Introducing a New Class of Survey-Grade Laser Scanning by use of Unmanned Aerial Systems (UAS)

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The Challenge

- New generation of aircraft opening a variety of new, complex surveying situations.

- While various types of unmanned aircraft (UAS / RPAS) are ready and about to enter civil airspace, it is time for a survey-grade LiDAR solution.
A new class in Laser Scanning

**RIEGL VQ-480-U**
- Op. altitude up to 2,450 ft AGL
- Laser PRR up to 550 kHz
- Eye safe Laser Class 1
- Lightweight: approx. 7.5 kg

**RIEGL VQ-820-GU**
- Compact Hydro/Topo scanner
- Measurement rate 520 kHz
- Fast 200 lines/sec scan rate
- Littoral zone design
- Ultrasound output

**RIEGL VUX-1**
- Measurement rate 500,000 (@550kHz PRR & 330° FOV)
- Operating Altitude >1,000 ft
- Compact 225x180x125mm
- Very lightweight: 3.85 kg
- Internal 240 Gbyte SSD Memory
- Eye safe Laser Class 1
NEW RIEGL VUX®-1

- Very compact (225 x 180 x 125 mm)
- Very lightweight (approx. 3.6 kg)
- High-accuracy ranging based on echo digitization and online waveform processing
- High laser pulse repetition rate up to 550 kHz for fast data acquisition
- Fast scan speed up to 200 scans / sec.
- Survey-grade measurement accuracy / precision 10 / 5 mm
- Operating flight altitude up to more than 1,000 ft
- Field of view up to 330° enabling data acquisition in narrow, complex environments
- Easily mountable to professional UAS/RPAS
- Internal data storage capability (240 GB SSD) for several hours of data acquisition
- Low Power consumption, 60W (while scanning)

Ranging performance

<table>
<thead>
<tr>
<th>Range Measurement Performance</th>
<th>Measuring Principle</th>
<th>Laser Pulse Repetition Rate (PRR) 1 3</th>
<th>Max. Measuring Range 3 9 10</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>50 kHz</td>
<td>100 kHz</td>
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<td></td>
<td></td>
<td>550 m</td>
<td>400 m</td>
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<td></td>
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<td>990 m</td>
<td>660 m</td>
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<td></td>
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<td>350 m</td>
<td>250 m</td>
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<td>[820 ft]</td>
<td>[560 ft]</td>
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<td>Practically unlimited (details on request)</td>
<td>Practically unlimited (details on request)</td>
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<tr>
<td>Minimum Range</td>
<td>Accuracy 7 13 14 15 16</td>
<td>10 mm</td>
<td>5 mm</td>
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<td></td>
<td>Precision 7 13 14 15 16</td>
<td>5 mm</td>
<td>5 mm</td>
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<tr>
<td></td>
<td>Max. Effective Measurement Range 7 13 14 15 16</td>
<td>500 m</td>
<td>350 m</td>
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<tr>
<td></td>
<td>Echo Signal Intensity</td>
<td>10 mm</td>
<td>5 mm</td>
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<tr>
<td></td>
<td>Laser Wavelength</td>
<td>10 mm</td>
<td>5 mm</td>
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<tr>
<td></td>
<td>Laser Beam Divergence</td>
<td>10 mm</td>
<td>5 mm</td>
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<td></td>
<td>Laser Beam Footprint</td>
<td>10 mm</td>
<td>5 mm</td>
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<td></td>
<td>(eko sensor beam definition)</td>
<td>10 mm</td>
<td>5 mm</td>
</tr>
</tbody>
</table>
Range Measurement Performance

PRR = 550kHz

Flight Altitude AGL = 100 m

57 pts/m²

30 kn

Field of View

FoV, valleys

FoV, urban canyons
Multiple Time Around

Field of View (FOV) 330°

MTA 1

MTA 2

Multiple Target Capability

Interaction of Laser Pulse with Target

Advantages
- High multi-target resolution
- High accuracy of multi-target echoes
- Pulse width estimation
- Enables radiometric calibration
- Excellent penetration of vegetation
- Accurate digital elevation map
- Improves classification process
- Remote control and autonomous operation capability
Set-up ULS LiDAR system

- Easily mountable to professional UAS
- Remote control and autonomous operation using RIEGL’s RiACQUIRE-Embedded

RiACQUIRE-Embedded

- running on RIEGL VUX-1
- stores all raw data on lean DR
- controls image acquisition
- prepares monitoring trajectory and scanner data for data transfer
- listens to and executes commands from ground-based RiACQUIRE

RiACQUIRE

- acts as master
- transfers data via radio-link
- usual interfaces and feedback to operator on the ground
System Set-Up (1)
Flying-Cam, Belgium

Example: planned integration of RIEGL VUX-1 with Flying-Cam SARAH 3.0 ©

System Set-Up (2)
Aeroscout, Swiss

Example: planned integration of RIEGL VUX-1 with AeroScout B1-100 UAV helicopter ©
System Set-Up (3)
Bygg Control AS, Norway

Example: planned integration of RIEGL VUX-1 with Camflight X8 ©

System Set-Up (4)
Near Earth Autonomy, USA

Example: planned integration of RIEGL VUX-1 with NEA helicopter
System Set-Up (5)
Geo-Info & RedChina, China

1st test flight
LAST WEEK

Example: preliminary system set-up together with the RIEGL VUX-1

Top 3D view

Example: preliminary system set-up together with the RIEGL VUX-1

1st INTEGRATED RIEGL VUX-1 in UAV-System © Geo-Info, GL70
Environmental Monitoring

Layers of Information
- Shrub layer & Deadfall
- Terrain Model
- Growth Monitoring
- Vegetation
- Ground Conditions
- Lidar data

Example Applications

Application: Power Line Inspection & Infrastructure Monitoring

Application: Topography in Open-Pit Mining Areas
Live Data Demo (Video)

First recently acquired VUX-1 scan data

Powerlines
Canyons
Architecture - cultural heritage
Caves
Gas lines
Cliff overhangs
Substations
Wind parks
Offshore oil rigs
Agricultural land
Aquaducts
Danger areas
Valleys
Flood zones
Traffic accident scenes
Power plants
Wildlife refuges
Complex industrial plants
Bridges
Open pit mines
Golf courses
Racetracks
Archeological sites
Port facilities
Aquaducts
Power plants
Wildlife refuges
Complex industrial plants
Bridges
Open pit mines
Golf courses
Racetracks
Recap

**VUX-1:** The world’s first UAS based LiDAR sensor enabling laser scanning in professional surveying quality for an emerging market

**ULS:** the innovative link between airborne, mobile and terrestrial laser scanning

Thank you for your kind attention!

Visit us @ booth 32 (RIEGL / GPS Lands)

Innovation in 3D