

Dr. Rahul Kumar Kamboj

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🏠 Sangrur, Punjab



About Me

Possesses strong research and implementation expertise in Battery Management Systems (BMS), power electronics, DC-DC converters, and real-time hardware-in-the-loop (HIL) validation using OPAL-RT and MATLAB/Simulink platforms. Demonstrates advanced knowledge in the design, modeling, control, and optimization of energy storage systems, electric vehicle powertrains, and power conversion technologies.

Experienced in applying Artificial Intelligence (AI) and Machine Learning (ML) techniques for battery state estimation, fault diagnosis, predictive maintenance, and time-series forecasting. Skilled in developing intelligent algorithms for State of Charge (SoC), State of Health (SoH), Remaining Useful Life (RUL), and Safe Operating Area (SOA) estimation of lithium-ion batteries.

Technically proficient in power converters, renewable energy integration, embedded control systems, real-time data acquisition, and hardware implementation using industrial communication protocols such as MQTT, SPI, I2C, and UART. Hands-on experience in PCB design, IoT-enabled monitoring systems, and deployment of intelligent energy management solutions.

Author of multiple SCI and Scopus-indexed research publications and an active member of IEEE and professional research communities. Dedicated to advancing reliable, explainable, and scalable AI-driven technologies for next-generation battery management, electric mobility, smart grids, and sustainable energy systems.

Employment History

- Aug, 2026 – Present **Assistant Professor (Research)**, Tulas University, Dehradun.
- Jan, 2026 – Aug, 2026 **Assistant Professor** CGC University, Mohali.
- Jan, 2024 – Jan, 2026 **Assistant Professor Cont-I**, Thapar Institute of Engineering and Technology, Patiala.
- May, 2022 – Dec, 2024 **Junior Research Fellow**, E-Mobility Research Lab, Thapar Institute of Engineering and Technology, Patiala.

Education

- 2022-2026 **Ph.D. (Electric Vehicle)**, Electrical and Instrumentation Engineering Department, Thapar Institute of Engineering and Technology, Patiala.
Thesis title: *Machine Learning-Based Estimation of Safe Operating Envelope for Electric Vehicle Batteries*
- 2020-2022 **Master of Engineering (Power System)**, Electrical and Instrumentation Engineering Department, Thapar Institute of Engineering and Technology, Patiala.
- 2016-2019 **Bachelor of Technology (Electrical Engineering)**, Guru Nanak Dev Engineering College, Ludhiana.
- 2013-2016 **Diploma (Electrical Engineering)**, BGPC, Sangrur.

Research Publications

Journal Articles

- 1 R. K. Kamboj, R. Sharma, M. Singh, A. Singh, and A. Bala, "Design of smart battery management system with soc estimation in real-time environment at trl 4," B. Virdee, S. D. Correia, A. Swaroop, N. Thakur, and S. D. Shetty, Eds., pp. 295–306, 2026.
- 2 R. K. Kamboj, M. Singh, A. Singh, and A. Bala, "Explainable parallel gru-lstm model for predictive maintenance of lithium-ion batteries," *Ionics*, pp. 1–17, 2026.

- 3 R. Kumar Kamboj, S. Singh, R. Sharma, H. Singh, and D. Garg, "Estimation of safe operating envelope for electric vehicle battery," B. Virdee, S. D. Correia, A. Swaroop, N. Thakur, and S. D. Shetty, Eds., pp. 398–409, 2026.
- 4 R. K. Kamboj, R. Sharma, M. Singh, A. Singh, and A. Bala, "Estimation of safe operating area for electric vehicle battery," *International Journal of Industrial Electronics and Electrical Engineering (IJIEEE)*, vol. 13, no. 1, pp. 24–33, Jan. 2025.
- 5 R. K. Kamboj, M. Singh, A. Singh, and A. Bala, "An intelligent fault detection (ifd) system for lithium-ion battery using machine learning approach," *Scientific Reports*, vol. 15, no. 1, p. 32 190, 2025.
- 6 R. Kumar Kamboj, M. Singh, A. Singh, and A. Bala, "Explainable artificial intelligence driven estimation of remaining useful life for lithium-ion battery," *Ionics*, vol. 31, no. 11, pp. 11 711–11 728, 2025.
- 7 A. Singh, S. Singh, R. K. Kamboj, and A. Bala, "Explainable optcnn-slstm hybrid model for enhanced lithium-ion battery state of health prediction," *Scientific Reports*, 2025.
- 8 M. Singh and R. K. Kamboj, "Development of passive battery management system at trl 4," *Teknomekanik*, vol. 5, no. 1, pp. 48–56, 2022.

Conference Proceedings

- 1 R. K. Kamboj, "Cnn-gru hybrid architecture for lithium-ion battery state-of-health estimation: A reproducible multi-dataset evaluation," in *Proceedings of the IEEE 6th International Conference on Sustainable Energy and Future Electric Transportation (SEFET)*, Accepted for presentation, IEEE, Nagpur, India, 2026.
- 2 R. K. Kamboj, "Comparative analysis of machine learning and deep learning approaches for lithium-ion battery state of charge estimation under degradation conditions," in *Proceedings of the IEEE 6th International Conference on Sustainable Energy and Future Electric Transportation (SEFET)*, Accepted for presentation, IEEE, Nagpur, India, 2026.
- 3 R. K. Kamboj, "Transformer networks with explainable ai for accurate battery rul prediction in electric vehicles," in *Proceedings of the IEEE 6th International Conference on Sustainable Energy and Future Electric Transportation (SEFET)*, Accepted for presentation, IEEE, Nagpur, India, 2026.
- 4 R. Sharma, R. K. Kamboj, and S. Singh, "An interpretable machine learning framework for multi-class diabtese risk prediction," in *ICAIN 2026*, 2026, pp. 1–6.
- 5 R. Sharma, R. K. Kamboj, A. Bala, A. Singh, S. Singh, and M. Singh, "Interpretable deep learning models for battery soh estimation using explainable ai," in *2025 IEEE 4th International Conference on Smart Technologies for Power, Energy and Control (STPEC)*, 2025, pp. 1–6.  DOI: 10.1109/STPEC66316.2025.11490604.

Skills

Languages	 Strong reading, writing, and speaking competencies for English, Hindi and Punjabi.
Core	 Proficiency in PCB Designing & Fabrication, Design expertise in AC Machines, In-depth knowledge of Microcontroller, Microprocessor, and IoT devices
Tools	 MATLAB, ANSYS, AutoCAD, SolidWorks, and Easy EDA
Misc.	 Engaged in extracurricular and volunteer pursuits, Active member of E2S2, IST, and IEEE.

Experience

Specialization

- Design and functionality of Electric Vehicle (EV) Motors, encompassing BLDC, PMSM, and 3IM, along with expertise in Controllers.
- Profound understanding and design proficiency in Battery Management Systems, covering both Active BMS and Passive BMS configurations.

Projects

- Worked on the manufacturing of Smart BMS for EV. Funded By Meity.
- Worked on the manufacturing of EV Tractor and Car. Funded By Escorts.
- Worked on manufacturing and R&D of Ekart. Funded By DST.

Internships

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| Jan - May 2019 | ■ Performed root cause analysis on electrical failures to prevent recurrence, SHERYANS INDUSTRIES. |
| Jun - Jul 2016 | ■ Root Cause Failure Analysis (RCFA), Preventative Maintenance (PM) ,PSPCL. |
| Jun - Jul 2015 | ■ Root Cause Failure Analysis (RCFA), Preventative Maintenance (PM) ,PSPCL. |

Subjects Taught

- Basic Electrical Engineering
- Computer Networks
- Artificial Intelligence
- Soft computing
- Battery Management System (M.E.)

Interests

- Reading books, music, and table tennis