What’s the Future of LiDAR?

Ron Roth
Product Manager – Airborne Topographic LiDAR
Online Panel Discussion 20-04-03
Market Trends/Pressures? Driving the Hybrid Sensor Paradigm

OUR FOCUS:
1. Efficient Capture
2. Efficient Processing
3. Easy accessibility for everyone
Why Hybrid?
Leica CityMapper examples from Melown Technologies
The trend is clear… but how do we stay “on the curve”?

Challenges for LiDAR

• Acquiring more data, more quickly
• Faster processing turnaround
• Faster scanning
• What about lasers? More power… but what about eye safety challenges?

• More detection sensitivity instead of more laser output?
• Food for thought
Thank You
The Future of Lidar 2020 from a Geospatial Perspective

James Van Rens
and
Dr. Andreas Ullrich

April 2020
The increasing role of photonics in general and lidar in particular in the day to day management of our lives is dramatic.

This also parallels the growth and importance of geospatial analytics to the management of our world.
Impact of Covid 19 on LiDAR

In the near to mid-term future the ongoing and accelerating climate change, migration flows, and covid-imposed future budget constraints will probably yield:
Application Expectations for LiDAR

• Increased demand in change detection and monitoring of all sorts

• Special emphasis on coastal and riverine areas due to progressive erosion and increased frequency of flooding events

• Continuous monitoring of supply networks (electricity, gas, water, ...)

• Data collection after local and nation-wide natural disasters

• Optimization in construction sector through BIM
Technology Expectations - Key Takeaways

The race for higher PRR and miniaturization will continue until we reach the limits of Moore’s Law.

The demand for highly accurate, and increased density point cloud data with equidistant point patterns will increase.
Impact on Segments - UAV

• Optimized sensors for corridor mapping borne by VTOL platforms (lightweight with reduced object shading, high measurement accuracy, high measurement speed, distinct multi-target capability.)

• In the long-haul performance, accuracy, data quality of “surveying-grade sensors” will supersede systems based on low-priced “automotive” sensors.
• Resolving range ambiguities becomes increasingly difficult for single-channel instruments. A feasible solution will be multiple-channel instruments, where each channel is operating at a PRR of today’s standard, but with individual looking directions. In this regard we will see more specialized laser scanners for specific tasks, like corridor mapping and power line monitoring, featuring unique scan patterns for minimizing shadowing effects.

• The demand for highly accurate and dense point cloud data will also increase. In the last few years it has been shown that scan data with low accuracy and high ranging noise are of limited use for tasks such as city modelling or change detection in vegetation. With the challenges of climate change, the monitoring of growth rates of large forest areas as well as discovering illegal tropical deforestation will be the domain of linear LIDAR.
Impact on Segments - Bathymetry

• Trend towards compact UAV-capable devices such as the RIEGL VQ-840-G will continue. This will lead to a further spread of bathymetry and hydrography due to a lower capital requirement.

• Due to the limitations of eye safety, development opportunities are more likely to arise in the area of small, flexible systems.
Impact on Segments – Mobile Lidar

• Improvements in pose estimation due to progress in global navigation satellite system augmented with 5G location services will benefit high quality data acquisitions in challenging urban environments.

• Further development in integrating sensors to aid existing engineering applications.
• Advances in automation of post-processing from AI for object recognition and classification and thus reduction in data cost.

• 5G enhances data movability.

• Data management through the Cloud.
Thank you for your kind attention!
The Future of Lidar
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Predicting the future is easy. You can make-up anything you want and by the time the future actually arrives, everybody has forgotten what you said.
Trends

• UAV commercialization combined with low-cost remote-sensing equipment (lidar/imagery) is a fundamentally disruptive innovation.

• Automated generation of true 3d colorized point clouds, oblique imagery and orthophotos from a single collection.

• Innovation is moving from “big, heavy, expensive” lidar to “small, light, cheap” lidar:
  
  • Lower-cost laser transceivers from the automotive industry.
  • Multi-channel transceivers (8-16-32-64-128) changing the problem space.
  • Alternatives to mechanical, rotating or oscillating scanning systems.
  • FLASH lidar for full 3d scene capture. *(Lidar-selfies at CES.)*
  • Geiger-mode/single-photon lidar; where is this going?

• Beware “customer-bias”; current customers usually want “better” they rarely want “different”.

•
• Demand for sensors shifting to smaller (lower capitalization) survey, mapping and professional services companies.
• Internalization by major players in verticals that embrace the disruption.
• More projects, less area.
• On-demand applications.
• Non-government, non-traditional end users fastest growing market segment.
• Off-the-shelf sensors with 1-2 cm accuracy from ranges of 200+ meters with high sampling rates will be available for under $10,000.
• We will all have a lidar in our pocket with a 5-10 m range that produces data as good as or better than current “automotive-class” data sets.
Follow the Money …..

- Venture capital, private equity and public market investment in “automotive” lidar start-ups.
  - $875 million in 2019.
  - +116% YoY (TTM)
  - $32 million median deal size.
  - $345 million median post valuation.
- Plus $200 million in first 45 days of 2020.

*All data from PitchBook via Chirpp

Nationwide 3DEP Acquisition (FY15-19)

$539 million spent, $304 million approved, $200 million sought (gap).

~$1 billion over the same period.
23 new lidar models announced by 15 manufacturers at CES 2020:

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16 additional manufacturers exhibiting as well:
Aeye, Benewake, Bosch, Cepton, Kyocera, LeddarTech, Leishen, Luminar, Outasight, Quanergy, Sony, SureStar, Valeo, Xenomatix, Yandex, Zvision
Why Should We Care?

- Why should the geospatial/mapping industry care about automotive lidar?

- Performance matters:
  - If it will do the job you need it to do, do you want big, heavy, expensive or do you want small, light, cheap?
  - Better is good; different is better. Innovation drives long-term growth.
  - They care about us: “We are deepening our investment ... and are positioned to prove the value of LIDAR for broader market applications.” Kevin Kennedy (CEO, Quanergy; April 4th)

- Scale matters:
  - What do we spend on R&D on traditional lidar technology? $15 million? $30 million? (Based on unit sales.)

- Purpose matters:
  - “Why” we use lidar matters more than the “How” or the “What” of lidar. It’s a great tool for seeing the world differently; we should put that in as many hands as possible to help people solve their problems, big or small.
Out there, right now, some driven entrepreneur is tinkering with these devices in their garage, not because they want to make better maps, but because they want to change the world.

That’s who we should ask about the future of lidar.
What is the Future of Lidar?

Dr. Qassim A. Abdullah
Chief Scientist, Woolpert, Inc.

Lecturer at Penn State and
University of Maryland Baltimore County (UMBC)

Geo Week Live Webinar, April 8, 2020
Where is Lidar Technology Heading?
• **Linear-mode lidar continues to evolve:**
  - Increased pulse rate
  - Denser data
  - Acquisition from a higher altitude

• **Single photon and Geiger mode technology is yet to make a grand market impact**

• **UAS-based lidar is growing rapidly**

• **Artificial intelligence, machine learning and deep learning are absent from lidar data processing**
Where is the Lidar Market Heading?
• **3DEP continues to be the driving force for the lidar market**
  - FY19 3DEP expenditures were $157M

• **Leading market forces:**
  
  • **Bathymetric lidar:** For better waterway navigation, riverine mapping and coastal resilience
  
  • **Road/transportation mapping:** To support autonomous vehicles and intelligent transportation systems (ITS)
  
  • **UAS-based lidar:** To support projects that are too small for conventional lidar survey

• **DaaS and subscription-based lidar services:** These will make modest appearances and have some success in the next 5 years
• Imagery-based point clouds will comprise a modest share of the lidar market, but only for small jobs
Our Noteworthy Projects Using Lidar Technology
USGS & FEMA WY 2019 Lidar

- **32,466** square miles acquired during summer 2019
- Utilized 3 Leica TerrainMappers and one Optech Galaxy
- Over **1,200** ground survey locations
- To support the 3DEP mission, the Natural Resources Conservation Service (NRCS) high-resolution elevation enterprise program, and the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment and Planning (MAP) program
- USGS Topo QL1 and Bathymetry of Kauai
  – used Leica HawkEye 4X

- USGS and NOAA Bathymetry in the South Pacific for the Commonwealth of the Northern Mariana Islands (CNMI)
  - used Leica HawkEye 4X
Indiana DOT Road Project

- A corridor north of Indianapolis
- Standard DOT project with feature extraction from edge of pavement to edge of pavement
- Create a 2-foot by 2-foot surface grid on hard surfaces
UAS-based Lidar and Photogrammetry
- CALTRANS/CSU project
- PennDOT Proof of Concept
Thank you!

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