLAB Simulation

R.Tamilamuthan*[*1], Farshid Mofidnakhaei[2], Alimohammad Fallah Andevari[3]
and *N. Ramya*[4]
[*1]Department of Electrical and Electronics Engineering,
PERI Institute of Technology, Chennai-48, India.
E-mail: tamilamuthan.rdg@gmail.com
[2]Department of Physics, Sar. C., Islamic Azad University, Sari, Iran.
E-mail: farshid.mofidnakhaei@gmail.com
[3]Department of Mathematics Education, Farhangian University,
P.O. Box 14665-889, Tehran, Iran.
E-mail: alimohamad.fallah@yahoo.com
[4*]Department of Mathematics, Kongu Engineering College,
Perundurai, Erode- 638060, Tamil Nadu, India.
E-mail: jpramyamaths@gmail.com
[*]Corresponding author

Received 12 November 2025; accepted 20 December 2025

Abstract. One of the most significant issues in electric vehicles is the fear of battery overheating, which raises reliability and safety concerns, particularly during fast charging or heavy loading. Intense heat accelerates ageing, increasing internal resistance and increasing the risk of thermal runaway. The usual thermal-management systems based on fixed blockades or manually regulated control strategies often intervene too late, resulting in incident-free overcooling, and take unnecessary action to take power. In this work, the integration of lumped thermal modelling and an adaptive fuzzy-logic controller was unified to create a thermal management framework in MATLAB. Rust generation is modelled through the phenomenon of ohmic losses. Convective heat dissipation is worked out under natural, forced, and enhanced cooling regimes. With the help of the fuzzy controller, battery temperatures and the rate of temperature increase are treated as decision variables, so that it eventually adjusts the cooling intensity according to the flow-inference rules. The regulation is smooth and intelligent, without the need for accurate parameter tuning or access to training data. The simulation results indicated a significant temperature drop each time the fuzzy controller was applied to a temperature level above 50 to 55°C under control conditions. At the same time, stabilisation occurs faster, while maintaining good energy-efficient operation. The proposed alternative provides a practicable way to integrate intelligent, computationally simple, and robust thermal-management systems into electric vehicle battery systems, thereby enabling safer operation and longer life while achieving better performance under load.

Keywords: Electric vehicle battery, fuzzy logic controller, thermal management, MATLAB simulation, heat production, convection cooling, intelligent control, battery safety, temperature regulation, fast recharging.

AMS Mathematics Subject Classification (2010): 16S99, 05C72

1. Introduction

1.1. Statement of problem

Initially, environmental consciousness and rising greenhouse gas emissions have forged the path for the successful implementation of electric vehicles (EVs). Battery overheating stands very crucial in the handling of the vehicle as the prospect of any effect is crowned for which heavy degradation of battery cells, capacity fading, and in the worst cases, thermal runaway cases may occur due to thermal-related damage, such as localized hotspots and uneven aging across cells under high-rate charging, deep discharge, and aggressive driving episodes where severe heat bursts take place. Therefore, efficient means for heat management for batteries is essential to ensure the reliability, longevity, and safe operation of EV systems.

1.2. Research gap

Existing passive methods of cooling, including passive cooling plates or elementary air-cooling systems, generally fail to maintain the battery in the recommended optimal temperature range of 20–35 °C while operating in realistic dynamic conditions. Many existing techniques increase system complexity or consume more power, thereby reducing vehicle efficiency. Furthermore, many studies examine only steady-state heat-transfer performance while ignoring transient heat loading and unloading dynamics under variable-load conditions. There is a need for a simple, analytically well-supported, and experimentally demonstrable thermal model that accurately predicts the temperature ramp and evaluates various cooling strategies under varying operating conditions.

1.3. The proposed solution and scope of work

An outline is developed to research the heat management system of EV batteries using mathematical simulation techniques in MATLAB. A lumped thermal model has been established to compute internal resistance and electrochemical losses that generate heat, followed by analysis of the various cooling mechanisms, such as natural convection and forced convection. This framework allows comparison of the temperature profile across various discharge currents, cooling coefficients, and ambient conditions. Hence, complexity, cost, and energy consumption can be minimisation criteria, while the findings of this analysis could provide design guidelines to select the best-fit thermal-management arrangement.

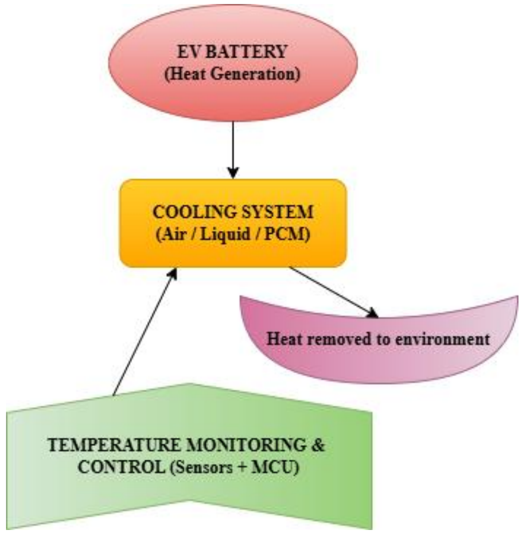

Figure 1: Schematic of EV battery thermal-management framework

This is illustrated in Figure 1, drawing a conceptual diagram of the proposed EV battery thermal-management framework, establishing the relationship among heat generation, cooling mechanism, and temperature response.

1.4. Related work

This has systematically described the varying strategies and tactics selected by researchers to pave the way for strong EV charging performance through power conversion and control. The inverter-based high-gain interleaved SEPIC for EV-charging designs with increased gain and efficiency improvements addressed in [1] is a step in the right direction. The research works narrated by [2] are on the back of trying to examine most difficult thermal and fluid flow descriptions that make them significant foundations in understanding of the thermal phenomena. All those studies, however, failed to address EV charger components. Works cited in [3] recapitulate extensive thorough moves such as holistic system management, whereas nothing is said on the importance of high-speed EV charger control. As detailed by [4], the hybrid optimization takes advantage of broader opportunities with "networks" such as increased capacity and robustness, forgetting entirely the context of converter-level charging actions. The converter control mechanism, as suggested in [5], can bring a marked improvement in ripple rejection and dynamic behavior, while, conversely, the compiler appears unsuitable for fast and secure EV charging. Consequently, these papers underscored the achievement of converter and control strategies as well as optimization techniques, hinting as well that the path ahead has to narrow down to possibly specific control strategies applicable to EV charging systems.

2. Literature survey

Heat effects, heat transfer mechanisms, and advanced mathematical modeling appear in all spheres of emerging engineering systems for vernacular references. Radiation and diffusion effects in hybrid nanofluids are analyzed based on a study reported in [6] along with related theoretical framework for transport problems. Moreover, optimization for devices with low-power circuit design is extensively discussed in [7], espousing its concerns on strategies to lessen the defeats in electronic systems. [8] Discusses network-oriented routing enhancements through hybrid heuristic optimization, with [9] addressing renewable energy-assisted EV charging with flexible energy coordination to show the relevance of hybrid control strategies in the field of electric flexibility. The paper [10] looks at the influence of electromagnetic and magnetic effects on complex fluid flows by providing deeper thermal-flow analytical tools extended to energy systems. Communication networks: Performance improvement and high throughput methodologies are looked into in [11]. Moreover, [12] delves into fuzzy logic based control strategies for improved control on EV charging under varying operating conditions.

Some other contributions have addressed hybrid fuzzy systems, chemical reactions, and nonlinear modeling [13], while blockchain-supported data management technologies for secure-powered environments are elaborated in [14]. Foreseeable intelligent charging operations that depend on machine-learning algorithms are discussed in [15], highlighting the breakthrough on the application of AI to manage asset demand and energy transfers. Joint comprehensibility of thermal performance of nanofluids in compact heat exchanges enhanced the understanding of multiphysics interactions described in [16]. In a comparatively broader approach, thermodynamics modeling and entropic modeling methodology of nanofluids are displayed in [17]. The following work presents a nanofluid flow through bio-transport; as a consequence, microheat for more advanced introduction to nanofluid heat transfers into the world of numerically computed literature. Specifically, intelligent-security-control concepts are treated in [19], while discussions on energy theft prevention and smart-metering frameworks are addressed in [20], clearly demonstrating successful application of control integration in a power system.

The works discussed temperature fields in non-Newtonian metros in arbitrary geometries [21], further in the manner of aerospace transformer enhancements [22], and so displaying a rich design adaptability of high-performance platforms. Agricultural supervision guided through artificial intelligence and automation in industries is then dealt with in [23], while infiltration effects through porous media with biochemicals are covered in [24]. [25] adds on selective layers of nano-composites as pertains to insulation dependability, while [26] brings in advanced heat-transfer formulations through semi-simple-layered fluxes. A set of algorithms provides for a deep-learning-based technique for classification of landcover from satellite data [28]. For data-driven modeling, that brings an advanced form of smartness to development trends. In [29], IoT based condition-monitoring strategies are explained in broad design. On the other track, [30] proposes a briefly written discussion of predictive analytics models which have been optimized with ML. Now artificial intel lence to help doctors with the diagnosis of referrals while coordinating future research is presented in [27]. Lastly, the concrete digital-trust solutions through extending them to environmental systems [31] form the last paper in this round with a warming-up introduction.

Both simulation models of nanofluids in fuzzy-graph theory [32], as well as two case studies of EV charging stations linked to RFID [33], relate practically to smart mobility infrastructure. The purpose of the article would be to demonstrate functional AI adoption across business domains by optimising financial risk with gradient boosting models [34]. The other paper, which is all about pure research, presents a comprehensive review contrasting DC-DC-bidirectional converters for the application in electric vehicles [35]-the considerations that are important to know in the development of advanced electric vehicle platforms are finely designed for in-depth analysis and strategies. These convoluted reviews in optimization, artificial intelligence (AI), control strategies, energy, and thermal-fluid analyses strongly suggest methodological orientations and impinge upon future research activities aimed at structuring reliable, efficient, and thermally-robust EVs.

3. Proposed methodology

3.1. Overview of the fuzzy-logic-based thermal management framework

The proposed methodology for analysis of the history of batter temperature in EV Battery modules using lumped thermal modeling encapsulated with intelligent controller based on fuzzy logic. There are heat flows from the inner losses due to ohmic losses and electrochemical reactions; the heat is then dispersed by natural and forced convection at the surface of the battery. In the proposed conceptual framework, cooling effort is dynamically modified by the controller in real-time adapting according to temperature-induced stresses, as opposed to the more rigid fixed early setpoints or predictive strategies in the name of additional safety and energy conservation for extras. The methodology provides room for studying the thermal response of the battery subject to various discharge current profiles, cooling coefficients of the battery system, and multiple ambient conditions in preparation for the possible implementation of optimal thermal management strategy for electric vehicles.

3.2. Mathematical modelling of battery heat generation

The internal heat generation of the battery is modeled using electrical loss and polarization effects. The instantaneous heat generated is expressed as

$$Q_{gen}=I^2R_{int} \tag{1}$$

where, I is discharge/charge current and R_{int} is internal resistance.
The battery temperature rise is computed from the energy balance:

$$mC_p\frac{dT}{dt} = Q_{gen} - Q_{loss} \tag{2}$$

where, *m* is mass, C_p is specific heat, and Q_{loss} is heat removed.

Heat loss through convection is modeled as:

$$Q_{loss}=hA(T-T_{amb}) \quad (3)$$

where, h is convective coefficient, A is exposed surface area, and T_{amb} is ambient temperature.
The cell temperature evolution becomes:

$$\frac{dT}{dt}=\frac{I^2R_{int}-hA(T-T_{amp})}{mC_p} \quad (4)$$

To ensure safe operation, a control constraint is introduced:

$$T_{safe} \leq T \leq T_{max} \quad (5)$$

where, T_{max} is the maximum allowable battery temperature.

3.3. Fuzzy controller aware of battery temperature

The fuzzy controller decides the degree of cooling by converting the battery temperature behavior into a linguistic form rather than adhering to any strictly numerical thresholds. One has to keep in mind two variables:

i. Battery temperature (T)
ii. Rate of temperature rise (dT/dt)

Each of these two variables is subdivided into fuzzy sets like Low, Medium, and High for temperature and Slow, Normal, and Fast for temperature rise. The output of the cooling level is correlated to the respective cooling zones in terms of the corresponding cooling coefficients (III) for Off, Mild, Medium, and Aggressive cooling.

The conventional fuzzy rules will say:

IF T is Low AND dT/dt is Slow → Cooling = Off
IF T is Medium AND dT/dt is Normal → Cooling = Mild
IF T is High AND dT/dt is Fast → Cooling = Aggressive

Following the Mamdani inference mechanism, defuzzification is applied to generate a numerical command for the cooling system. This rule-based reasoning allows smooth and adaptive reaction to thermal variations without requiring detailed battery parameter tuning or predictive training data.

3.4. Simulation procedure and assessment

Using MATLAB, the entire model is in practice. For every simulation step, the thermal model computes the instantaneous temperature, from which the temperature gradient is obtained. These values are fed into the fuzzy controller, which updates the effective convection coefficient hhh. The resulting cooling intensity dynamically regulates battery temperature.

Simulations are to be undertaken by considering:

1. Multiples of C-rates, ranging from 0.5 to 3 C.
2. Natural, forced, and enhanced convection levels
3. Different ambient environmental conditions
4. Performance-predictions are founded on peak temperatures, stabilization time, and the preservation of thermal limits.

3.5. Workflow

A. Collect the electric and thermal parameters of the battery.
B. Calculate heat generation and convective heat loss.
C. Estimate temperature evolution based on the lumped thermal model.
D. Estimate temperature rise rate.
E. Apply Fuzzy rules to determine cooling intensity.
F. Update cooling coefficient and iterate through simulation.

This structured loop aims for effective thermal control, reduces thermal stress, and avoids unnecessary power consumption associated with continuous high-intensity cooling.

3.6. Validation and significance

The proposed MPPT with ANN-based method offers a most promising approach for implementing EVs in battery management systems. The concept is realistic and can be demonstrated on an experimental basis when attached to the control system via a temperature sensing device within programmable cooling hardware. The rule-based control is robust under different driving and charging scenarios, while recording a simple and reliable computation level. The observance of Battery and Thermal parameters, utilized therein, is shown in Table 1. Table 2 gives the Cooling System Operating Conditions.

Table 1: Battery and Thermal Parameters Used

Parameter	Symbol	Value (Example)	Unit
Nominal capacity	(C_{nom})	50	Ah
Internal resistance	(R_{int})	0.002	Ω
Mass	(m)	25	kg
Specific heat	(C_p)	900	J/kg·K
Surface area	(A)	0.35	m^2

Table 2: Cooling System Operating Conditions

Case	Cooling Type	(h) (W/m^2K)	Comment
Case 1	Natural convection	5–10	Baseline
Case 2	Forced air cooling	15–25	Moderate cooling
Case 3	Enhanced cooling	30–50	Aggressive cooling

4. Results and discussion

4.1. Battery temperature rise under baseline operation

Figure 2 represents the thermal characteristics of the battery at 1C discharge with no cooling. With time, the battery temperature evolves in a slightly slope shape. The continuous upward temperature trajectory moderates the non-flatter slope until approaching a mark. The most probable explanation for this is Joule heating. This waste heat is produced inside the cell due to its resistance and current input. As the discharge current remains the same, the heat accumulates with no way of dissipating it, leading to an upward temperature ramp. Thus, we arrived at the conclusion that lessons learned from this experiment are that these batteries have to be actively and promptly cooled within the narrow range of 40C to 50°C.

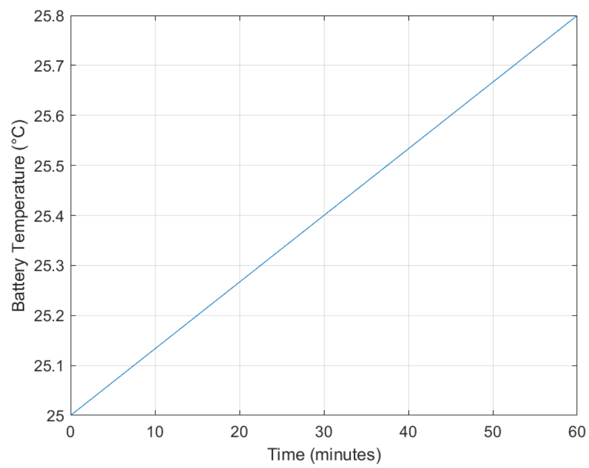

Figure 2: Battery temperature rise during 1C discharge without cooling

4.2. Heat generation behavior at different C-rates

Finally, the impact of discharge rates on heat generation can be observed in Figure 3, where the heat generation was considerably higher at a reasonable level of C rates, as expected. Heat generation increases almost exponentially as we rise to 2C and 3C (the exception to this figure is the 0.5C to 2C comparison, which is merely linear in log scale). The mean heat generation shows an undeniable square control on the current, meaning an increase in two-fold current could lead to four folds of heat generation. It makes the case for the urgent need of active thermal management strategies for the avoidance of dramatic thermal incidents associated with high-power charging and discharging currents.

$$Q_{gen} \propto I^2 \quad (6)$$

In plain terms, one can predict that if the current carried by the electrode is doubled, the heat buildup could be near quadrupled-quite a convincing argument for the necessity of an intelligent heat control to limit overheating during fast charging.

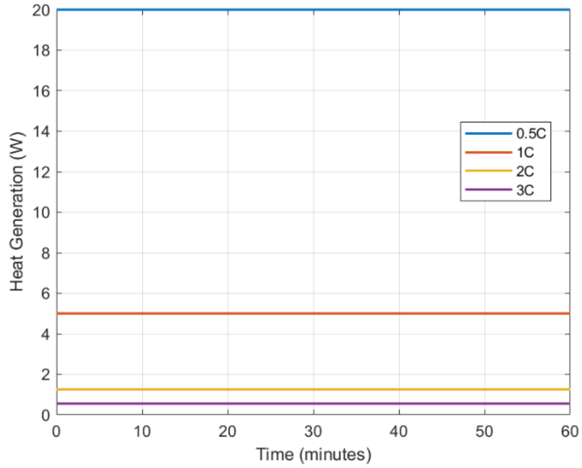

Figure 3: Heat generation characteristics of the battery under different C-rates

The relationship is governed by:

4.3. Effectiveness of forced convection cooling

A graph representing battery temperature with and without cooling is provided in Figure 4. It shows that when forced convection is applied, not only does the peak temperature drop significantly but the temperature rises much more gradually. In the un-cooled scenario, the locked condition perpetually rises in temperature; in contrast, in the cooled setup, leveling off at a much lower temperature entirely due to continuous extraction of heat from the surface of the battery. Such a result further confirms the importance of thermal management strategies like air cooling fans, liquid cooling, or PCM-assisted systems.

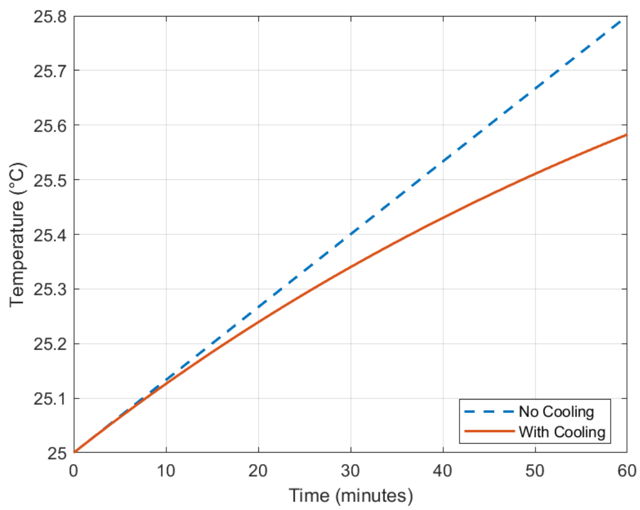

Figure 4: Comparison of battery temperature rise with and without forced convection cooling

The reduction in temperature may be described by the convective heat-loss expression:

$$Q_{loss}=hA(T-T_{amb}) \quad (7)$$

where, higher values of the convective coefficient h correspond to more effective cooling performance.

4.4. Effect of cooling coefficient on temperature development

The rate of substance for very large coefficients of cooling is zero (increasing convection heat transfer coefficient) allowing the initial compressive temperature peak to be put towards the floor, because it will likewise disappear within a short period of time. It is mainly the correspondence of the cooling interface including air cavities, surface fins, size and rate of the cooling fluid flow, and area of contact that would broadly decide the ultimate thermal behavior of the system. In such terms, high cooling coefficients can ensure that heat is evenly transferred across the battery surfaces to cancel out hot spots-selectively enhancing cell safety and battery service life.

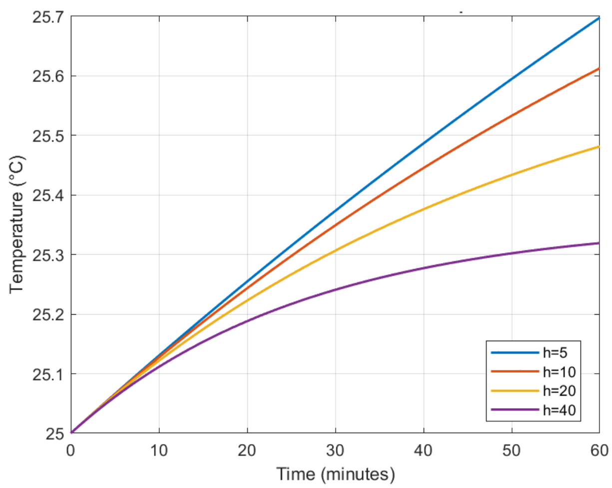

Figure 5: Effect of convective heat-transfer coefficient (h) on battery temperature evolution

4.5. Steady temperatures versus discharge currents

Interestingly, the steady-state temperature curves shown in Figure 6 provide insights into the thermal stability at varying current levels. The temperature gradually increases and lowers to a point that safety risks become conspicuous due to an increment in the discharge currents. The implications of this curve are great concerning limits on current and operational bounds that contribute towards safe operation. This curve, if taken into account by the designer, would define the maximum profile curving current for different cooling conditions.

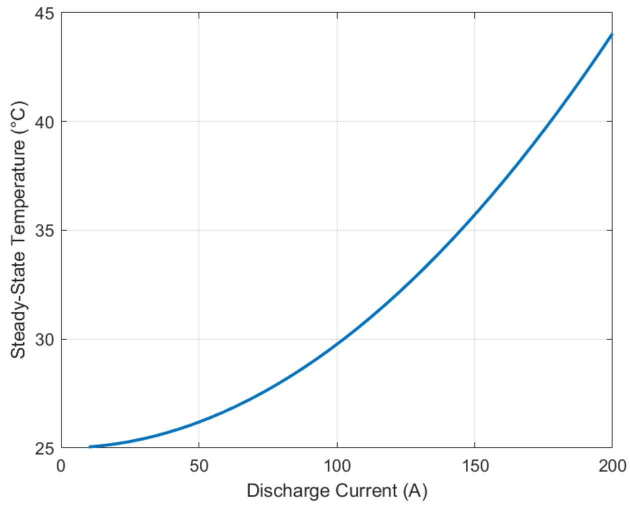

Figure 6: Steady-state battery temperature as a function of discharge current

4.6. Comparative evaluation of cooling scenarios

Matrix laboratory (MATLAB) simulation data afforded an epoch-making opportunity for gauging with utmost precision against the numerical results retrieved from the present research work.

Table 3: Comparative Analysis of Cooling Performance

Scenario	Cooling Type	Peak Temperature (°C)	Stabilization Time	Remark
Case A	No cooling	> 55	Not stabilized	Overheating risk
Case B	Natural convection	45–48	Slow	Marginally acceptable
Case C	Forced air cooling	35–40	Moderate	Suitable for standard operation
Case D	Enhanced cooling (higher (h))	< 32	Fast	Best thermal safety

It is absolutely clear that there is pertinent evidence to suggest that hybrids (air+PCM/liquid) with forced convection are the best options for both safety and sustainability-this is suggestive of higher temperature due to natural convection that may be inadequate during high-load or fast-charging conditions.

4.7. Practical implications discussion

A. Putting the data of Figures 2 to 6 together gives us the practical implications, thus:
B. Inadequate cooling makes battery temperature shots-high altitude with very high C-rates.

C. Heat generation increases with the square of current, so the implications could mean ties with intense quick charging accompanied by thermal stresses.
D. Forced cooling systems are highly essential to reducing thermal stress for safety margining.

Hence control algorithms must accommodate thermal-management architecture to reserve all the conditions for cooling-power application, with very solid-state curve-mapping shall be sufficient to extract safe operation boundaries to help young engineers with basic permissible current profiles.

These observations confirm earlier studies and provide a strong basis for arguing that a powerful thermal management structure is becoming a necessity for the battery function in modern electric vehicles. Optimum cooling paths, sensor locations, and temperature-aware controls could further extend the battery system's operational safety, reliability, and service life.

5. Limitations and practical implications

5.1. Model assumptions and their influence

In the present study, a thermal model was used in which the battery was conceived as a uniform existing body. In the actual case, battery cells and battery packs do not follow temperature gradients across different layers, terminals, and modules. Instead, localized hotspots may form in places where heat dissipation is less, particularly during fast charging or a period of high loads. Thus, while the trade-off made for simplification allows the utilization of the model in the context of preliminary design and academic analysis, it cannot represent the spatial temperature gradients that arise in real EV battery packs.

5.2. Effects of aging and use history

The present simulation study-model assumes an underestimation of long-term thermal behavior due to assumptions of bat- tery characteristics remaining constant during operation. With constant charge/discharge cycles, however, batteries will heat in proportion to the increment in internal resistance, while this heat is carried away more effectively by new batteries compared to more deteriorated, older batteries. Neglecting these effects might serve as an under-estimation of the effect of long-term in-service heat stress. Forthcoming models must consider these degradation phenomena by making the watch on battery degradation liabilities and State of Health (SOH) estimation.

5.3. Variabilities under cooling conditions

By its very nature, the performance of cooling in real systems varies and is not always constant. This is governed by the airflow, the speed of coolant, the ambient temperature, the type of duct geometries, and the TIM material. In fact, it is the fans and pumps, which operate at variable speeds that lead to the dynamic behavior of the cooling system. Therefore calibrating simulation assumptions to experimental measurements helps reduce errors in predicting the actual performance of the system.

5.4. Practical suggestions for EV designers

However, those issues aside, the proposed structure is highly applicable and feasible real world and provided results in terms of actual engineering applications. The final result clarified that in the case if the battery temperature was not managed, it would ascend beyond the safe limit of operation; however, well-designed cooling systems effectively greatly reduce thermal stress. Subsequently, upon their finalization, the above findings and interpretation would enable designers to pick suitable cooling methods, secure optimum-based charging timetables, and apply nip-and-subdue methods wherever needed. This means that the methodology benefits from enhanced safety, lower theoretical energy demand, and longer-lasting batteries in those surplussed operations. But the approach still makes the most deficient realization power, and more detailed experiments until then will be carried on within the pack-scale modelling and the endorsement of experimental design. At some point most probably, the whole description would evolve into a useful decision-making tool helping to cusp EV battery design.

6. Conclusion and future works

The work entails developing a battery thermal management framework for electric vehicles with a lumped thermal model and adaptive fuzzy-logic controller, which controls the heat-demanding operating conditions. The thermal model, which can effectively predict heating from internal resistance and discharge-current accommodation, offers different probability models for natural cooling, forced cooling, and cooling enhancement. The cooling intensity is dynamically modified by fuzzy logic, as opposed to static or predictive methods, in connection with the present battery temperature and rate of change of temperature, to satisfy smooth and safe functioning with very little consumption of energy. Simulation results demonstrated that furry control is pretty much able to prevent overheating, reduce the thermal stress in each case much more than if not controlled, and afford faster stabilization. To make things simple accordingly, the rule-based controller coordinates the operations without requiring tuning or training data based on a set of predefined rules that rather simplify calculations and make the system more robust to uncertainty in design. Robustness of the fuzzy controller could take immediate precedence if interfaced into battery-management-safety systems to provide the high degree of protection and reliability necessary in the realm of EV operation.

Turning to future prospects, the considered study has resulted in numerous other research areas. Extensions can be sought to involve pack-level modeling with effort on working out non-uniform temperature distributions and hotspot occurrences across modules along with aging-aware models taking into account internal resistance variations with time. Since the controller needs to contain adaptive or self-tuning mechanisms supporting membership functions and rule systems that learn evolving to degradation on their own based on operation history, future efforts might include another innovative initiative where liquid cooling is coupled with phase-change materials, microchannels, or heat pipes-no doubt, for this is a switch to extinguishing energy consumption in the course of stage development. Otherwise, experimental verification of the obtained data using power electronics or hardware-in-the-loop platforms and instrumented battery modules would be necessary in substantiate numerical findings for practical-performance validation. Having said that far, coupling thermal diagnostics with safety-protection mechanisms could serve to enhance perception of abnormal events while resisting potential occurrences of thermal runaway. Each of these developments will sure polish the proposed fuzzy logic-based framework into an implementable and intelligent thermal management system for the next-gen EVs.

Acknowledgment. We sincerely thank the reviewers for giving us the opportunity to present our work and for their valuable comments and constructive suggestions, which have greatly enhanced the quality and clarity of this research.

Author's Contribution: All the authors have equally contributed.

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. R. Tamilamuthan and B. T. Geetha, Optimized high gain interleaved SEPIC converter for electric vehicle charging stations with emphasis on renewable energy integration, *SSRG International Journal of Electrical and Electronics Engineering*, 11(3) (2024) 1–14. doi: 10.14445/23488379/IJEEE-V11I3P101.
2. N. Ramya and M. Deivanayaki, Numerical simulation of Casson micropolar fluid flow over an inclined surface through porous medium, *Journal of Mines, Metals and Fuels*, 71(11) (2023) 2143–2149.
3. C. S. Yadav, S. Singh et al., Energy efficient and optimized genetic algorithm for software effort estimator using double hidden layer bi-directional associative memory, *Sustainable Energy Technologies and Assessments*, 56 (2023) 102986. doi: 10.1016/j.seta.2022.102986.
4. S. D. Nandakumar, M. Lakshmanan and V. D. Sundar, A multi-objective function derived for traffic capacity enhancement using hybrid optimization of energy-aware routing in ad hoc wireless network, *Sustainable Computing: Informatics and Systems*, (2025) 101165.
5. R. Tamilamuthan, B. T. Geetha and S. L. Sreedevi, PID switching controller for ripple free single phase interleaved buck converter, in *Proceedings of the 6th International Conference on Inventive Research in Computing Applications (ICIRCA)*, IEEE, Coimbatore, India, (2025) 78–83. doi: 10.1109/ICIRCA65293.2025.11089691.
6. N. Ramya and M. Deivanayaki, Heat radiation on Casson nanofluid flow over an inclined stretching surface with heat and mass diffusions, in *Proceedings of the 1st International Conference on Recent Advancements in Materials Science and Technology (ICRAMST 2024)*, Springer Proceedings in Physics, 414 (2024). doi: 10.1007/978-3-031-69970-2_27.

7. B. T. Geetha, B. Padmavathi et al., Design methodologies and circuit optimization techniques for low power CMOS VLSI design, in *Proceedings of the IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI)*, IEEE, Chennai, India, (2017) 610–615. doi: 10.1109/ICPCSI.2017.8392016.
8. N. Seekarajapuram Dinakaran, L. Muthusamy and V. D. Sundaresan, Implementation of energy-aware optimal routing for improving traffic capacity in ad hoc wireless network using hybrid heuristic algorithm, *International Journal of Communication Systems*, 38(4) (2025) e6126.
9. S. L. Sreedevi, B. T. Geetha and R. Tamilamuthan, Optimizing electric vehicle charging through integration of flexible energy sources, in *Proceedings of the 6th International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV)*, IEEE, Tirunelveli, India, (2025) 1507–1513. doi: 10.1109/ICICV64824.2025.11085988.
10. N. Ramya and M. Deivanayaki, Influence of Lorentz force on Casson micropolar nanofluid flow over a stretching surface in a fuzzy environment, *Annals of Pure and Applied Mathematics*, 29(2) (2024) 133–143. doi: 10.22457/apam.v29n2a05939.
11. B. T. Geetha, M. V. Srinath and V. Perumal, Energy efficient throughput maximization for wireless networks using piece wise linear approximation, *Indian Journal of Science and Technology*, 8(7) (2015) 683–688. doi: 10.17485/ijst/2015/v8i7/62866.
12. R. Tamilamuthan, S. Suganthi, S. Dinakar Raj and M. Sabareeshwaran, Enhanced V2G and G2V operation using fuzzy logic controller and EMI filtering in EV chargers, in *Proceedings of the 6th International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV)*, IEEE, Tirunelveli, India, (2025) 1498–1506. doi: 10.1109/ICICV64824.2025.11085991.
13. N. Ramya and M. Deivanayaki, Fuzzy logic analysis of the effects of Eckert number on Casson micropolar nanofluid flow over an inclined magnetic field with chemical reactions, *International Journal of Fuzzy Mathematical Archive*, 22(1) (2024) 15–32. doi: 10.22457/ijfma.v22n1a02241.
14. M. Lakshmanan, G. A. Mala and K. M. Anandkumar, A study on blockchain based health records: Merkle tree with hybrid heuristic algorithm, *AIP Conference Proceedings*, 3162(1) (2025) 020004.
15. S. Lakshmi, S. Srinivasan, R. Tamilamuthan, S. L. Sreedevi, B. Pandyselvi and A. Antonycharles, Smart EV charging architecture using predictive machine learning and hybrid renewable energy integration, in *Proceedings of the International Conference on Intelligent Communication Networks and Computational Techniques (ICICNCT)*, IEEE, Bidar, India, (2025) 1–6. doi: 10.1109/ICICNCT66124.2025.11233048.

16. N. Ramya and M. Deivanayaki, Impact of Soret and Dufour effects on Casson nanofluid flow in a magnetic field with heat and mass transfer, *Indian Journal of Science and Technology*, 18(13) (2025) 1059–1070. doi: 10.17485/IJST/v18i13.4028.
17. N. Ramya, R. Tamilamuthan, H. Rashmanlou and F. Mofidnakhaei, Holographic and thermodynamic topological perspectives on AdS Einstein–Power–Yang–Mills black holes with generalized entropy, *Journal of Holography Applications in Physics*, (2025). doi: 10.22128/jhap.2025.3126.1156.
18. N. Ramya and M. Deivanayaki, Thermophoresis and Brownian motion effects on the Casson ternary hybrid nanofluids over a horizontal plate containing gyrotactic microorganisms, *Chemical Physics Impact*, 10 (2025) 100887. doi: 10.1016/j.chphi.2025.100887.
19. G. Shanmugam and D. Balusamy, Intelligent anti-theft system with automated spray control using ESP32 WROOM, in *Proceedings of the IEEE International Conference on Communication Systems and Network Technologies (CSNT)*, IEEE, (2025) 409–413.
20. R. Tamilamuthan and B. T. Geetha, IoT-driven solutions for efficient energy management and theft prevention for smart meter, in *Proceedings of the 3rd International Conference on Optimization Techniques in the Field of Engineering (ICOFE)*, (2024).
21. J. Raji, P. Yamunaa and R. Tamilamuthan, Design of power converter with coupled inductor for aerospace applications, *International Journal of Management Research and Social Science*, 12(2) (2025). doi: 10.30726/esij/v12.i3.2025.123006.
22. G. Shanmugam and D. Balusamy, Sustainable agriculture with advanced plant disease detection using YOLOv11 and XAI, in *Proceedings of the IEEE International Conference on Communication Systems and Network Technologies (CSNT)*, IEEE, (2025) 598–603.
23. N. Ramya and M. Deivanayaki, Influence of microorganisms on Jeffrey nanofluid flow through a Darcy–Forchheimer porous medium in magnetohydrodynamic systems, *Journal of Nanofluids*, 14(2) (2025) 251–258. doi: 10.1166/jon.2025.2237.
24. S. Suganthi, T. Kesavan, S. V. Nagalakshmi and R. Tamilamuthan, Efficiency enhancement of power equipment using nano filler infused polymer composites, *International Journal for Multidisciplinary Research*, 7(6) (2025).
25. N. Ramya and M. Deivanayaki, Analysis of homogeneous and heterogeneous micropolar nanofluid flow over an exponentially stretching surface with Cattaneo–Christov heat flux incorporating thermophoresis and Brownian motion effects, *Discover Applied Sciences*, 7 (2025) 554. doi: 10.1007/s42452-025-07037-7.
26. B. Deepa, S. Geetha, S. Sreesanth, B. Sridhar and M. Yuvarani, Brain tumor detection with severity identification using K-means clustering, in *Proceedings*

of the IEEE First International Conference on Advances in Computer Science, Electrical, Electronics, and Communication Technologies (CE2CT), IEEE, (2025) 157–161.

27. R. Tamilamuthan, Implementation of deep learning technique for accurate land cover classification, *International Journal of Advanced Trends in Engineering and Management*, 3(5) (2024) 35–43.
28. B. Dhivya, S. Vijayalakshmi, P. Aileen Sonia, S. L. Sreedevi, R. Tamilamuthan, A. Antony Charles and R. Kanthimathi, Condition monitoring of transformer using IoT, *International Journal of Innovative Research in Technology*, 10(10) (2024).
29. K. Logeswaran, S. Sah, S. Savitha, S. Geetha, S. B. Naganathan, B. Jagan and P. Maiyarasu, Optimized machine learning models for diabetes prediction: hyperparameter tuned comparative study, in *Proceedings of the IEEE International Conference on Communication and Signal Processing (ICCSP)*, IEEE, (2025) 486–491.
30. M. Lakshmanan, J. A. Dhanraj, R. Sriramkumar, M. N. Naik, Mithaguru and T. Godhandaraman, Blockchain-enabled medical waste management system for enhanced traceability, safety and environmental protection, *International Journal of Advances in Soft Computing and its Applications*, 17(2) (2025) 246–268. doi: 10.15849/IJASCA.250730.13.
31. N. Ramya, J. Pavithra and F. Mofidnakhaei, Unified perspective on MHD nanofluid simulation and fuzzy graph applications in complex systems, *International Journal of Fuzzy Mathematical Archive*, 23(1) (2025). doi: 10.22457/ijfma.v23n1a01247.
32. B. Dhivya, S. Vijayalakshmi, P. Aileen Sonia, S. L. Sreedevi, R. Tamilamuthan, A. Antony Charles, R. Kanthimathi and B. Pandyselvi, E-vehicle charging system using RFID, *International Journal of Innovative Research in Technology*, 10(11) (2024).
33. S. Acharya and I. V. Pustokhina, An improved gradient boosting tree algorithm for financial risk management, *Knowledge Management Research and Practice*, 20(5) (2022) 657–670. doi: 10.1080/14778238.2021.1954489.
34. B. T. Geetha and R. Tamilamuthan, Non-isolated interleaved bidirectional DC–DC converter for electric vehicles: A review, *International Journal on Recent and Innovation Trends in Computing and Communication*, 11(9) (2023).