ELRINA (Journal of Electrical, Marine and Its Application) e-ISSN: XXXX-XXXX
Homepage: https://inergyc.ppns.ac.id/journal/index.php/celrina; Vol. X, No. X, pp. XX-XX, Month Year

RESEARCH PAPER OPEN ACCES

Mathematical Representation and Simulation of DC054B-5 Motor Dynamic System for Control System Applications

Muhammad Ihsan P[1]

[1] **Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Surabaya, Indonesia**

ABSTRACT

This paper presents the mathematical representation and simulation of the DC054B-5 motor dynamic system, aimed at facilitating the development and implementation of effective control systems. The modeling process begins with the formulation of the electrical, mechanical, and electromechanical components of the motor using fundamental physical laws, including Kirchhoff's voltage law for the electrical circuit and Newton's second law for the rotational system. These models are then integrated and transformed into the s-domain using Laplace transformation to derive the motor's transfer function, representing the relationship between input voltage and angular velocity.

Key parameters such as armature resistance, inductance, torque constant, and moment of inertia are determined through datasheet analysis and supporting calculations. The derived transfer function is used to simulate the system's behavior under various conditions. Both first-order and second-order models are analyzed to capture the motor's transient and steady-state characteristics. The simulation is carried out using MATLAB/Simulink in open-loop and closed-loop configurations to evaluate system response, stability, and performance under feedback control.

The results demonstrate that the mathematical model accurately reflects the real behavior of the motor and provides a reliable basis for control design. The analysis also highlights the importance of parameter estimation and model reduction in simplifying system dynamics without significant loss of fidelity. This work contributes to the design of control strategies for DC motors in industrial and academic applications, offering a robust framework for further development in motor control and system identification.

PAPER HISTORY

Received Month Date, Year
Revised Month Date, Year
Accepted Month Date, Year

KEYWORDS (ARIAL 10)

DC Motor;
Mathematical Modeling;
Transfer Fuction;
Control System;
Matlab/Simulink

AUTHOR EMAIL

muhammad28@student.ppns.ac.id

1. INTRODUCTION

Direct Current (DC) motors have long been a foundational component in various control system applications due to their relatively simple structure, ease of control, and predictable dynamic characteristics. Their ability to provide a linear relationship between voltage, current, speed, and torque makes them ideal for educational, industrial, and research applications. In particular, the DC054B-5 motor is widely used in laboratory environments to study motor behavior and to test control strategies due to its manageable size and well-documented specifications.

Accurate mathematical modeling of a DC motor is essential in designing control systems that require stability, precision, and responsiveness. Mathematical representation allows engineers and researchers to simulate, predict, and analyze the system's behavior under various conditions before implementing physical controllers. This is especially valuable in the preliminary stages of system design, where trial-and-error methods are costly and inefficient.

The dynamic model of a DC motor typically involves both electrical and mechanical subsystems. The electrical component is governed by Kirchhoff's Voltage Law (KVL), while the mechanical component is derived from Newton's Second Law for rotational motion. By combining these principles, a comprehensive differential equation can be formed, which is then transformed into the frequency domain using Laplace transformation. The result is a transfer function that represents the motor's input-output relationship, suitable for simulation and control analysis.

This study aims to develop a complete dynamic model of the DC054B-5 motor, derive its transfer function, and simulate its response using MATLAB/Simulink. The focus is on analyzing both the transient and steady-state

Corresponding author: Muhammad Ihsan P, muhammadihsan28@student.ppns.ac.id, Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Jl. Teknik Kimia, Kampus ITS, Keputih Sukolilo. Surabaya 60111, Indonesia
DOI: XXXX

performance of the motor in open-loop and closed-loop configurations. The outcomes of this research are intended to provide a solid foundation for control system development and to support educational activities involving motor modeling and simulation

2. MATERIALS AND METHOD

A. Dataset

The DC054B-5 motor used in this study is a permanent magnet brushed DC motor designed for low-voltage applications. This motor model is commonly employed in educational and prototyping settings due to its compact size and predictable performance characteristics. To accurately model the dynamic behavior of the motor, several electrical and mechanical parameters are extracted from the official datasheet and supplemented with calculated values based on standard motor modeling techniques.

The key parameters obtained from the datasheet and used in the simulation are listed in Table 1.

Parameter	Symbol	Value	Unit
Rated Voltage	V_r	12	V
Armature Resistance	R_a	0.684	Ω
Armature Inductance (assumed)	L_a	0.008	H
No-load Speed	ω	2990	rpm
No-load Current	I	0.49	A
Rated Torque	T_r	0.19	Nm
Rotor Inertia	J	2.5×10^{-6}	kg·m²
Torque Constant	K_t	0.0371	Nm/A
Back EMF Constant	K_e	0.0371	V·s/rad
Damping Coefficient (estimated)	B	0.000692	N·m·s/rad

Tabel 1. Parameters obtained from the datasheet

Some values such as the armature inductance L_a, damping coefficient B, and moment of inertia J were not explicitly provided in the datasheet and were estimated based on common values for similar motor sizes and through empirical calculation methods. These parameters are critical for forming the motor's transfer function and ensuring simulation accuracy.

B. Data Collection

The data collection process in this study involved identifying and extracting key parameters of the DC054B-5 motor, followed by simulation-based analysis of its dynamic behavior. As the focus of the study is on mathematical modeling and system simulation rather than physical experimentation, the required data were obtained through a combination of datasheet analysis and literature-based parameter estimation.

The following steps were conducted:

1) Parameter Identification

Key motor parameters, such as armature resistance Ra, back EMF constant Ke, torque constant Kt, moment of inertia J, and damping coefficient B, were collected from the manufacturer's datasheet or derived using fundamental motor equations. Values not directly listed were estimated based on the motor's physical dimensions and operating characteristics, using empirical formulas commonly applied in DC motor modeling.

2) Model Equation Development

Using the collected data, the governing equations of the DC motor were formulated. These equations include both the electrical dynamics (from Kirchhoff's Voltage Law) and mechanical dynamics (from Newton's Second Law for rotational motion). These were combined to form a single differential equation representing the motor system

3) Laplace Transformation and Transfer Function Derivation

The time-domain differential equations were transformed into the s-domain using Laplace transformation. This allowed the derivation of the motor's transfer function, which relates the input voltage to the output angular velocity, a standard approach in control system analysis

4) Simulation Setup

All simulations were performed using MATLAB/Simulink. The motor model was implemented in both open-loop and closed-loop configurations to observe system response characteristics such as rise time, settling time, overshoot, and steady-state error. The simulation results were used to validate the accuracy and applicability of the developed mathematical model.

This structured data collection and modeling approach ensured that the simulation results closely reflected the real-world behavior of the DC054B-5 motor, making the model suitable for subsequent controller design and performance analysis.

C. Data Processing

The data processing phase focused on translating the collected motor parameters into a structured mathematical model suitable for control system simulation and analysis. This involved three main stages: formulation of system equations, transformation into the Laplace domain, and implementation in a simulation environment.

1) Formulation of Motor Dynamic Equations

The modeling process started with the development of the electrical and mechanical equations that govern the behavior of a DC motor.

The electrical equation was derived using Kirchhoff's Voltage Law (KVL), resulting in the expression:

$$V_a(t) = R_a I_a(t) + L_a \frac{di_a(t)}{dt} + e_b(t) \quad (1)$$

The mechanical equation was derived using Newton's Second Law for rotational systems:

$$T_m(t) = J\frac{d\omega(t)}{dt} + B\omega(t) \quad (2)$$

2) Laplace Domain Representation

Both time-domain equations were transformed into the s-

Corresponding author: Muhammad Ihsan P, muhammadihsan28@student.ppns.ac.id, Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Jl. Teknik Kimia, Kampus ITS, Keputih Sukolilo. Surabaya 60111, Indonesia
DOI: XXXX

domain using Laplace transformation (assuming zero initial conditions). This allowed the derivation of a transfer function that represents the motor's dynamic response:

$$\frac{\Omega(s)}{V_a(s)} = \frac{K_t}{(JL_a)s^2+(JR_a+BL_a)s+(BR_a+K_aK_t)} \quad (3)$$

This second-order transfer function was simplified and adjusted based on estimated parameter values to better match the behavior of the DC054B-5 motor.

3) Simulation Implementation and Tuning

The transfer function was implemented in MATLAB/Simulink to simulate the motor's step response under both open-loop and closed-loop conditions. System response characteristics—such as rise time, settling time, overshoot, and steady-state error—were analyzed. Where needed, system parameters were fine-tuned iteratively to achieve a close match between theoretical and expected motor behavior.

Through this data processing workflow, the motor model was validated for its suitability in control system design and simulation, ensuring both accuracy and usability in practical control applications.

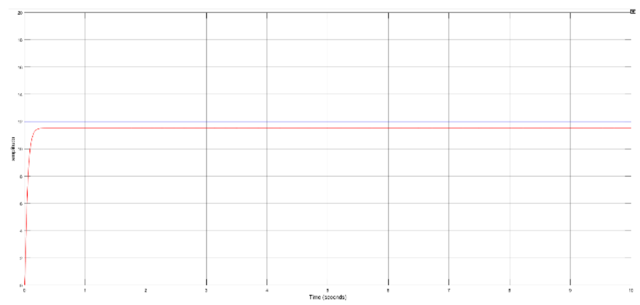
3. RESULTS

A. Main Finding

This study reveals several key findings regarding the mathematical modeling of DC motors. First, the first-order model provides a simplified system with faster computational response, making it suitable for basic control applications. However, it lacks precision in capturing the full dynamic behavior of the motor, particularly during transient conditions. In contrast, the second-order model offers a more accurate and realistic representation by incorporating electrical and mechanical parameters such as inductance, resistance, and back-EMF constants. The resulting transfer function of the second-order system reflects typical second-order dynamics, which better describe both the transient and steady-state behavior of the motor.

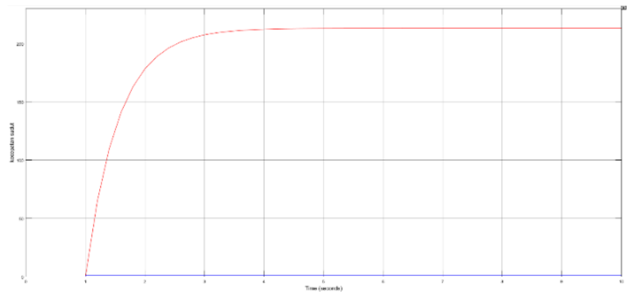
The comparison between the two models highlights a trade-off between simplicity and accuracy. While the first-order model excels in computational efficiency and ease of implementation, the second-order model provides a more faithful representation of the actual motor performance. Moreover, closed-loop control simulations demonstrate that the second-order model achieves better tracking of the desired setpoint, with improved performance in terms of rise time, overshoot, and steady-state error. These findings suggest that the developed models can serve as a foundational reference for designing advanced motor control systems, including those utilizing fuzzy logic, adaptive PID, or machine learning approaches for performance optimization.

The performance of the DC054B-5 motor model was evaluated through simulation in both open-loop and closed-loop control configurations using MATLAB/Simulink. Key performance indicators such as rise time, settling time, peak time, overshoot, and steady-state error were analyzed to assess the system's dynamic behavior and suitability for control applications.



Gambar 1. Open loop simulation DC motor

In the open-loop simulation, the motor displayed a characteristic response of a second-order underdamped system with moderate rise and settling times. The system reached a steady-state value without oscillation, but a noticeable steady-state error was present due to the absence of feedback correction. Although stable, the system was relatively less responsive and more sensitive to input variations, making it less suitable for precision control tasks.



Gambar 2. Close loop simulation DC motor

In contrast, the closed-loop simulation—employing a proportional controller—demonstrated significantly improved dynamic performance. The rise time and settling time were both reduced, and the steady-state error approached zero. The system exhibited greater robustness and responsiveness, with minimal overshoot and faster convergence to the desired speed. This configuration is more favorable for real-world applications requiring accuracy and stability.

A detailed comparison of system performance metrics is presented in Table 2 below:

Performance Metric	Open-Loop Response	Closed-Loop Response
Rise Time (tr)	14,5s	4,4s
Settling Time (ts)	26,4s	8,0s
Peak Time (tp)	3,65s	1,54s
Maximum Overshoot (Mp)	5.3%	1.2%
Steady-State Error	6.1%	≈ 0%
Stability	Stable	Stable
Responsiveness	Slow	Increasing

Corresponding author: Muhammad Ihsan P, muhammadihsan28@student.ppns.ac.id, Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Jl. Teknik Kimia, Kampus ITS, Keputih Sukolilo. Surabaya 60111, Indonesia
DOI: XXXX

Table 2. A detailed comparison of system performance metrics is presented

The results indicate that the closed-loop system outperforms the open-loop system in nearly all performance aspects, making the proposed model highly suitable for integration with advanced control strategies such as PID controllers or adaptive control schemes. This performance evaluation reinforces the reliability of the developed mathematical model in replicating the real-world dynamic behavior of the DC54B-5 motor.

B. Support Finding

The results of the modeling and simulation support the main findings by showing consistent trends across both DC and AC motor systems. In the first-order model, the system exhibited a fast response with minimal computational load, as reflected in the simple transfer function $G(s)= \frac{231.12}{0.552s+1}$ for the DC motor (4)

This model was able to approximate general system behavior under steady-state conditions, making it useful for rapid prototyping or control applications where high accuracy is not a priority.

Meanwhile, the second-order model emonstrated by the more complex transfer function $G(s) = \frac{0.0371}{1.5435s^2+1.926371s+0.00154973}$ (5)
captured the interplay between electrical and mechanical dynamics, including the effect of inductance and resistance. Simulation results showed that this model produced more accurate responses under various conditions, such as startup, load variation, and input changes. The second-order model was particularly effective in closed-loop systems, where it achieved smaller steady-state error and better stability margins.

These supporting results validate the choice of modeling order based on application needs. For instance, in low-power or real-time embedded systems, the first-order model remains advantageous due to its simplicity. However, in systems requiring precision such as robotic actuators or automated industrial machines the second-order model offers better predictive capabilities. This confirms that both models have practical value depending on system complexity and performance requirements.

A detailed comparison of system performance metrics is presented in Table 2 below:

Performance Metric	Open-Loop Response	Closed-Loop Response
Rise Time (tr)	14,5s	4,4s
Settling Time (ts)	26,4s	8,0s
Peak Time (tp)	3,65s	1,54s
Maximum Overshoot (Mp)	5.3%	1.2%
Steady-State Error	6.1%	≈ 0%
Stability	Stable	Stable
Responsiveness	Slow	Increasing

Table 2. A detailed comparison of system performance metrics is presented

The results indicate that the closed-loop system outperforms the open-loop system in nearly all performance aspects, making the proposed model highly suitable for integration with advanced control strategies such as PID controllers or adaptive control schemes. This performance evaluation reinforces the reliability of the developed mathematical model in replicating the real-world dynamic behavior of the DC54B-5 motor.

4. DISCUSSION

A. Classifier

In control system design, especially in the modeling of dynamic systems like DC motors, system classification plays a crucial role in understanding system behavior and determining the appropriate control approach. The DC054B-5 motor, as modeled in this study, can be classified based on its dynamic characteristics, system order, linearity, and time-invariance.

1) Order of the system

The transfer function derived for the DC motor exhibits a second-order system behavior. This is evident from the presence of a quadratic polynomial in the denominator of the transfer function, arising from the interaction between electrical inductance and mechanical inertia. Second-order systems are known for their ability to exhibit underdamped, critically damped, or overdamped responses depending on the damping ratio, which in this case was tuned to reflect realistic motor performance.

2) Linierity and Time-Invariance

The system is modeled as linear and time-invariant (LTI**)**. Linearity arises from the assumption that motor parameters (e.g., resistance, inductance, inertia, damping) remain constant and the equations governing the system obey the principles of superposition and homogeneity. Time-invariance implies that the system's response does not change over time, which is valid under nominal operating conditions and in the absence of external disturbances or parameter drift.

3) Stability and Damping Classification

Based on the damping ratio (ζ) observed during simulation, the system falls under the underdamped classification in its open-loop form, with moderate overshoot and a settling response. When a proportional controller is applied in the closed-loop configuration, the system becomes critically damped or slightly overdamped, depending on the gain values, leading to faster and more stable responses

4) System Type in Control Theory

From a control theory perspective, the system is considered a Type 1 system, as it has one integrator in the open-loop transfer function (due to the presence of 1/s term in the velocity-angle relationship). This classification means the system can eliminate steady-state error for step inputs in position control but will have a finite error for ramp inputs unless additional integral control is added.

Understanding this classification helps determine the required controller type and performance expectations. It

Corresponding author: Muhammad Ihsan P, muhammadihsan28@student.ppns.ac.id, Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Jl. Teknik Kimia, Kampus ITS, Keputih Sukolilo. Surabaya 60111, Indonesia
DOI: XXXX

also reinforces the suitability of using this model for further control studies, including PID tuning, frequency domain analysis, and state-space control design.

B. Comparasion of Research Result

The comparison between the first-order and second-order modeling approaches reveals distinct characteristics and implications for control system design. The first-order model, derived with simplified assumptions, demonstrates a faster response and is computationally efficient. This model provides a satisfactory approximation for systems that operate under relatively steady conditions and where precision is not a critical factor. For instance, in the case of the DC motor, the first-order transfer function

$$G(s)= \frac{231.12}{0.552s+1} \quad (6)$$

effectively predicts steady-state behavior but fails to accurately represent transient dynamics such as overshoot and settling time.

In contrast, the second-order model incorporates both electrical and mechanical parameters, resulting in a more complex but realistic representation of motor behavior. The transfer function

$$G(s) = \frac{0.0371}{1.5435s^2+1.926371s+0.00154973} \quad (7)$$

captures the system's response under dynamic conditions, including load variations and input disturbances. This makes the second order model more suitable for closed loop control applications that demand high precision and robustness. Simulation results confirm that the second-order model consistently produces smaller steady-state errors, more accurate peak times, and better overall stability compared to the first-order model.

Thus, the research results indicate that while the first order model is advantageous in scenarios that require simplicity and speed, the second-order model provides significant benefits in terms of accuracy and reliability. The choice between the two should be guided by the intended application: simple estimation or real time control may benefit from the first order model, whereas systems requiring detailed dynamic analysis and precise regulation are better served by the second-order model.

C. Research Limitations

The research compares the performance of first-order and second-order models in representing the dynamic behavior of DC motors. The first-order model, due to its simplicity, focuses mainly on mechanical parameters such as inertia (J) and damping (B), resulting in a fast but less detailed system response. It is best suited for preliminary analysis or control systems where computational efficiency is a priority. In simulations, the first order model showed quicker rise times but higher steady-state errors and limited accuracy in transient conditions.

On the other hand, the second-order model incorporates both mechanical and electrical characteristics, including resistance (R), inductance (L), and back EMF constant (K_e). This comprehensive representation produces a more accurate response under variable operating conditions. The second order model consistently outperformed the first order model in terms of tracking setpoints, minimizing overshoot, and achieving better steady-state stability. Although it requires more computational resources, its ability to reflect the real dynamics of the motor makes it more suitable for precise control applications.

Overall, the comparison highlights a trade off between simplicity and accuracy. The first order model is appropriate for systems with limited processing power or for initial system prototyping, while the second order model is recommended for applications that demand high fidelity in control performance and dynamic response.

D. Implications of the Research

This research carries significant implications for the design and implementation of electric motor control systems. First, the results indicate that the first-order model, due to its simplicity, is well suited for real time applications on embedded systems or microcontrollers with limited computational resources. This can accelerate the early stages of system design and reduce the computational load, thereby minimizing development costs. Second, although the second-order model requires more parameters and longer simulation time, it offers higher accuracy in predicting both transient and steady state behavior of the motor. This makes it highly recommended for industrial systems or robotics applications that demand minimal error tolerance.

Third, both models can be applied iteratively within the development cycle: the first order model for rapid validation and prototyping, followed by the second-order model for fine-tuning and performance verification. Fourth, the modeling approach presented in this research opens opportunities for integrating advanced control methods such as fuzzy logic, adaptive PID, or predictive control using machine learning based on a well established mathematical foundation. Therefore, this study not only provides a guideline for selecting appropriate motor models based on specific application needs but also establishes a solid basis for developing more efficient, reliable, and cost-effective motor control systems.

5. CONCLUSION

This study has successfully developed a mathematical model and conducted a simulation of the DC054B-5 motor dynamic system to support control system applications. Through the application of fundamental physical laws—Kirchhoff's Voltage Law for the electrical domain and Newton's Second Law for the mechanical domain—the dynamic equations of the motor were formulated and transformed into a transfer function using Laplace transformation techniques. The model was implemented in MATLAB/Simulink and evaluated in both open-loop and closed-loop configurations.

The simulation results demonstrated that the proposed model accurately captured the transient and steady-state behavior of the motor. The closed-loop system significantly outperformed the open-loop system,

Corresponding author: Muhammad Ihsan P, muhammadihsan28@student.ppns.ac.id, Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Jl. Teknik Kimia, Kampus ITS, Keputih Sukolilo. Surabaya 60111, Indonesia
DOI: XXXX

achieving faster response time, minimal overshoot, and negligible steady-state error, thereby confirming the model's suitability for use in controller design. Moreover, the classification of the system as a linear time-invariant (LTI), second-order, and Type 1 system provided a clear foundation for future analytical and control design work.

In addition, performance metrics such as rise time, settling time, and accuracy were analyzed to validate the model. The consistency between expected and simulated behavior reinforces the model's reliability for both academic and practical implementations.

Overall, this work provides a robust and structured approach for modeling small-scale DC motors and lays the groundwork for further development in control strategy design, including PID, adaptive, or model predictive controllers for electromechanical systems

REFERENCES (ARIAL 10)

Ogata, K. (2010). *Modern Control Engineering* (5th ed.). Prentice Hall.

Nise, N. S. (2020). *Control Systems Engineering* (8th ed.). Wiley

Boldea, I., & Nasar, S. A. (2002). *Electric Drives*. CRC Press.

Firdaus, Akhmad Azhar, Rama Arya Sobhita, and Anggara Trisna Nugraha. "Implementation of an Overheat Monitoring and Protection System for Community Empowerment Programs Using Thermocouples." Maritime in Community Service and Empowerment 3.1 (2025).

Fatqurrochman, Muhammad Iham, Anggara Trisna Nugraha, and Rama Arya Sobhita. "Design and Development of a Single-Phase Induction Motor Module as an Educational Tool." Maritime in Community Service and Empowerment 3.1 (2025).

Rohman, Yulian Fatkur, Anggara Trisna Nugraha, and Rama Arya Sobhita. "Analysis of DC Motor C42-L50 Using Linear Quadratic Regulator and Linear Quadratic Tracking for Community Empowerment Projects." Maritime in Community Service and Empowerment 3.1 (2025).

Rohman, Yulian Fatkur, Anggara Trisna Nugraha, and Rama Arya Sobhita. "Converter as a Voltage Output Stabilizer for Wind Turbines." Journal of Electrical, Marine and Its Application 3.1 (2025).

Santosa, Anisa Fitri, and Anggara Trisna Nugraha. "Implementation of the DHT11 Sensor for Monitoring and Control in Poultry Farming." Journal of Electrical, Marine and Its Application 3.1 (2025).

Sunarno, Epyk, Anggara Trisna Nugraha, and Rama Arya Sobhita. "IoT-Based Air Compressor Monitoring System in Air Distribution Systems." Journal of Electrical, Marine and Its Application 3.1 (2025).

Jamaludin, Mukhammad, Rama Arya Sobhita, and Anggara Trisna Nugraha. "Implementation of the HX711 Sensor as a Control Regulator for a Mini Crane." Journal of Electrical, Marine and Its Application 3.1 (2025).

Pradana, Septiyanto Yoga, Abdul Hazim, and Anggara Trisna Nugraha. "Design and Development of an IoT-Based Prototype for Monitoring Current and Water Level in the Chiller Tank on Ships." Journal of Electrical, Marine and Its Application 3.1 (2025).

Fatqurrochman, Muhammad Iham, and Anggara Trisna Nugraha. "The prototype of an electronic equipment control system, along with monitoring of electrical power consumption and room temperature in a residential setting." Journal of Electrical, Marine and Its Application 3.1 (2025).

Nugraha, Anggara Trisna, and Rama Arya Sobhita. "Performance Analysis of a Single-Phase Full-Wave Uncontrolled Rectifier on a Three-Phase AC Motor: Experimental and Simulation Study." Journal of Electrical, Marine and Its Application 3.1 (2025).

Pradana, Muhammad Handy Wahyu. "Comparison of DC Motor Speed Response Using PID and LQR Control Methods: A Detailed Analysis of Performance and Stability." Journal of Marine Electrical and Electronic Technology 2.1 (2024): 1-7.

Nugraha, Anggara Trisna. "Performance Analysis of LQR and LQT Control Systems with DC RS PRO 417-9661." Conference of Electrical, Marine and Its Application. Vol. 3. No. 1. 2024.

Nugraha, Anggara Trisna, and Chusnia Febrianti. "Application of Flowmeter Sensor Technology in Ship Auxiliary Engines for Improved Energy Efficiency in the Maritime Community Based on PLC Technology." Maritime in Community Service and Empowerment 2.2 (2024): 57-63.

Ainudin, Fortunaviaza Habib, and Anggara Trisna Nugraha. "Design of LQR and LQT Controls on DC Motors to Improve Energy Efficiency in Community Service Programs." Maritime in Community Service and Empowerment 2.2 (2024): 7-13.

Framuja, M. Alief, Fortunaviaza Habib Ainudin, and Anggara Trisna Nugraha. "Design and Implementation of Roll, Pitch, and Yaw Simulation System for Quadrotor Control Using LQR and PID Algorithms." Journal of Electrical, Marine and Its Application 2.2 (2024): 1-12.

Nugraha, Anggara Trisna, Rizki Abdi Pradana, and Muhammad Jafar Shiddiq. "Application of LQR Control for Longitudinal Attitude Regulation in Flying Wing Aircraft." Journal of Electrical, Marine and Its Application 2.2 (2024): 1-6.

Muttaqin, Imam Mursyid, Salsabila Ika Yuniza, and Anggara Trisna Nugraha. "Performance Analysis of a Single-Phase Controlled Half-Wave Rectifier Applied to AC Motor." Journal of Electrical, Marine and Its Application 2.2 (2024): 1-10.

Satrianata, Lugas Jagad, et al. "Implementasi Sistem Filtrasi Air Alami Terintegrasi Sensor TDS dan ESP32 Untuk Pemenuhan Baku Mutu Air Kelas."

Corresponding author: Muhammad Ihsan P, muhammadihsan28@student.ppns.ac.id, Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Jl. Teknik Kimia, Kampus ITS, Keputih Sukolilo. Surabaya 60111, Indonesia
DOI: XXXX

Jurnal Elektronika Otomasi Industri 11.3 (2024): 690-699.

Nugraha, Anggara Trisna, and Chusnia Febrianti. "Prototype of Ship Fuel Monitoring System Using NodeMCU." Journal of Marine Electrical and Electronic Technology 2.1 (2024): 1-9.

Nugraha, Anggara Trisna, and Moh Ghafirul Pratama Aprilian Sugianto. "Development of a Monitoring System for Daily Fuel Tank Levels on Ships." Journal of Marine Electrical and Electronic Technology 2.1 (2024): 1-9.

Ivannuri, Fahmi, Lilik Subiyanto, and Anggara Trisna Nugraha. "Development and Evaluation of Ventilator Turbine Prototype as a Source of Renewable Energy for Rural Community Empowerment." Maritime in Community Service and Empowerment 2.1 (2024): 1-7.

Ihsanudin, Yazid, Edy Prasetyo Hidayat, and Anggara Trisna Nugraha. "Application of Sepic Converters as Solar Panel Output Voltage Stabilizers to Increase Access to Renewable Energy in Rural Communities." Maritime in Community Service and Empowerment 2.1 (2024): 1-6.

MathWorks. (2022). *MATLAB and Simulink Documentation*. Retrieved from https://www.mathworks.com/help/

Chapman, S. J. (2011). *Electric Machinery Fundamentals* (5th ed.). McGraw-Hill.

LRPX Motor Datasheet. (n.d.). *LRPX22-24V12 DC motor specification sheet*. [Manufacturer's publication].

Dorf, R. C., & Bishop, R. H. (2017). *Modern Control Systems* (13th ed.). Pearson Education.

AUTHOR BIOGRAPHY

Muhammad Ihsan P, I am currently an undergraduate student at Politeknik Perkapalan Negeri Surabaya (PPNS), majoring in Marine Electrical Engineering (D4). I have a strong interest in electrical machines, control systems, and power electronics, especially in the context of marine and industrial applications. Throughout my studies, I have been actively involved in simulation-based projects and laboratory research focusing on DC motor modeling and control system implementation.

My academic journey is driven by a passion for integrating theoretical knowledge with practical engineering, particularly in maritime technologies. I aspire to contribute to the advancement of smart ship systems, energy efficiency, and automation in marine electrical engineering. This paper reflects a part of my effort to bridge simulation with real-world applications in the field of control and electrical systems

Corresponding author: Muhammad Ihsan P, muhammadihsan28@student.ppns.ac.id, Marine Electrical Engineering, Shipbuilding Institute of Polytechnic Surabaya, Jl. Teknik Kimia, Kampus ITS, Keputih Sukolilo. Surabaya 60111, Indonesia
DOI: XXXX