AIRBORNE GEIGER MODE LIDAR - LATEST ADVANCEMENTS IN REMOTE SENSING APPLICATIONS

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Harris Company Information

- HQs in the US
- Offices in 125 countries
- Global Customer Base
- Advanced, technology-based solutions for government and commercial customers

SECURITY

INFORMATION

COMMUNICATION

23,000 people

120 years of experience

9,000 scientists & engineers

3,689 active patents

8th largest aerospace & defense contractor
Geiger-Mode LiDAR

World leader in next generation Geiger LiDAR technology.

Advantages
✓ Wide Area Mapping
✓ Greater Point Density
✓ Higher Cost Effectiveness
✓ Better Precision/Accuracy
Collection Simulation Comparison (8ppm)

Linear LiDAR vs Geiger LiDAR
### Collection Metrics at 8ppm

#### Superior Performance

<table>
<thead>
<tr>
<th>Metric</th>
<th>Linear LiDAR</th>
<th>Geiger LiDAR</th>
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</thead>
<tbody>
<tr>
<td>Density (points per meter)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Instantaneous Coverage Rate (mi²/hr)</td>
<td>50</td>
<td>850</td>
</tr>
<tr>
<td>RMSEz (cm)</td>
<td>9.25</td>
<td>9.25</td>
</tr>
<tr>
<td>Altitude (AGL ft)</td>
<td>3,200</td>
<td>27,000</td>
</tr>
<tr>
<td>Swath Width (ft)</td>
<td>3,300</td>
<td>16,000</td>
</tr>
<tr>
<td>Ground Speed (kts)</td>
<td>90</td>
<td>290</td>
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</tbody>
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Efficiency gains keep costs down at higher collection densities.
Higher Efficiencies at Higher Resolutions

Linear Systems

Geiger-mode

Higher the resolution greater the payback
Solution: Multi-Look and Oversampling

Multi-angle Illumination
What makes Geiger Mode so Different

Geiger-mode sensors sample the same spot on the ground multiple times
Multi-look approach

- 4096 measurements per laser flash
- 50,000 flashes per second
- Approx= 205 million elevation measurement per second

- Every spot illuminated 100’s of times

- The dozens of photon detections are processed to determine the real objects

- Programmable Forward/Sidelap
SBET refined to produce final Aggregate Points

Multi-Swath Alignment via Sensor Based 3D Photogrammetric Bundle Adjustment

Enables Rigorous Accuracy Statements per Point

Sensor Position and Attitude Covariance at Multiple Times

Adjusted Sensor Position @ Time=t

Adjusted Sensor Trajectory

Point Cloud Data

LOS to Point

3D point uncertainties

3D point

Pre > Post adjustment

Sensor-based adjustment enables per point accuracy statements
Benefits of Geiger-mode LiDAR

- Dramatically improves speed of collection
- Higher density (resolution) at lower cost
- Improves foliage penetration (Better terrain information)
- Multi-look reduces shadows and voids (Higher quality)
- Robust bundle adjustment (Higher accuracy)
- Enterprise production (Improved Delivery/Schedule)

Large-area, high-density collection leads to new adopters and opportunities
8 points per meter: Higher Point Density enables accurate decisions

Nearly mirrors existing high precision survey data.
Why do higher densities matter?

Improves accuracy and enables a high level of automation

Infrastructure details better defined

Improves foliage penetration to better sample bare earth

2 pts/m²
8 pts/m²
20 pts/m²
20pts/m² Geiger LiDAR downtown w/ intensity
20pts/m² Geiger LiDAR Suburbia w/ intensity
Roof-Top Geometry from LiDAR Example
Solar Panel Site Assessment

Uses: Solar Panel House Candidates
Airborne Geiger Mode LiDAR Technology to Connect, Inform and Protect

Transmission and Distribution

Provides Highly Homogenous High-Density Accurate Data

Maps Both Systems In Single Collect
Utilities

Airborne Geiger Mode LiDAR Technology to Connect, Inform and Protect

Fully classified to customer specifications
Predictive Flood modeling

Uses: Parcel level flood inundation with building models
Transportation

Uses: DOT ROW mapping / asset management / autonomous vehicles
20pts/m2 Geiger LiDAR overpass w/ intensity
Forestry

Uses: Harvest maturity (value) / biomass / Fire Risk (models) / other analytics
Enabling the Digital Oilfield
High Altitude at High Resolution =

Fly once

Use for many applications
Spring 2017 20 PPM Lidar Collection
Recently Assessed Accuracies

Results from Independent QAQC Assessment – April 2016

Delta Z (Squared) : \text{Rmse table}

- Concrete: 0.0786 ft.
- Asphalt: 0.0583 ft.
- Dirt Parking: 0.0261 ft.

Compared to the 2015 Lidar this 2016 QL-1 Lidar has much less noise on the road areas tested.
The percent of tin edges \text{under 6cm}:
2015 Phase _III ranges from 82% to 89%
2016 Phase _IV ranges from 99.97% to 100%
Airborne Geiger Mode LiDAR Technology to Connect, Inform and Protect

- Faster
- Cost Effective
- Higher Point Density
- Higher Accuracy

Geiger Mode LiDAR Sensor
Questions?

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