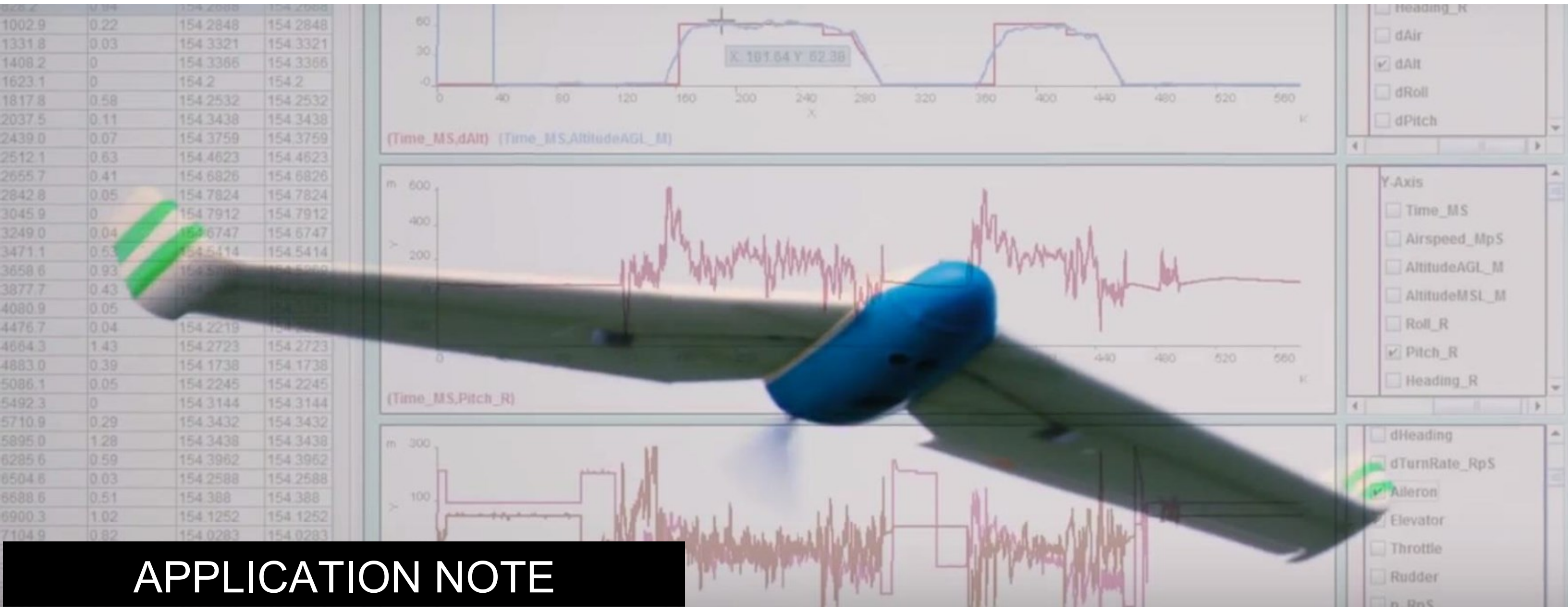
Using Solid-State Flash LiDAR Sensors in Drone Altimeter Applications

How a commercial fixed-wing UAV manufacturer enables safer, smoother landings by integrating inexpensive flash LiDAR technology



The Challenge

Performing smooth take-offs and landings has always been a challenge for commercial UAVs[1] and drones, which often carry expensive and sophisticated payloads onboard. Knowing the exact distance to the ground below is crucial, yet obtaining reliable altitude data remains an issue with the traditional equipment and sensors used in this industry.

This is particularly true for fixed-wing commercial drones, which land by gliding on their bellies. During a fixed-wing UAV landing approach, specific manoeuvers must be performed at specific distances from the ground and the power to the motor needs to be cut at a crucial time to obtain the right speed and angle required for a smooth landing.

1 Unmanned aerial vehicles.

When drone maker Robota began designing the Eclipse™, an advanced fixed-wing drone for surveying applications, its engineers knew they would have to leverage the latest and best technologies available in order to set their offering apart from the competition.

Antonio Liska, President at Robota, recalls the challenges faced in searching for the perfect altimeter: "Previous drone models that we have produced used ultrasonic sensors, which are widely used on drones for proximity sensing, but which lack range and environmental durability. The Eclipse was a fresh start, and we knew we needed a robust ranging sensor. But it was very challenging to find a small sensor with sufficient range and precision that would work in a variety of outdoor conditions."

When integrating any component to the design of a battery-powered UAV, key elements such as size, weight, power consumption, ruggedness and cost must all be carefully addressed. "For a small drone like the Eclipse, we needed small-size, low-power, outdoor operation and reliable detection on targets, including snow," added Mr. Liska.

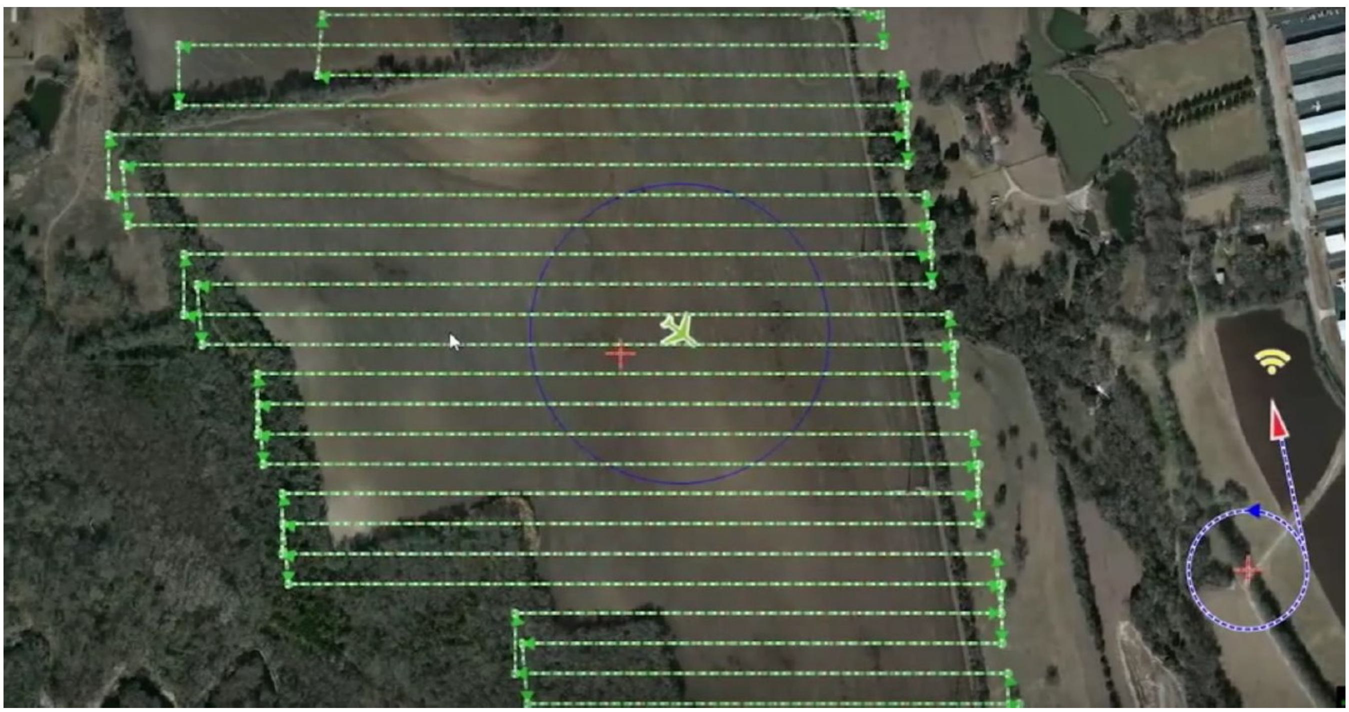


Figure 1 – Surveying drones follow a pre-set flight plan to capture data over a specific area before returning to the landing point

In Search of a New Solution

Ruling out ultrasonic sensors, which are often used in entry-level UAVs but lack in performance and reliability, Robota's engineering team did plenty of research and ended up shortlisting a variety of optical solutions readily available.

Optical flow sensors, which are used in some commercial fixed-wing UAVs, were on that list. Laser-based ranging sensors, which are also used in drone altimetry, were considered as well. The company acquired various LiDAR sensors for evaluation purposes from different vendors, including LeddarTech. Doing their homework, Robota's engineers thoroughly tested and compared the various technologies. "Our results demonstrated that optical flow solutions couldn't compete with the accuracy and speed of sensors such as the LeddarOne," stated Mr. Liska.

The LeddarOne is a very compact (2-inch diameter), single-beam flash LiDAR module that is entirely dedicated to a single-point measurement. Its 3-degree, diffuse beam provides measurement range up to 40 m (130 ft) with an accuracy of <5 cm at an acquisition rate of up to 140 Hz.

When comparing the LeddarOne with other optical sensors, it rapidly became clear that the use of a diffuse infrared light beam (generated from LED instead of using a narrow, collimated laser beam) was a distinctive advantage. The LED's wide-beam pattern, coupled with proprietary Leddar digital signal accumulation and oversampling, helped smoothing the terrain measurements and ensured consistent readings, especially when flying over brush, bush or tall grass. In comparison, sensors using collimated laser beams tended to return variations in altitude, which may be unwanted and confuse the autopilot.

In the end, the LeddarOne, which uses the patented Leddar digital signal processing technology that has been developed and optimized over a decade of R&D and successful implementations in various industries from traffic management to collision avoidance, was selected as the best altimeter.

Figure 2 – Hand-launched take-off is performed by the operator by simply throwing the Eclipse drone in the air

Integrating LeddarOne Into the UAV Design

The custom-made Eclipse UAV is an advanced mapping system that can cover nearly 400 acres per 50-minute flight and capture high-resolution images with onboard cameras. Its applications include agriculture, construction, mining and urban analysis.

The Eclipse has been designed for seamless integration of the LeddarOne sensor within its body. As seen in the pictures below, only two small openings under the fuselage reveal the presence of the altimeter's emitter and receiver. A polycarbonate lens is placed on the openings, preventing dust accumulation. The sensor communicates the measurement data via Modbus protocol to the proprietary onboard autopilot, which uses it to perform the landing operations.

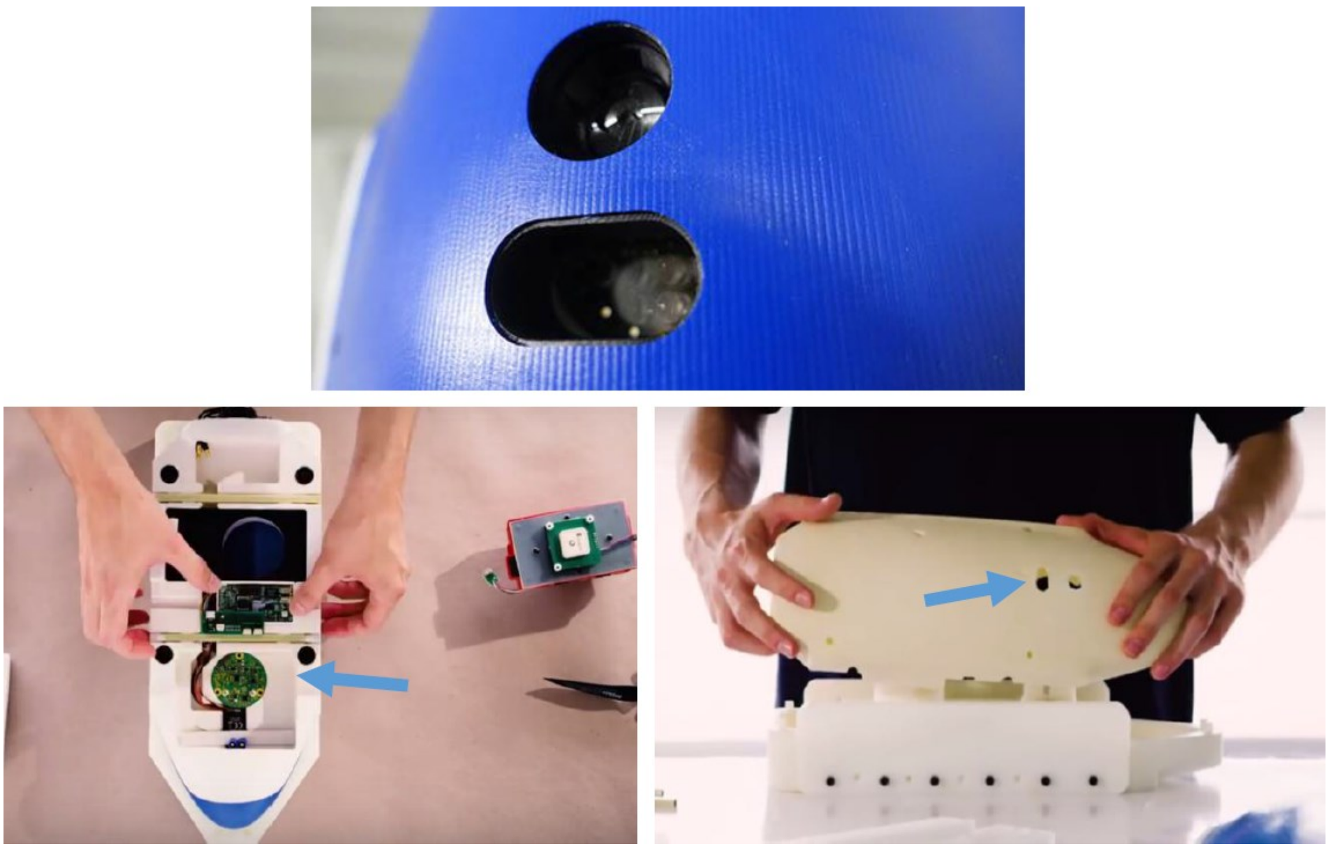


Figure 3 – LeddarOne small-form factor allowed for simple and seamless integration into the Eclipse's design

Operating the Drone With the Optical Altimeter

The Eclipse offers a unique combination of features for its market. Launching the drone is easy: the hand-launched take-off allows the operator to simply throw the drone in the air, after which the motor will automatically start, sending the drone on its predefined flight path.

The Eclipse's design provides higher wing loading for better high-wind performance, enabling it to perform its flight missions in winds up to 45 km/h (28 mph). The UAV autopilot system takes care of ensuring a secure landing, relying on the real-time height-above-ground-level measurements provided by the LeddarOne sensor.

Figure 4 – Various altitude-dependent steps are performed during the Eclipse's approach and landing phases to ensure a smooth glide to the ground

Various altitude-dependent steps are performed during the Eclipse's approach and landing phases. Thanks to its motor's reverse thrust capabilities, the Eclipse requires a shorter than normal landing range. The accurate timing of the engine shutdown and landing flare (the transition between the final approach and the touchdown) is performed by the autopilot, which relies on precise data provided by the altimeter.

LeddarTech: A Technology Provider of Choice

Many factors influenced Robota’s decision to use LeddarOne. In particular, the sensor’s low cost, compact size and superior power and range were key elements.

Even if standard integration challenges were faced along the course of the project, the ease of doing business with the supplier was an element that clearly stood out, according to Robota’s President: “Besides the superior functionality of the product, I enjoy the configurability of the device and the frequent firmware updates provided. Moreover, we received consistent support and prompt feedback from the LeddarTech team.”

The LeddarOne LiDARs can be used in various types of drones, including multi-rotors, for altimetry applications. Other models of Leddar sensors, such as the multi-segment Leddar™ Vu8 LiDAR module, cater to other drone applications, including collision avoidance.

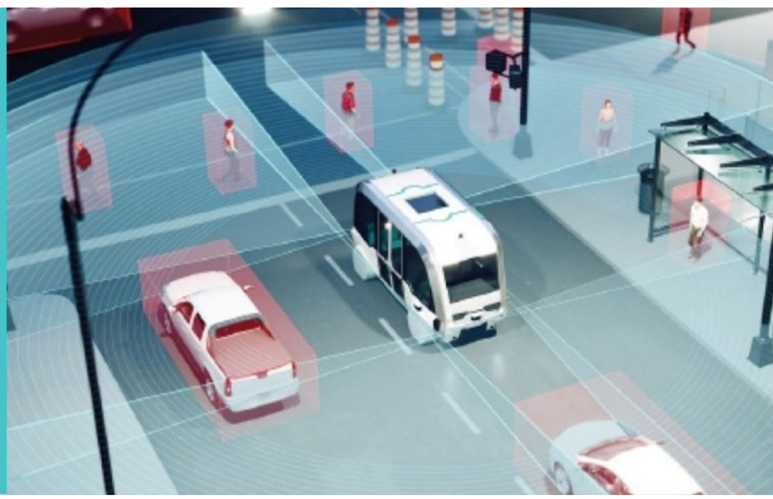
Find out more on LiDAR solutions for drones and UAVs at www.leddartech.com/drone

This document was originally published in 2016 and has been reformatted. Some of its content and links have been updated to provide the most accurate information possible.

About LeddarTech

LeddarTech provides the most flexible, robust and accurate sensing technology for advanced driver assistance systems (ADAS) and autonomous driving (AD). LeddarTech enables customers to solve critical environmental sensing, fusion and perception challenges across the entire value chain. The company offers cost-effective, scalable solutions such as LeddarVision™, a raw-data sensor fusion and perception platform that generates a comprehensive 3D environmental model with multi-sensor support for camera, radar and LiDAR configurations. LeddarTech supports LiDAR makers and Tier 1-2 automotive system integrators with LeddarSteer™, a digital beam steering device, and the LiDAR XLRator development solution for automotive-grade solid-state LiDAR based on the LeddarEngine™ and core components from global semiconductor partners. LeddarTech is responsible for several cutting-edge remote-sensing innovations, with over 100 patented technologies (granted or pending) enhancing ADAS and autonomous driving capabilities.

For more information: sales@leddartech.com



LeddarTech®

CANADA – USA – AUSTRIA – FRANCE – GERMANY – ITALY – ISRAEL – HONG KONG – CHINA

Head Office
4535, boulevard Wilfrid-Hamel, Suite 240
Québec (Québec) G1P 2J7, Canada
leddartech.com

Phone: + 1-418-653-9000
Toll-free: 1-855-865-9900