RIEGL Airborne Laserscanner Systeme für die effiziente Kartierung großflächiger Gebiete: Technik, Anwendungen und Ausblick

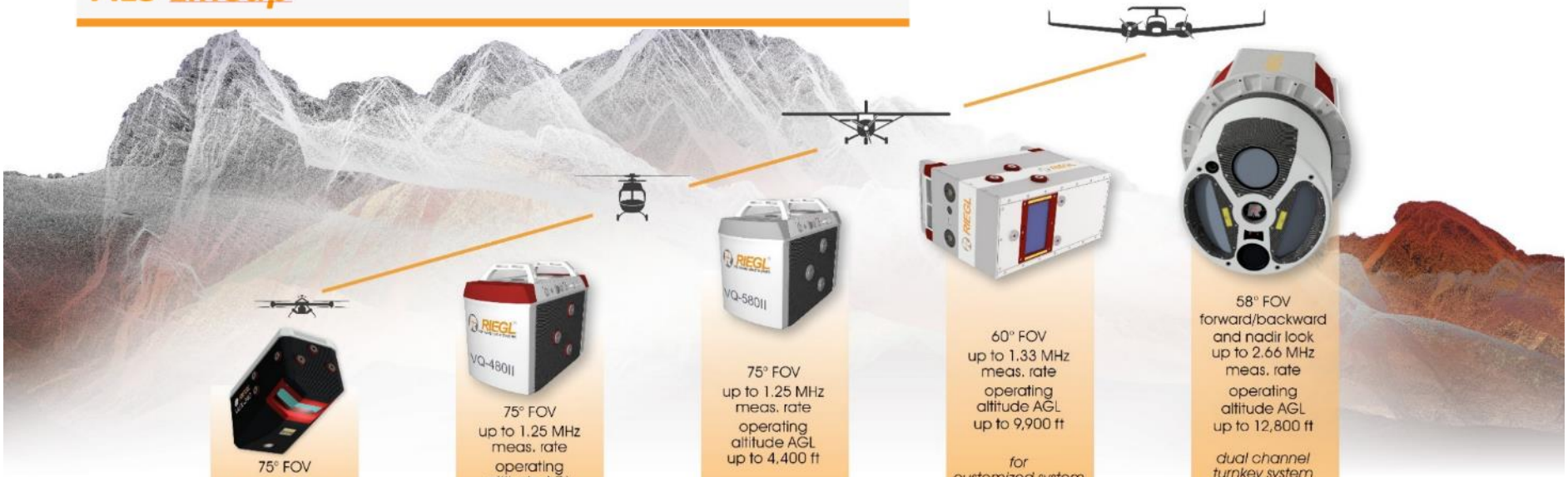
Peter Rieger
Manager ALS Business Division

Agenda

- ***RIEGL*** Airborne Laserscanner und Systeme
- VQ-780II-S und VQ-1560II-S
- Systemtechnik – Scanmechanismen
- Effizienz – Flächenleistung
- RiPROCESS 1.9

RIEGL

ALS Lineup



VUX-240	VQ-480 II	VQ-580 II	VQ-780 II / II-S	VQ-1560 II / II-S
75° FOV up to 1.5 MHz meas. rate *for UAVs and small aircraft*	75° FOV up to 1.25 MHz meas. rate operating altitude AGL up to 3,900 ft *for small planes or helicopters*	75° FOV up to 1.25 MHz meas. rate operating altitude AGL up to 4,400 ft *especially for snowy and icy terrain*	60° FOV up to 1.33 MHz meas. rate operating altitude AGL up to 9,900 ft *for customized system configurations*	58° FOV forward/backward and nadir look up to 2.66 MHz meas. rate operating altitude AGL up to 12,800 ft *dual channel turnkey system for high altitude, large scale mapping*

for surveying at low flight altitudes
e.g. powerline, rail track, pipeline inspection, and archeology

for surveying at mid flight altitudes
e.g. corridor mapping, city modeling, agriculture, and forestry

for surveying at high flight altitudes
e.g. wide area mapping of complex environments

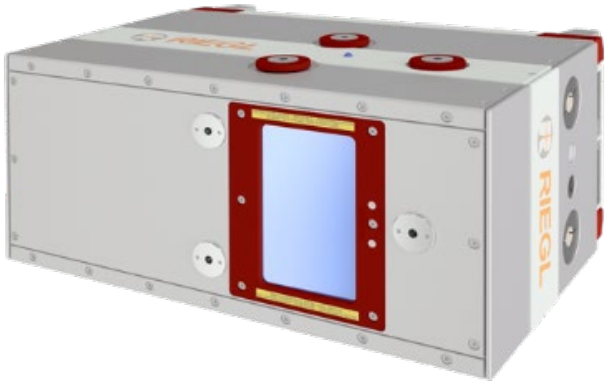
VQ-780II-S

- The ***RIEGL* VQ-780II** ist a state-of-the-art **waveform processing LIDAR**
- up to **2 million** laser pulses per second, yielding up to **1.33 million pulses/measurements per second** on the ground
- data acquisition at a wide range of avg. point densities: **2 pts/m²** up to more than **70 pts/m² (@ 80kn, 400m AGL)**
- Multiple-Time-Around (MTA) processing of up to **36 pulses simultaneously in the air** (2500m AGL @ target reflectivity 60%)
- **online waveform processing** and/or **full waveform** recording and **smart waveform** recording
- excellent multiple target detection capability
- external inertial measurement unit and GNSS receiver

NEW RIEGL VQ-780 II-S

with increased laser power for ultra-wide area mapping

measurement range up to 4,800 m (target reflectivity ≥ 20%)



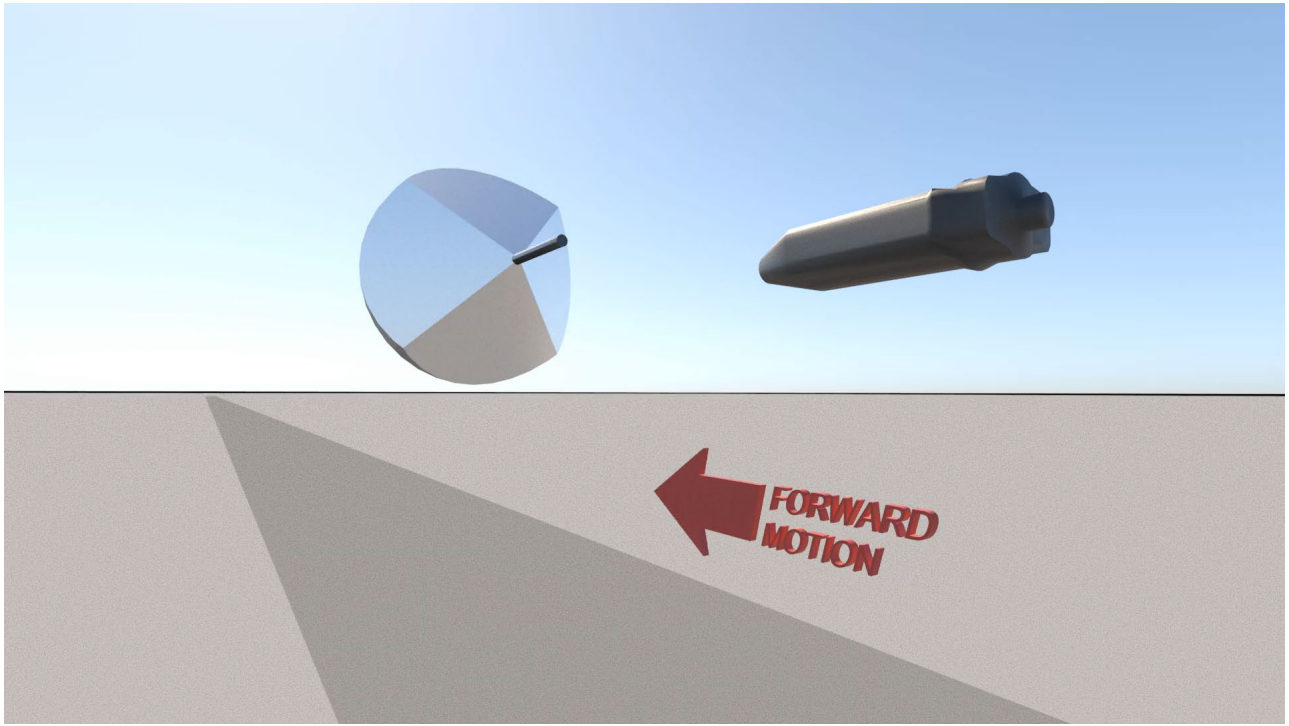
Polygon mirror wheel

RIEGL
VQ-780II

RIEGL
VQ-480II

RIEGL
VQ-580II

RIEGL
VUX-240



The VQ-1560 series

Dual Channel Waveform Processing Airborne LiDAR Systems

fully integrated with IMU/GNSS and cameras

- online waveform processing and smart and full waveform recording
- up to 2.66 million measurements/sec on the ground

RIEGL VQ-1560 II

two infrared laser channels for a high maximum range and a wide selection of point densities with an optimum distribution of the measurements on the ground

- for large scale, high altitude, complex environment mapping
- measurement range up to 4,500 m (target reflectivity ≥ 20%)

RIEGL VQ-1560 II-S

with increased laser power for ultra-wide area mapping

- measurement range up to 4,800 m (target reflectivity ≥ 20%)

RIEGL VQ-1560-DW

enhanced target characterization by simultaneous measurements at **green and infrared laser wavelengths**

RIEGL

The new VQ-1560II-S

Dual Channel Laser Scanner:

- ***NEW: up to 1.4x extended measurement range***
- extremely fast: 2 x 2 MHz
- unique dual channel design
- forward-nadir-backward “Crossfire” looking capability
- high point density and best point spacing
- Full Waveform and Online Waveform Processing
- gapless acquisition from all altitudes

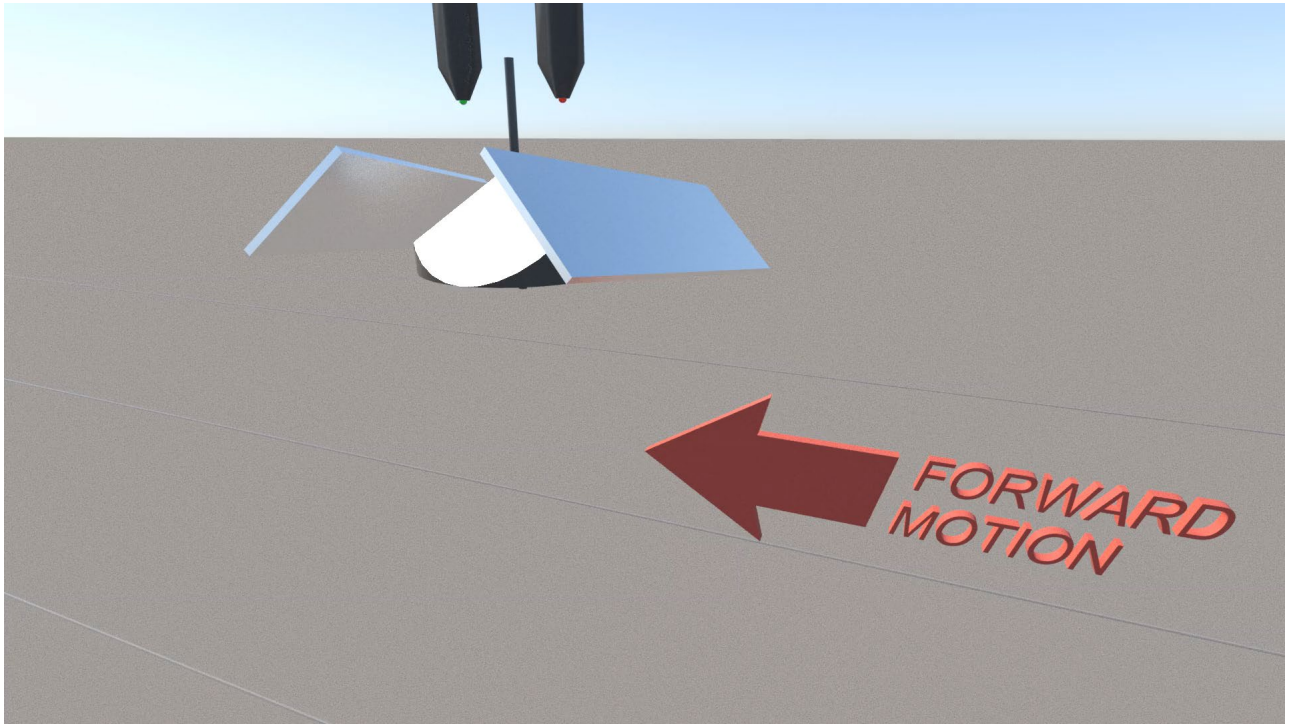
Compact Laser Scanner System:

- with integrated high-grade IMU/GNSS system
- with integrated 150 MPix camera
- with optional 150 MPix NIR camera or thermal IR camera
- for optional use with gyro-stabilized mounts (GSM 4000)

Dual channel polygon mirror wheel

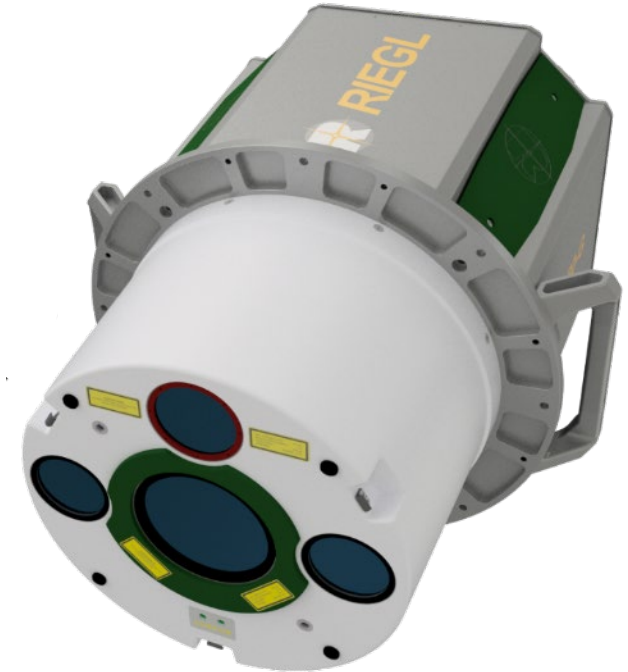
RIEGL
VQ-1560II

RIEGL
VQ-1560i - DW



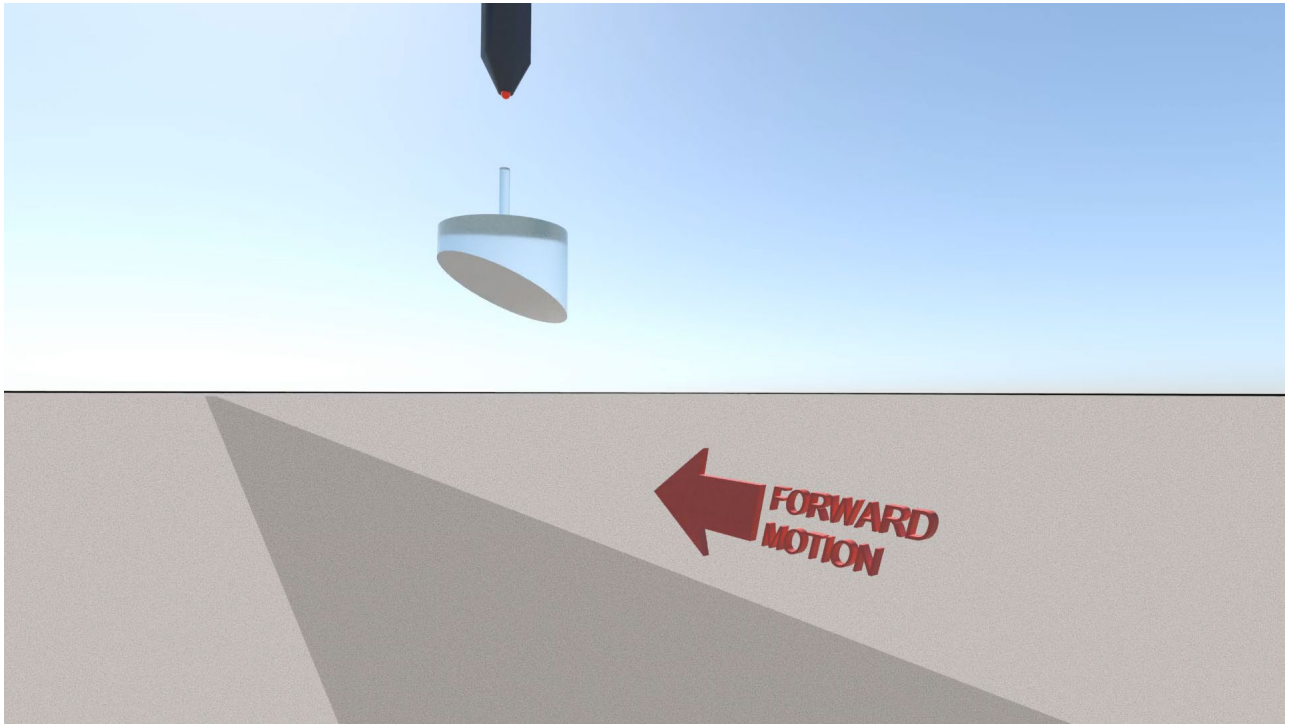
The VQ-880G-II

- **Green channel**
  - high measurement rate (up to 700 kHz)
  - circular scan pattern (up to 80 lines per second)
  - online waveform processing
  - waveform storage capability
- **IR channel**
  - high measurement rate (up to 279 kHz)
  - nearly linear scan pattern (up to 100 lps)
- Cameras
  - 2 PhaseOne cameras (RBG and NIR)
  - up to 100 MPixel CMOS without FMC or up to 80 MPixel CCD with FMC



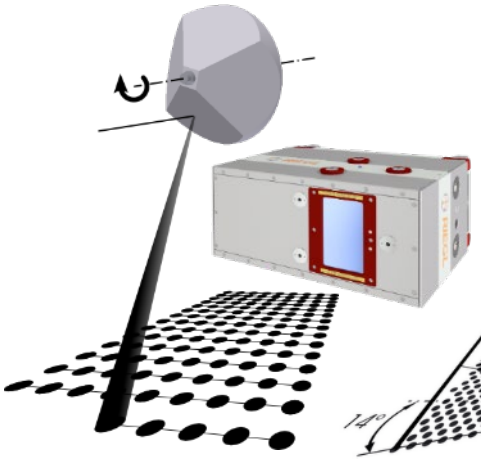
ALS: Palmer Scanner – rotating glass wedge

RIEGL
VQ-880-GII
VQ-840-G
… and other scanners



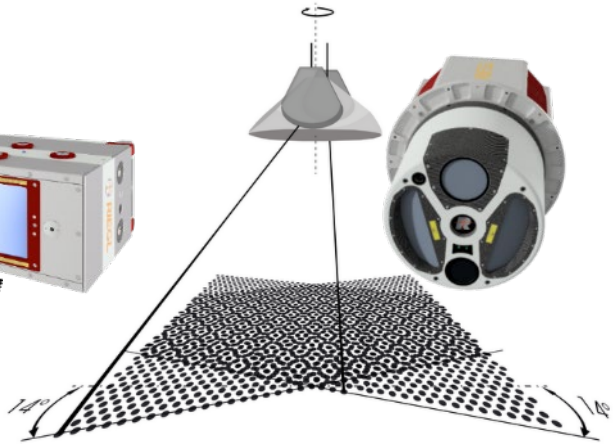
RIEGL linear vs. oscillating and circular scan pattern

RIEGL VQ-780II



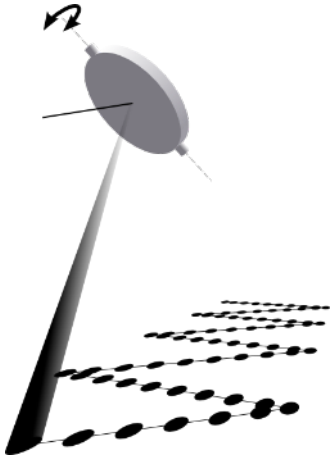
- Linear scan lines
- “matrix scan”

RIEGL VQ-1560II



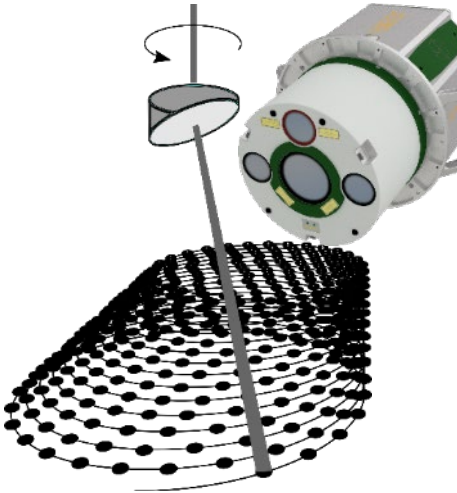
- tilted straight scan lines
- optimum interleaving independent of acquisition parameters

oscillating mirror



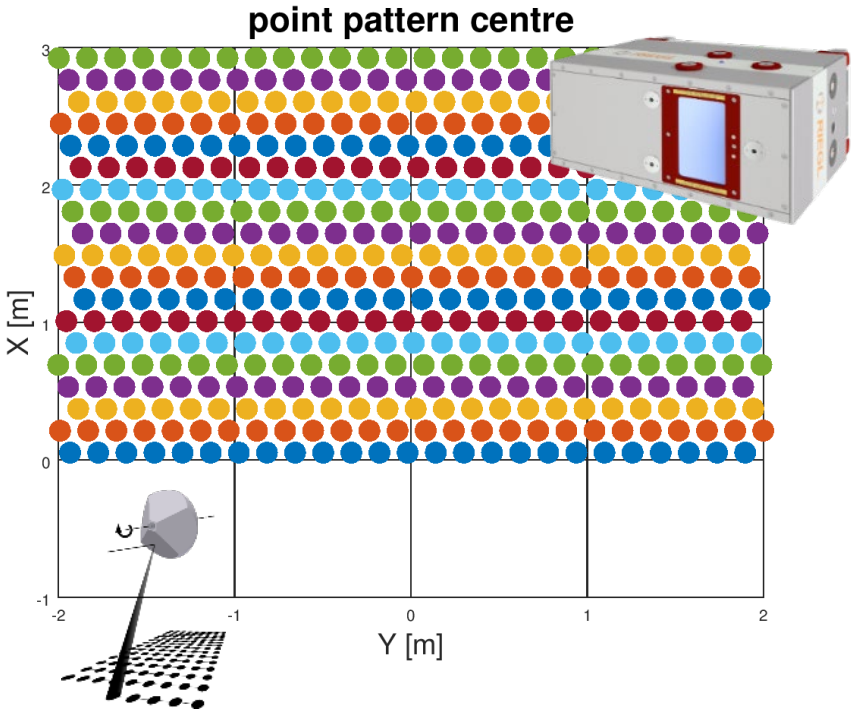
- interleaving zig-zag or sinusoidal scans
- prone to “unfavorable“ phase conditions

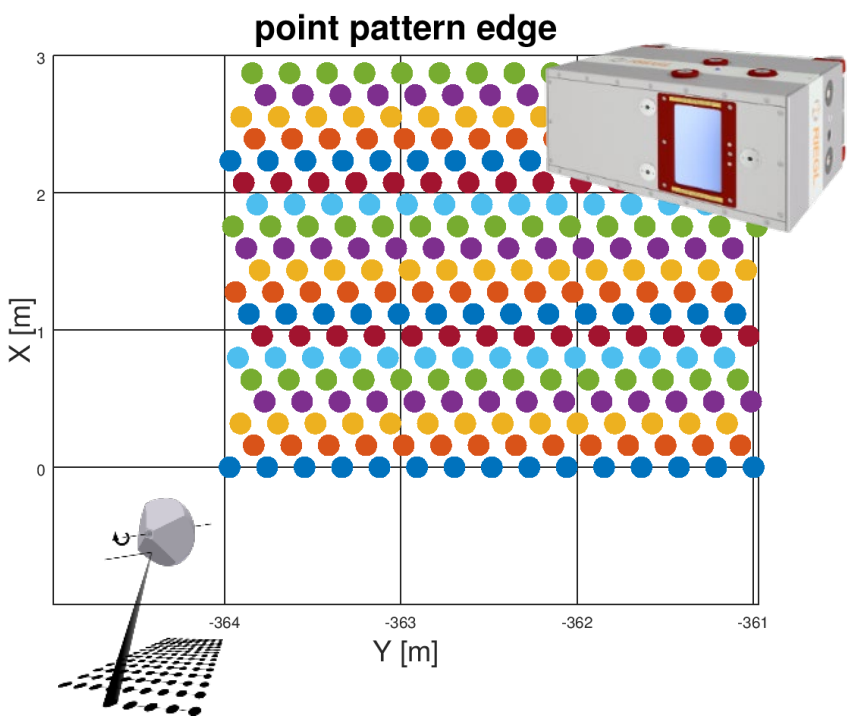
RIEGL VQ-880-GII



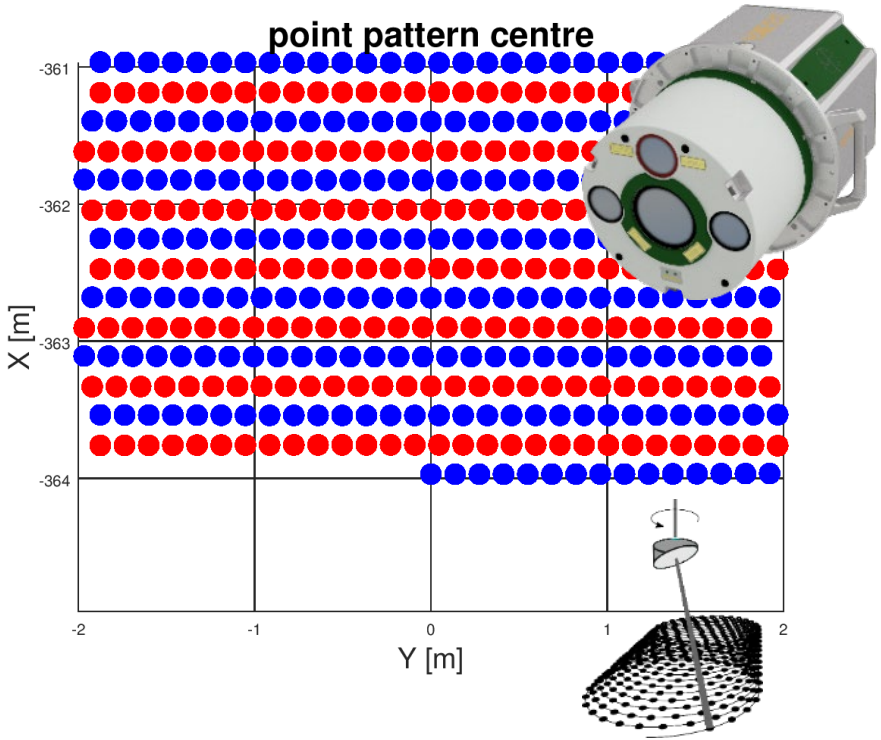
- circular scan pattern
- unfavorable point distribution

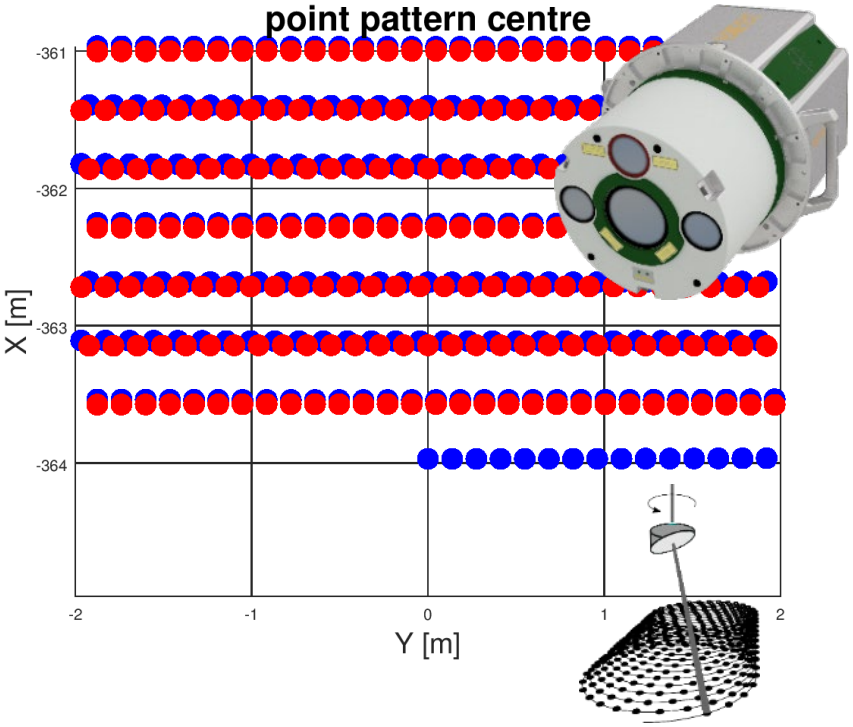
Point Distribution: Polygon Mirror Wheel



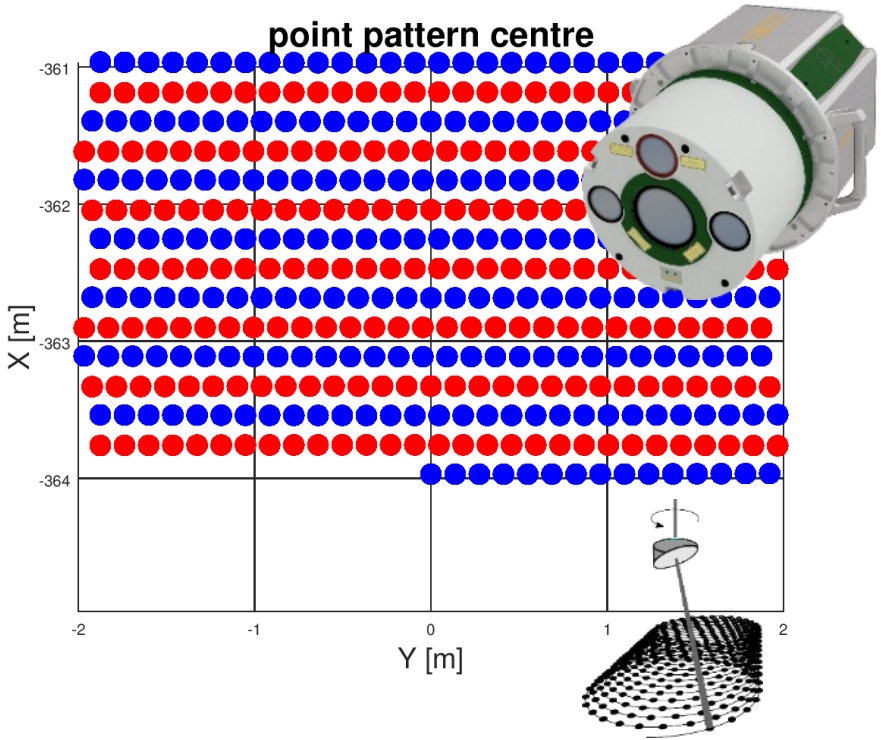


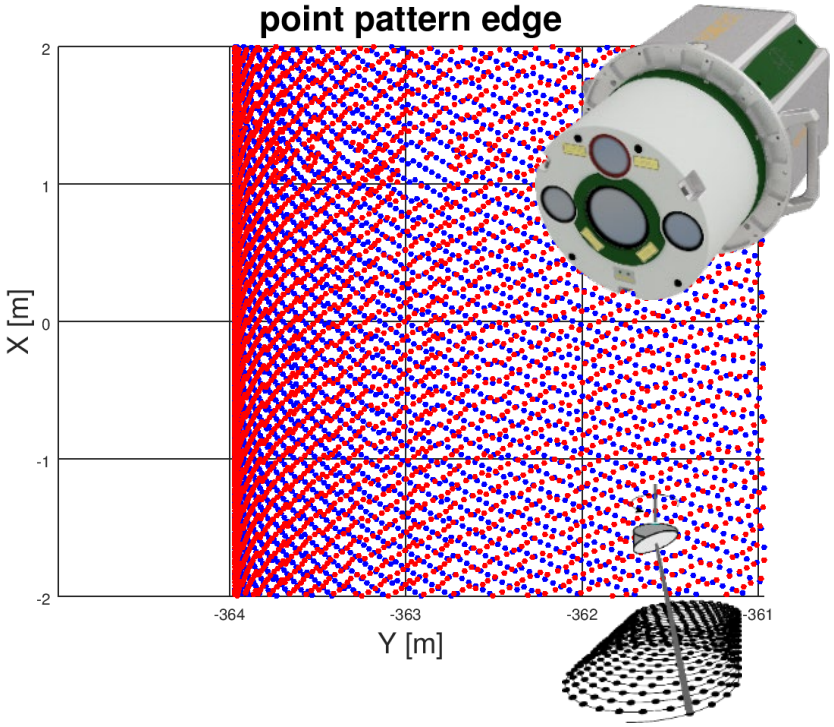
Point Distribution: Circular scan pattern



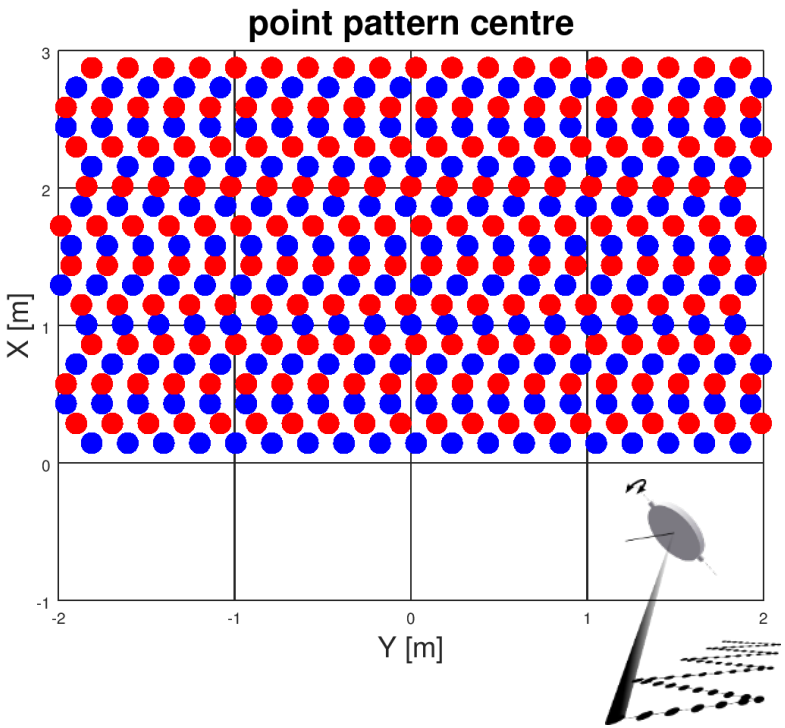


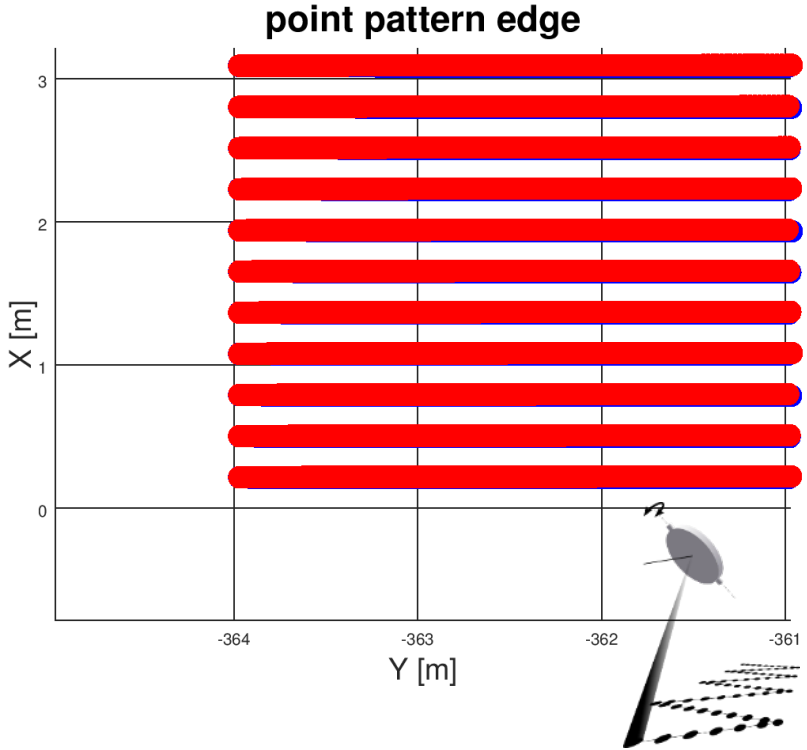
Point Distribution: Circular scan pattern



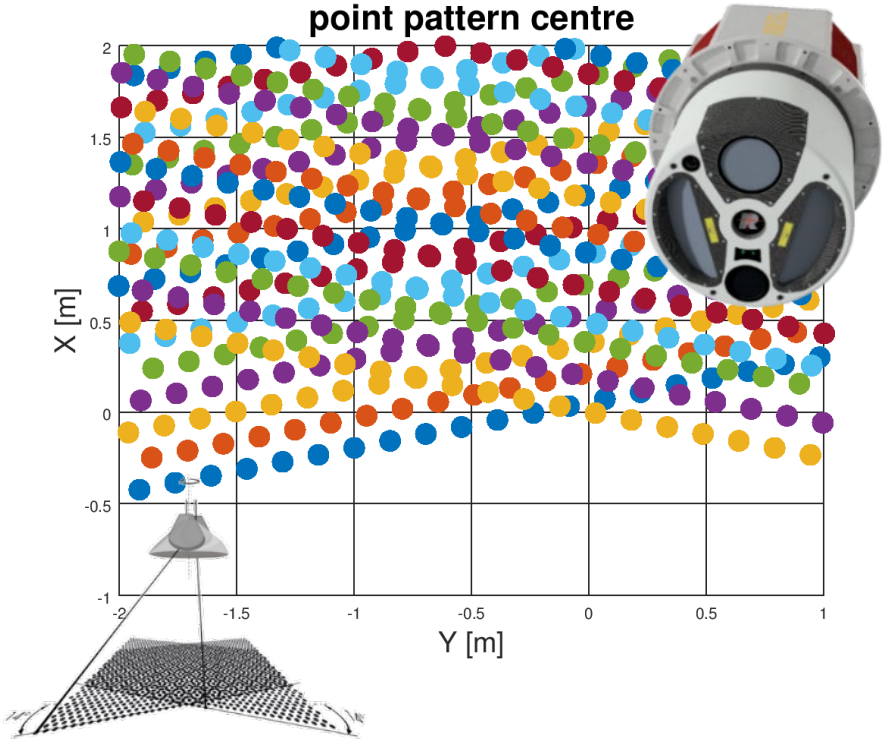


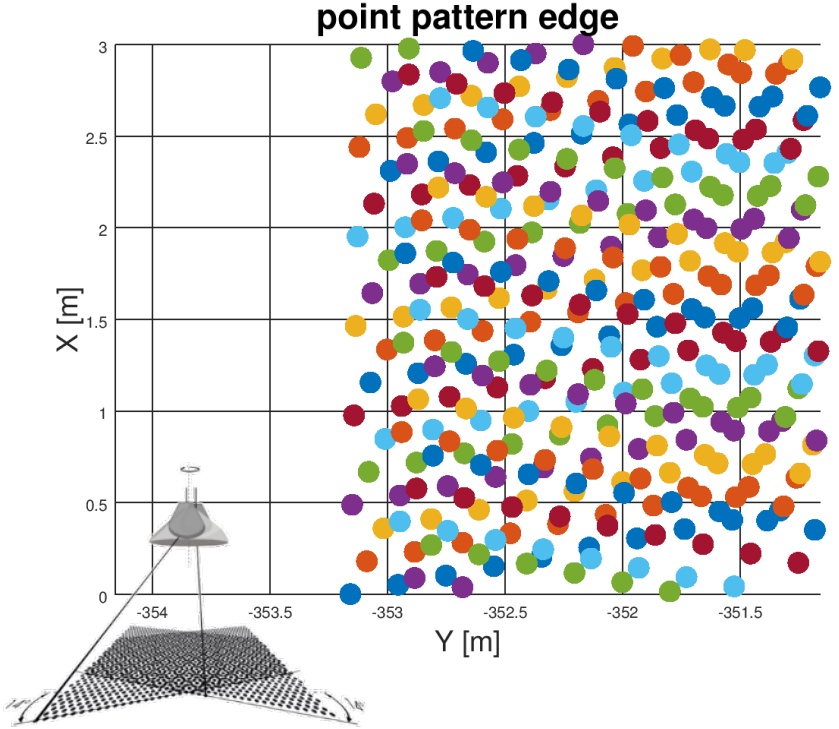
Example 1: VQ-780II – linear vs. circular scan pattern



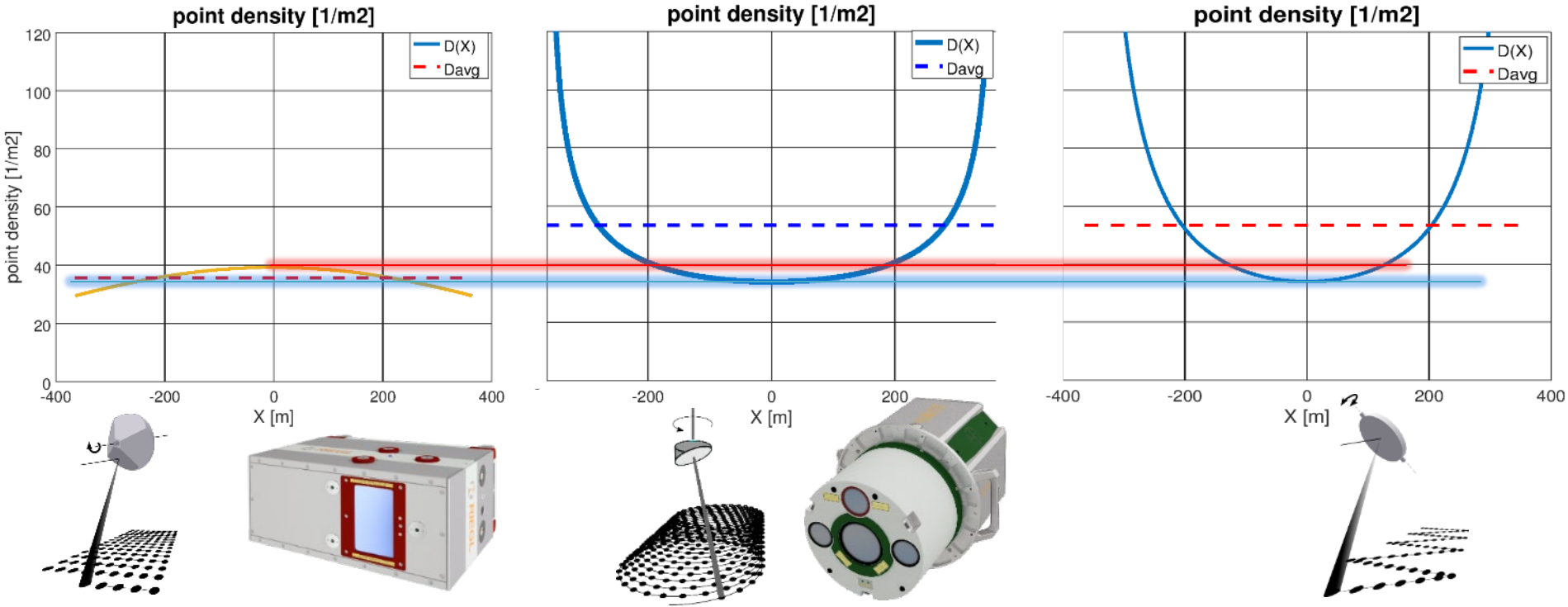


Example 3: VQ-1560II – linear vs. circular scan pattern

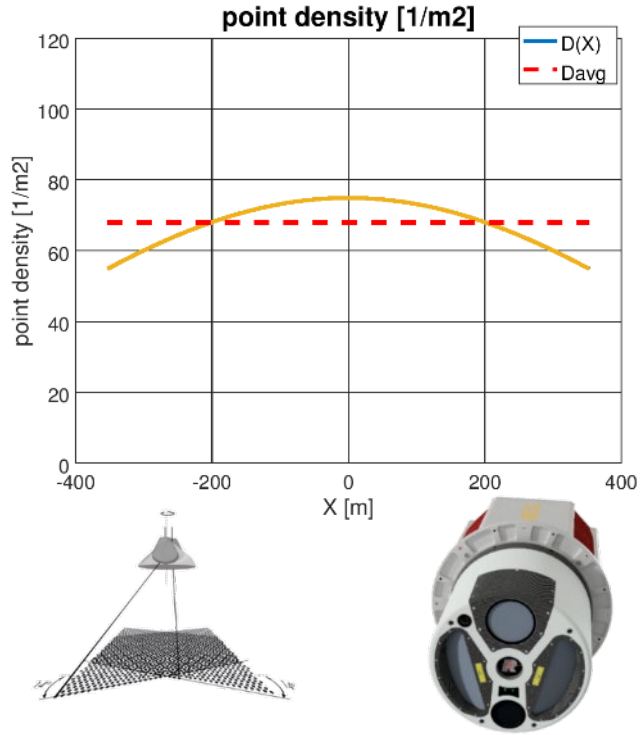


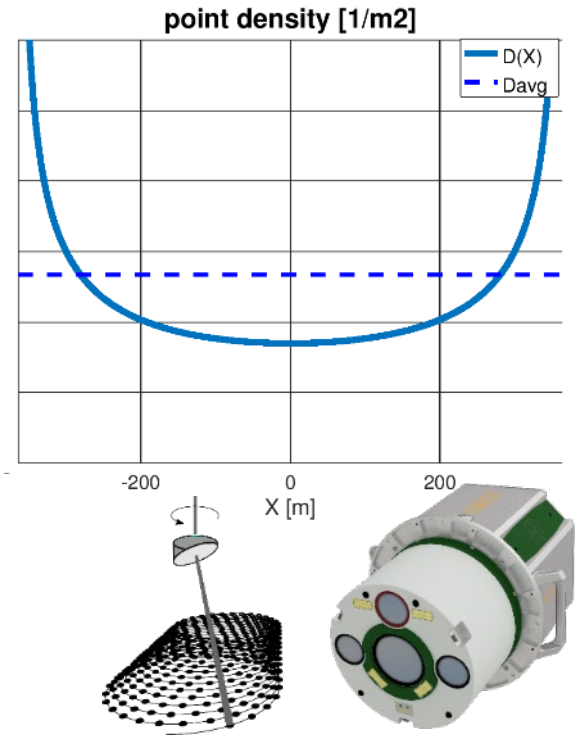


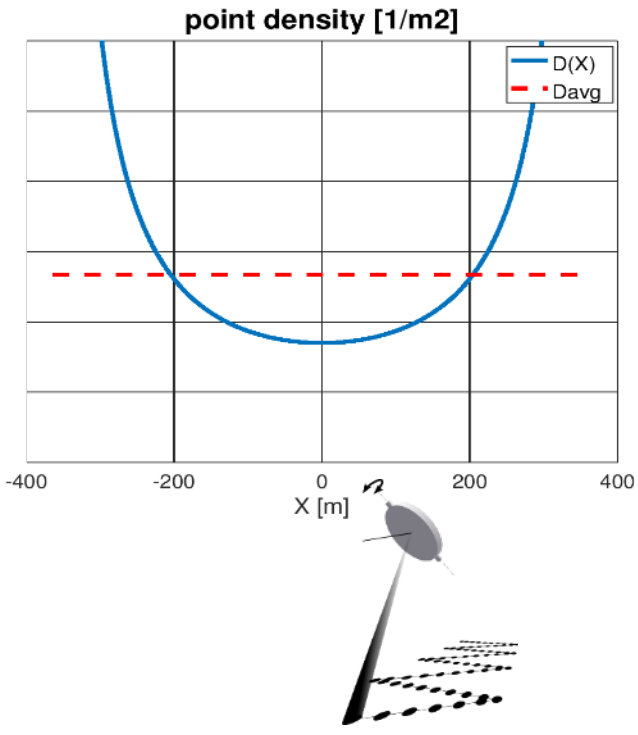
Point Density



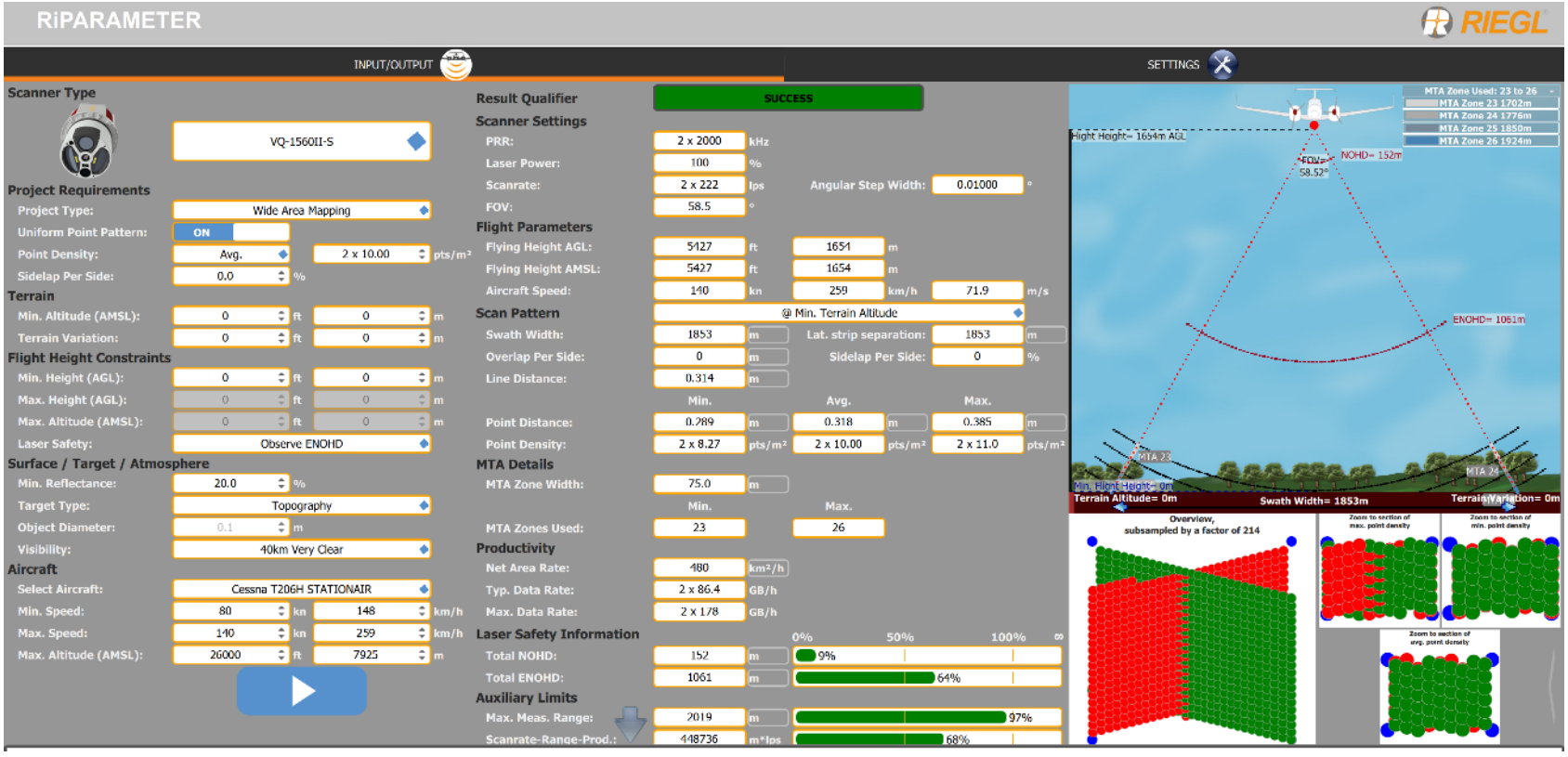
Point Density





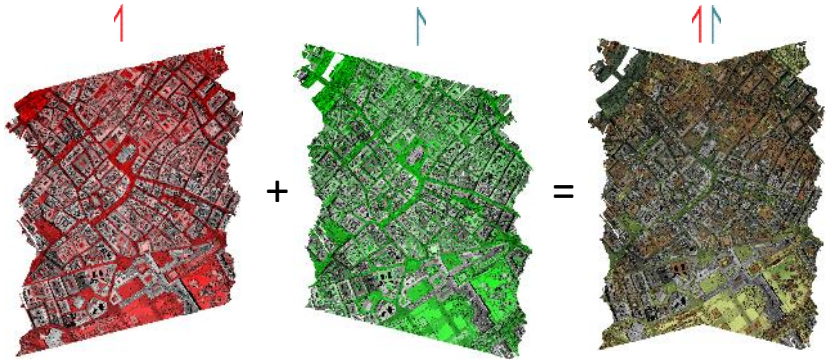


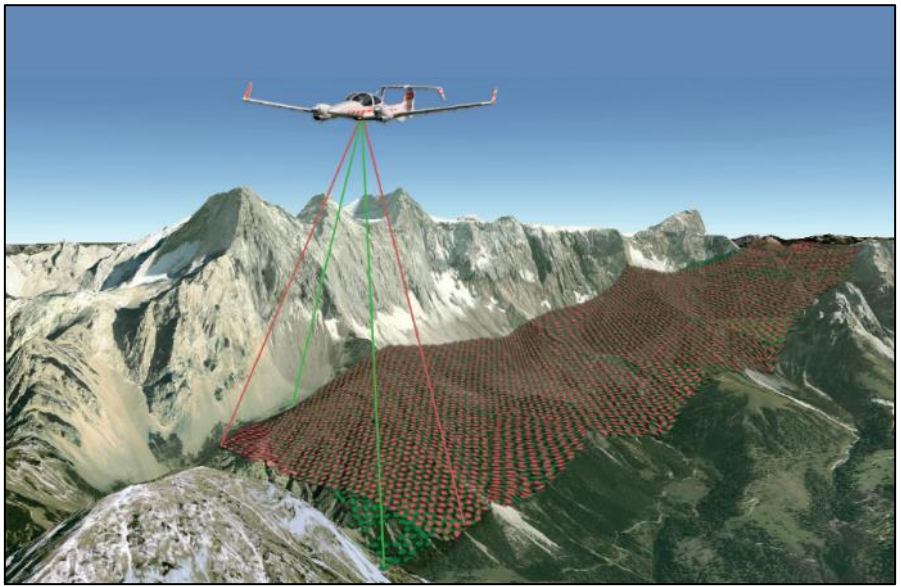
RiPARAMETER



Crossfire Scan Pattern

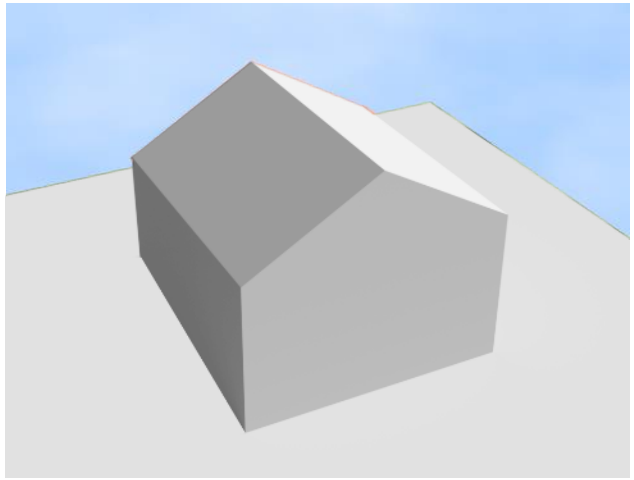
- 2-channel laser optical design
- Single rotating mirror
- 2x matrix scan pattern
- “Interleaved” design provides homogenous point distribution across entire FOV (58 deg.)
- Increased vertical density with off-nadir and nadir view angles



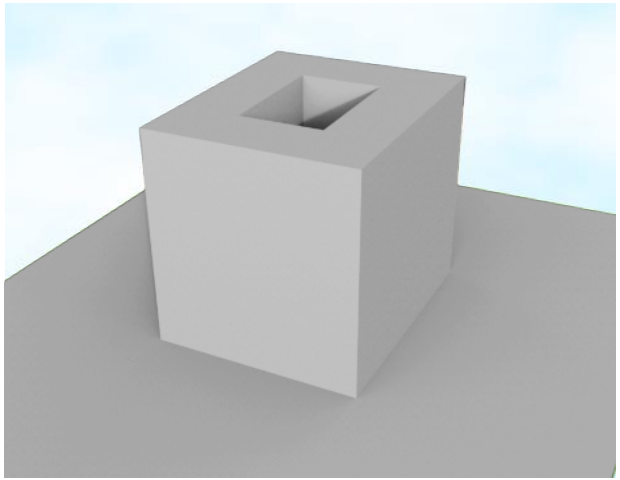


CROSSFIRE Simulations of Coverage

Small House MODEL
Size: 6 x 6 m
Height: 3.5 m
Roof angle: 30 deg

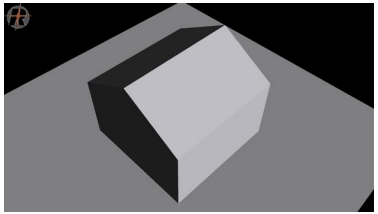


Building w/ Inner Court MODEL
Size outside: 12 x 10 m
Size inside: 6 x 4 m
Height: 10.5 m

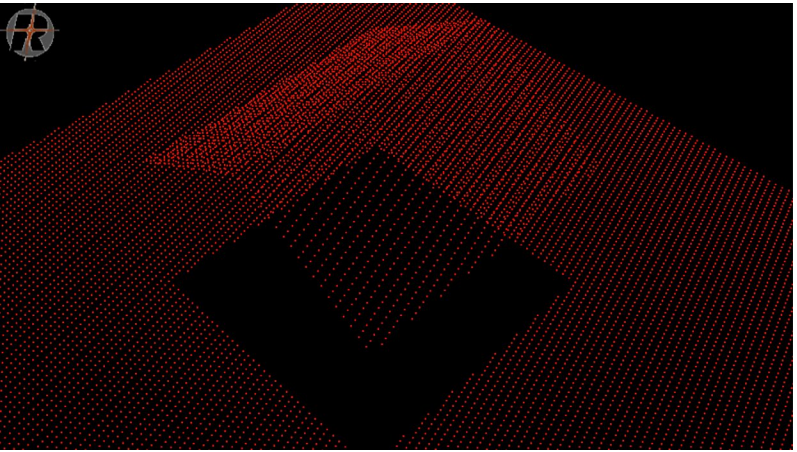


Coverage Success: Sensor Scan Geometry and Flight Patterns

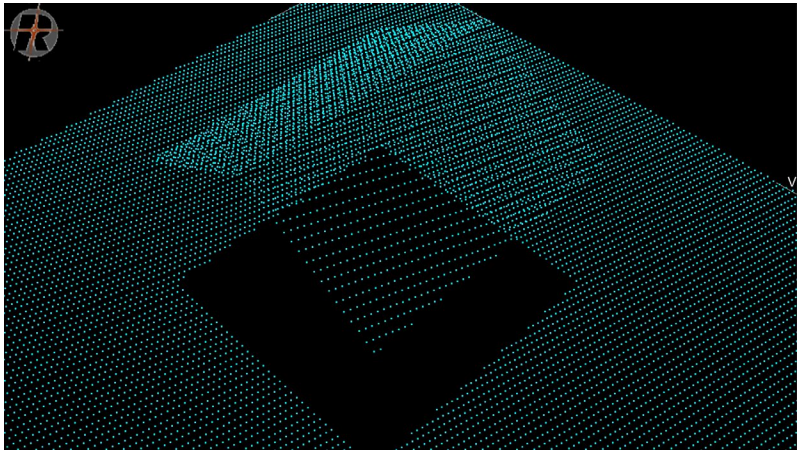
Small House MODEL



Channel 1

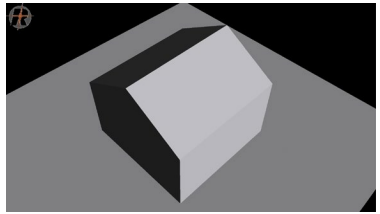


Channel 2

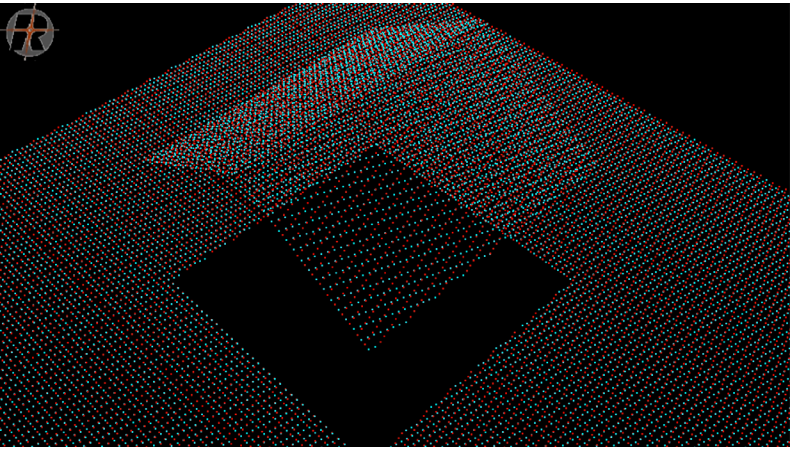


Coverage Success: Sensor Scan Geometry and Flight Patterns

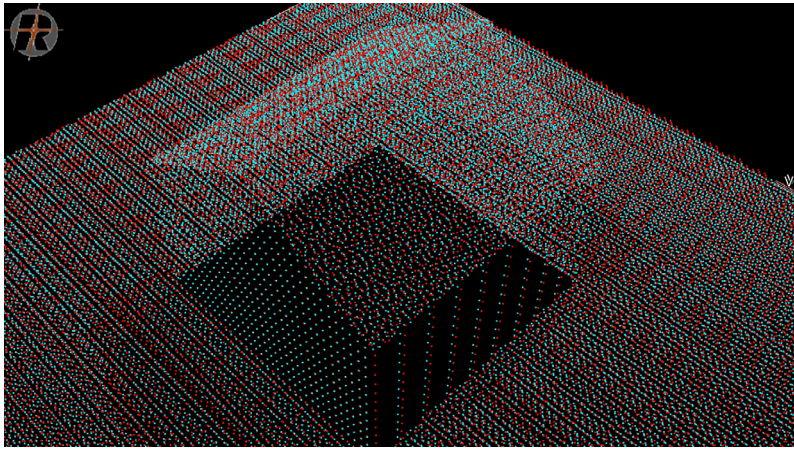
Small House MODEL



Channels 1 & 2 *(1 pass)*

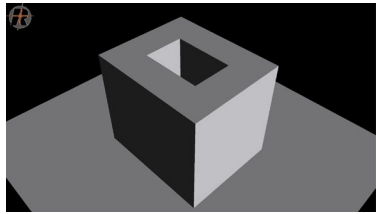


Channels 1 & 2 *(3 passes - 50% sidelap)*

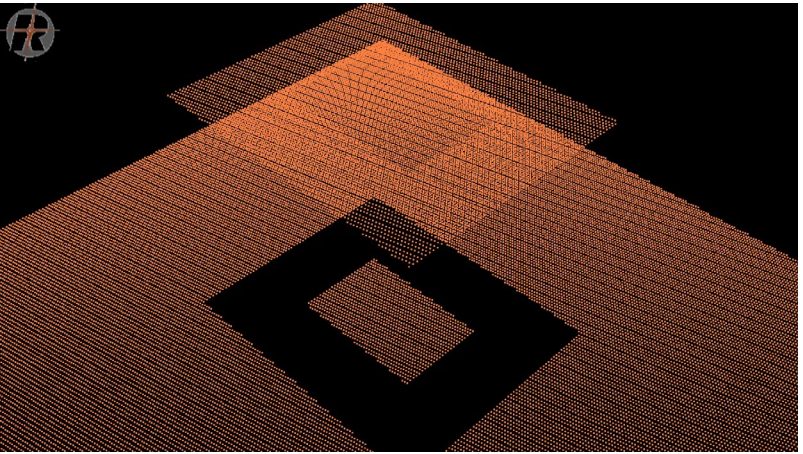


Coverage Success: Sensor Scan Geometry and Flight Patterns

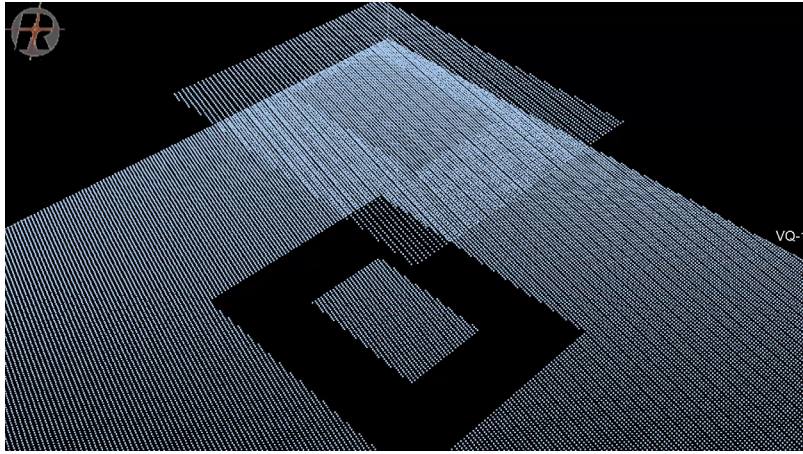
Building with Inner Courtyard MODEL



Channel 1

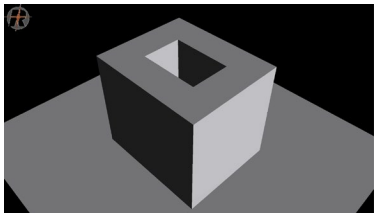


Channel 2

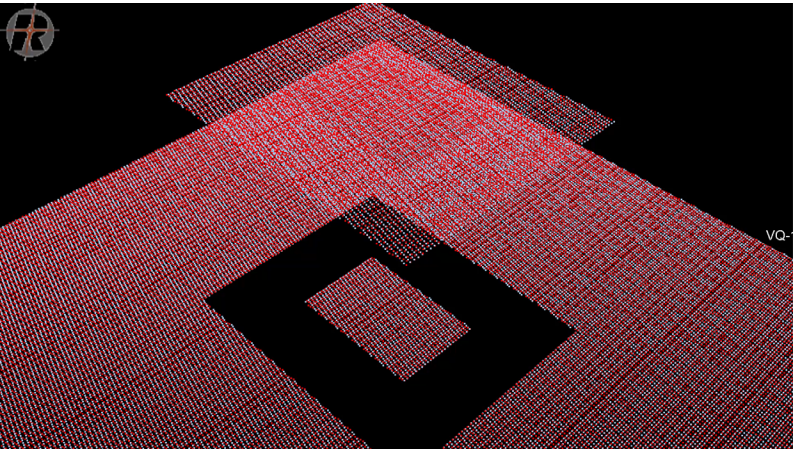


Coverage Success: Sensor Scan Geometry and Flight Patterns

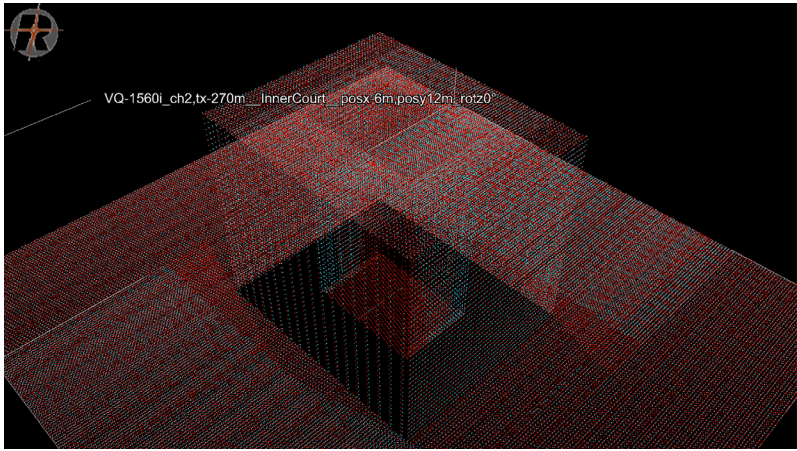
Building with Inner Courtyard MODEL

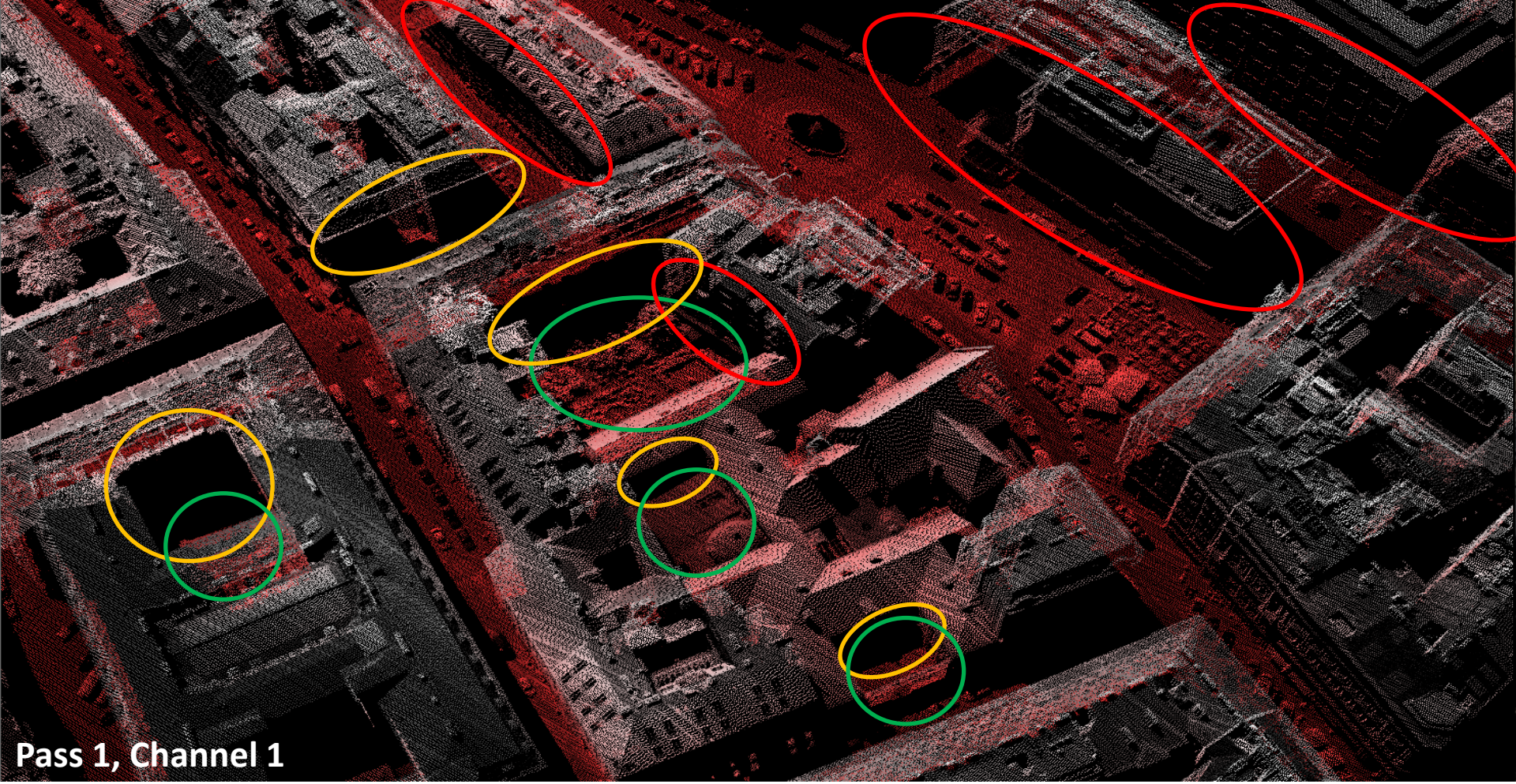


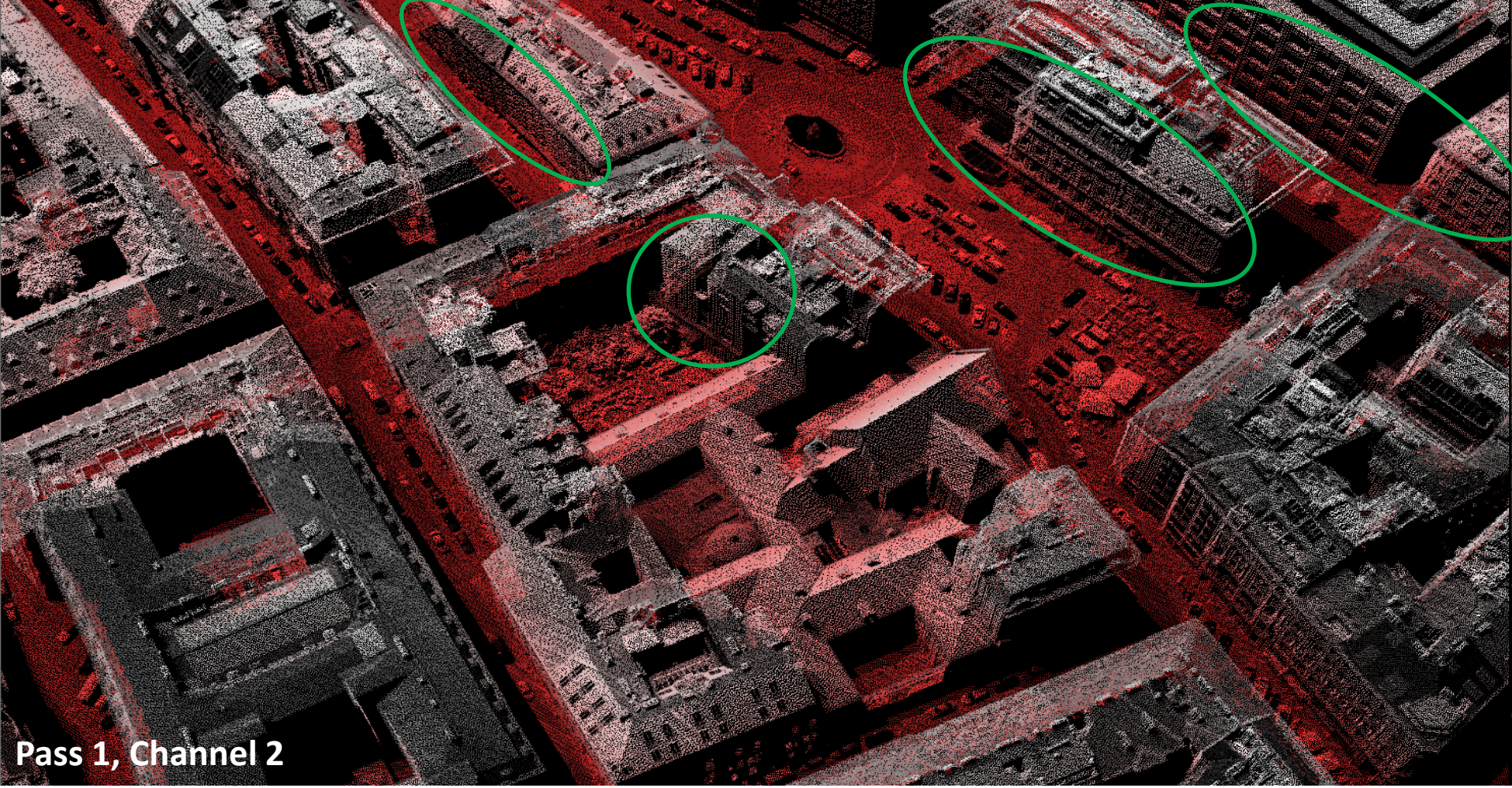
Channels 1 & 2 *(single pass)*

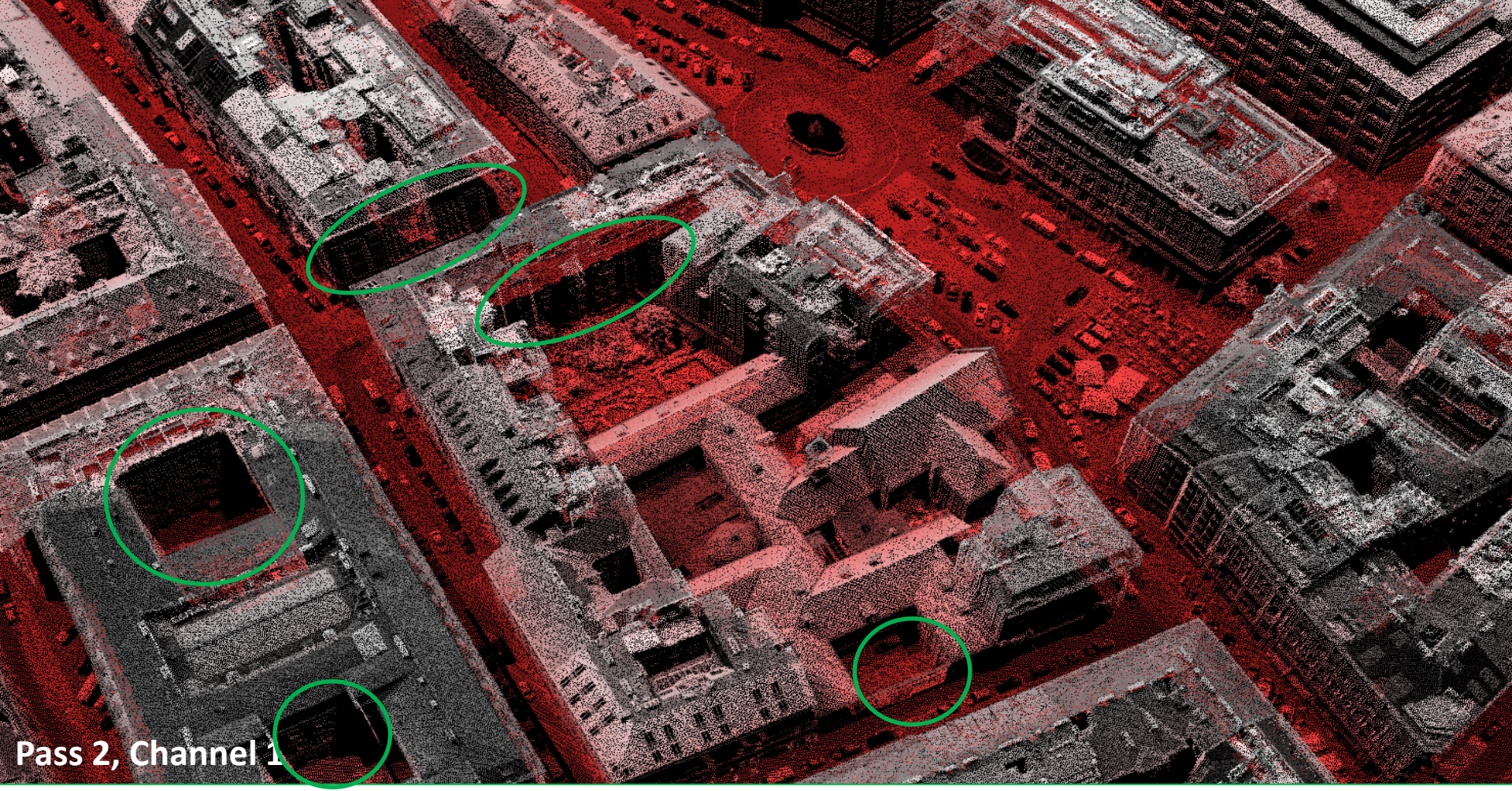


Channels 1 & 2 (3 passes - 50% offset)

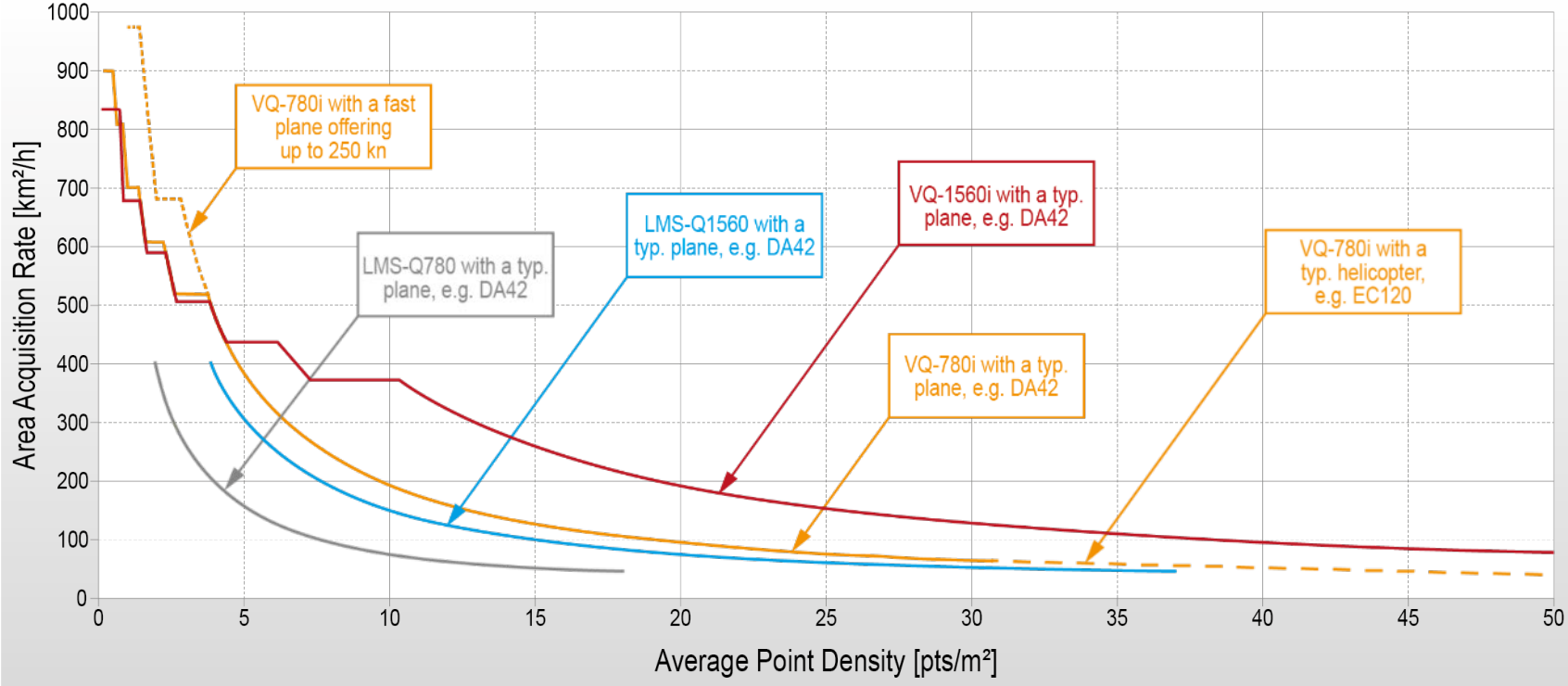




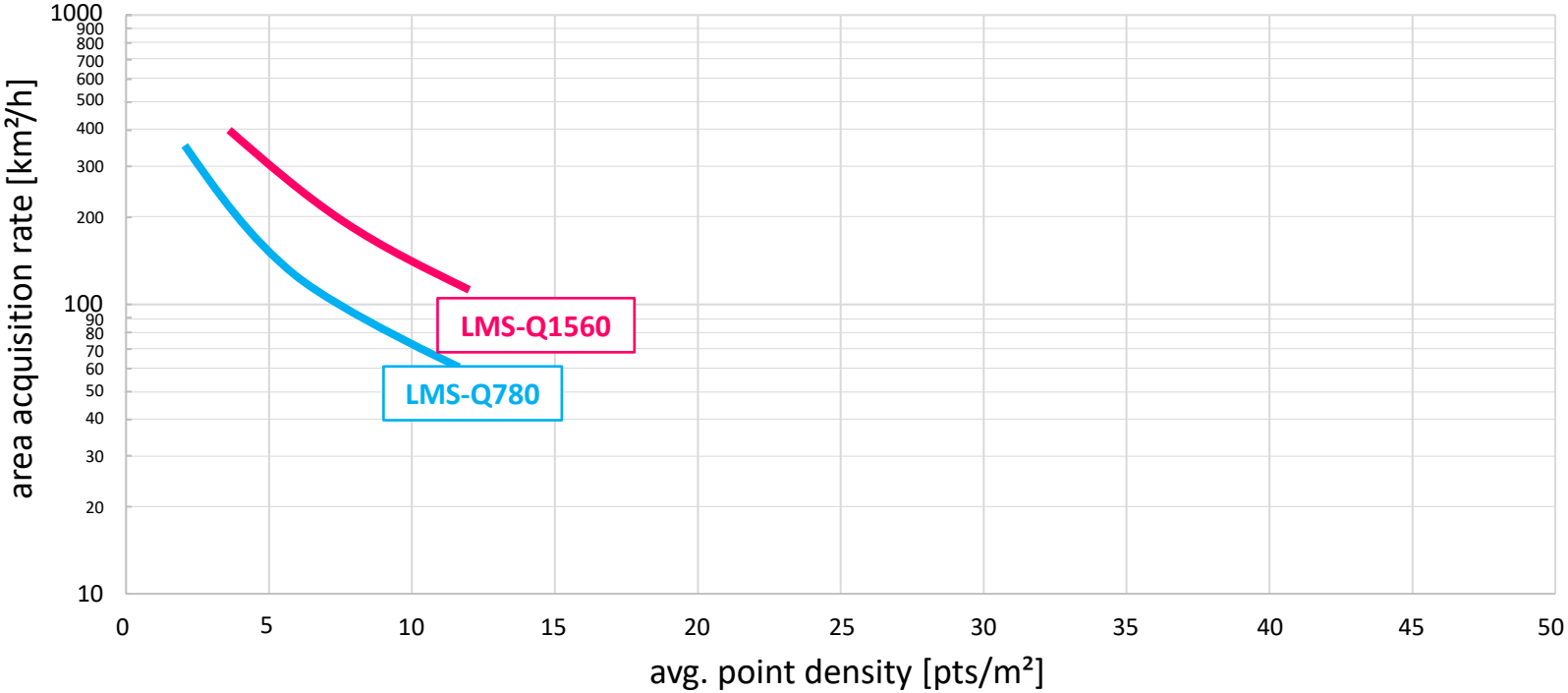




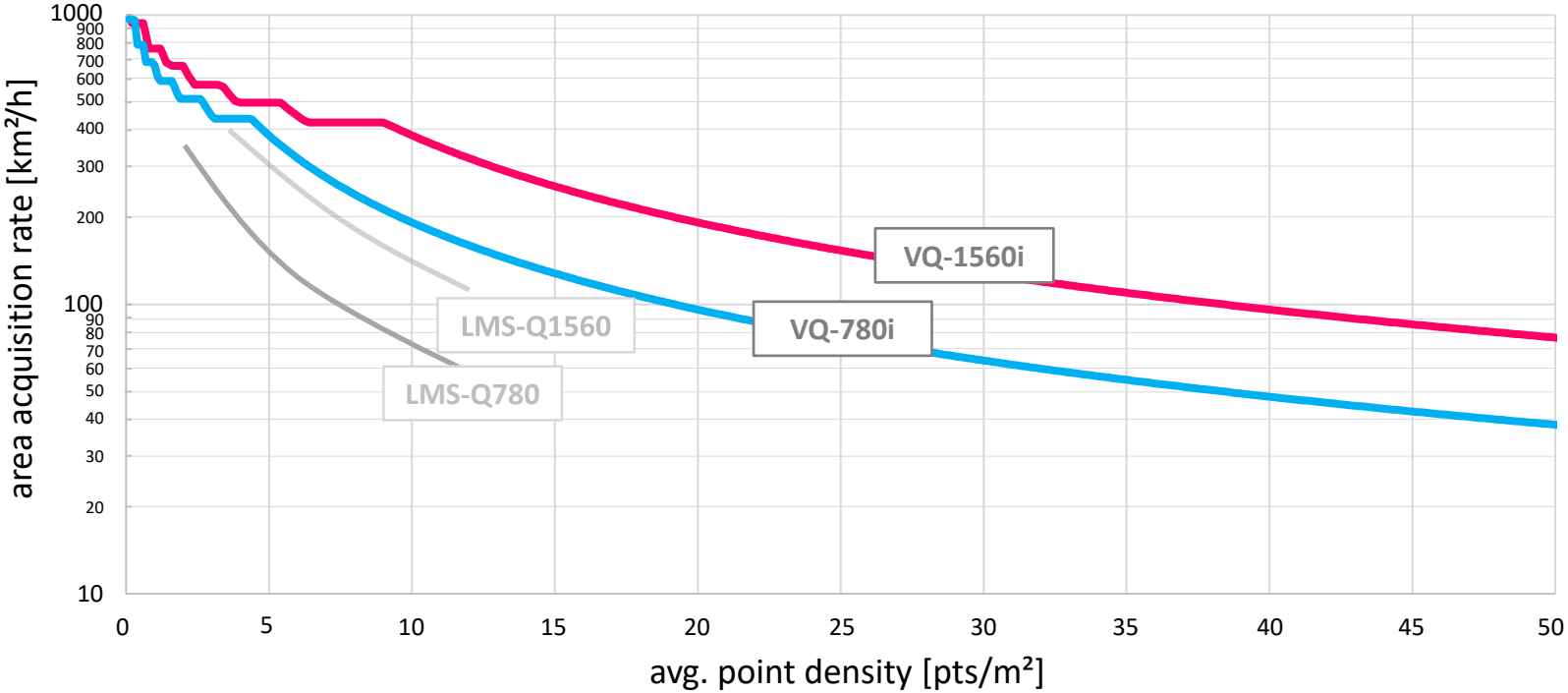
Data acquisition efficiency



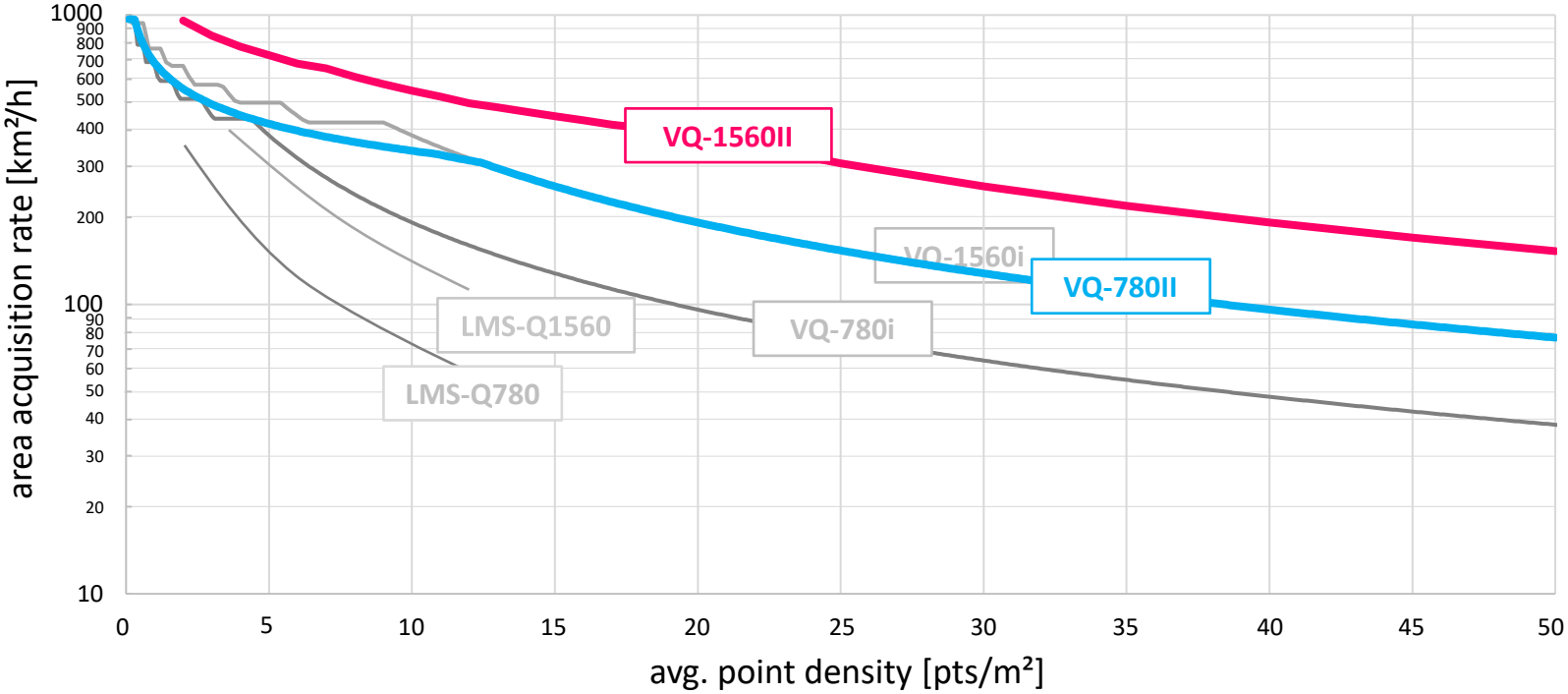
Data acquisition efficiency



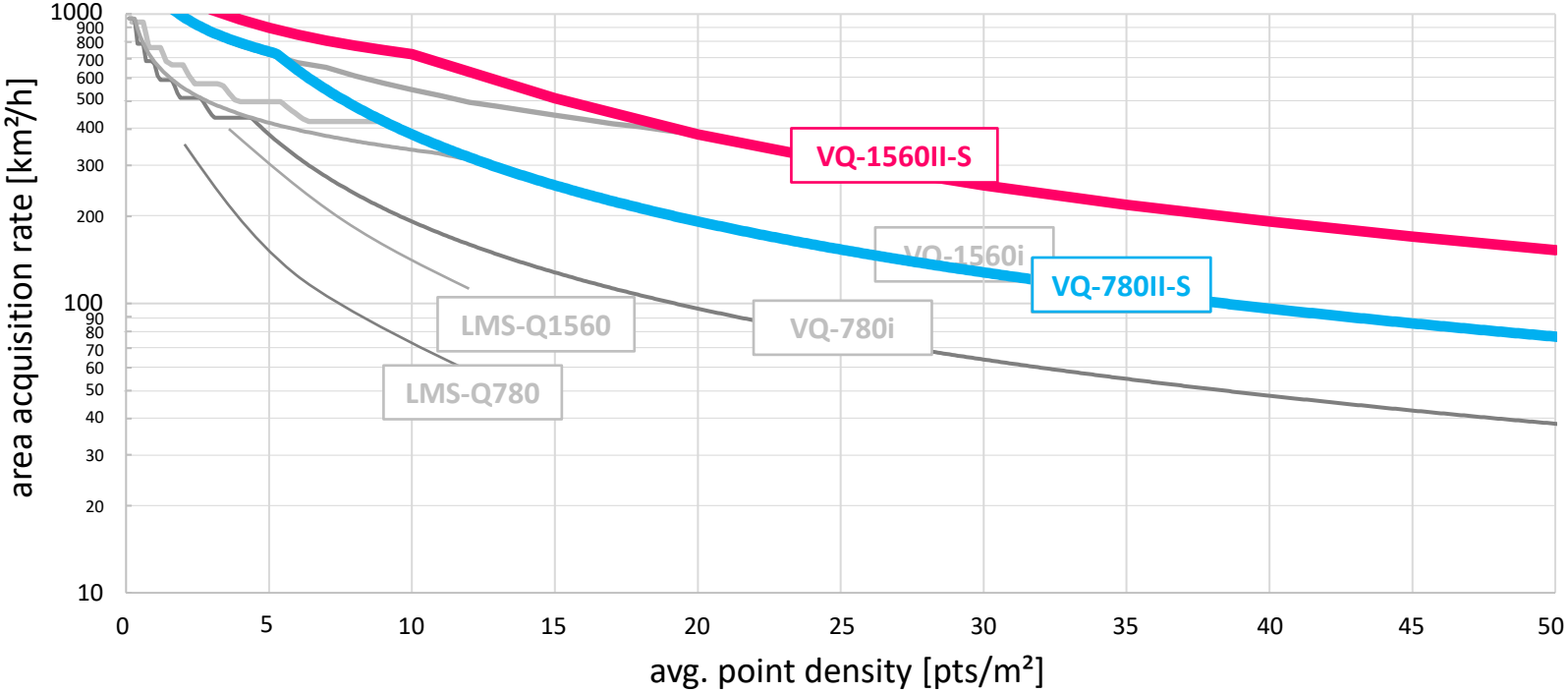
Data acquisition efficiency



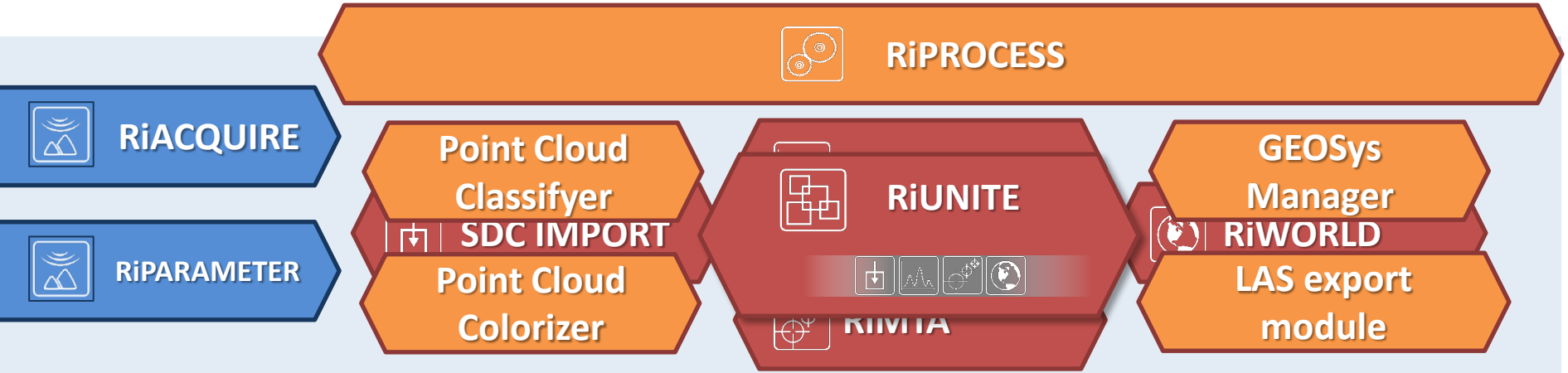
Data acquisition efficiency



Data acquisition efficiency



RiPROCESS 1.9



- 64-bit modules allows accessing huge memories conveniently
- faster processing – reduced data handover
- less and smaller data files – less data volume

KINEMATIC DATA PROCESSING

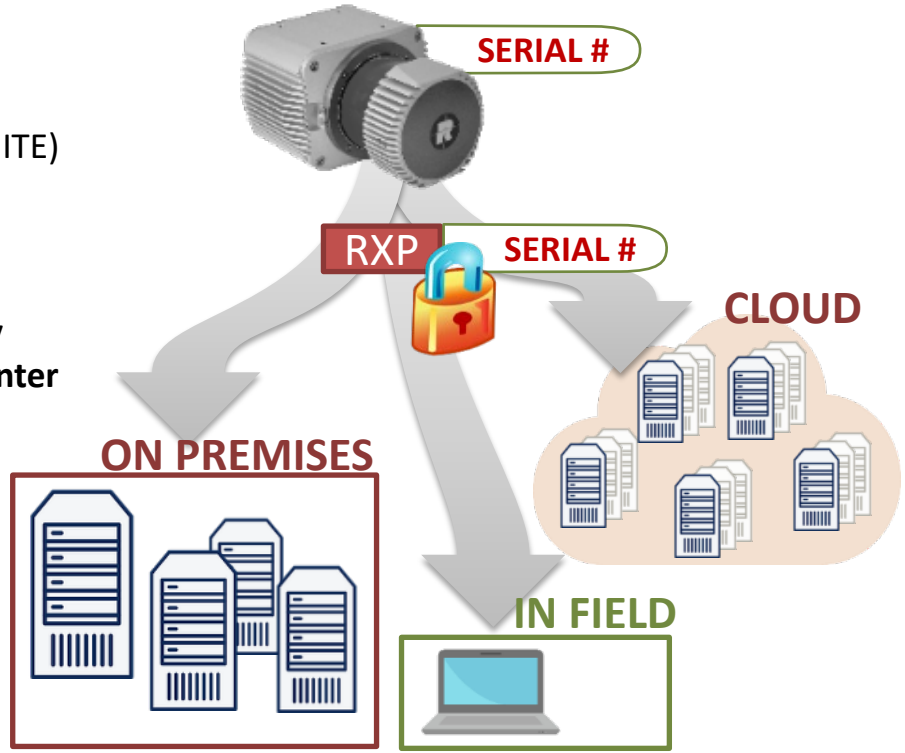
RiPROCESS 1.9 performance improvement (wrt. 1.8.7)

- **processing speed** (raw data to georefenced point cloud, ALS data, no waveforms)
  x 1.8 faster
- **data storage size** (*RIEGL* VQ-780 II data, partially with waveforms)
  50% to 75% file size reduction
- **speed of scan data adjustment** (boresight alignment)
  x 3 faster
- **speed of colorizing** (georeferenced point clouds, lots of images, e.g., LadyBug)
  x 3 to x 4 faster
- **speed of exporting** (colorized point clouds, in LAS 1.2)
  x 6 to x 10 faster

Licensing scheme in RiPROCESS 1.9

serial number licenses tied to *RIEGL* LiDAR device:

- require RiPROCESS 1.9 (or any of the modules, e.g., RiUNITE)
- may require **updating** of the **V-Line LiDAR instrument's firmware** (for reliable signature of serial number)
- licenses can be installed and utilized concurrently on **any number of workstations** / laptops via ***RIEGL's*** **License Center**
- enables an **infinite number of instances** running concurrently on every workstation
- **no dongles** required
- especially suited for **mass data processing in the cloud**



Thank you
for your kind attention!