



Experimental Comparative Performance Analysis of Li-Po and Li-Ion Batteries Using Telemetry-Based Flight Testing in Fixed-Wing UAV for KRTI LELA Mission

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Abstract—The Indonesian Flying Robot Contest (KRTI) Long Endurance Low Altitude (LELA) division evaluates fixed-wing Unmanned Aerial Vehicles (UAVs) not only based on endurance, but also on mission completion speed, where faster completion yields additional scoring points. This study aims to analyze and compare the performance characteristics of Lithium-Polymer (Li-Po) and Lithium-Ion (Li-ion) batteries in fixed-wing UAV operations and to evaluate their suitability based on competition-oriented mission strategies. An experimental approach was employed by conducting flight tests under identical UAV configurations, autonomous waypoint trajectories, flight altitudes, and termination voltage limits to ensure consistency. The evaluated parameters include voltage behavior, average current consumption, flight duration, cruising speed, and distance traveled. The results indicate that the Li-Po battery achieved a longer flight duration of 51 minutes with a lower average current of 18.82 A and a cruising speed of 25 m/s, demonstrating stronger endurance capability. Conversely, the Li-ion battery exhibited a shorter flight duration of 39 minutes but operated at a higher cruising speed of 32.5 m/s with an average current of 30.77 A, enabling a longer travel distance of 68.4 km compared to 64.5 km for the Li-Po battery. These findings highlight a significant trade-off between endurance and mission completion speed. The study confirms that battery selection in fixed-wing UAV operations for KRTI LELA should be aligned with mission scoring priorities rather than focusing solely on endurance. Furthermore, this research contributes to UAV energy system optimization by experimentally demonstrating the interaction between battery characteristics and operational strategies in determining mission performance outcomes.

Keywords: Fixed-wing UAV; Lithium-Polymer; Lithium-Ion; Long Endurance Low Altitude; KRTI

1. INTRODUCTION

The increasing complexity of UAV mission requirements highlights the need for a more comprehensive evaluation framework that integrates technical performance with operational strategy, particularly in competitive environments such as KRTI LELA where multiple performance indicators must be optimized simultaneously (Joshi & Pandey, 2024). The rapid advancement of aerial robotics has transformed the operational landscape of modern aviation systems, particularly in the domain of small-scale unmanned platforms. Increasing demands for efficiency, autonomy, and mission adaptability have driven the evolution of Unmanned Aerial Vehicles (UAVs) toward more sophisticated energy management and propulsion strategies. In this context, the selection and optimization of onboard energy sources have become critical factors influencing not only technical performance but also mission success (Austin, 2010). Among various UAV configurations, fixed-wing UAVs are extensively developed for long endurance missions due to their aerodynamic efficiency. Compared to multirotor UAVs, fixed-wing UAVs generate lift through wing aerodynamics, resulting in lower and more stable power consumption during cruise flight (Beard & McLain, 2012).

In long endurance low altitude (LELA) missions, the reliability and efficiency of the electrical power system play a decisive role in determining UAV operational performance. The battery, as the primary energy source, directly affects flight duration, propulsion stability, avionics reliability, and overall flight safety (Zhang et al., 2018). Battery characteristics such as voltage stability, discharge behavior, and internal resistance significantly influence propulsion efficiency during prolonged flight operations (Hannan et al., 2017).

Lithium-based batteries are currently the dominant energy storage solution for electrically powered UAVs due to their high energy density and relatively low weight (Linden & Reddy, 2011). The two most commonly used lithium battery types are Lithium-Ion (Li-ion) and Lithium-Polymer (Li-Po). Li-ion batteries are known for their high energy density and long cycle life, which potentially support extended flight durations (Nitta et al., 2015). In contrast, Li-Po batteries offer high discharge rates and fast power response, making them suitable for applications requiring stable voltage under dynamic loads, although they generally exhibit lower energy density and faster degradation (Hannan et al., 2017).

Previous studies have investigated lithium battery performance in UAV applications; however, most research focuses on multirotor platforms or evaluates battery performance solely based on endurance metrics (Zhang et al., 2018). Fixed-wing UAVs operating under long-duration cruise conditions exhibit different power consumption characteristics compared to multirotor UAVs, necessitating a distinct analytical approach (Beard & McLain, 2012). Furthermore, limited experimental studies directly compare Li-Po and Li-ion batteries under identical fixed-wing UAV configurations, particularly within mission scenarios that emphasize operational strategy rather than endurance alone.

In the Indonesian research context, several studies have examined battery performance for UAV and electrical systems. (Aritonang, 2024) reviewed lithium-based batteries for defense UAV applications, while (Wicaksono et al.,

2020) analyzed current consumption behavior in drone systems under varying payload conditions. Although these studies provide valuable insights into battery characteristics, they do not specifically address fixed-wing UAVs operating under competition-based mission scoring systems. In the context of the Kontes Robot Terbang Indonesia (KRTI) Long Endurance Low Altitude (LELA) division, UAV performance is evaluated not only based on flight endurance but also on mission completion speed. The competition scoring system awards additional points to UAVs that complete mission trajectories in shorter times. Consequently, UAV operating strategies in this competition are not always oriented toward maximizing flight duration but instead involve a trade-off between endurance, cruising speed, and mission completion efficiency. This condition implies that battery selection must consider power delivery characteristics that support higher cruising speeds, not merely total energy capacity.

This study aims to compare the performance of Lithium-Polymer (Li-Po) and Lithium-Ion (Li-ion) batteries in a fixed-wing UAV under KRTI LELA mission conditions by analyzing voltage characteristics, current consumption, flight duration, cruising speed, and distance traveled. The analysis focuses on evaluating the trade-off between endurance and mission completion speed as a basis for determining appropriate battery selection strategies in competition-oriented long endurance low altitude UAV operations.

The novelty of this study lies in the integration of lithium battery performance analysis with competition-oriented mission scoring strategies for fixed-wing Unmanned Aerial Vehicles (UAVs). Unlike most previous studies that emphasize endurance optimization or theoretical energy density comparisons, this research experimentally demonstrates how Li-Po and Li-ion batteries influence both flight endurance and mission completion speed under identical UAV configurations and controlled voltage termination limits. By contextualizing battery performance within the KRTI LELA scoring framework, this study provides practical insights for optimizing UAV power system design based on competition performance priorities rather than endurance alone.

2. RESEARCH METHODOLOGY

This study uses a quantitative experimental method with a comparative approach, namely comparing the performance of two types of lithium batteries, Lithium-Polymer (Li-Po) and Lithium-Ion (Li-ion), in the operation of a Long Endurance Low Altitude (LELA) fixed-wing Unmanned Aerial Vehicle (UAV). This approach was chosen because it allows for the evaluation of battery performance based on direct testing under actual UAV operating conditions.

The object of this study is the LELA fixed-wing UAV electric power system, with a focus on battery performance as the main energy source. Testing was conducted using the same UAV platform to ensure consistency in testing conditions. The UAV platform used was a Talon fixed-wing aircraft, which has stable and efficient aerodynamic characteristics for long endurance missions.

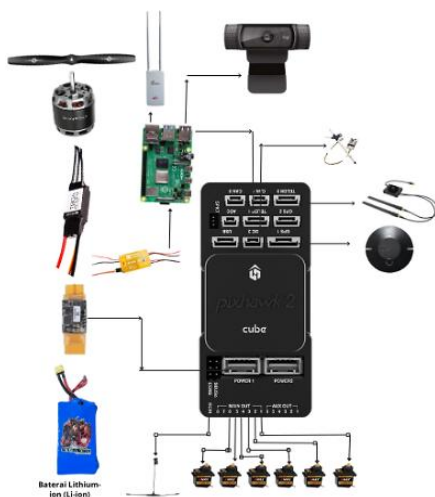


Figure 1. li-po battery circuit

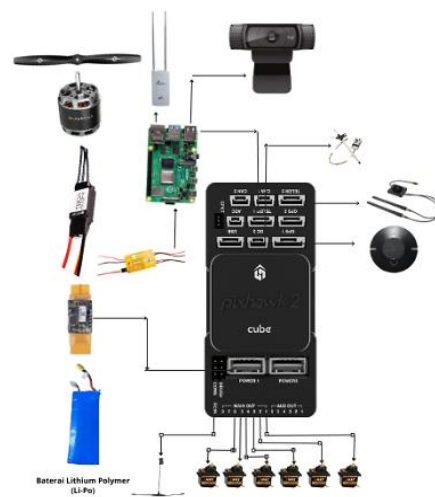


Figure 2. Li-ion battery circuit

Figure 1 shows the Li-Po battery configuration in the UAV power system. The circuit distributes energy to the ESC, flight controller, and avionics, providing stable voltage for consistent and endurance-focused flight performance. Figure 2 presents the Li-ion battery configuration in the UAV system. As shown in Figure 2, the circuit supports higher current output, enabling greater propulsion power and suitability for high-speed flight operations.

The UAV power system consists of a battery, TMOTOR AT3520 550KV brushless motor, Electronic Speed Controller (ESC) TMOTOR 80A, a power module, a MATEK UBEC, a Pixhawk Cube black flight controller + GPS here 2, a Raspberry Pi 4, a Logitech c920 camera, an HsAirpo modem, an MD 08 motor servo, a SIYI HM 30 telemetry system, and a Ground Control Station (GCS). In this study, two types of batteries were used, namely a 16,000 mAh 25c Li-Po battery and a 20,000 mAh Li-ion battery, which were tested separately with identical power and propulsion system configurations. This was done to ensure that the differences in performance obtained were solely due to battery characteristics.

Table 1. Specifications of Li-ion and Li-Po Batteries Used

Specifications	Baterai Li-Ion 6s	Baterai Lipo 6s
Minimum Voltage	3.3 V	3.5 V
Maximal Voltage	25,2 V	25,2 V
Cell Total	6s	6s
Weight	1,7 Kg	2,0 Kg
Capacity	20.000 Mah	16.000 Mah

The tests were conducted by applying each battery to the UAV in turn. The UAV was flown in autonomous mode using the same waypoint trajectory for each test. During the flight, electrical and flight performance data were recorded in real time via the GCS.

The flight was conducted until it reached the minimum safe voltage limit according to the battery specifications. The test data was then stored for further analysis. The research data was obtained through a telemetry system connected to the flight controller and GCS. The parameters collected included battery voltage, electric current, electric power, and UAV flight time.

The research process began with the preparation of the UAV and the installation of each battery, followed by system calibration and flight safety checks. Next, autonomous waypoint-based flights were conducted with the same parameters for each test. Electrical data was recorded during the flight until it reached the minimum safe voltage limit, then analyzed to compare the performance of the two types of batteries.

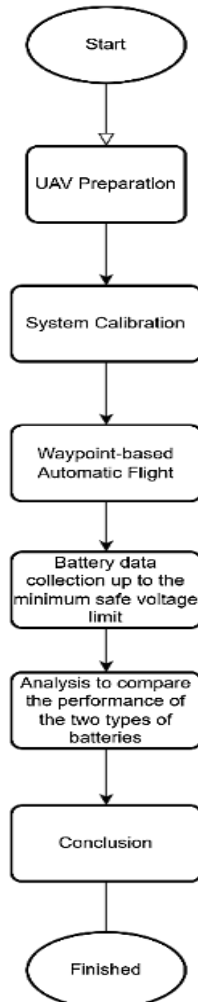


Figure 3. Research Flow Diagram of Battery Performance Testing

Figure 3 illustrates the overall research procedure, starting from UAV preparation and battery installation, system calibration, autonomous waypoint configuration, flight testing, real-time telemetry data acquisition, data logging, and comparative performance analysis of Li-Po and Li-ion batteries. This structured flow ensures that both batteries were tested under identical operational conditions to maintain experimental validity. Testing is stopped when the battery voltage reaches the minimum safe limit, which is 3.3 V per cell for Lithium-Ion (Li-ion) batteries and 3.5 V per cell for Lithium-Polymer (Li-Po) batteries. However, to maintain fairness in the comparison, testing of both batteries is stopped at a total voltage of 22.2 V. The termination voltage of 22.2 V (3.7 V per cell) was selected to

ensure safe competition-level operation and to simulate realistic strategic flight conditions rather than deep discharge endurance testing.

3. RESULT AND DISCUSSION

3.1 Unmanned Aerial Vehicle Flight for the KRTI LELA Mission

The tests were conducted using a fixed-wing UAV with the same power system configuration, waypoint trajectory, and flight altitude for each type of battery. The initial battery voltage at takeoff was 25.2 V. To maintain fairness in the comparison and avoid cell damage, testing of both batteries was stopped at a voltage of 22.2 V even though the safe limits for each battery cell were different. In the context of the Indonesian Flying Robot Contest (KRTI) Long Endurance Low Altitude division mission simulation, the UAV's cruising speed is an important parameter because completing the mission in a shorter time will result in additional points. Therefore, in tests using Lithium-Ion (Li-ion) batteries, the UAV cruising speed was set higher to represent a competition strategy oriented towards mission completion speed. The experimental results show distinct operational characteristics between the two battery types:

Table 2. test results between the two battery

Battery Type	Li-Po Battery	Li-Ion Battery
Flight Duration	51 Minutes	39 Minutes
Average Cruising	25 M/S	32,5 M/S
Distance Traveled	64,5 Km	68,4 Km
Average Current	18,82 A	30,77 A
Energy Efficiency (distance per energy)	0.18 km/Wh	0.154 km/Wh

Although the Li-ion flight duration is shorter, the distance traveled is greater due to the higher cruising speed. These results show that battery performance comparisons cannot be based solely on flight duration, but must also consider speed and mission completion efficiency, especially in the context of the KRTI LELA competition. In addition to electrical characteristics, battery mass also influences UAV flight performance. The lighter Li-ion battery (1.7 kg) reduces overall aircraft weight, contributing to lower aerodynamic load and enabling higher cruising speeds compared to the heavier Li-Po battery (2.0 kg).

3.2 Voltage Drop Characteristics

The voltage degradation profile for both batteries shows a gradual decrease from 25.2 V to 22.2 V. However, the discharge rate differs significantly.

Table 3. Battery Voltage Characteristics versus Flight Time

Time (minutes)	Li-Po voltage (V)	Li-ion voltage (V)
0	25,2 V	25,2 V
5	24,9 V	24,8 V
10	24,6 V	24,4 V
15	24,3 V	24 V
20	24 V	23,6 V
25	23,7 V	23,2 V
30	23,4 V	22,8 V
35	23,1 V	22,4 V
39	22,8 V	22,2 V
45	22,5 V	
51	22,2 V	

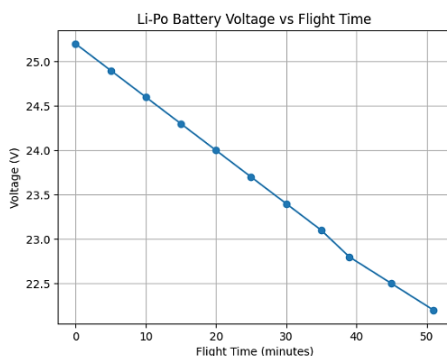


Figure 4 Graph Li-Po Battery Voltage vs Flight Time

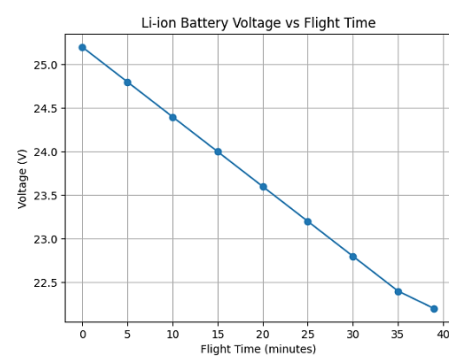


Figure 5 Graph Li-Ion Battery Voltage vs Flight Time

The characteristics of the voltage drop in Lithium-Polymer and Lithium-Ion batteries over flight time are shown in Figure 4 and Figure 5. Both batteries experience a voltage drop from 25.2 V to 22.2 V, but at different rates.

The Li-Po battery showed a more gradual and stable voltage decline, enabling it to maintain power supply for a longer flight duration. In contrast, the Li-ion battery reached the same minimum voltage in a shorter time, namely 39 minutes. This was not solely due to battery characteristics, but was also influenced by the UAV operating strategy at higher cruising speeds. At higher speeds, the propulsion power requirement increases, causing the current drawn from the Li-ion battery to become greater and accelerating the rate of voltage decline. Thus, the Li-ion voltage decline characteristics in this study reflect more aggressive mission operating conditions and a focus on completing the flight path quickly, rather than simply battery capacity limitations.

High current demand increases internal resistance losses, leading to faster voltage degradation under dynamic propulsion loads (Xiong et al., 2018). In UAV applications, such voltage instability can affect propulsion efficiency and flight stability, especially during high-speed cruise conditions.

The observed voltage degradation behavior is consistent with previous findings on lithium-based battery discharge characteristics. According to (Linden & Reddy, 2011), Li-Po batteries generally exhibit more stable voltage profiles under moderate loads due to their lower internal resistance. This explains the gradual voltage decline observed during the Li-Po flight tests. In contrast, Li-ion batteries tend to experience more pronounced voltage sag when subjected to higher current demands, particularly during high-speed operation (Nitta et al., 2015).

3.3 Current Characteristics and Energy Consumption

The average flow during flight is calculated using the equation:

$$I_{avg} = \frac{C}{t} \tag{1}$$

where:

C = battery capacity (Ah)

t = flight duration (hours)

Average Li-ion current

$$I_{avg \text{ Li-ion}} = \frac{20 \text{ (Ah)}}{0,65 \text{ (hours)}} = 30,77 \text{ A}$$

Average Li-Po current

$$I_{avg \text{ Li-po}} = \frac{16 \text{ (Ah)}}{0,85 \text{ (hours)}} = 18,82 \text{ A}$$

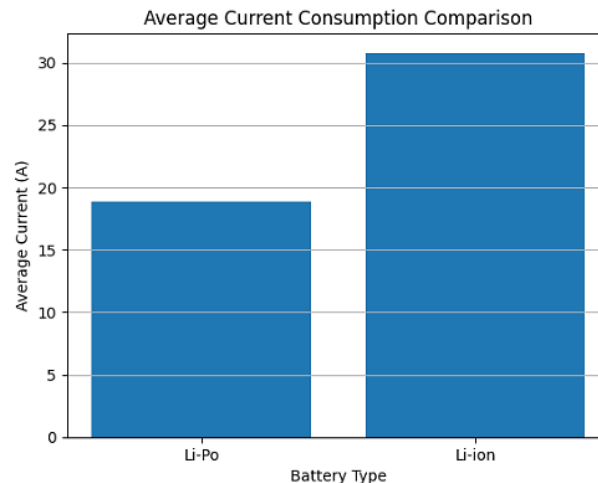


Figure 6. Graph average Current Consumption Comparison

Figure 6 shows the comparison of average current consumption between Li-Po and Li-ion batteries. The Li-ion battery records a higher current of 30.77 A, while the Li-Po battery operates at 18.82 A. As seen in Figure 6, this difference is influenced by the higher cruising speed in the Li-ion configuration, which requires greater propulsion power. The Li-Po battery exhibits lower and more stable current consumption, supporting longer flight duration. Overall, Figure 6 highlights the trade-off between higher power demand and energy efficiency, where Li-ion supports speed, while Li-Po is more suitable for endurance (Suti et al., 2022).

Based on the calculations, Li-ion batteries have an average current of 30.77 A, while Li-Po batteries have an average current of 18.82 A. The higher current value in Li-ion batteries correlates directly with UAV operation at higher cruising speeds, which require higher propulsion power. Higher current draw not only accelerates voltage decline but also increases thermal stress inside the battery cells. Reported that elevated discharge rates significantly accelerate degradation mechanisms and thermal accumulation in lithium-ion batteries (Cao et al., 2020). Therefore, the higher

average current observed in the Li-ion configuration (30.77 A) reflects a trade-off between propulsion power demand and long-term battery health. Although Li-ion batteries have a higher current and a shorter flight duration, the total distance traveled by UAVs with Li-ion batteries is greater than that of Li-Po batteries. This shows that Li-ion batteries are more conducive to mission efficiency, while Li-Po batteries are superior in maintaining UAV operation for longer durations with a relatively lower current load (Wan Hassan & Peter Rogers, 2025). The higher average current observed in Li-ion battery operation aligns with the findings of (Wicaksono et al., 2020), who reported that increased propulsion demand significantly raises current consumption in UAV systems. Furthermore, (Prasetiyo & Irmawan, 2021) emphasized the importance of real-time current monitoring in UAV applications, as excessive current draw can accelerate battery degradation and reduce operational safety margins.

3.4 Energy Efficiency Analysis (Distance per Energy Unit)

To evaluate mission efficiency more comprehensively, energy performance is analyzed as follows:

$$\text{Li-Po} = 16 \text{ Ah} \times 22.2 \text{ V} = 355 \text{ Wh}$$

$$\text{Li-ion} = 20 \text{ Ah} \times 22.2 \text{ V} = 444 \text{ Wh}$$

Energy efficiency (distance per energy):

$$\text{Li-Po} = 64.5 \text{ km} / 355 \text{ Wh} = 0.18 \text{ km/Wh}$$

$$\text{Li-ion} = 68.4 \text{ km} / 444 \text{ Wh} = 0.154 \text{ km/Wh}$$

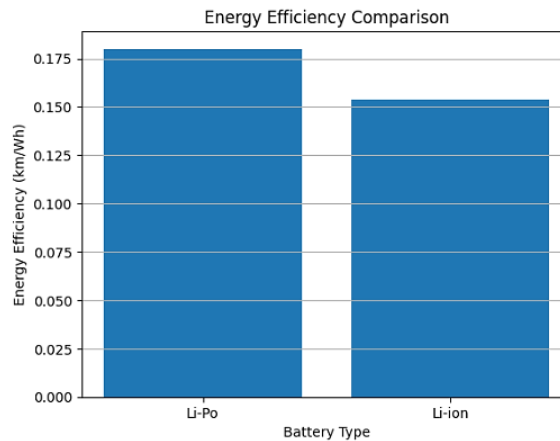


Figure 7. Graph Energi efficiency Comparison

Figure 7 presents a clear comparison of energy efficiency between Lithium-Polymer (Li-Po) and Lithium-Ion (Li-ion) batteries in terms of distance traveled per unit of energy (km/Wh). The figure illustrates that the Li-Po battery achieves a higher energy efficiency value of 0.18 km/Wh compared to the Li-ion battery, which records 0.154 km/Wh. This indicates that, for each unit of energy consumed, the Li-Po battery is able to convert energy into flight distance more effectively. As shown in Figure 7, the difference in energy efficiency can be attributed to variations in current consumption and discharge stability between the two battery types. The Li-Po battery operates with a lower average current, resulting in reduced energy losses and more stable voltage output during flight. In contrast, the Li-ion battery, although capable of achieving higher cruising speeds and longer total distance, experiences higher current draw, which reduces its overall energy efficiency.

Furthermore, Figure 7 highlights that higher mission performance in terms of distance does not necessarily correspond to better energy efficiency. The Li-ion battery covers a greater distance due to its higher speed; however, this is achieved with higher energy consumption, leading to lower efficiency values. This reinforces the conclusion that energy efficiency and mission effectiveness represent two different performance dimensions that must be evaluated simultaneously. Overall, Figure 7 provides a visual confirmation of the trade-off between efficiency and speed, emphasizing that Li-Po batteries are more suitable for energy-efficient operations, while Li-ion batteries are better aligned with speed-oriented mission strategies.

3.5 Battery Performance Analysis for KRTI LELA Mission Strategy

Test results show a clear trade-off between flight duration and mission completion speed when using Li-Po and Li-ion batteries. Li-Po batteries provide longer flight durations and stable voltage characteristics, making them suitable for mission strategies oriented towards maximum endurance. Conversely, Li-ion batteries allow UAVs to operate at higher cruising speeds, enabling them to complete mission trajectories in less time and achieve greater distances despite shorter flight durations. In the context of the KRTI LELA competition, this condition is advantageous because the scoring system awards additional points for mission completion speed.

**Table 4.** Comparative Performance Summary of Li-Po and Li-ion Batteries

Parameters	Li-Po	Li-ion
Initial voltage (V)	25,2 V	25,2 V
Final voltage (V)	22,2 V	22,2V
Average current (A)	18,82 A	30,77 A
Average speed (m/s)	25 m/s	32,5 m/s
Flight duration (minutes)	51 minutes	39 minutes
Distance traveled (Km)	64,5 Km	68,4 Km
Energy Efficiency (distance per energy)	0.18 km/Wh	0.154 km/Wh

From an electrochemical perspective, the performance difference between Li-Po and Li-ion batteries can be explained by their internal resistance and discharge characteristics. Li-Po batteries generally exhibit lower internal resistance and higher discharge rates (C-rate capability), enabling more stable voltage under moderate loads. This explains the gradual voltage decline observed during the 51-minute flight. Conversely, Li-ion batteries, although having higher energy density per unit mass, tend to experience faster voltage sag under high current loads. In this study, the higher cruising speed setting increased propulsion power demand, resulting in higher average current (30.77 A) and accelerated voltage reduction. This indicates that operational strategy significantly influences apparent battery performance outcomes.

From an energy systems perspective, the relationship between power demand and flight strategy becomes a critical factor in determining overall UAV performance. The Li-Po battery demonstrates a more efficient energy utilization pattern under moderate load conditions, as reflected by its higher energy efficiency value (0.18 km/Wh). This indicates that, for missions emphasizing endurance and energy conservation, Li-Po batteries provide a more optimal solution. In contrast, the Li-ion battery prioritizes power delivery over efficiency, enabling higher thrust generation that supports increased cruising speeds. This distinction highlights the importance of aligning battery selection with mission objectives rather than relying solely on nominal capacity or energy density (Viswanathan et al., 2022).

Another important aspect to consider is the thermal behavior of both battery types under different load conditions. Higher current draw in the Li-ion configuration leads to increased internal heat generation due to resistive losses. This thermal effect not only accelerates voltage drop but may also influence long-term battery degradation and safety performance (Alotaibi et al., 2023). In practical UAV applications, excessive heat accumulation can reduce battery lifespan and increase the risk of failure, particularly in high-speed mission profiles. Therefore, thermal management becomes an essential consideration when implementing Li-ion batteries in competition scenarios that demand aggressive flight strategies (Sornek et al., 2025).

In addition, the influence of battery mass on flight dynamics plays a significant role in shaping the observed performance differences. The lighter Li-ion battery reduces the overall weight of the UAV, which in turn decreases lift requirements and allows for higher achievable speeds (Chittoor et al., 2021). This weight reduction contributes to improved aerodynamic efficiency at higher velocities, partially compensating for the increased energy consumption. Conversely, the heavier Li-Po battery imposes a greater load on the airframe, resulting in lower cruising speeds but enhanced stability and smoother power delivery during flight. This trade-off between weight and stability further reinforces the need for mission-specific optimization in UAV system design.

The findings also suggest that the concept of “optimal performance” in UAV operations is multidimensional and cannot be defined by a single parameter. While endurance has traditionally been considered the primary metric for evaluating UAV performance, this study demonstrates that mission completion time and distance coverage are equally important, particularly in competitive environments such as KRTI LELA (Telli et al., 2023). As a result, a more holistic evaluation framework is required, incorporating multiple performance indicators to accurately assess system effectiveness.

Furthermore, the integration of operational strategy into performance analysis provides new insights into UAV energy optimization. The deliberate adjustment of cruising speed in the Li-ion test scenario illustrates how flight parameters can be strategically manipulated to achieve specific mission outcomes. This approach aligns with the concept of adaptive mission planning, where UAV operation is dynamically adjusted based on performance targets and environmental conditions (Sasane et al., 2024). In future implementations, such strategies could be enhanced through the use of intelligent control systems that optimize speed, altitude, and power consumption in real time.

Another dimension that warrants attention is the potential role of hybrid energy systems or advanced battery management techniques. Combining the stable discharge characteristics of Li-Po batteries with the high energy density of Li-ion batteries could potentially yield a more balanced performance profile (Jiao et al., 2023). Additionally, the implementation of advanced Battery Management Systems (BMS) capable of real-time monitoring and adaptive load balancing may improve both efficiency and safety. Such systems could regulate current draw, prevent excessive voltage sag, and optimize energy usage based on mission phase requirements (Ahoutou et al., 2022).

The results of this study also have implications beyond competition scenarios. In practical applications such as surveillance, mapping, and environmental monitoring, the choice between Li-Po and Li-ion batteries should be guided by mission priorities (Pierri et al., 2021). For instance, long-duration monitoring missions may benefit from the stability and endurance of Li-Po batteries, while rapid-response or wide-area coverage missions may favor the higher speed



capabilities of Li-ion batteries (Tacconi et al., 2026). This highlights the broader relevance of the study in supporting decision-making processes for UAV system design and deployment.

Finally, it is important to consider that real-world UAV operations are subject to environmental uncertainties that were not fully addressed in this study. Factors such as wind conditions, air density variations, and temperature fluctuations can significantly affect aerodynamic performance and battery behavior. Future research should incorporate these variables into experimental and simulation models to provide a more comprehensive understanding of UAV energy system performance under realistic operating conditions. Additionally, the development of predictive models that integrate environmental data with battery performance characteristics could further enhance mission planning and system optimization (Wanner et al., 2024).

Furthermore, when evaluating mission effectiveness based on distance traveled per flight session, Li-ion batteries demonstrate superior mission efficiency despite shorter endurance. This confirms that battery selection in competition UAVs must consider not only energy capacity but also power delivery characteristics under mission-specific load profiles. The selection of battery type for fixed-wing competition UAVs cannot be determined solely based on flight duration, but must be adjusted to the scoring strategy, whether it is endurance-oriented or mission completion time efficiency-oriented. These results indicate that the optimization of the power system of competition UAVs depends not only on battery capacity, but also on operating strategies tailored to the mission scoring system.

From a competition perspective, the results confirm that battery performance should not be evaluated solely based on endurance metrics. Zhang et al. (2018) demonstrated that power system optimization for long-endurance UAVs must consider mission-specific load profiles. In the context of the KRTI LELA competition, operating at higher cruising speeds using Li-ion batteries represents a deliberate strategic choice to maximize scoring potential, even at the expense of reduced flight duration. The novelty of this study lies in its integration of battery performance analysis with competition-oriented mission strategy. Unlike previous studies that focus exclusively on endurance or energy density, this research demonstrates how battery selection influences scoring outcomes in a real competition framework. By experimentally comparing Li-Po and Li-ion batteries under identical fixed-wing UAV configurations and controlled voltage limits, this study provides practical insights for optimizing UAV energy systems based on mission scoring priorities rather than theoretical endurance alone.

This study is limited to a single fixed-wing UAV platform and controlled environmental conditions. Variations in airframe design, payload configuration, and environmental factors such as wind speed and temperature were not considered. These factors may influence battery performance under real competition conditions and should be addressed in future studies.

4. CONCLUSION

The conclusion Based on the results of testing and comparative analysis of the performance of Lithium-Polymer (Li-Po) and Lithium-Ion (Li-ion) batteries in fixed-wing UAVs in the context of the KRTI Long Endurance Low Altitude division competition, the following conclusions can be drawn: Lithium-Polymer (Li-Po) batteries are capable of providing longer flight durations with more stable voltage characteristics, making them suitable for mission strategies oriented towards maximum endurance. Lithium-Ion (Li-ion) batteries allow UAVs to operate at higher cruising speeds, enabling them to complete mission trajectories in less time and cover greater distances despite shorter flight durations. The difference in performance between the two batteries shows a clear trade-off between flight duration and mission completion speed, which is highly relevant to the scoring system in the KRTI LELA competition. The choice of battery type for fixed-wing competition UAVs cannot be determined solely based on flight duration, but must be tailored to the desired scoring strategy, whether it is endurance-oriented or mission completion time efficiency-oriented. Based on the research results and assessment system characteristics in the KRTI Long Endurance Low Altitude division competition, several suggestions for further research development are as follows: (1) Further research could examine the effect of cruise speed variations and mission profiles on the performance of Lithium-Ion and Lithium-Polymer batteries, in order to obtain the most optimal UAV operating strategy in the context of competition scoring. (2) Further studies can focus on analyzing energy efficiency based on distance traveled per unit of energy (km/Wh) as an indicator of UAV competition mission performance. (3) Testing under varying environmental conditions, such as temperature and wind speed, is necessary to evaluate battery performance consistency under different competition operating conditions. (4) The integration of a Battery Management System (BMS) that is more adaptive to load changes and speed strategies can be researched to improve the safety and efficiency of the competition UAV power system.

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