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### Patent Search

Invention Title	DESIGN AND ANALYSIS OF A NOVEL ELECTRIC VEHICLE CONTROLLER TO ENHANCE SYSTEM EFFICIENCY
Publication Number	36/2025
Publication Date	05/09/2025
Publication Type	INA
Application Number	202541077027
Application Filing Date	13/08/2025
Priority Number	
Priority Country	
Priority Date	
Field Of Invention	ELECTRICAL
Classification (IPC)	B60L7/10, B60L15/20, H02P6/10, G05B13/02, G06N3/043, B60L7/10, B60L15/20, H02P6/10

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#### Abstract:

ABSTRACT In modern transportation, Electric Vehicles (EVs) and Hybrid Electric Vehicles (HEVs) powered by Permanent Magnet Brushless DC Motors (PMBLDCM) have conventional vehicles due to their efficiency, stability, and low maintenance. However, challenges such as speed control, electromagnetic torque (EMT) generation, back electromotive force (BEMF), stator current (SC) regulation, and uncertainty handling persist due to dynamic load conditions. This research develops an Adaptive Neural Sliding-Mode Controller (ANF-SMC) for PMBLDCM-based electric propulsion systems, addressing these limitations to enhance overall system efficiency under varying proposed controller is simulated and implemented in hardware, with a comparative analysis against PID, SMC, FSMC, and AFSMC controllers. Additionally, a Regenerative (RB) system is designed using modified direct torque control and fuzzy-based parameter tuning, overcoming drawbacks of conventional systems such as complexity, costs, and low BEMF generation. The proposed RB system reduces brake pad wear, extends driving range, and lowers system maintenance costs. Finally, hardware-in testing and mathematical analysis validate the robustness and transient response improvements of the proposed controller in DC-DC boost converter-fed BLDCM systems. The findings confirm its superiority in performance and energy efficiency for electric vehicles.

## Complete Specification

### Description:FIELD OF THE INVENTION

The present invention relates to the field of electric vehicle (EV) propulsion systems, particularly focusing on advanced motor control, regenerative braking, and power management to improve overall system efficiency. With the growing demand for sustainable and energy-efficient transportation, this invention addresses the critical challenges in electric vehicle drive systems, such as speed regulation, torque ripple reduction, power flow optimization, and regenerative energy recovery. The invention specifically applies to Permanent Magnet Brushless Direct Current Motors (PMBLDCM), which are widely used in electric vehicles due to their high efficiency, reliability, and low maintenance requirements.

This invention introduces an Adaptive Neuro-Fuzzy Sliding-Mode Controller (ANF-SMC), which combines neural networks, fuzzy logic, and sliding-mode control techniques to dynamically adapt to varying load conditions. Unlike conventional controllers such as PID, SMC, FSMC, and AFSMC, the proposed system offers real-time learning, improved transient response, and enhanced steady-state performance. The fuzzy logic-based regenerative braking system is designed to maximize energy recovery, reduce battery wear, and enhance driving range, while a DC-DC boost converter ensures optimized power distribution between the battery and the propulsion system.

The field of this invention extends to automotive engineering, renewable energy integration, and intelligent transportation systems, where precise motor control and efficient energy utilization are critical. The proposed system is applicable in electric cars, hybrid electric vehicles (HEVs), electric two-wheelers, and commercial electric vehicles, offering a cost-effective and scalable solution for next-generation EV technology. By improving motor performance, energy efficiency, and braking effectiveness, this invention contributes to the advancement of green mobility solutions and smart electric powertrains.

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Page last updated on: 26/06/2019