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Efficient Surveying in Colorado's Rugged Landscape

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MERRICK & COMPANY acquired our first lidar system over 15 years ago and we've seen many models pass by in that time. Each new model brings new technologies to make our work simpler, better, and more efficient.

The Optech Galaxy is our newest airborne lidar, and employs several new enhancements that improve our efficiency, especially in mountainous regions. We recently had the perfect opportunity to compare its performance to our other lidar systems when we won a Colorado Water Conservation Board and USGS 3DEP project to deliver QL2 data over a wide area in the Colorado Rocky Mountains. For such a large project, we employed the Galaxy, as well as three other lidar systems. We were interested to see the efficiency and data quality benefits of the new Galaxy sensor relative to other sensor models.

	SwathTRAK	Fixed FOV
Area covered	3,394 sq. miles	3,394 sq. miles
# of flightlines	477 lines	925 lines
Flight distance	8,375 miles	16,736 miles

Colorado has the sort of rugged terrain that cripples the efficiency of lidar systems. Flying over a valley increases the aircraft's range to the ground and reduces its point density, but flying over a mountain reduces the range and makes the swath width narrower. This creates a challenge when trying to meet the required point density on both mountain peaks and valleys with the most efficient means possible.

The solution for our fixed-FOV sensors was to plan for the worst-case scenario, where the swath width is narrowest at the mountain peak. This meant using a narrow FOV to achieve 2 ppm^2 in the valleys, but spacing

CORPORATE PROFILE

Teledyne Optech has pioneered the design, development and manufacture of advanced lidar instruments for over 40 years. We are widely recognized for our technological depth, with decades of experience in lidar and photogrammetry, as well as auxiliary technologies such as GPS integration and waveform digitization. Our rugged, reliable, and innovative lidar and camera products are deployed on all seven continents—and even on other planets, where a Teledyne Optech lidar provided proof of precipitation on Mars.

From this innovation heritage, our clients have come to depend on us to provide industry leadership with new technologies and capabilities to maximize their collection accuracy and efficiency. Teledyne Optech works closely with commercial, government, military, and space-based organizations to meet their specialized application requirements. Now a Teledyne company, we are expanding our commitment to advancing the state of the art of lidar technology.

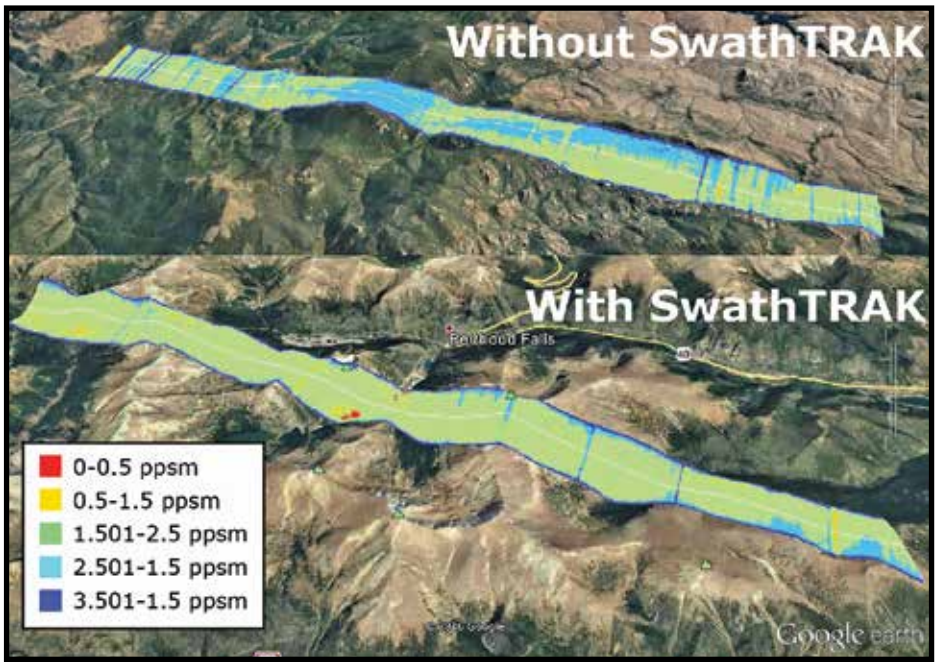
We offer standalone and fully integrated lidar and camera solutions in airborne mapping, airborne bathymetry, mobile mapping, terrestrial laser scanning, mine cavity monitoring, and industrial process control, as well as space-proven sensors. Complete with extensive survey planning, operation and automated post-processing software, Teledyne Optech systems enable clients to collect, manage and deliver survey data to their customers quickly and profitably. Our latest solutions are the backpack-mountable Maverick mobile mapper, the advanced Polaris TLS, and the operator-less Eclipse airborne data collection system.

flightlines closer together to ensure the proper sidelap on the peaks. While this tactic did meet the project specs, it required far more flightlines than we'd normally need for flat terrain.

The Galaxy's SwathTRAK™ technology proved to be the perfect solution to this issue. SwathTRAK monitors the current range to the ground and adjusts the Galaxy's FOV dynamically during flight. This enabled us to collect fixed-width data swaths with consistent point density, even when flying over mountain peaks and valleys. With a constant swath width we could significantly decrease the overall number of flightlines required to meet the project density and sidelap specifications, saving us substantial time and money.

In this case, the Galaxy was assigned to cover 3,394 square miles in the heart of the Colorado Rocky Mountains, including several of Colorado's fourteeners (a mountain peak with an MSL elevation of at least 14,000 feet / 4,267 meters). The efficiency benefits of SwathTRAK were remarkable: based on our flight plans, SwathTRAK cut the number of miles of flying in half (see table). In addition to saving our operating costs, this also let us finish the job faster and get on to the next paying contract.

The Galaxy's 550-kHz PRF was another major boost to our efficiency. As a scanner-based system, the Galaxy can actually put all 550,000 laser shots per second on the ground to achieve higher point density. This let us employ a wider, more efficient swath, yet still meet the required 2 ppm^2.



Point density map showing how SwathTRAK maintains consistent point density in rugged terrain.

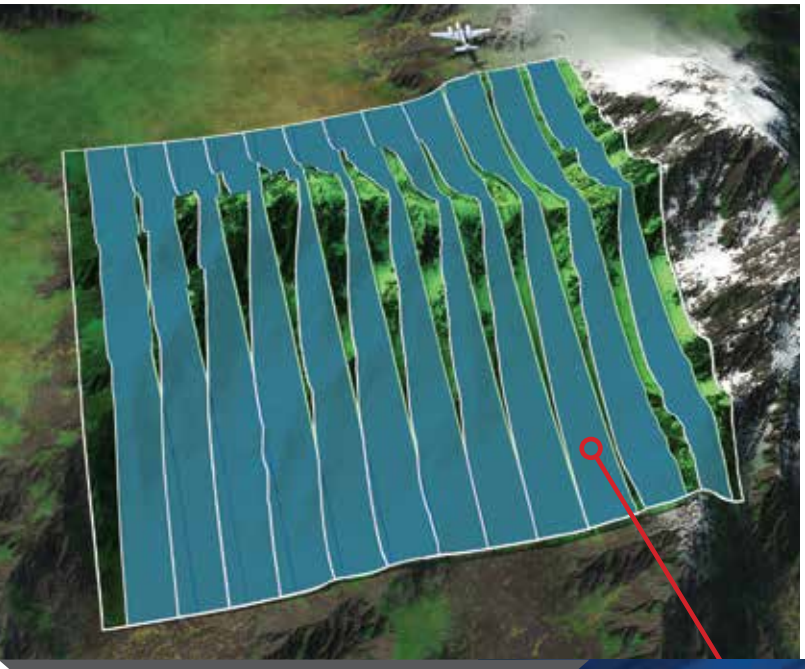
Such high-PRF lidars rely on multi-pulse tracking for extended range capability. However, this can create no-data zones when terrain or swath widths exceed the time-of-flight limitations for tracking a single emission. This was the case in Colorado, where the objective was to fly a single flight altitude for the entire collect. Several technologies exist to solve for this condition, but some do so by reducing point density across the multi-pulse transition zone, and we were not willing to generate synthetic points from interpolation across the zone for full density.

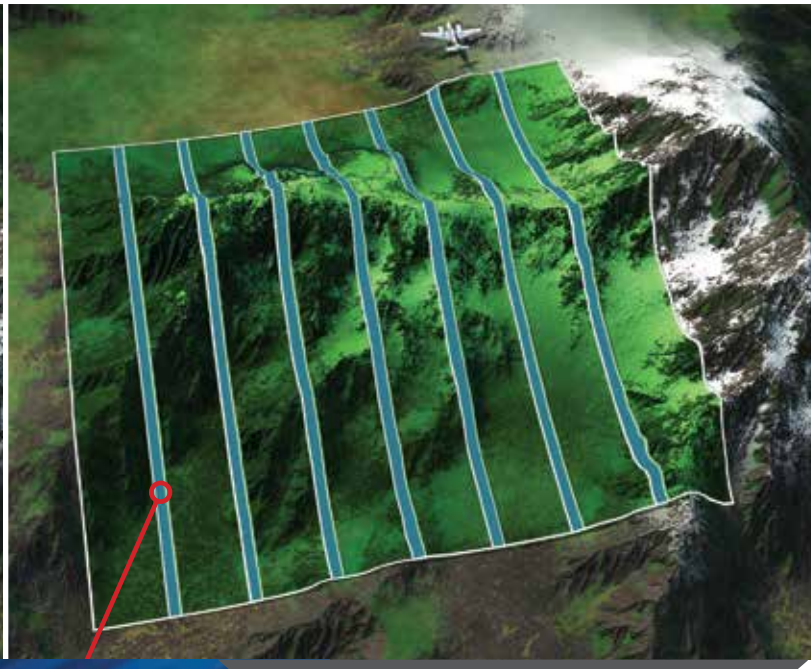
The Galaxy's solution to this problem is its PulseTRAK technology, which eliminates blind zones and maintains 100% point density across the multi-pulse transition zone without data interpolation. PulseTRAK worked well throughout the entire Colorado survey, enabling multi-pulse operation in high-relief terrain with no data gaps or significant changes in point density. This gave us greater confidence to meet the project density requirements within a single swath and made planning so much simpler.

From our experience, the performance of this sensor in rugged terrain is unsurpassed. Of all four sensors used in the project, our Galaxy outperformed all the others in providing efficient flight planning and collection, consistent swath widths and point densities over varying terrain, and absolutely no blind zones to contend with. In some cases, sensors just a few years old required four swaths to cover the same area as a single Galaxy swath. ■

THE SwathTRAK™ ADVANTAGE

SwathTRAK maintains a fixed-width data swath in complex terrain by varying the scan FOV dynamically in flight.





Without SwathTRAK 13 flightlines

Sidelap areas: data redundancy

With SwathTRAK 8 flightlines

Maximum productivity

World's most efficient airborne terrain mapper

ALTM GALAXY NOW COLLECTING AT 1 MHZ!

Wide-area surveying has never been so easy and affordable. The new Galaxy T1000 maximizes productivity with SwathTRAK technology by eliminating the data and flightline redundancy found in fixed-FOV sensors.

Coupled with a 1 MHz on-the-ground measurement rate, the Galaxy's productivity is second to none.

Galaxy wide-area lidar sensor

See SwathTRAK in action:
www.teledyneoptech.com/galaxy

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