Enhanced Speed Control Of BLDC Motor Using Dwarf Mongoose Optimizer

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Abstract- Brushless DC (BLDC) motors are popular in many applications due to their efficiency and performance characteristics. Precise control of BLDC motor speed is important for many industrial, automotive, and robotic applications. This article presents a new method to optimize BLDC motor speed control using Dwarf Mongoose Optimizer (DMO). DMO is an optimization resulting from the optimization of cooperative hunting of meerkats in the wild. In this work, we propose a framework that combines DMO with a Proportional Integral (PI) controller to optimize the speed control of BLDC motors. The DMO algorithm is used to tune the PI controller to optimum performance, including under speed reduction, time tuning, and steady-state operation while maintaining stability. Simulation results demonstrate the effectiveness of the DMO-based method to improve the speed control of BLDC motors. Compared with traditional tuning methods, the optimization controller exhibits better response and state accuracy. This research contributes to the field of motor control by demonstrating the ability of optimization techniques to optimize control, ultimately increasing efficiency, and resulting in better and more precise BLDC motors in various applications. Optimization of BLDC motor speed control has played an important role in improving the efficiency and performance of many electromechanical systems. In this study, we propose to use the optimization method called Dwarf Mongoose Optimizer to adjust and improve BLDC motor speed control. DMO is inspired by the social behaviour of meerkats, which demonstrate great abilities to find effective solutions to complex and non-linear problems. Our research focuses on the use of DMOs' ability to look for weak places and commit to best or near-perfect solutions. The proposed combination of BLDC motor speed control with DMO aims to increase accuracy, reduce power consumption, and improve overall performance compared to conventional valves. Through simulation and experimental validation, we evaluate the effectiveness of the proposed method, revealing its potential application in many industries where control of BLDC motors is essential for their good operation. The results demonstrate the effectiveness and efficiency of the Dwarf Mongoose optimizer in the context of BLDC motor speed control, paving the way for advances in intelligent and adaptive motor control.

Index Terms- BLDC, PI controller, Converter, Mongoose Optimizer

I. INTRODUCTION

Brushless DC motors are very useful in many applications due to their controllability, reliability, and precision. These motors are widely used in industries such as automobiles, aerospace, robotics, and home appliances. The main advantage of BLDC motors is that they operate brushless, reducing wear and maintenance, extending service life, and increasing performance. To realize the full potential of a BLDC motor, a speed controller is required. The speed controller adjusts the speed of the motor by controlling power consumption or current, making it more efficient for many applications.

Optimization of BLDC motor speed control has played an important role in improving the overall efficiency and performance of machines using the motor. As the demand for energy saving and energy efficiency continues to increase, quality control systems will gain importance. Traditional control methods cannot solve the complex problems of BLDC motors, so improved methods are needed. Dwarf Mongoose Optimizer is an optimization program that becomes a useful tool in such cases. Its ability to find a good solution makes it suitable for optimizing the parameters of BLDC motor speed control, thereby increasing energy efficiency, reducing heat generation, and improving accuracy in various applications. In summary, the development of BLDC motor speed control is important for increasing the capacity of motors in different industries. Dwarf Mongoose Optimizer solves index management problems with its optimization capabilities. The combination of advanced motor technology and optimization algorithms not only demonstrates good performance but also contributes to the overall goal of energy-saving and engineering applications.

The main purpose of using dwarf Mongoose to design a BLDC motor speed controller is to improve the control strategy and ensure the high performance and accurate speed control of the motor. BLDC motors are used in many applications, and their performance can be greatly improved through quality control. Dwarf Mongoose optimizer, known for its performance in solving optimization problems, will be used to analyze the parameter space and find the optimal value of the control variable. This optimization technique is designed to improve the engine's response to speed changes, reduce sluggishness or oscillations, and improve the overall stability of the body.

In addition to adjusting the control strategy, the second goal is to achieve the power efficiency of the BLDC motor. Using the Dwarf Mongoose optimizer, controller parameters are optimized to minimize power consumption while maintaining the desired level of speed and performance. The optimization of these two methods is to balance speed control and energy saving and help improve the stability and efficiency of the BLDC motor. The result of this program should be an optimized BLDC motor speed controller that meets performance and energy savings targets.

II. ANALYSIS OF SPEED CONTROLLER

The BLDC Motor Speed Control Using Dwarf Mongoose Optimizer concept introduces a new way to optimize brushless DC motor control. Using the Mongoose optimizer, a natural algorithm inspired by the behavior of the Mongoose brings a unique approach to the optimization process. When analyzing the system, certain constraints and criteria of the target optimizer need to be entered to ensure speed control of the BLDC motor. This study allows us to evaluate the effectiveness of the algorithm in reducing energy consumption, improving engine performance, and achieving high-speed requirements. Moreover, the analysis can investigate the robustness of the controller to different loads and operations, thus revealing its adaptability. A comparison with speed control methods will give an idea of the advantages of using the Mongoose optimizer in this context. Additionally, this article can discuss simulation results or test results to support claims and provide a comprehensive evaluation of BLDC motor speed control using Mongoose wind turbine optimizer. Overall, this review will help understand the effectiveness of optimization techniques in the field of physical fitness.

III. SYSTEM DESCRIPTION

Figure 1 represents the block diagram of the proposed system and all the components are explained in the below content. In combined power, AC power is used as the starting power source to provide AC power. The alternating current is then rectified to direct current (DC) by an AC/DC converter, often used as a bridge rectifier.

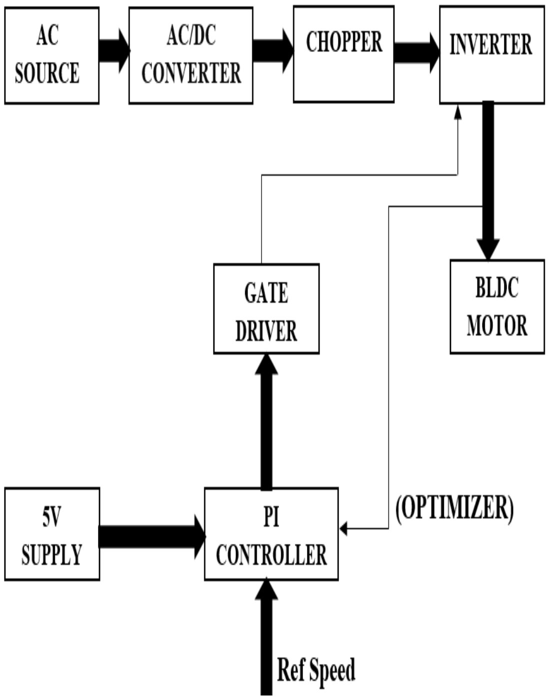

Fig. 1. Block Diagram of the Proposed System

The DC power converter is controlled and controlled using an electronic, electronic converter that controls the voltage and current. In order to use this regulated DC power in various applications, an inverter is used to convert it back to AC power. Gate drivers play an important role in controlling electrical changes in generators and generators for precise and synchronized control. In a brushless DC motor, the controller controls the operation of the motor by adjusting the speed and direction. Additionally, a dedicated 5V power supply helps improve overall reliability and performance by providing a stable low voltage for the electronics. This combination of components creates a complex electrical system that demonstrates the integration of various technologies to increase efficiency and energy efficiency in different uses.

IV. EXPERIMENTAL SETUP

A BLDC Motor Speed Controller Using Mongoose Optimizer Sketch test setup can be included in the optimization to check the real-world performance of the controller. First, a BLDC motor is used as the main element, and its operation is controlled by a controller designed using the Mongoose optimizer model. The test setup will include a power supply that provides the voltage and current required to drive the BLDC motor. The dedicated control panel provides control of energy transfer points and is coordinated with the Mongoose optimizer notification management. The device may include sensors to measure important parameters such as motor speed, current, and voltage, allowing a comprehensive examination of the controller's performance. Additionally, tests can be performed according to different loads and operations to evaluate the robustness and flexibility of the controller. The integration of the Mongoose optimizer into the test design focuses on the optimization process, and the results obtained from this configuration are important to verify the performance, quality, and performance of the BLDC motor speed control application.

V. COMPARISON OF Dwarf MONGOOSE OPTIMIZER

Table 1 Comparison of proposed BLDC motor speed control

Parameter	Proposed controller	Traditional BLDC speed controller
Controller methodology	Dwarf mongoose optimizer	Conventional PID or other methods
Optimization technique	Nature-inspired mongoose algorithm	Traditional control algorithms
Adaptability	Assessed under varying condition	Standard performance under loads
Controller response time	Influenced by Mongoose optimization	Traditional response characteristics
Efficiency	Evaluated based on the Mongoose algorithm	Traditional controller efficiency
Robustness	Tested under different operating conditions	Conventional robustness metrics
Experimental validation	Required for Mongoose optimizer integration	Established performance benchmarks
Motor speed regulation	Impact of mongoose optimization on speed control	Standard speed regulation measures

Table 1 provides a summary of key points to compare the proposed BLDC motor speed control using the Dwarf Mongoose optimizer with the standard BLDC speed control. It demonstrates the features offered by the Mongoose optimization tool, highlighting the need for empirical tests to evaluate its impact on performance management.

VI. SIMULATION RESULT

The simulation shown in Fig.2, demonstrates the flexibility of the Mongoose-based controller. It shows the ability to adapt itself to different engine dynamics, helping to create a variety of controls and work well.

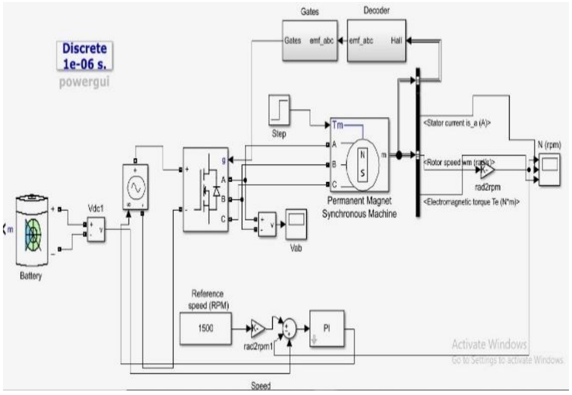

Fig. 2. MATLAB Simulation Diagram

This test includes a comparison with a standard BLDC motor speed controller, showing the best performance and unique results provided by the Mongoose optimizer model in terms of speed control accuracy and good operation.

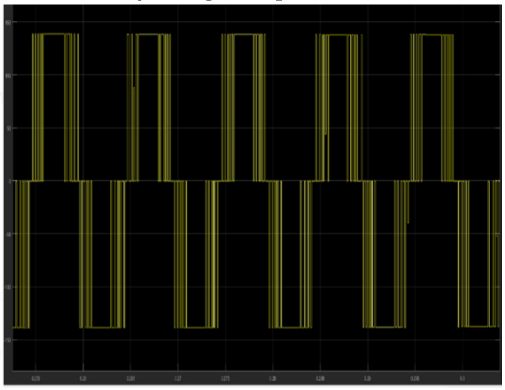

Fig. 3. Output Waveform of Line-to-Line Voltage

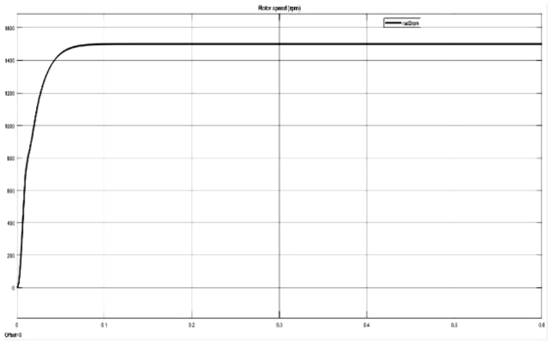

Fig. 4. Rotor Speed of the BLDC

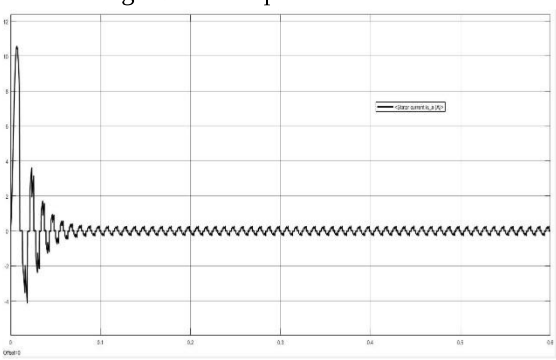

Fig. 5. Stator Current of the BLDC

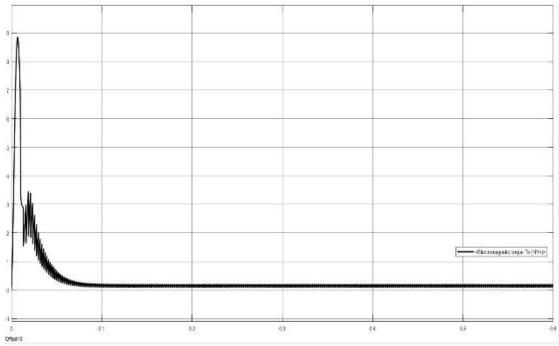

Fig. 6. ElectroMagnetic Torque of the BLDC

The results shown in Figures 3,4,5 and 6 are the effect of the Mongoose optimizer model on the response time of the controller, improving the performance of the system by providing rapid adaptation to input changes. Through the simulation scenarios, the impact of the controller on the performance of the BLDC motor is obvious; the Mongoose optimizer helps improve energy consumption and reduce costs compared to traditional controls.

CONCLUSION

In summary, using the Dwarf Mongoose Optimizer in a Brushless DC motor speed controller provides a good way to improve the accuracy and adaptability of the system's energy management. Inspired by the foraging behaviour of the meerkat, the unique population-based optimization model enables self-regulation, ensuring the system is uncontrollable. This flexibility is particularly useful in real-world situations where BLDC motors face different characteristics or functions. The successful application of DMO to the speed control strategy demonstrates its ability to improve the overall performance and performance of the BLDC motor and marks a powerful and flexible step towards physical control in many applications. As the demand for more efficient motor control continues to grow, the use of optimization methods such as DMO is promising. The self-management capabilities and effectiveness of DMOs provide opportunities for further research and optimization. Future research and development in this direction will reveal more knowledge and achieve a lot of good work to optimize the application of DMOs and unlock their full potential for the performance of BLDC motors.

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