INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

www.ijprems.com
editor@ijprems.com

Vol. 03, Issue 12, December 2023, pp : 283-287

e-ISSN : 2583-1062

Impact Factor : 5.725

ELECTRIC VEHICLES MODELLING IS A FUTURE ERA OF SOCIETY

Dr. Shiv Kumar Sonkar[1], Rishabh Kumar Sonkar[2]

[1]Associate Professor & Head, Department of Electrical & Electronics Engineering Madhyanchal Professional University, Faculty of engineering and Technology, School of Electrical & Electronics Engineering, Bhopal, M.P, India.

[2]Student Electrical & Electronics Engineering, Sagar Institute of Research & Technology Ayodhya Bypass Bhopal, India.

ABSTRACT

The role of electrified powertrain technologies in the transportation sector, particularly focusing on Battery Electric Vehicles (BEVs) and their potential impact on reducing greenhouse gas emissions. Here's a breakdown of the key points and considerations you've highlighted: The transportation sector is recognized as a significant contributor, responsible for up to 25% of global greenhouse gas (GHG) emissions. To address the environmental impact, there's a push to reduce the usage of fossil fuels. Electrified powertrain technologies, including Hybrid Electric Vehicles (HEVs), Battery Electric Vehicles (BEVs), and Fuel Cell Electric Vehicles (FCEVs), are seen as solutions. There's a noticeable emphasis on the development and rollout of Battery Electric Vehicles (BEVs). Numerical simulation using MATLAB is employed to investigate and enhance BEV performance. Research and development in BEV technologies are crucial for improving performance and ensuring competitiveness. The study provides an overview of the technology outcomes and market consequences for future compact BEVs, along with comparisons to HEVs, FCEVs, and Internal Combustion Engine Vehicles (ICEVs). Techno-economic aspects of BEVs, market projections, and cost analyses up to 2050 are investigated. Important characteristics of BEVs are explored and compared with other vehicle types. The study includes a well-to-wheel analysis of BEVs, comparing it with HEVs, FCEVs, and ICEVs. This comprehensive approach considers not only the environmental benefits of BEVs but also delves into the economic and technological aspects, providing a holistic view of their potential impact on the transportation sector. The emphasis on numerical simulation and MATLAB for performance improvement underlines the significance of technological advancements in achieving sustainability goals

Keywords: BEV, HEV, PHEV, FCEV, battery electric vehicles, hybrid electric vehicles

1. INTRODUCTION

An electric vehicle (EV) is a vehicle that uses one or more electric motors for propulsion. It can be powered by a collector system, with electricity from extravehicular sources, or it can be powered autonomously by a battery (sometimes charged by solar panels, or by converting fuel to electricity using fuel cells or a generator).[1] EVs include but are not limited to road and rail vehicles, and broadly can also include electric boat and underwater vessels (submersibles, and technically also diesel- and turbo-electric submarines), electric aircraft and electric spacecraft.

Electric road vehicles include electric passenger cars, electric buses, electric trucks and personal transporters such as electric buggy, electric tricycles, electric bicycles and electric motorcycles/scooters. Together with other emerging automotive technologies such as autonomous driving, connected vehicles and shared mobility, EVs form a future vision of transportation called Connected, Autonomous, Shared and Electric (CASE) mobility

The environmental impact of the transportation sector. Let's break down the key points in the provided text:

Greenhouse Gas Emissions in Transportation:

- The transportation sector is identified to emit about 25% of greenhouse gas (GHG) emissions (Mahmoudzadeh Andwari et al., 2017).

  Electric Vehicles (EVs):

- EVs are gaining popularity as a commercially viable and technology-ready solution to reduce GHG emissions.
- Advantages of EVs include ease of operation, quiet operation, and the absence of fuel costs associated with conventional vehicles.
- Well-suited for urban environments due to factors such as the lack of liquid, flammable fuels, immediate torque from start-up, suitability for frequent start-stop driving, and the absence of the need for gas stations.

Renewable Energy and Smart Grids:

- Renewable energy sources and the smart grid are gaining momentum in addressing the Environmental impact of the transportation sector.

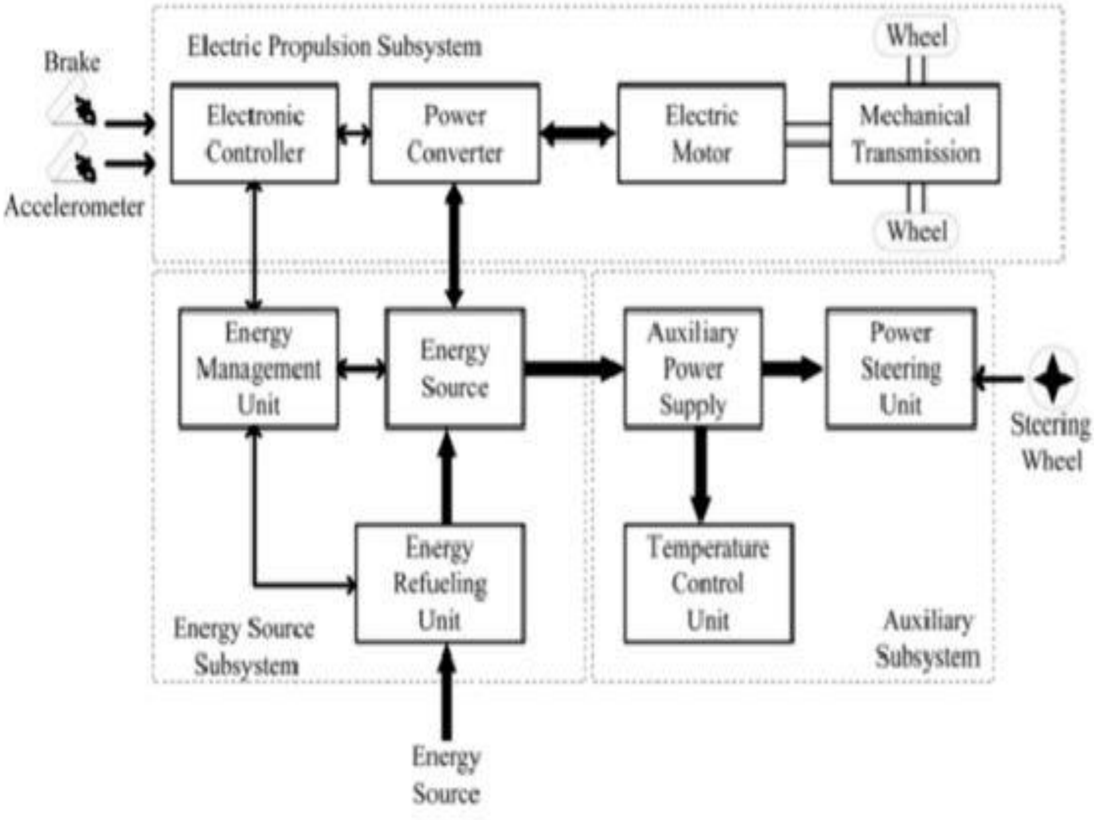

Figure 1 BEV Sub System

2. METHODOLOGY

The Simulink model for the Class D BEV likely includes various subsystems to represent different components and functionalities of the electric vehicle. The battery subsystem includes the selected battery chemistry models (Lithium-Sculpture, Lithium-ion, Nickel-Cadmium). Battery management system (BMS) for monitoring and controlling the battery state, temperature, and state of charge. Voltage and current controllers to manage the power flow in and out of the battery. Subsystems for both Permanent Magnet Synchronous Motor (PMSM) and Induction Motor (IM). Motor controllers for torque and speed control. Charging controller and model for simulating the charging process. Interaction with external charging infrastructure. DC-DC converters and other power electronics components for managing power distribution within the vehicle. Control algorithms for optimizing energy efficiency, torque control, regenerative braking, and other control strategies. Thermal management system to simulate and control the temperature of key components, especially the battery. Inverter models for converting DC power from the battery to AC power for the motor.

Battery electric vehicles (BEVs), focusing on motor types (Permanent Magnet Synchronous Motor and Induction Motor) and battery chemistries (Nickel-Cadmium, Lithium-ion, and Lithium-Sulphur). The simulation was conducted in MATLAB and Simulink.

Components: Control system, electrical system, and vehicle dynamics.

Detailed Electrical System Model: Includes the battery, DC—DC converter, generator for regenerative braking, and motor for vehicle propulsion.

Control Block: Processes include speed demand acknowledgment, battery charger controller managing current flow, motor controller controlling the electric motor, and recording motor speed and current for torque calculation.

This information provides an overview of the study's focus on motor and battery configurations for medium-sized BEVs, the simulation methodology, and the key components of the modeled BEV system

Modeling

The modeling results of a compact Battery Electric Vehicle (BEV) using MATLAB/Simulink. The analysis focuses on various performance aspects, including battery performance, motor performance, range, and acceleration. The FTP-75 drive cycle is specified as the basis for all simulations.

To better assist you, could you please specify what information or assistance you're seeking regarding the modeling results? Are you looking for an explanation of the figures 2.

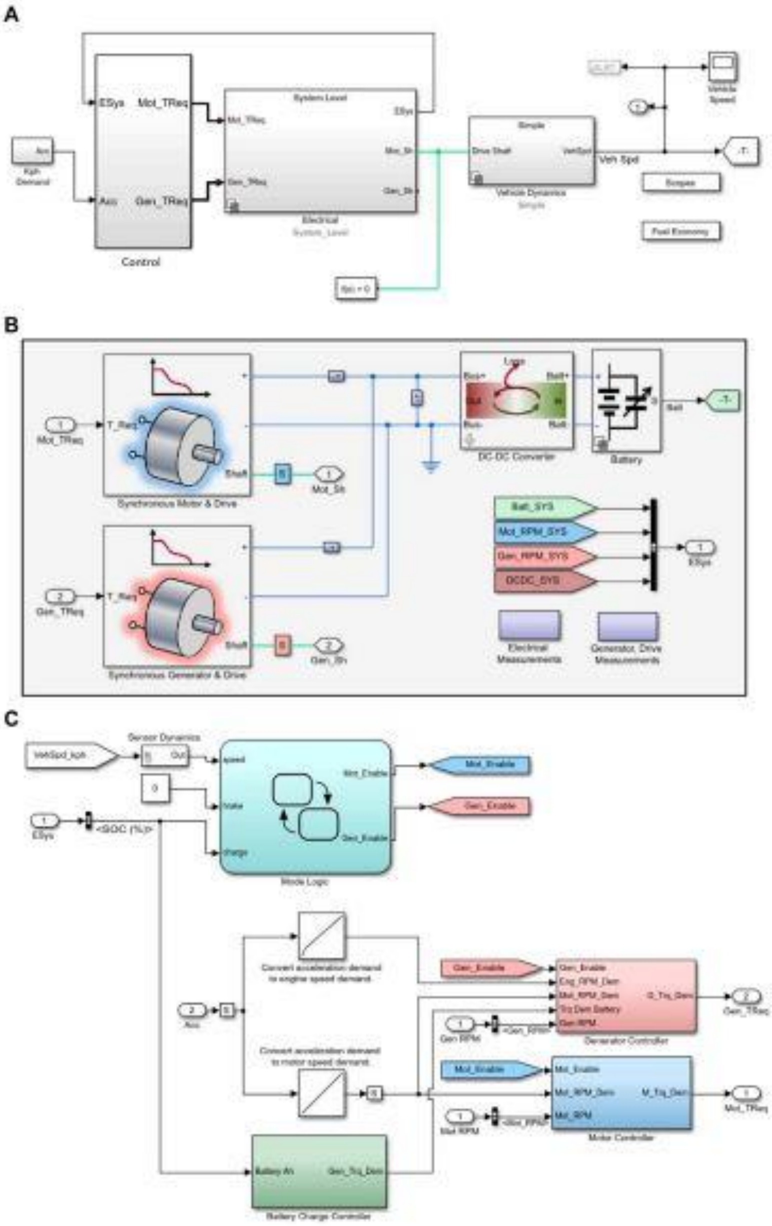

Figure 2 | Simulink Models of (A) Block of a BEV (Chen and Rincon-Mora, 2006) (B) Electrical system configuration and (C) Control system configuration.

3. CONCLUSION

The growing influence of hybrid and electric vehicles (HEVs, PHEVs, and BEVs) in the light-duty vehicle market. The analysis covers various aspects of BEVs, including types, energy sources, configurations, battery technology, and electric motor technology. Let's break down the key points:

Increasing Stringency of Emission Regulations and Fuel Prices:

The introduction mentions that stringent emission regulations and rising fuel prices are driving the adoption of alternative vehicles in the light-duty vehicle market.

Economically Viable Alternative:

Battery Electric Vehicles (BEVs) are highlighted as an economically viable alternative to conventional Internal Combustion Engine (ICE) vehicles.

Analysis of BEV Types and Technologies:

The research delves into various aspects of BEVs, including energy sources, configurations, battery technology, and electric motor technology.

Modeling Different Combinations:

The study involves modeling different combinations of battery and motor technologies for a medium-sized vehicle.

Prominent Technologies:

The conclusion suggests that Lithium-Sulfur batteries and permanent magnet motors are identified as the most prominent technologies for future BEVs.

Challenges with Permanent Magnet Motors:

Despite their prominence, there is a mention of stability issues with permanent magnet motors, and ongoing research aims to address this challenge.

Techno-Economics of BEVs:

Further research explores the techno-economics of BEVs, with a focus on factors such as battery recycling, government subsidies, and consumer behavior influencing future sales.

Future Market Projections:

The research anticipates an increase in the penetration of BEVs in the market and a gradual elimination of Internal Combustion Engine (ICE) vehicles.

4. REFERENCES

[1] Andwari, A. M., Abdul Aziz, Azhar., Aziz, A. A., Said, M. F. M., Latiff, Z. A., and Ghanaati, A. (2015). Influence f Hot Burned Gas Utilization on the Exhaust Emission Characteristics of A Controlled Auto-Ignition Two-Stroke Cycle Engine. Int. J. Automot. Mech. Eng. 11, 2396–2404. doi:10.15282/ijame.11. 2015.20.0201

[2] Andwari, A. M., Muhamad Said, M. F., Abdul Aziz, A., Esfahanian, V., Idris, M. A., Mohd Perang, M. R., et al. (2018). Design and Simulation of a High-Pressure Gasoline Direct Injection (GDI) Pump for Engine Applications. J. Mech. Eng. (JMechE) S1 6 (1), 107–120. (ISSN: 1823-5514).

[3] Bayindir, K. C., Gozukucuk, M. A., and Teke, A. (2015). A Comprehensive Overview of Hybrid Electric Vehicle: Powertrain Configurations, Powertrain Control Techniques and Electronic Control Units. Energy Convers. Manag. 52, 1305–1313. doi:10.1016/j.enconman.2010.09.028

[4] Bin Wan Ramli, W. R., Pesyridis, A., Gohil, D., and Alshammari, F. (2020). Organic Rankine Cycle Waste Heat Recovery for Passenger Hybrid Electric Vehicles. Energies 13 (17), 4532. doi:10.3390/en13174532

[5] Chalk, S. G., and Miller, J. F. (2014). Key Challenges and Recent Progress in Batteries, Fuel Cells, and Hydrogen Storage for Clean Energy Systems. J. Power Sources 159, 73–80. doi:10.1016/j.jpowsour.2006.04.058

[6] Chan, C. C. (2014). The State of the Art of Electric and Hybrid Vehicles. Proc. IEEE 90, 247–275. doi:10.1109/5.989873 Chen, M., and Rincon-Mora, G. A. (2006). Accurate Electrical Battery Model Capable of Predicting Runtime and I-V Performance. IEEE Trans. Energy Convers. 21 (2), 504–511. doi:10.1109/tec.2006.874229

[7] Cooper, A., and Moseley, P. (2013). "Progress in the Development of Lead-Acid Batteries for Hybrid Electric Vehicles,"in Proceedings of the IEEE Vehicle Power and Propulsion Conference (Windsor, UK, 1–6. DunnGaines, J. B. L., Gaines, L., Sullivan, J., and Wang, M. Q. (2012). Impact of Recycling on Cradle-To-Gate Energy Consumption and Greenhouse Gas Emissions of Automotive Lithium-Ion Batteries. Environ. Sci. Technol. 46, 12704–12710. doi:10.1021/es302420z

[8] Dzulkfli, M. S. B., Pesyridis, A., and Gohil, D. (2020). Thermoelectric Generation in Hybrid Electric Vehicles. Energies 13 (1314), 3742. doi:10.3390/en13143742 Edwards, D. B., and Kinney, C. (2011). "Advanced Lead Acid Battery Designs for Hybrid Electric Vehicles," in Proceedings of the 16th Battery Conference on Applications and Advances (Long Beach, CA, USA, 207–212. Ellingsen,

[9] L. A.-W., Majeau-Bettez, G., Singh, B., Srivastava, A. K., Valøen, L. O., and Strømman, A. H. (2014). Life Cycle Assessment of a Lithium-Ion Battery Vehicle Pack. J. Industrial Ecol. 18, 113–124. doi:10.1111/jiec.12072

[10] 10.Feneley, A. J., Pesiridis, A., and Andwari, A. M. (2017). Variable Geometry Turbocharger Technologies for Exhaust Energy Recovery and Boosting-A Review. Renew. Sustain. Energy Rev. 71, 959–975. doi:10.1016/j.rser.2016. 12.125

[11] Fetcenko, M. A., Ovshinsky, S. R., Reichman, B., Young, K., Fierro, C., Koch, J., et al. (2014). Recent Advances in NiMh Battery Technology. J. Power Sources 165, 544–551. doi:10.1016/j.jpowsour.2006.10.036

[12] Forero Camacho, O. M., and Mihet-Popa, L. (2016). Fast Charging and Smart Charging Tests for Electric Vehicles Batteries Using Renewable Energy. Oil Gas. Sci. Technol. - Rev. IFP Energies Nouv. 71, 13–25. doi:10.2516/ogst/ 2014001

[13] Frank, J. H., Pickett, L. M., Bisson, S. E., Patterson, B. D., Ruggles, A. J., Skeen, S. A., et al. (2015). Quantitative Imaging of Turbulent Mixing Dynamics in HighPressure Fuel Injection to Enable Predictive Simulations of Engine Combustion. Sandia Technical Report SAND2015-8758, September 2015. Available at: https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2015/ 158758.pdf.

[14] Ghanaati, A., Muhamad Said, M. F., Mat Darus, I. Z., Muhamad Said, M. F., and Andwari, A. M. (2015). A Mean Value Model for Estimation of Laminar and Turbulent Flame Speed in Spark-Ignition Engine. Int. J. Automot. Mech. Eng. 11, 2224–2234. doi:10.15282/ijame.11.2015.5.0186

[15] Grunditz, E. A., and Thiringer, T. (2016). Performance Analysis of Current BEVs Based on a Comprehensive Review of Specifications. IEEE Trans. Transp. Electrific. 2, 270–289. doi:10.1109/tte.2016.2571783

[16] Hannan, M. A., Lipu, M. S. H., Hussain, A., and Mohamed, A. (2017). A Review of Lithium-Ion Battery State of Charge Estimation and Management System in Electric Vehicle Applications: Challenges and Recommendations. Renew. Sustain. Energy Rev. 78, 834–854. doi:10.1016/j.rser.2017.05.001

[17] Hidrue, M. K., Parsons, G. R., Kempton, W., and Gardner, M. P. (2014). Willingness to Pay for Electric Vehicles and Their Attributes. Resour. Energy Econ. 33, 686–705. doi:10.1016/j.reseneeco.2011.02.002

[18] Jassim, E. I., Sphicas, P., and Jasem, B. I. (2019). Environmental Impact of Mixing Biofuel with Gasoline in Spark Ignition Engine. IOP Conf. Ser. Earth Environ. Sci. 401 (1), 012013. doi:10.1088/1755-1315/401/1/012013

[19] Khaligh, A., and Li, Z. (2014). Battery, Ultracapacitor, Fuel Cell, and Hybrid Energy Storage Systems for Electric, Hybrid Electric, Fuel Cell, and Plug-In Hybrid Electric Vehicles: State of the Art. IEEE Trans. Veh. Technol. 59, 2806–2814. doi:10.1109/TVT.2010.2047877

[20] Kramer, B., Chakraborty, S., and Kroposki, B. (2016). "A Review of Plug-In Vehicles and Vehicle-To-Grid Capability," in Proceedings of the 34th IEEE Industrial Electronics Annual Conference, Orlando, FL, USA, 2278–2283. 10 – 13. Li, B., Gao, X., Li, J., and Yuan, C. (2014). Life Cycle Environmental Impact of High-Capacity Lithium Ion Battery with Silicon Nanowires Anode for Electric Vehicles. Environ. Sci. Technol. 48, 3047–3055. doi:10.1021/ es4037786

[21] Mahmoudzadeh Andwari, A., Pesiridis, A., Rajoo, S., Martinez-Botas, R., and Esfahanian, V. (2017). A Review of Battery Electric Vehicle Technology and Readiness Levels. Renew. Sustain. Energy Rev. 78 (October), 414–430. doi:10. 1016/j.rser.2017.03.138

[22] Mahmoudzadeh Andwari, A., Pesyridis, A., Esfahanian, V., and Said, M. (2019). Combustion and Emission Enhancement of a Spark Ignition Two-Stroke Cycle Engine Utilizing Internal and External Exhaust Gas Recirculation Approach at Low-Load Operation. Energies 12 (4), 609. doi:10.3390/en12040609