

PID Based BLDC Motor Control For Electric Vehicle

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Abstract- Brushless DC (BLDC) motors are widely used in electric vehicles due to their high efficiency and low maintenance. This paper presents a PID-based speed control method for BLDC motors. The controller compares reference speed with actual speed and minimizes the error. The proposed system aims to improve speed regulation under varying load condition. The performance can be evaluated using simulation.

Keywords- BLDC Motor, Electric Vehicle, PID Controller, Speed Control, Motor Drive.

I. INTRODUCTION

Electric vehicles are becoming an important alternative to conventional internal combustion engine vehicles because of their potential to reduce fuel consumption, emissions, and dependence on fossil fuels. The electric motor is one of the key components of an EV propulsion system, as it converts electrical energy from the battery into mechanical energy to drive the vehicle.

Brushless DC (BLDC) motors are suitable for electric vehicle applications because they offer high efficiency, good dynamic response, high power density, and reduced maintenance compared with brushed DC motors. Unlike brushed motors, BLDC motors use electronic commutation instead of mechanical brushes and a commutator.

However, motor speed may vary when the vehicle encounters changing road conditions or load demands. An effective control system is therefore required to maintain the desired motor speed and achieve satisfactory dynamic performance.

A Proportional-Integral-Derivative (PID) controller is a commonly used feedback controller that calculates the difference between the reference speed and actual motor speed. Based on this error, the controller adjusts its output to reduce speed deviation. The proportional term responds to the present error, the integral term addresses accumulated error, and the derivative term responds to the rate of change of error.

This project focuses on developing a PID-based BLDC motor speed control system for electric vehicle

applications. The system can be modeled and evaluated using simulation to study its speed response, stability, and performance under different operating conditions.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

The main objective of this project is to develop a closed-loop speed control system for a BLDC motor. The system uses a PID controller to reduce speed error and improve motor response. The study focuses on speed regulation, stability, and performance under different operating conditions. The proposed method can be evaluated using MATLAB/Simulink simulation.

WRITE DOWN YOUR STUDIES AND FINDINGS

The proposed system consists of a PID controller, BLDC motor, inverter, and speed-feedback system. The controller calculates the difference between reference speed and actual speed. Based on this error, it adjusts the control signal to regulate motor speed. The motor response can be analyzed under different reference speeds and load conditions. Performance parameters include rise time, settling time, overshoot, and steady-state error.

- A. Bits and Pieces together
- B.

In this system configuration, the individual components are integrated to achieve precise speed control of the BLDC motor. The setup combines the following core elements:

PID Controller: Calculates the error value as the difference between the measured speed and the desired reference speed, applying proportional, integral, and derivative corrections.

Inverter Circuit: A three-phase voltage source inverter that switches power to the motor windings based on rotor position.

BLDC Motor: The main actuator driving the electric vehicle application, requiring electronic commutation.

Feedback System (Hall Effect Sensors): Detects the rotor's magnetic position to synchronize the inverter switching and calculate the real-time rotor speed.

III. GET PEER REVIEWED

The proposed PID-based BLDC motor control system can be reviewed to verify the control strategy, system design, and simulation methodology. The review should focus on the suitability of PID control for speed regulation and the accuracy of the performance evaluation. Feedback from reviewers can help identify limitations and improve the technical quality of the research paper.

IV. IMPROVEMENT AS PER REVIEWER COMMENT

The proposed system can be improved by tuning the PID controller parameters to achieve better speed response and stability. Further improvements may include reducing overshoot, minimizing steady-state error, and testing the motor under different load conditions. Future work may explore advanced control techniques for improved performance in electric vehicle application.

CONCLUSION

This paper presented a closed-loop speed control method for a Brushless DC (BLDC) motor using a PID controller tailored for electric vehicle applications. Through simulation analysis, the system demonstrated reliable performance in regulating motor speed when subjected to varying dynamic load conditions. The integration of the PID algorithm successfully minimized steady-state error and optimized response parameters, balancing rise time and overshoot.

Future extensions of this work could explore self-tuning fuzzy-PID algorithms to further enhance performance under sudden torque variations, as well as hardware-in-the-loop testing to validate these findings on a physical EV powertrain.

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REFERENCES

[1] B. K. Bose, *Modern Power Electronics and AC Drives*, Upper Saddle River, NJ: Prentice Hall, 2002.

- [2] C. L. Xia, *Permanent Magnet Brushless DC Motor Drives and Controls*, Hoboken, NJ: John Wiley & Sons, 2012.
- [3] P. Pillay and R. Krishnan, "Modeling, simulation, and analysis of permanent magnet motor drives. II. The brushless DC motor drive," *IEEE Transactions on Industry Applications*, vol. 25, no. 2, pp. 274-279, Mar./Apr. 1989.
- [4] A Tashakori and M. Ektesabi, "A Simple Fault Diagnosis and Fault Tolerant Control Technique for BLDC Motor Drives in Electric Vehicles," *IEEE Transactions on Industrial Electronics*, vol. 60, no. 12, pp. 5820-5830, Dec. 2013.