Možnosti laserového skenování s využitím skenerů Riegl

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RIEGL®

Innovation in 3D


TERRESTRIAL
TLS


AIRBORNE
ALS


MOBILE
MLS


UNMANNED
ULS


INDUSTRIAL
ILS

RIEGL®

fast terrestrial laserscanning

High Performance terrestrial 3D Laserscanning Systems

- **scanning speed: 40-60 panoramic scans / hour**
- **measurement range from 0,5 m to 800 m**
- accuracy / precision: 5 mm / 3 mm @ 100 m

0,5 m to 2500 m

***RIEGL* VZ-400i** **RIEGL VZ-2000i**

Rechargeable Li-Ion Battery RBLI 2900

Technology	Li-Ion 28.8 V
Weight with 1 battery pack with 3 battery packs	 1.5 kg 2.2 kg

Operating Time Capacity	1 battery pack	3 battery packs
VZ-400i (typ. scan @ 1200 kHz ”Panorama 50”)	typ. 1 h 40 min	typ. 5 h
VZ-2000i (typ. scan @ 50 kHz ”long range”)	typ. 1 h 35 min	typ. 4 h 45 min

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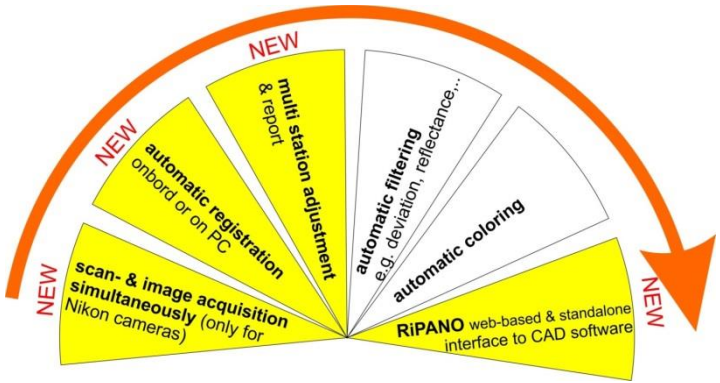
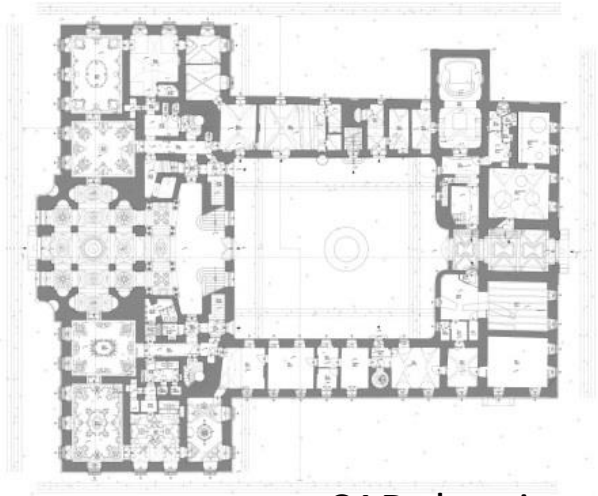
basics of the automatic registration – „fast & robust“

laser scan





CAD drawing

improved workflow for the VZ-i series scanners (Intergeo 2018)

Fortuna-Stolln

Ludwig Boltzmann Institute
Archaeological Prospection and Virtual Archaeology

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scan pattern

scan pattern	„Panorama50“
scan time	30 sec
meas. points	approx. 15 Mio
resolution	0,050°=> 4,4mm @ 5m
precision	3 mm @ 100m
laser scanner	*RIEGL* VZ-400i *RIEGL* VZ-2000i

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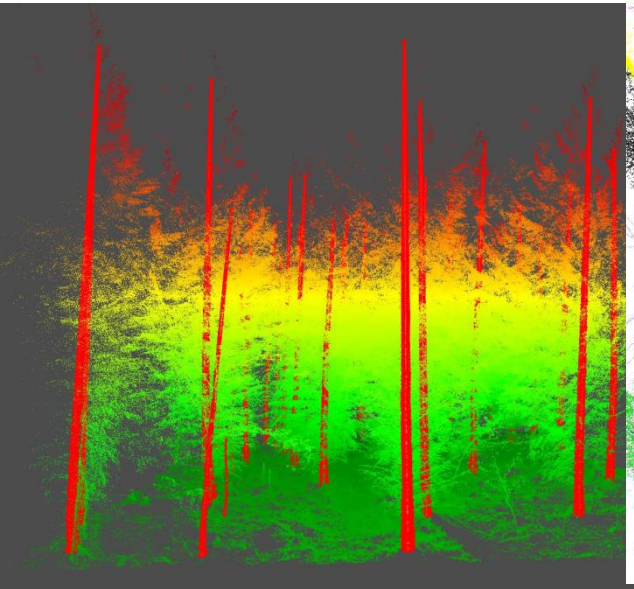
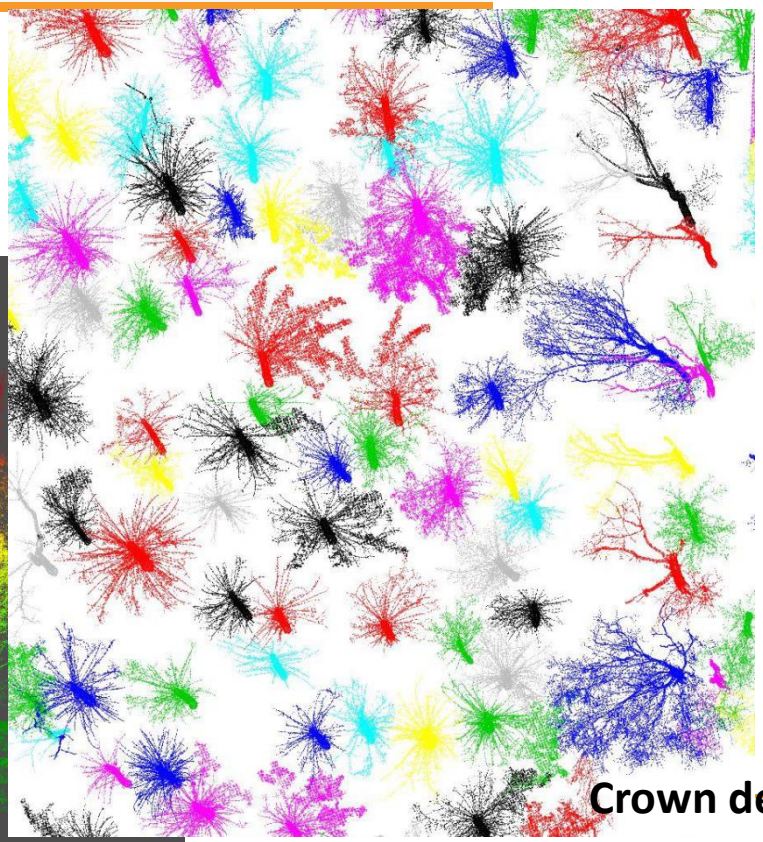
registration - forest

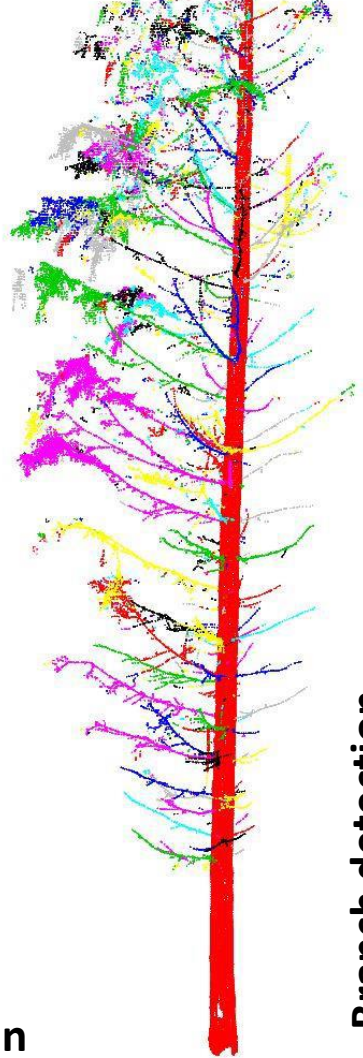
registration - forest

Chair of Forest Growth and Yield Science
TUM School of Life Sciences Weihenstephan
Technical University of Munich





Crown detection



Branch detection

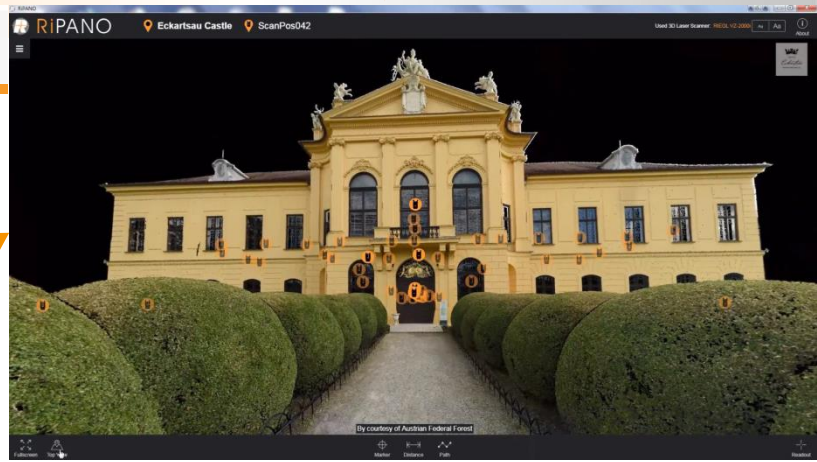
RiPANO – distribution of TLS projects

browser-based or as standalone software
for **many users** at the same time
publication on the **Internet** / Intranet

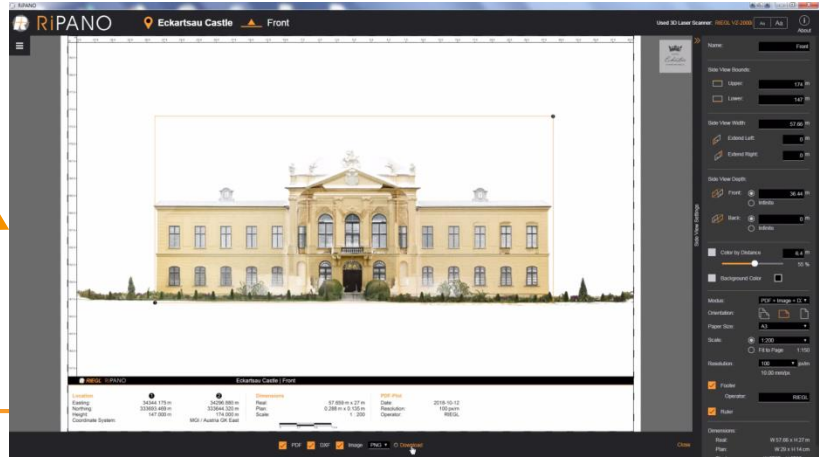
no software installation necessary
free of charge for the end user
(license for RiSCAN PRO required)
Easy to use

panorama view with

- simple measurements
- marker definition
- path definition

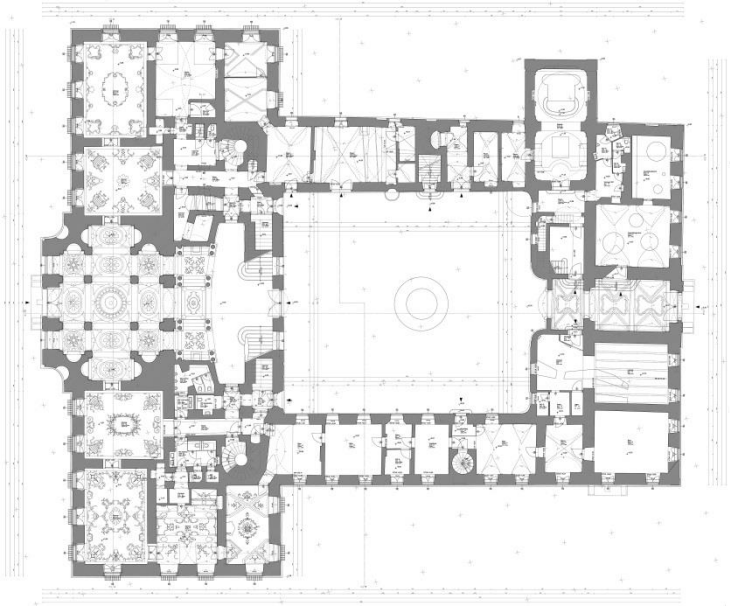


NEW:
quick extraction of
plans and views



RiPANO – for CAD user

(c) EKG Baukultur GmbH &
Österreichische Bundesforste AG



point cloud= raw product

CAD drawing = useful end product created by the end customer!

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RIEGL Mobile Mapping Systems

VMZ

the kinematic upgrade for terrestial scanners

VMQ-1HA

compact and economically priced

VMX-2HA

upmost performance and flexibility

VMX-RAIL

first triple scanner system designed for rail application

Mobile Laser Scanning | portfolio

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RIEGL Mobile Mapping Systems

VMX – 2HA

New

dual camera mount

optimized for pavement analysis

VMX-2HA

VMX-2HA

VMX-2HA GigE-Vision cameras

backward facing camera is optimized for

- detailed capturing of road paintings
- pavement analysis
- crack indexing
- downward looking close to nadir

VMX-2HA | pavement camera

VMX-2HA Basic Configuration

New

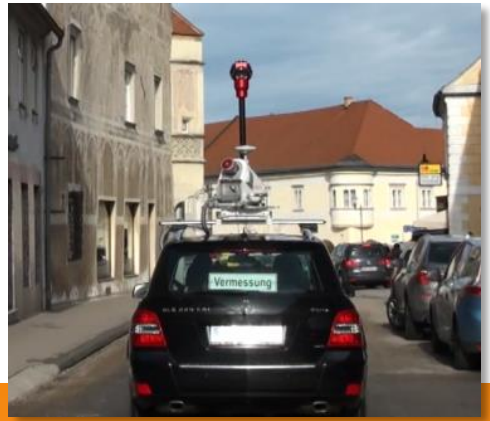
The **VMX-2HA-BC** is designed for users

- desiring no compromise on accuracy and scanning performance
- having no need on industrial high resolution cameras
- focusing on scan data complemented by spherical imagery
- requesting an economically priced dual scanner system
- 6 kg weight reduction
- still having the option to upgrade later to the VMX-2HA camera mount with support of up to 7 GigE Vision cameras

VMX-2HA | Basic Configuration

VMQ-1HA

compact, high-speed single scanner mobile mapping



VMQ-1HA | compact and economically priced

VMX – RAIL

Triple Scanner Mobile Mapping System

Specifically Designed for Rail Application

VMX-RAIL | designed for harsh conditions

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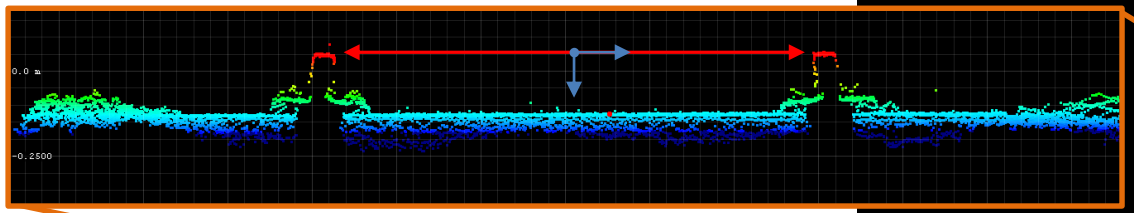
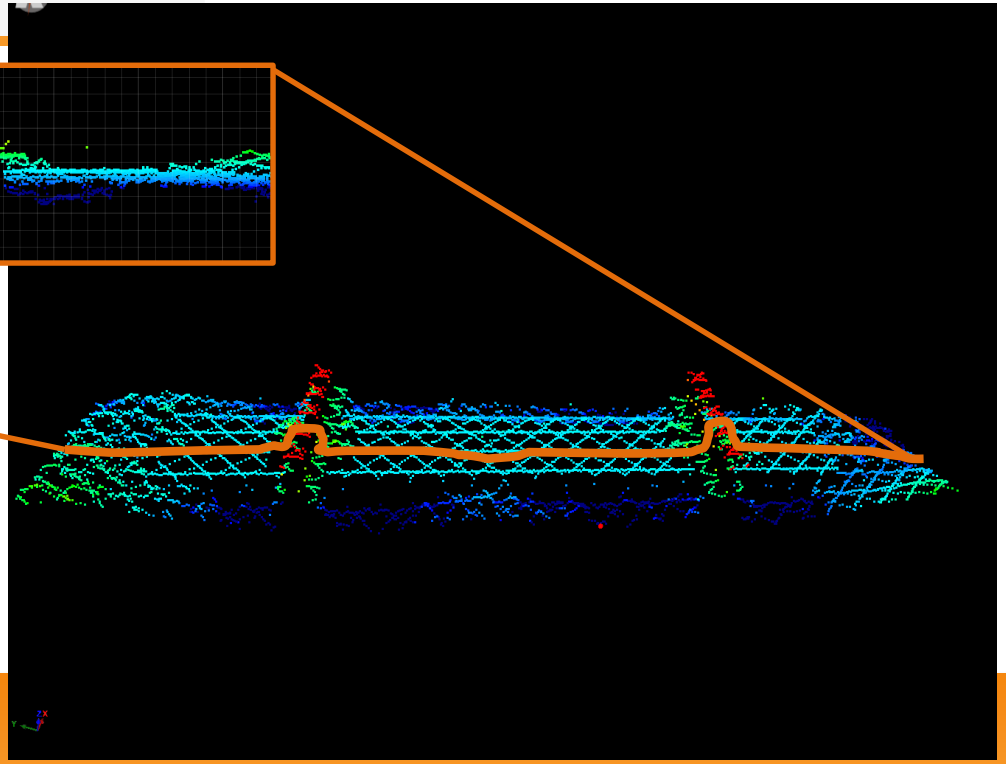
VMX-RAIL

- rugged measuring head for reliable long-term operation in harsh environments
- optimized on-site maintenance capabilities by modular measuring head setup
- equipped with three VUX-1HA High Accuracy Laser Scanners
- **3 MHz** pulse repetition rate
  750 lines per second resulting in
  up to **7000 pts/m²** in 3m range @ 80 km/h

VMX-RAIL | key features

VMX-RAIL





- extraction of rail position and width
- measurement of superelevation
- calculation of 6 DOF rail axes

VMX-RAIL | point cloud pattern

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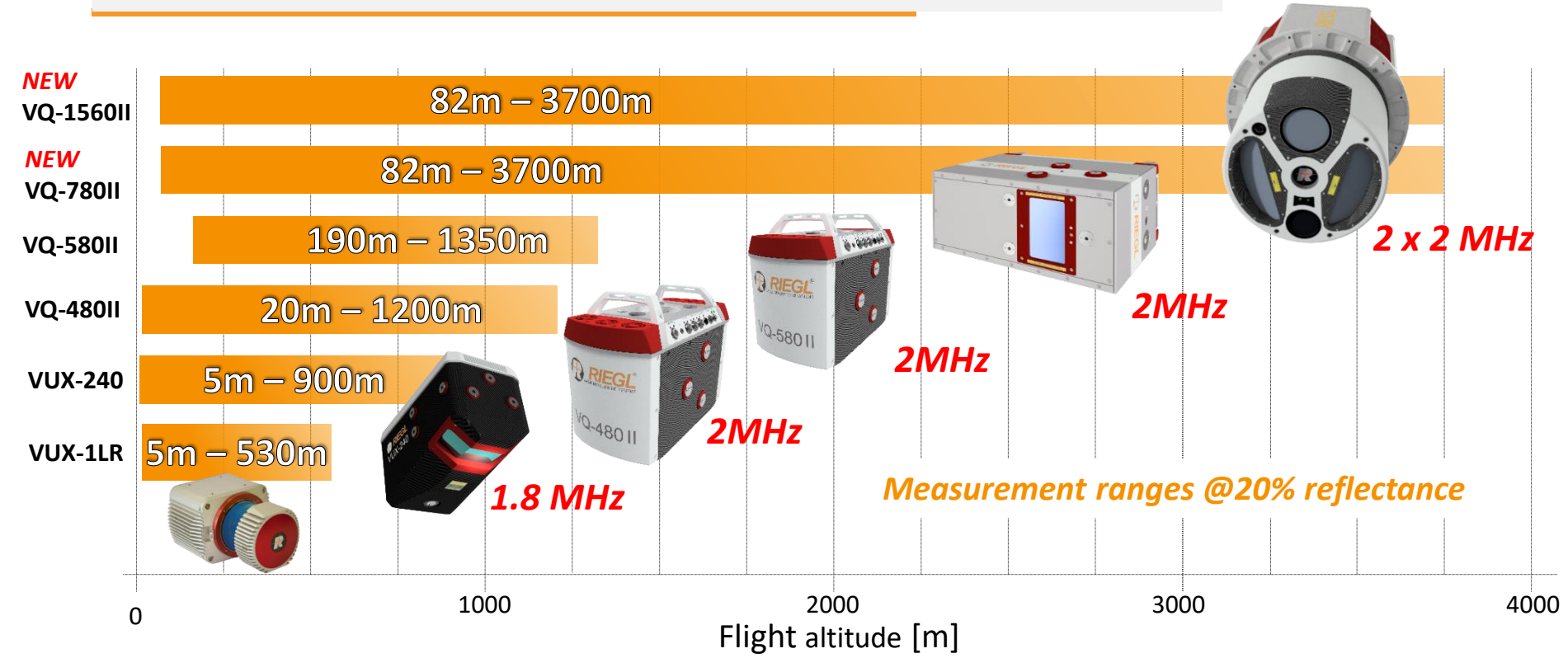
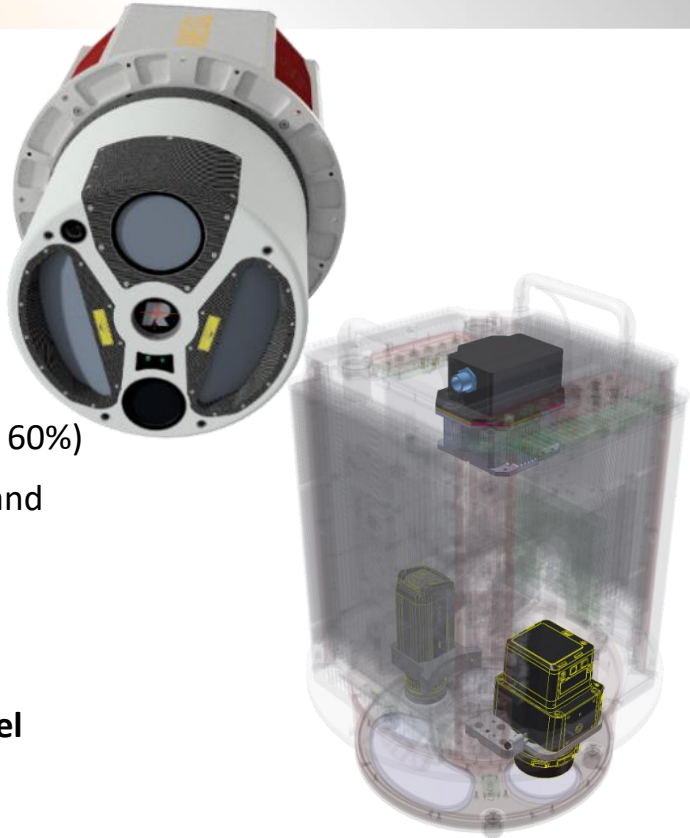
Line-up of RIEGL ALS instruments



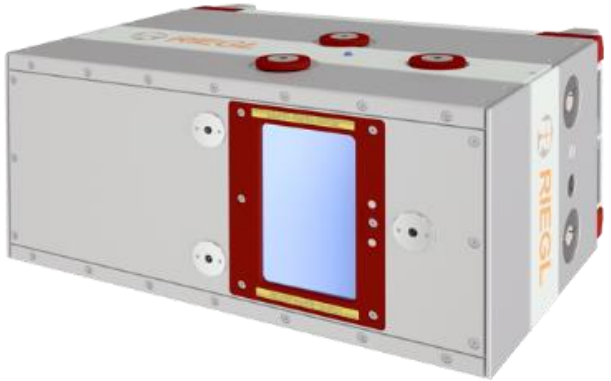
VQ-1560II – key features

- ***RIEGL* VQ-1560i** is the state-of-the-art **waveform processing LIDAR**
- up to **4 million** laser pulses per second, yielding up to **2.66 million pulses/measurements per second** on the ground
- data acquisition at a wide range of avg. point densities: **4 pts/m²** up to more than **140 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** with optional **full waveform** recording and **smart waveform** recording
- excellent multiple target detection capability
- integrated inertial measurement unit and GNSS receiver
- integrated, easily accessible **medium format camera, up to 150MPixel**
- prepared for integration of **a secondary camera**, e.g. **thermal, monochrome or NIR** (near infrared)

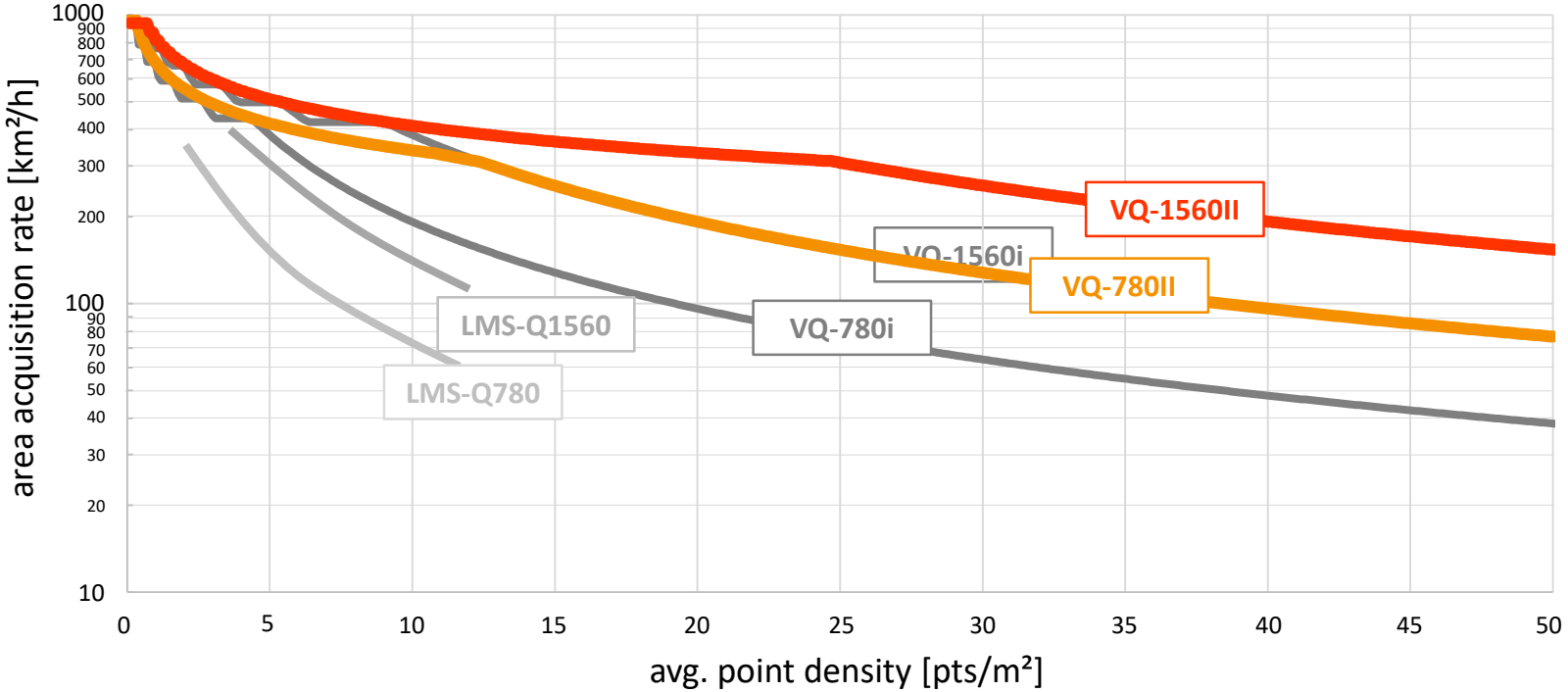


VQ-780II – key features

- ***RIEGL* VQ-780II** is the 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
- integrated inertial measurement unit and GNSS receiver
- integrated, easily accessible **medium format camera, up to 150MPixel**
- prepared for integration of **a secondary camera**, e.g. **thermal, monochrome or NIR** (near infrared)



Comparison: data acquisition efficiency



The new VP-1 with VUX-240

RIEGL VUX®-240 Sensor System

System Components	*RIEGL* VUX-240 LiDAR sensor IMU/GNSS unit with GNSS antenna control unit digital cameras (optional)
Scanner Performance	refer to VUX-240 table below
Total Weight	approx. 20 kg (depending on camera configuration)
IMU/GNSS Unit	Applanix AP20
accuracy Roll, Pitch / Heading IMU sampling rate position accuracy (typ.)	0.015° / 0.035° 200 Hz 0.05 m - 0.3 m
Camera Interfaces	trigger and event marker
Technical Data	quick installation & removal using the existing mounts (e.g. AirFILM Camera System); mounting and operation at enduser's responsibility; area exposed to wind 0.114m²

Unmanned Laser Scanning

Laser scanning utilizing high-end unmanned airborne platforms provides the possibility to acquire data in dangerous and / or hard-to-reach areas, while offering an excellent cost-to-benefit-ratio for numerous applications, e.g. precision farming, forestry and mining.

ULS

LiDAR Sensors for Unmanned Aircraft

RIEGL VUX-1UAV

- 3.5 kg / 7.7 lbs
- up to 500,000 meas./sec
- accuray 10 mm
- operating flight altitude more than 1,000 ft

NEW

RIEGL miniVUX-2UAV

- 1.55 kg / 3.4 lbs
- up to 100,000 meas./sec
- accuracy 15 mm

RIEGL miniVUX-1DL

- „downward-looking“, optimized for corridor mapping
- up to 100,000 meas./sec
- accuracy 15 mm

Innovation in 3D

RiCOPTER UAS

Fully integrated turnkey solution

- MTOM: < 25kg
- up to 6.5kg sensor payload
- foldable arms, X8
- up to 30 minutes endurance with full payload
- fully **redundant** system (main & backup flight control)

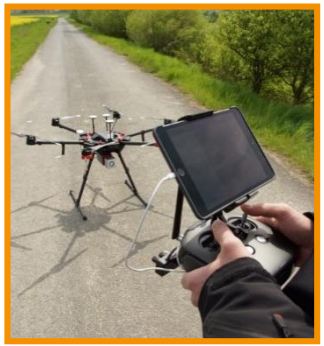
NEW

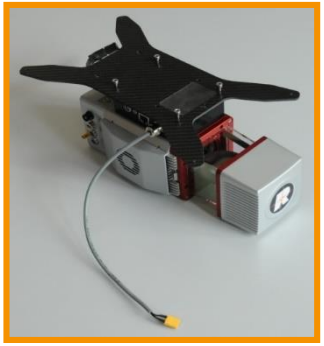
  - *RIEGL* own development – partly based on open-source

- live video & telemetry downstream to ground station display
- customizable frequencies (433, 868, 915 MHz)
  MAVLINK-based command and control link
- powerful telemetry functions (remote control, on-screen-display, etc.)

- optimized for operation of *RIEGL* VUX-SYS with RGB cameras

Integration Kit 600





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RIEGL miniVUX Series

- miniVUX-1UAV
  - APX-15 UAV
  - APX-20 UAV

PRR: 100 kHz
100.000 meas./sec.

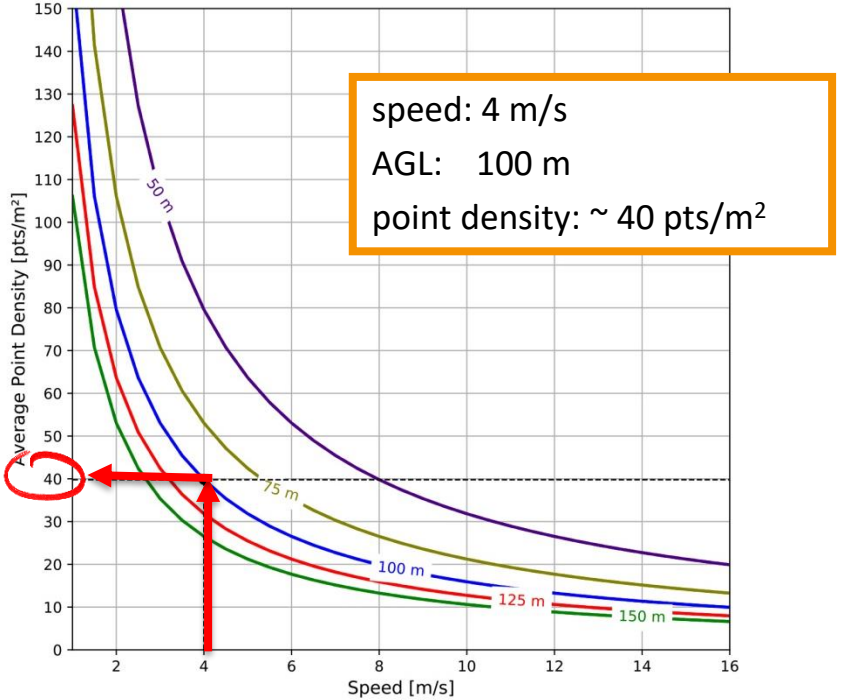
- **miniVUX-2UAV**
  - APX-15 UAV
  - APX-20 UAV

PRR: 200 kHz
200.000 meas./sec.

- miniVUX-1DL
  - APX-15 UAV
  - APX-20 UAV

PRR: 100 kHz
100.000 meas./sec.

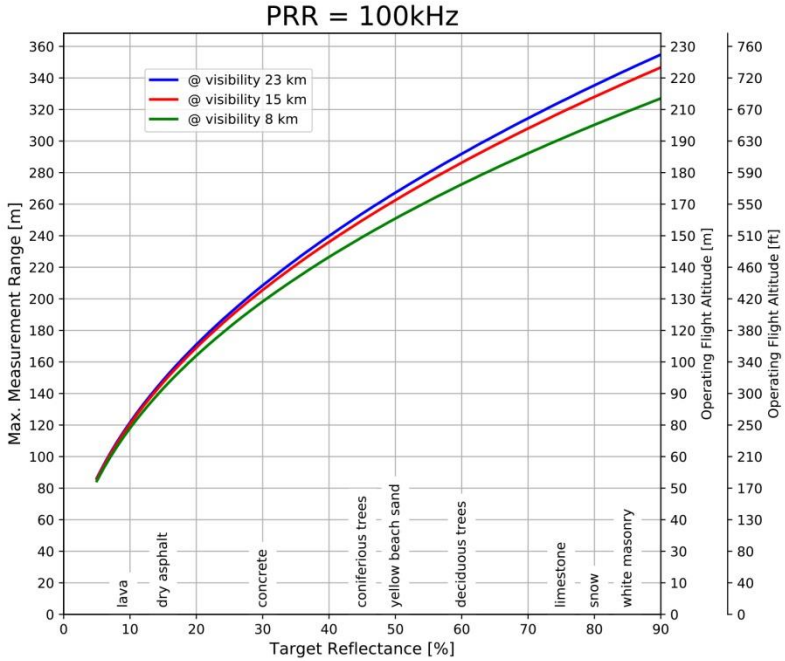
miniVUX-2UAV: Performance Charts – 100 kHz



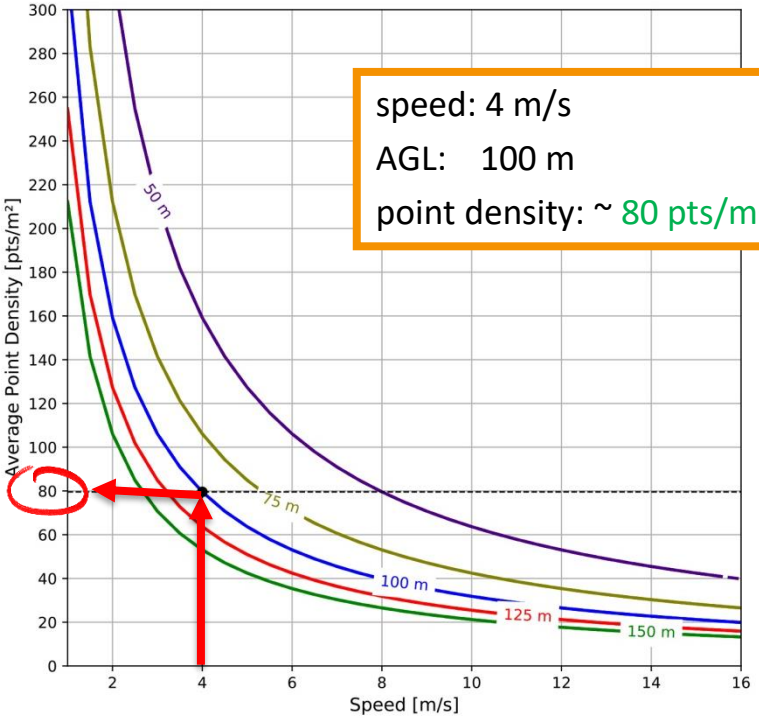
speed: 4 m/s

AGL: 100 m

point density: ~ 40 pts/m²



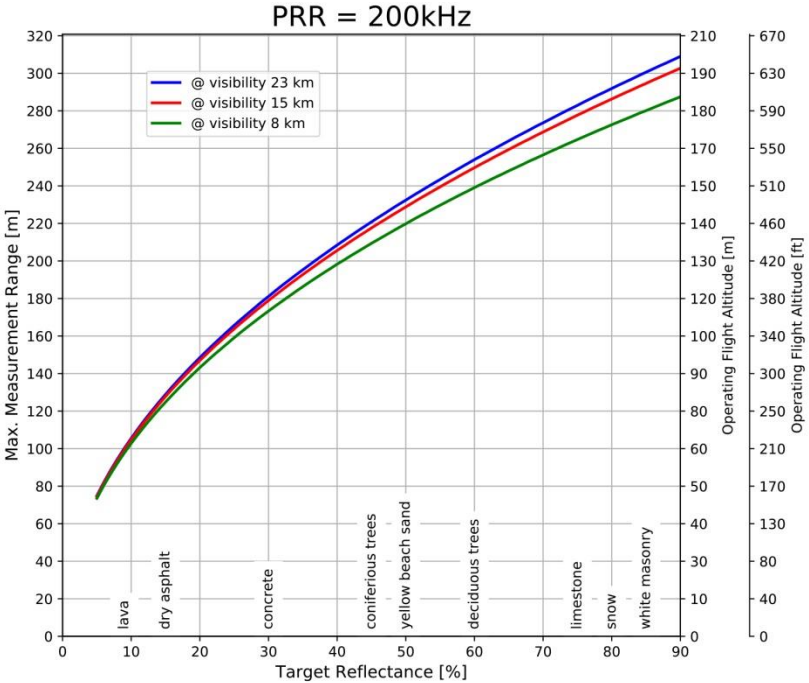
miniVUX-2UAV: Performance Charts – 200 kHz



speed: 4 m/s

AGL: 100 m

point density: ~ 80 pts/m²



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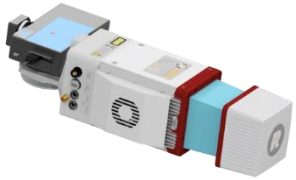
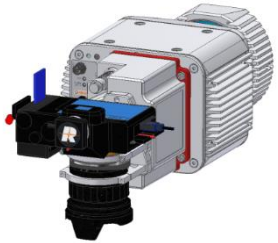
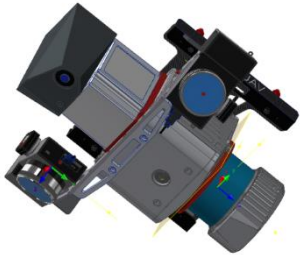
RIEGL miniVUX LiDAR Series - comparison

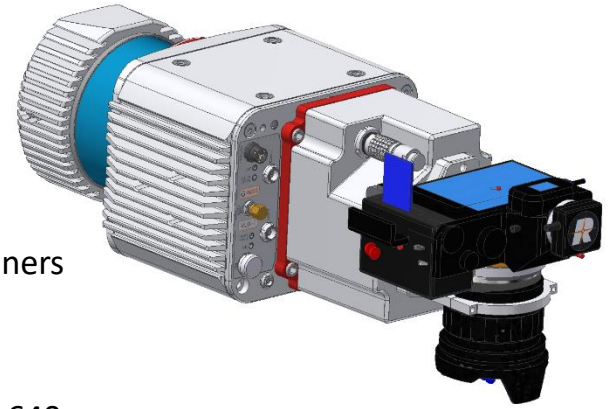
	miniVUX-2UAV (NEW)	miniVUX-1UAV	miniVUX-1DL
PRR (max.) / eff. meas. rate	100 / 200 kHz (selectable) 200.000 meas./sec.	100 kHz 100.000 meas./sec.	100 kHz 100.000 meas./sec.
accuracy	15 mm	15 mm	15 mm
precision	10 mm	10 mm	10 mm
max. measuring range	170 m @ 20 % - 100 kHz 290 m @ 60 % - 100 kHz 330 m @ 80 % - 100 kHz 150 m @ 20 % - 200kHz 250 m @ 60 % - 200kHz 280 m @ 80 % - 200kHz	170 m @ 20 % 290 m @ 60 % 330 m @ 80 %	140 m @ 20 % 240 m @ 60 % 260 m @ 80 %
typ. operating flight altitude AGL	100 m @ 20 % - 100kHz 160 m @ 60 % - 100 kHz 85 m @ 20 % - 200 kHz 140 m @ 60 % - 200 kHz	100 m @ 20 % 160 m @ 60 %	100 m @ 20% 160 m @ 60 %

camera solutions









- nadir and oblique camera solution for all scanners
  - Sony Alpha 6000 or Sony Alpha 7R
- Thermal / hyperspectral imagery integration
  - Flir Tau2 / Vue Pro or Workswell WIRIS 640

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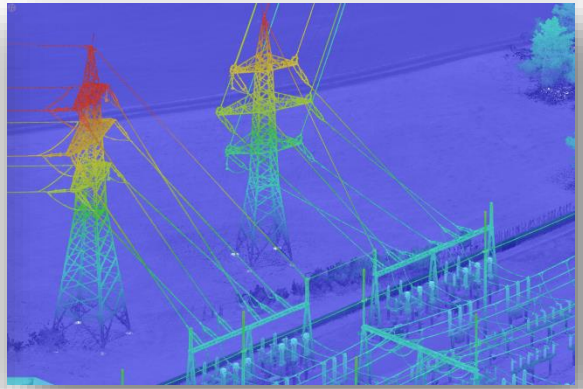
RIEGL VUX-240 - update

- deliveries planned by end of next month (Oct/2019)
- possibility for integration of Sony A7R III or PhaseOne iXM-50/100 RGB camera, etc.
- fully integrated with APX-20 UAV INS/GNSS + CFast memory card holder



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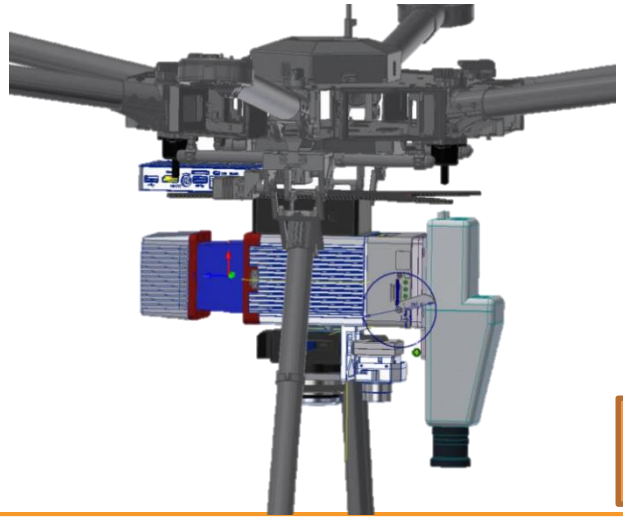
"special" multi sensor integration

- multi sensor integration:
  - LiDAR, RGB, thermal, hyperspectral
  - weight: < 4 kg



data fusion (1) – combined dataset (TLS/ULS)

Why combined scanning?

- **Coverage:**
  Can the object be fully covered, any shadows expected?
- **Accessibility:**
  Any possibility to scan it from other perspectives?
- **Efficiency:**
  How efficient would it be to cover the object with just one system?
- **Accuracy/Details:**
  What are the accuracy and detail demands on a project?

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data fusion (2) – combined dataset (TLS/ULS)

- ULS for perfect roof coverage,
  TLS shows big gaps on roof data
- ULS data variation in line density due to light pitch variations during UAV flight
- TLS data angular resolution around single scan positions
- TLS data higher resolution and more precise and accurate

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Thank you for your kind attention!

Innovation in 3D