

## EXPLORING THE TOP 5 DRONES FOR LAND MEASUREMENTS: A REVIEW

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### **Abstract**

*In the paper titled "Exploring the Top 5 Drones for Land Measurements", we conduct a comprehensive analysis of the latest drone technology applied in the field of geospatial surveying. The study evaluates five leading drone models based on their accuracy, efficiency, and cost-effectiveness in land measurement tasks. Through a series of field tests and data comparisons, the paper highlights the strengths and limitations of each drone, providing insights into their suitability for various surveying contexts. The findings aim to guide professionals in selecting the most appropriate drone technology for their specific land measurement needs, ultimately contributing to more informed decision-making in the industry. This abstract summarizes the paper's intent to bridge the gap between drone technology and practical application in land surveying.*

**Key words:** AI, drones, future, land, measurements.

### **INTRODUCTION**

Globalization has been driven by technological integration, and drone technology has been one of its most prominent technological advancements.

#### ***The Evolution of Land Surveying***

Land surveying, once reliant on traditional methods that were often time-consuming and labor-intensive, is undergoing a revolutionary transformation. Today, improvements and new tools have emerged for land survey, remote sensing, hydrography, map data processing and data transmission (Bryan et al., 2023). The fusion of drones (unmanned aerial vehicles - UAVs) and artificial intelligence (AI) is reshaping the landscape of surveying practices, propelling the industry into an era of unparalleled efficiency, accuracy, and innovation.

#### ***Historical Perspectives: From Theodolites to Drones***

Surveying, deeply rooted in human history, has evolved from early theodolite measurements to satellite-based systems. The limitations of these traditional methods have spurred the quest for technological alternatives. Drones, equipped with advanced sensors and AI capabilities, have emerged as the vanguards of this technological

evolution. While drone technology is evolving, advances in sensor technology will drive further innovation and expand the potential of UAVs in many areas, shaping the future of aerial intelligence and disrupting industries around the world (Emimi et al., 2023).

#### ***The Rise of Drones in Land Surveying***

The integration of drones into land surveying practices has marked a seismic shift in the industry. Drones offer agility and accessibility, enabling surveys of terrains that were once arduous to navigate. These aerial marvels have become indispensable tools for capturing high-resolution imagery and collecting geospatial data with unprecedented speed and precision.

Due to their low cost, ease of use, vertical take-off and landing, and ability to operate in high-risk or hard-to-reach areas, drones have found many applications (Quamar et al., 2023). The use of drones in various fields, especially in areas such as mapping, surveying (Jiang et al., 2022) disaster management (Tonti et al., 2023), agriculture (Fareed & Rehman, 2020), healthcare and the military, has seen a remarkable increase.

#### ***AI's Role in Revolutionizing Land Surveying***

The symbiotic relationship between drones and AI unlocks a realm of possibilities for surveyors. AI algorithms process vast datasets collected by

drones, unraveling patterns, detecting anomalies, and making real-time decisions. This marriage of technologies enhances the analytical capacity of surveying, transforming raw data into actionable insights.

### ***Advancements in Drone Technology***

Modern surveying drones transcend their predecessors. They boast longer flight endurance, allowing for extensive coverage in a single mission. Enhanced payload capacities accommodate sophisticated sensors, including LiDAR and multispectral cameras, elevating the quality and scope of data acquisition (Popescu et al., 2019). Obstacle avoidance features contribute to safer and more efficient surveying operations (Croitoru et al., 2023).

### ***Precision and Accuracy Redefined***

The hallmark of drone and AI integration lies in the unprecedented precision it brings to land surveying. Real-time kinematic (RTK) technology, combined with AI-enhanced data processing, delivers centimeter-level accuracy. This level of precision not only surpasses traditional surveying methods but also reduces the margin of error, instilling confidence in survey outcomes.

### ***Efficiency and Cost-Effectiveness***

Efficiency is the heartbeat of modern surveying. Drones, guided by AI, execute surveys swiftly, reducing project timelines significantly. The cost-effectiveness of drone surveys, stemming from quicker data acquisition and fewer operational expenses, positions this technology as an economic boon for surveying projects of varying scales.

### ***Challenges and Ethical Considerations***

While the integration of drones and AI brings transformative benefits, it is not without challenges. Regulatory complexities, privacy concerns, and ethical considerations surrounding data usage necessitate a thoughtful approach. Striking a balance between innovation and responsible implementation becomes imperative for the sustainable growth of the industry.

### ***Future Trends and Innovations***

The trajectory of land surveying points towards a future laden with innovations. Ongoing research in AI algorithms, sensor technologies, and drone design promises continuous enhancements. The advent of 5G connectivity holds the potential to further elevate real-time

data transmission, allowing for even more dynamic and responsive surveying practices.

### ***Environmental Monitoring and Sustainability***

Drones equipped with AI extend their utility beyond traditional surveying applications. Environmental monitoring becomes a focal point as these technologies aid in assessing ecological health, tracking changes in vegetation, and contributing to sustainable land management practices. The marriage of surveying, AI, and environmental stewardship emerges as a powerful force for sustainable development.

### ***Case Studies: Showcasing Success Stories***

Examining real-world case studies provides a tangible understanding of the impact of drone and AI integration. Projects ranging from large-scale infrastructure surveys to environmental conservation efforts highlight the transformative outcomes and lessons learned from adopting this innovative approach.

## **TOP 5 DRONES**

### **1. DJI Phantom 4 RTK**

The DJI Phantom 4 RTK (Figure 1) has earned its place as a stalwart in the realm of land measurements. Known for its high-precision RTK (Real-Time Kinematics) capabilities, this drone offers unparalleled accuracy, making it a preferred choice for professionals engaged in precise topographic surveys.

#### ***Key Features:***

- RTK Technology: The integration of RTK technology ensures centimeter-level accuracy, vital for detailed land measurements.
- Obstacle Avoidance: With obstacle sensors on all sides, the Phantom 4 RTK excels in navigating challenging terrains, enhancing data collection in complex environments.
- High-Quality Camera: The drone boasts a high-resolution camera, capturing detailed imagery essential for topographic mapping ([https://dl.djicdn.com/downloads/phantom\\_4\\_rtk/20200721/Phantom\\_4\\_RTK\\_User\\_Manual\\_v2.4\\_EN.pdf](https://dl.djicdn.com/downloads/phantom_4_rtk/20200721/Phantom_4_RTK_User_Manual_v2.4_EN.pdf)).

#### ***Pros:***

- Exceptional accuracy due to RTK technology.
- Robust obstacle avoidance capabilities.
- Reliable and widely used in professional surveying applications.

**Cons:**

- The price point might be a deterrent for smaller-scale projects.

**Overall Impression:**

The Phantom 4 RTK stands out for its reliability and precision. While the initial investment may be substantial, its performance justifies the cost for projects demanding utmost accuracy.



Figure 1. DJI Phantom 4 RTK  
(<https://www.appia-drones.ro/echipament/p4-m-rtk/>)

## 2. SenseFly eBee X

The senseFly eBee X (Figure 2) caters to the demands of large-scale land surveys, offering an impressive combination of flight endurance and versatility. This fixed-wing drone has garnered attention for its interchangeable payloads, allowing professionals to adapt to diverse mapping needs (<https://ageagle.com/wp-content/uploads/2022/06/AgEagle-eBee-X-EN-2022-2.pdf>).

**Key Features:**

- Long Flight Endurance: The eBee X boasts extended flight times, facilitating coverage of extensive areas in a single flight session.
- Payload Flexibility: The ability to swap payloads ensures adaptability, making it suitable for varied mapping applications.
- Professional-Grade Data: Its precision and reliability make it a favorite for mapping professionals handling extensive projects.

**Pros:**

- Long flight endurance.
- Interchangeable payloads for versatile data collection.
- Well-suited for large-scale land surveys.

**Cons:**

- Initial setup may be complex, particularly for beginners.

**Overall Impression:**

The senseFly eBee X impresses with its capacity for large-scale surveys. While setup complexity might pose a challenge initially, its performance justifies the learning curve for professionals engaged in expansive mapping projects.



Figure 2. SenseFly eBee X  
(<https://www.lewisinstruments.com/products/sensefly-ebee-x>)

## 3. Parrot Anafi USA

The Parrot Anafi USA (Figure 3) stands out in the world of land measurements for its compact design and high-resolution imaging capabilities. Ideal for smaller-scale projects and inspections, this drone is a cost-effective yet reliable choice (<https://www.parrot.com/assets/s3fs-public/2023-02/ANAFI-USA-user-manual.pdf>).

**Key Features:**

- Compact and Portable: The Anafi USA's lightweight design makes it highly portable, ideal for on-the-go land measurements and inspections.
- High-Resolution Imaging: Equipped with a high-quality camera, it provides detailed imagery for accurate mapping and analysis.
- Thermal Imaging Options: The inclusion of thermal imaging enhances its utility for diverse surveying applications.

**Pros:**

- Portability is a significant advantage.
- Competitive pricing for the features offered.
- Suitable for smaller-scale land measurements and inspections.

**Cons:**

- Limited flight time compared to other professional drones.

**Overall Impression:**

The Parrot Anafi USA shines as a portable and cost-effective solution for smaller-scale land measurements. Its versatility, combined with

thermal imaging options, adds a layer of functionality for various applications.



Figure 3. Parrot Anafi USA  
(<https://pilotinstitute.com/course/parrot-anafi-usa-deep-dive/>)

#### 4. DJI Matrice 300 RTK

The DJI Matrice 300 RTK (Figure 4) is an industrial-grade drone designed to meet the demanding requirements of topographic surveys. With triple redundancy systems and the ability to carry multiple payloads simultaneously, it offers unmatched reliability and flexibility ([https://dl.dji.com/downloads/matrice-300/20200507/M300\\_RTK\\_User\\_Manual\\_EN.pdf](https://dl.dji.com/downloads/matrice-300/20200507/M300_RTK_User_Manual_EN.pdf)).

##### **Key Features:**

- Triple Redundancy Systems: The drone incorporates redundant sensors and systems, ensuring robust performance in challenging environments.
- Multiple Payloads: Its capacity to carry multiple payloads simultaneously enhances its versatility for different surveying needs.
- High-Performance RTK: The Matrice 300 RTK maintains high accuracy through advanced RTK technology.

##### **Pros:**

- Industrial-grade reliability.
- Capability to carry multiple payloads.
- High precision with RTK technology.

##### **Cons:**

- Complexity may be overwhelming for beginners.
- Higher price point compared to consumer-grade drones.

##### **Overall Impression:**

The Matrice 300 RTK caters to professionals requiring industrial-grade performance. Its robustness and capacity for multiple payloads

make it a top choice for complex topographic surveys.



Figure 4. DJI Matrice 300 RTK  
(<https://www.dslrpros.com/matrice-350-rtk-agriculture-package.html>)

#### 5. Autel Robotics EVO Lite+

The Autel Robotics EVO Lite+ (Figure 5) strikes a balance between affordability and functionality. With a 6K camera resolution and versatility for mapping and inspection, it offers a compelling option for those seeking a cost-effective yet capable drone (<https://www.vertigodrones.com/assets/images/EVO%20Lite%20Series%20User%20Manual%20-%20EN.pdf>).

##### **Key Features:**

- Affordability: The EVO Lite+ offers competitive pricing without compromising on essential features.
- High-Resolution Camera: A 6K camera resolution ensures detailed imagery for accurate land measurements.
- Versatility: Suitable for both mapping and inspection applications, making it a versatile choice.

##### **Pros:**

- Cost-effective option for the features offered.
- Competitive camera resolution.
- Versatile for different surveying needs.

##### **Cons:**

- May lack some advanced features found in higher-end models.

##### **Overall Impression:**

The Autel Robotics EVO Lite+ provides a cost-effective entry point for professionals and educational purposes. While it may not have all the advanced features of premium drones, its functionality and affordability make it a valuable choice.

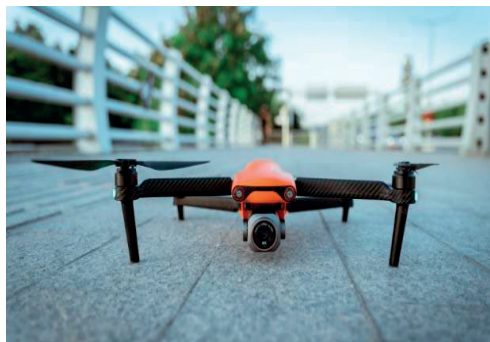


Figure 5. Autel Robotics EVO Lite+  
(<https://www.thedronegirl.com/2022/01/06/autel-evo-nano-and-lite-drones-have-arrived/>)

## THE FUTURE OF DRONE TECHNOLOGY IN LAND MEASUREMENTS

### 1. AI Integration

The integration of artificial intelligence (AI) into drone technology is poised to revolutionize land measurements. AI algorithms can analyze real-time data during flights, enabling drones to make instantaneous decisions for more efficient and accurate mapping.

### 2. Improved Sensors

Continued advancements in sensor technologies are expected to enhance the precision and range of data collection. From LiDAR (Light Detection and Ranging) to more sophisticated environmental sensors, the future will see drones equipped with sensors capable of capturing a broader spectrum of data.

### 3. Extended Flight Endurance

Researchers and engineers are actively working on developing longer-lasting batteries and more energy-efficient drone designs. Extended flight endurance will allow drones to cover larger areas in a single flight, reducing the need for multiple take-offs and landings during extensive land measurements.

### 4. Autonomous Operations

The future holds increased autonomy for drones. Advancements in artificial intelligence and machine learning will empower drones to navigate complex terrains independently, minimizing the need for constant manual control. This autonomy will streamline surveying processes and enhance overall efficiency.

### 5. Environmental Monitoring Features

As environmental concerns grow, future drones used in land measurements are likely to

incorporate advanced sensors for monitoring factors such as air quality, vegetation health, and soil conditions. This expansion of capabilities will contribute to a more holistic understanding of the land's health and sustainability.

## CONCLUSIONS

The current array of drones for land measurements caters to a diverse range of needs, from high-precision surveys to cost-effective solutions for smaller-scale projects. Each drone reviewed has its unique strengths, addressing different requirements within the field of topography.

The future of land surveying propelled by drones and artificial intelligence is a compelling narrative of progress and promise. As industry navigates uncharted territories, the synergy between technological advancements and the evolving needs of surveyors charts a skyline of possibilities. The collaboration between drones and AI transcends the limits of traditional surveying, ushering in an era where precision, efficiency, and sustainability converge to redefine the very essence of land surveying.

The journey ahead promises not only technological breakthroughs but a transformative impact on how we perceive, analyze, and safeguard the landscapes that shape our world.

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