

# Data quality from high-end, high-altitude airborne laser scanning employing state-of-the-art Waveform Processing Lidar

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# RIEGL VQ-1560i: key features

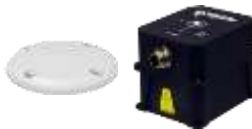
- **RIEGL VQ-1560i** is the state-of-the-art **Waveform-Lidar**
- **Online Waveform Processing** with optional **Full Waveform** and **Smart Waveform** recording
- Two lidar channels: **excellent multiple target detection capability**
- Up to **2 MHz laser PRR**, yielding up to **1.33 million pulses/measurements per second** on the ground
- Operating altitudes **up to 15.500 ft. AGL**
- Multiple-Time-Around (MTA) processing of up to **20 pulses simultaneously in the air**
- **Forward/Backward Looking** capability
- Integrated IMU/GNSS system
- Integrated, easily accessible medium format camera, up to 100MPixel
- Prepared for integration of a secondary camera, e.g. thermal, monochrome or NIR (near infrared)

# VQ-1560i: system configuration

RIEGL DR1560



IMU/GNSS system  
(fully integrated)



Operator laptop



Laser safety box



Gyro-stabilized  
mount (optional)



Medium format camera



Lidar channel 2

thermal, monochrome or  
NIR camera (optional)

Pilot display



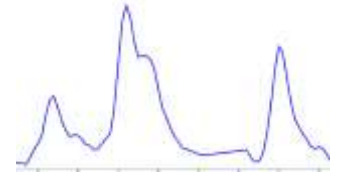
Lidar channel 1



# Signal digitization and waveform processing

- **Online Waveform Processing**

- waveforms are processed within the LIDAR system during data acquisition
- processing of each echo provides range, amplitude, reflectance, pulse shape information
- **no need for using RiANALYZE software**
- supports rapid response applications



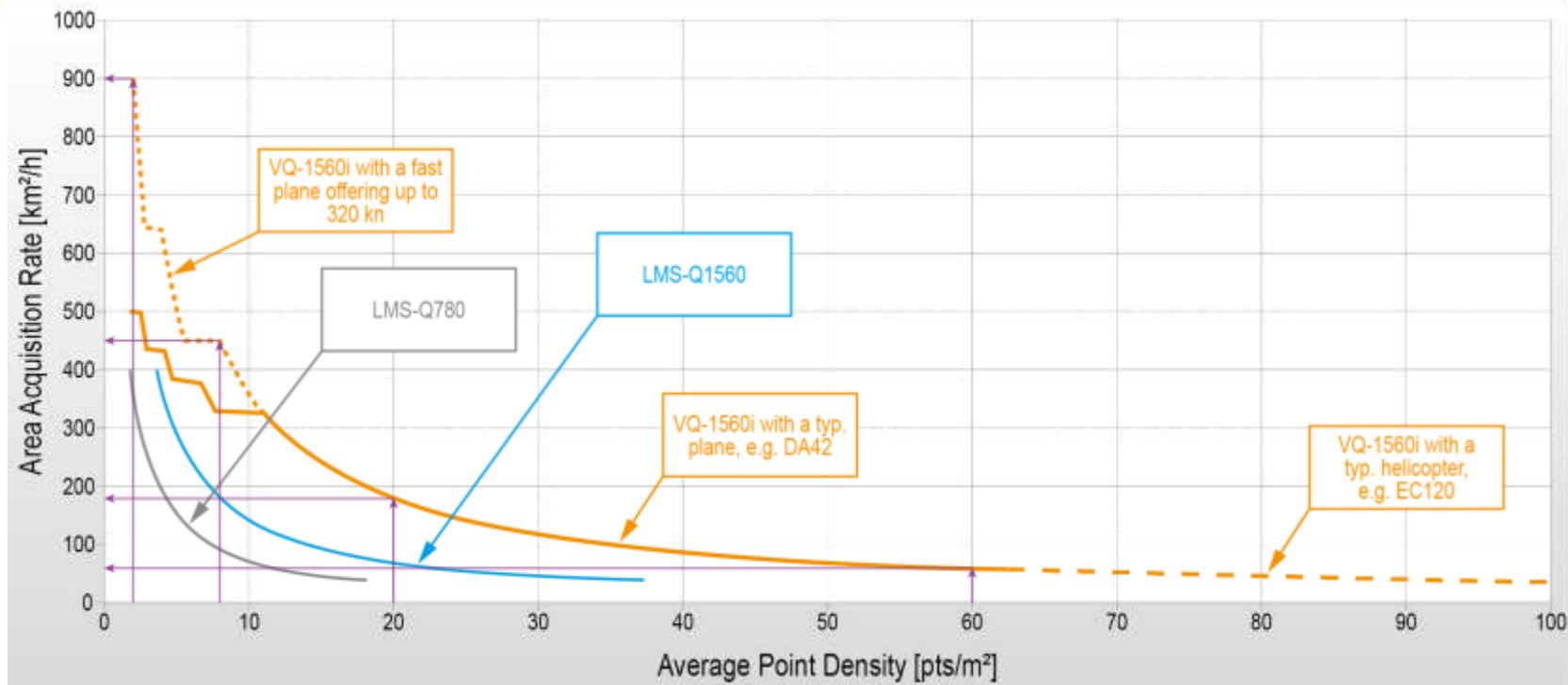
- **Full Waveform Recording**

- waveforms as well as results of online waveform processing are fully recorded (i.e. on the *RIEGL* DR1560 datarecroder)
- all waveforms are available later on for
  - full waveform analysis in post-processing (RiANALYZE) to extract additional information not provided by online waveform processing
  - exporting to e.g. LAS/Pulswave data files

- **Smart Waveform Recording**

- all waveforms are processed by online processing during data acquisition
- waveforms meeting specific criteria are recorded **additionally**
- filter criteria: poor quality of data from online waveform processing (i.e. high pulse shape deviation)  
→ provides means to specifically select waveforms originating from complex target situations (merging echo pulses)
- recorded waveforms are subsequently available for post-processing by full waveform analysis, e.g. using RiANALYZE software.
- post-processing only for a small part of the acquired data

# Productivity



The higher the point density the lower the area acquisition rate and vice versa !

# Productivity

examples<sup>1)</sup>:

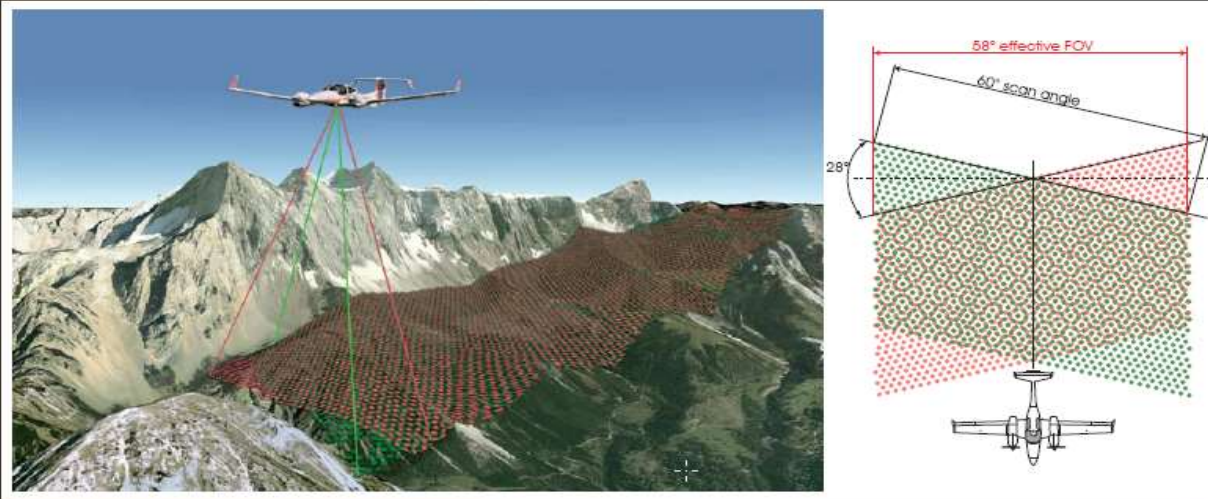
average point density	2 pts/m <sup>2</sup>	8 pts/m <sup>2</sup>	20 pts/m <sup>2</sup>	60 pts/m <sup>2</sup>
measurement rate	660 000 meas./sec	1.3 mill. meas./sec	1.3 mill. meas./sec	1.3 mill. meas./sec
area acquisition rate	900 km <sup>2</sup> /h	450 km <sup>2</sup> /h	180 km <sup>2</sup> /h	60 km <sup>2</sup> /h
ground speed	315 kn	210 kn	115 kn	110 kn
flight height AGL	6000 ft 1830 m	4500 ft 1370 m	3300 ft 1000 m	1150 ft 350 m
swath width	2040 m	1540 m	1130 m	400 m

<sup>1)</sup> calculated for a stripe overlap of 25% and a terrain reflectance of 20%



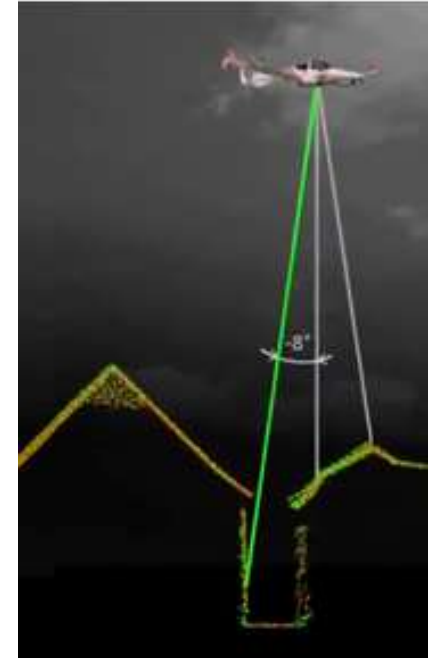
# Performance examples

forward / backward looking capability



Tilt Angle of Scan Lines  
Forward/Backward Look in Non-Nadir Direction

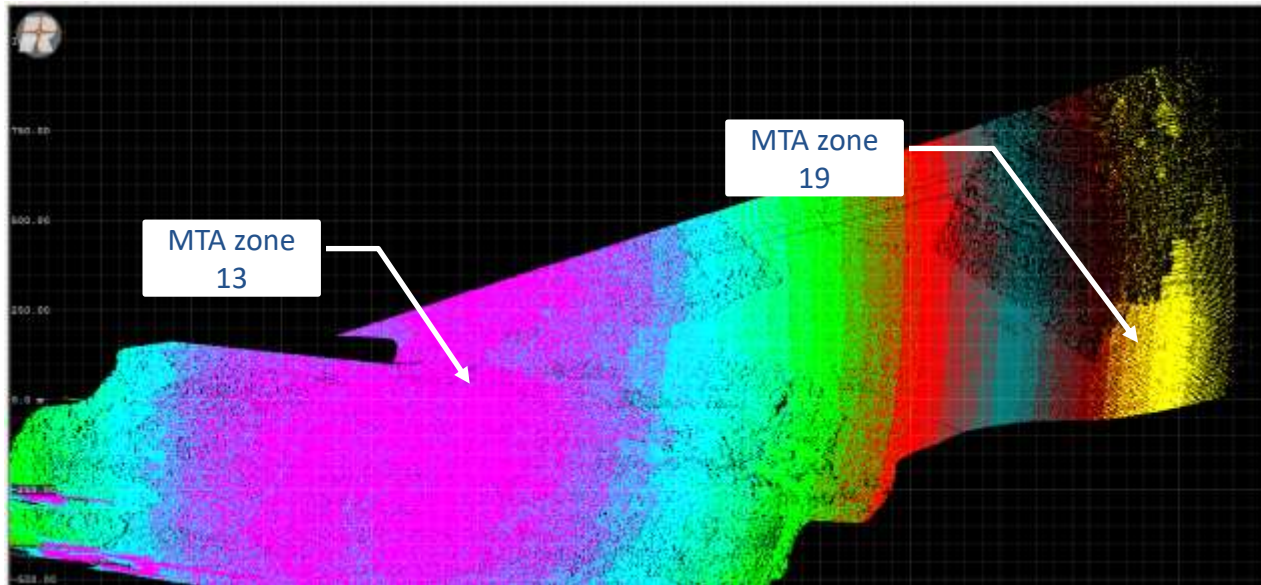
+/- 14°  
+/- 8° at the edges





# Performance examples

MTA (Multiple Time Around Capability) – up to 20 pulses simultaneously in the air

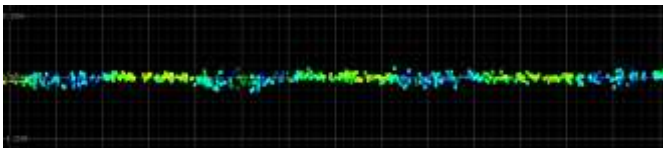


# Performance examples

## Example: pedestrian crossing

bright and dark stripes:

- resulting height difference:  $\Delta z \leq 8 \text{ mm}$

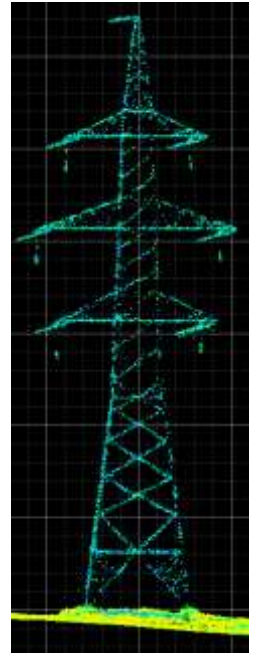
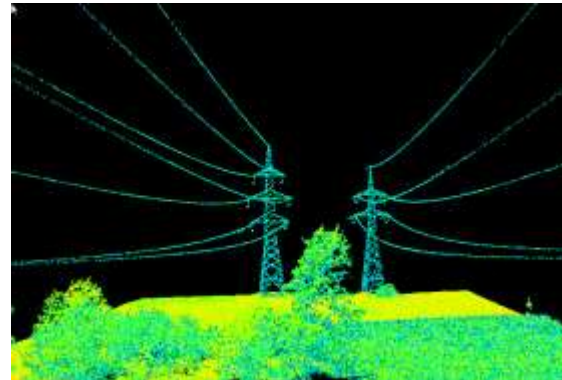


## Example: power lines

- very high point density: 60pts/m<sup>2</sup> average

- 350m AGL, 110kV, 2x1000kHz

- acquires infrastructure very detailed



# Performance examples

