Geosmart Asia 2018

Automated Scan Data Registration for Improving TLS Data Acquisition Efficiency

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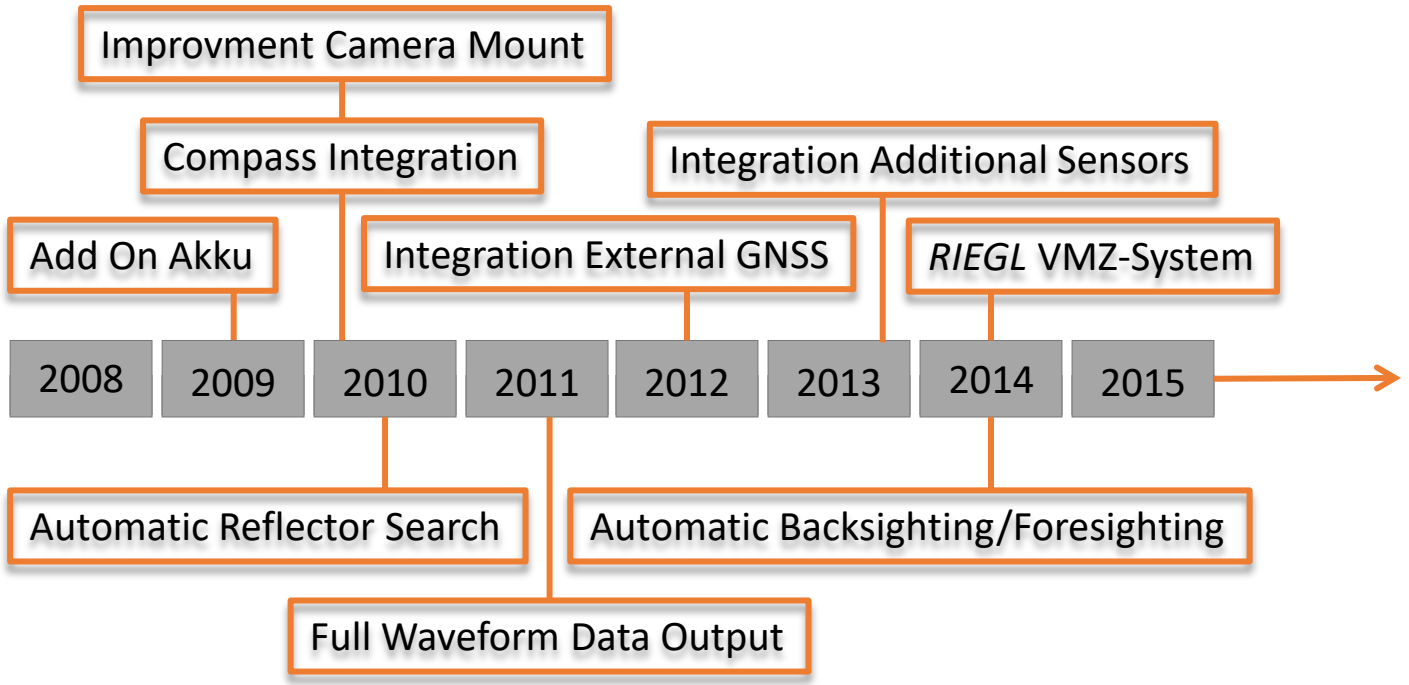
- Hardware/Firmeware Architecture
- Onboard Realtime Postprocessing Tasks
- *Onboard Registration 2.0 – leaving the scene with a registered point-cloud*
- Example data from different applications

RIEGL VZ-scanner overview

VZ-400	VZ-400i	VZ-1000	VZ-1000i	VZ-2000i	VZ-4000	VZ-4000i	VZ-6000	VZ-6000i
max. range 600m	max. range 600m	max. range 1400m	max. range 1400m	max. range 2050m	max. range 4000m	max. range 4000m	max. range 6000m	max. range 6000m
precision 3mm accuracy 5mm	precision 3mm accuracy 5mm	precision 5mm accuracy 8mm	precision 5mm accuracy 8mm	precision 5mm accuracy 8mm	precision 10mm accuracy 15mm	precision 10mm accuracy 15mm	precision 10mm accuracy 15mm	precision 10mm accuracy 15mm
Laser Class 1	Laser Class 1	Laser Class 1	Laser Class 1	Laser Class 1	Laser Class 1	Laser Class 1	Laser Class 1	Laser Class 3B
2008		2010		2014	2011		2012	

continuous developments on VZ-platform



RIEGL VZ-400i / VZ-2000i key features

2015

- pulse repetition rate up to 1,2MHz
- effect. meas. rate up to 500.000/sec.
- max. range 800m (VZ-400i), 2500m (VZ-2000i)
- multiple-time around capability
- line speed – 240 lines/sec.
  frame speed – 150°/sec.
- cloud connectivity
- **executing post-processing tasks**

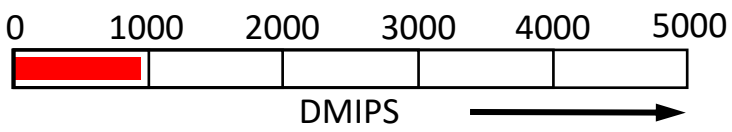
2017

additional processing power

RIEGL VZ-400 / VZ-1000 / VZ-2000

single-core processor
running at 470 MHz

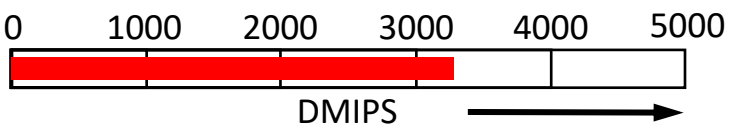
900 DMIPS



RIEGL VZ-400i / VZ-2000i

dual-core processor
running at 660 MHz

3300 DMIPS



additional processing power

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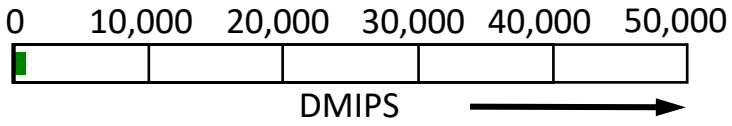
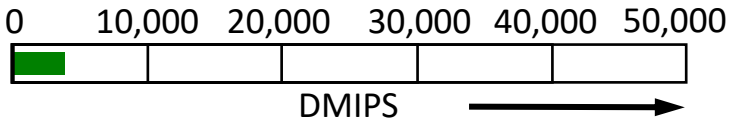


RIEGL VZ-400i / VZ-2000i

dual-core processor
running at 660 MHz

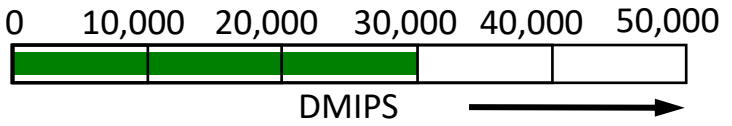
3,300 DMIPS



RIEGL VZ-400i / VZ-2000i LIDAR system

quad-core processor
@ up to 2.2 GHz

30,000 DMIPS



GPU with 192 cores
running at up to 850 MHz

firmware/software architecture

VZ-400i / VZ-2000i LIDAR engine firmware

computational resources
- dual-core @ 660 MHz
- high performance IP cores

main tasks
- echo digitization
- online waveform processing
- data attributes
- data stream compression
- housekeeping and control

VZ-400i / VZ-2000i LIDAR system software

computational resources
- quad-core @ 2200 MHz
- GPU 192 cores @ 850 MHz

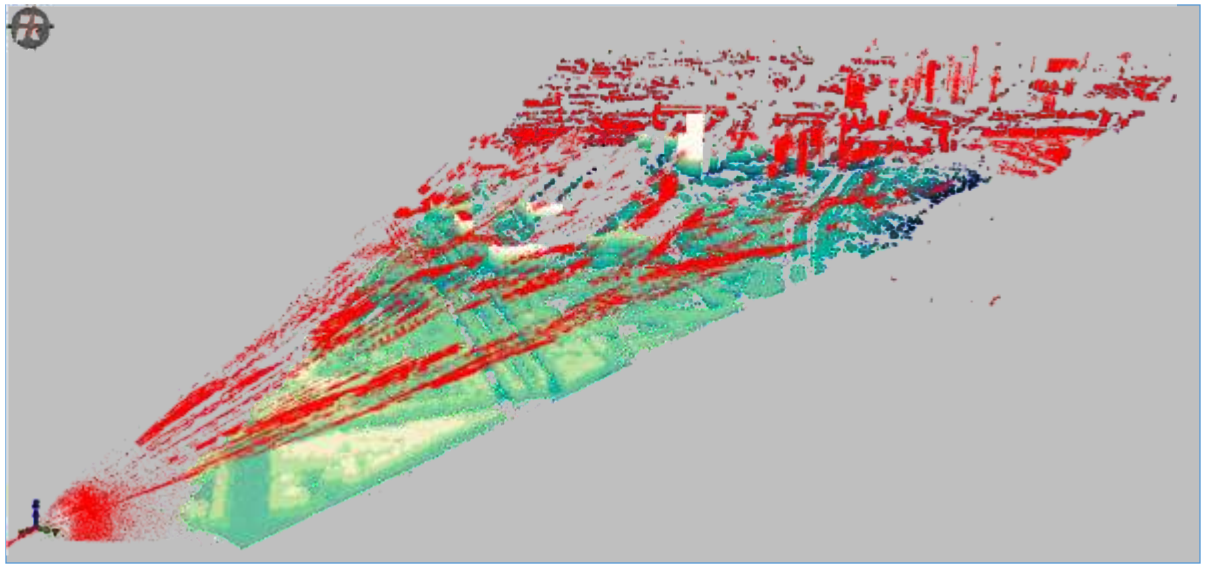
main tasks
- LIDAR engine commanding
- graphical user interface
- acquisition & processing of
  - camera images
  - GNSS data
  - pose sensor data
- managing interface
- executing post-processing tasks

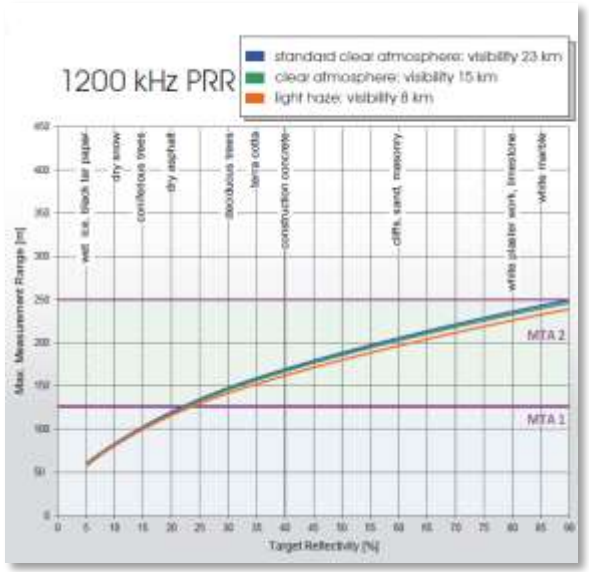
post-processor runs libraries and executables

- RDBLibrary
- as used by RiSCAN PRO
- Creates point cloud database
  - spatially sorted
  - data compression
  - level-of-detail (LOD)
  - supporting arbitrary attributes
- enables e.g. visualization of large point clouds on tablets or on remote clients via low-bandwidth connections

post-processor runs libraries and executables

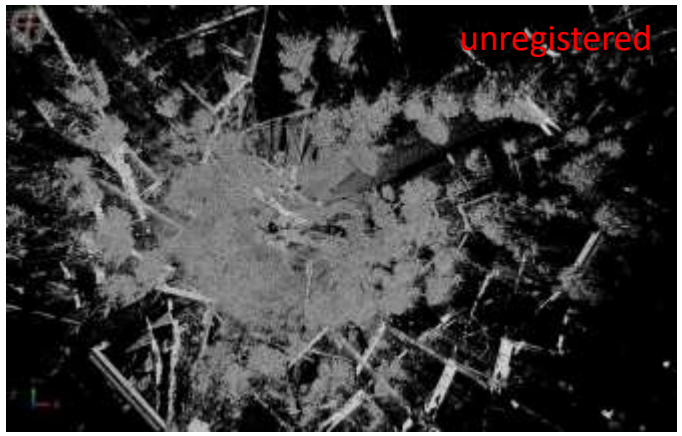
- RDBLibrary
- RiMTA-TLS
  - solving range ambiguities caused by high pulse repitition rate





post-processor runs libraries and executables

- RDBLibrary
- RiMTA-TLS
- Registration Module
  - by in-built sensors (GNSS, IMU, Compass)
  - by automatic registration module 2.0

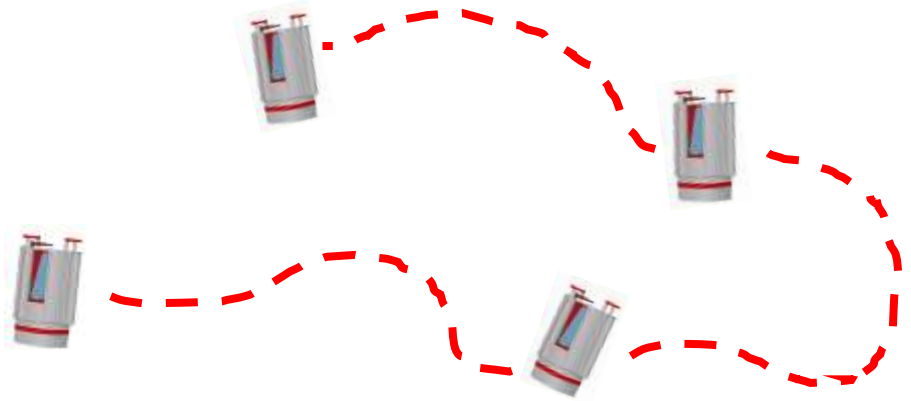


Automatic Onboard Registration

pre-registration by onboard sensors

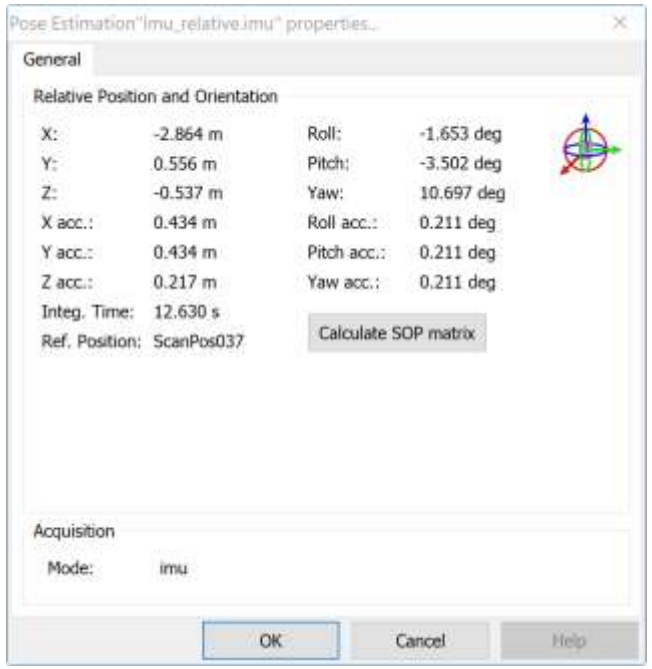
outdoor

- GNSS data - position
- IMU data - roll/pitch
- magnetic compass - yaw



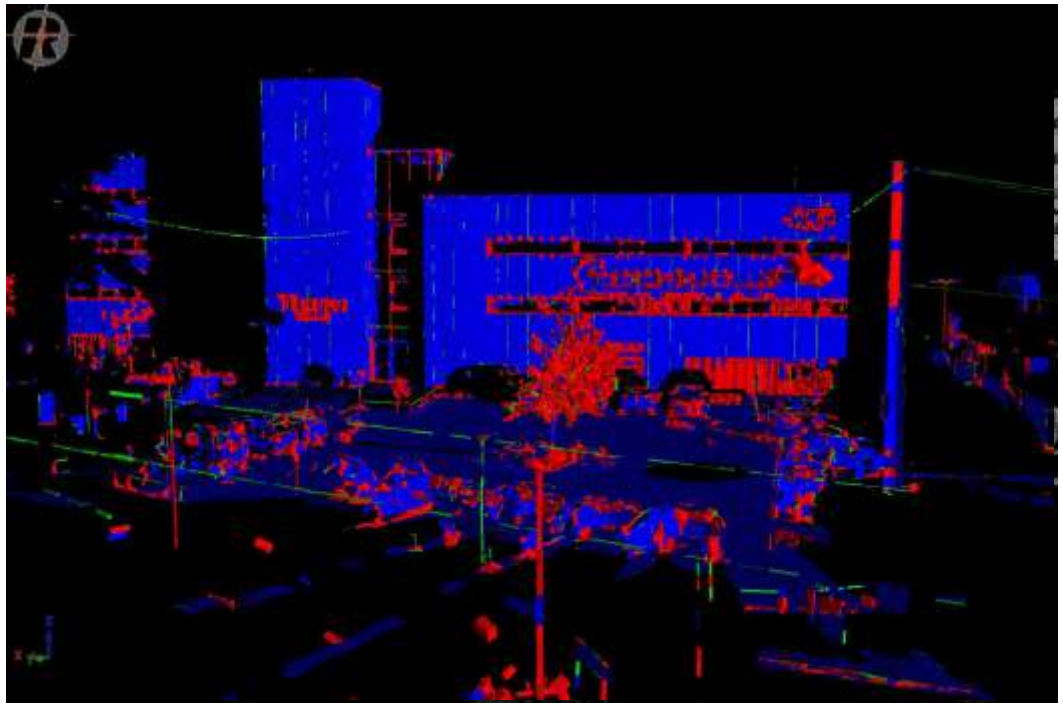
indoor

- first position user defined
- relative position and orientation by trajectory from IMU data



Automatic Onboard Registration

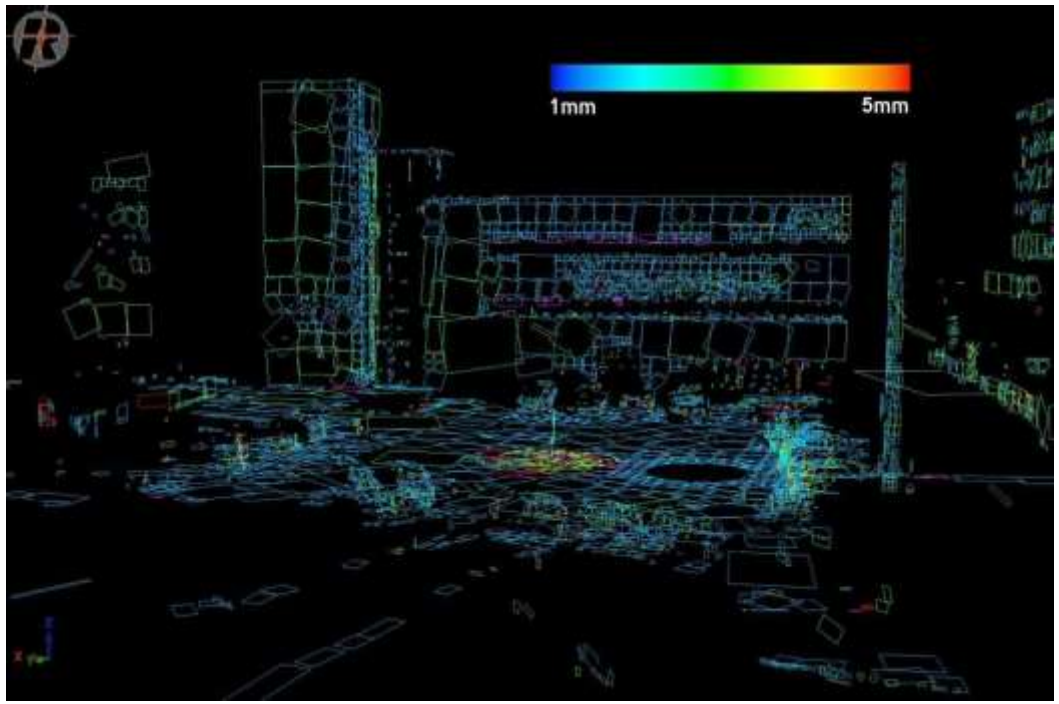
1st level registration by automatic voxel extraction and fitting



- scan-data
- voxels
- voxels with reflectance
- voxel classification
  - unregular
  - plane object
  - linear object
- voxel visualisation by class

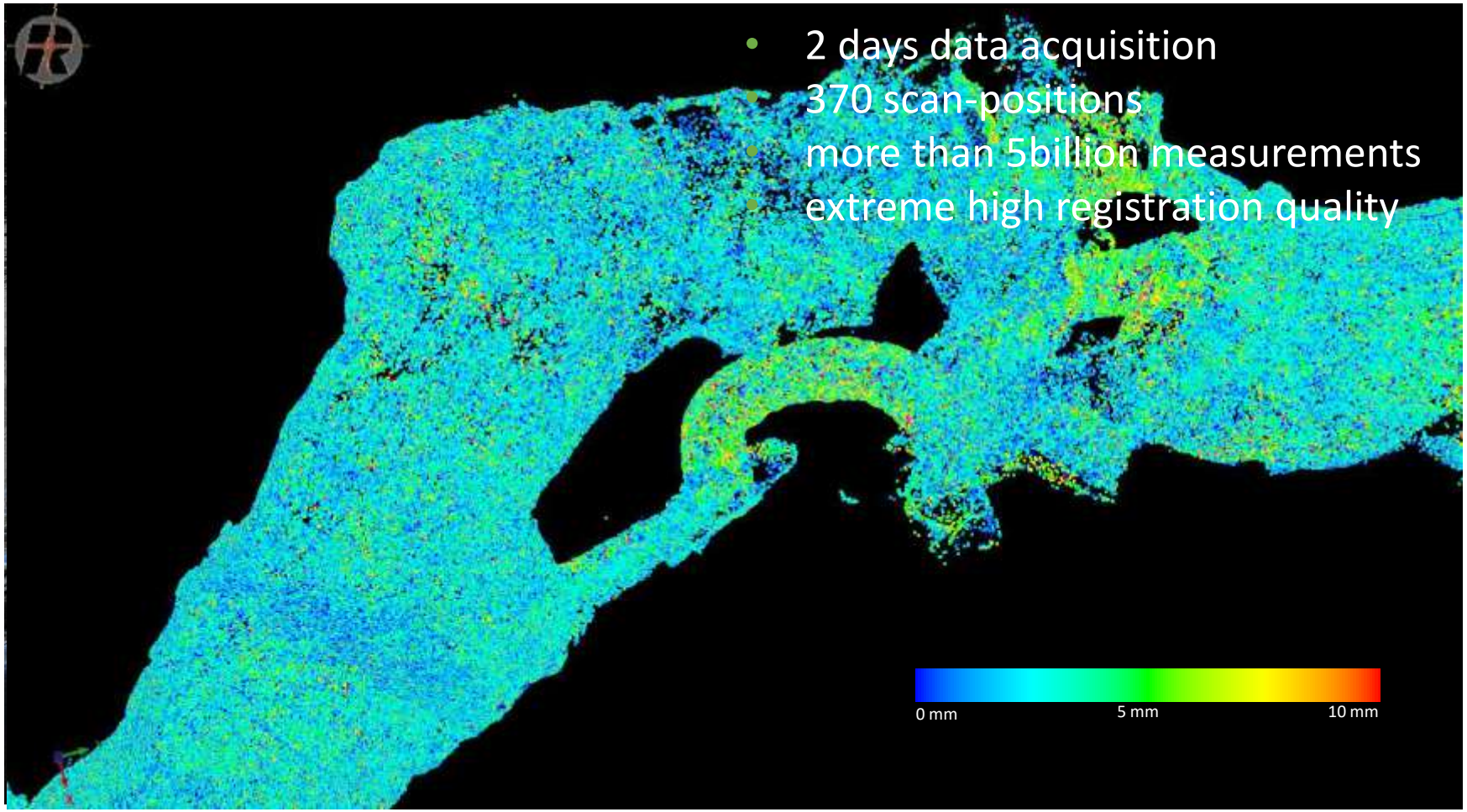
Automatic Onboard Registration

2nd level registration by automatic plane extraction and fitting

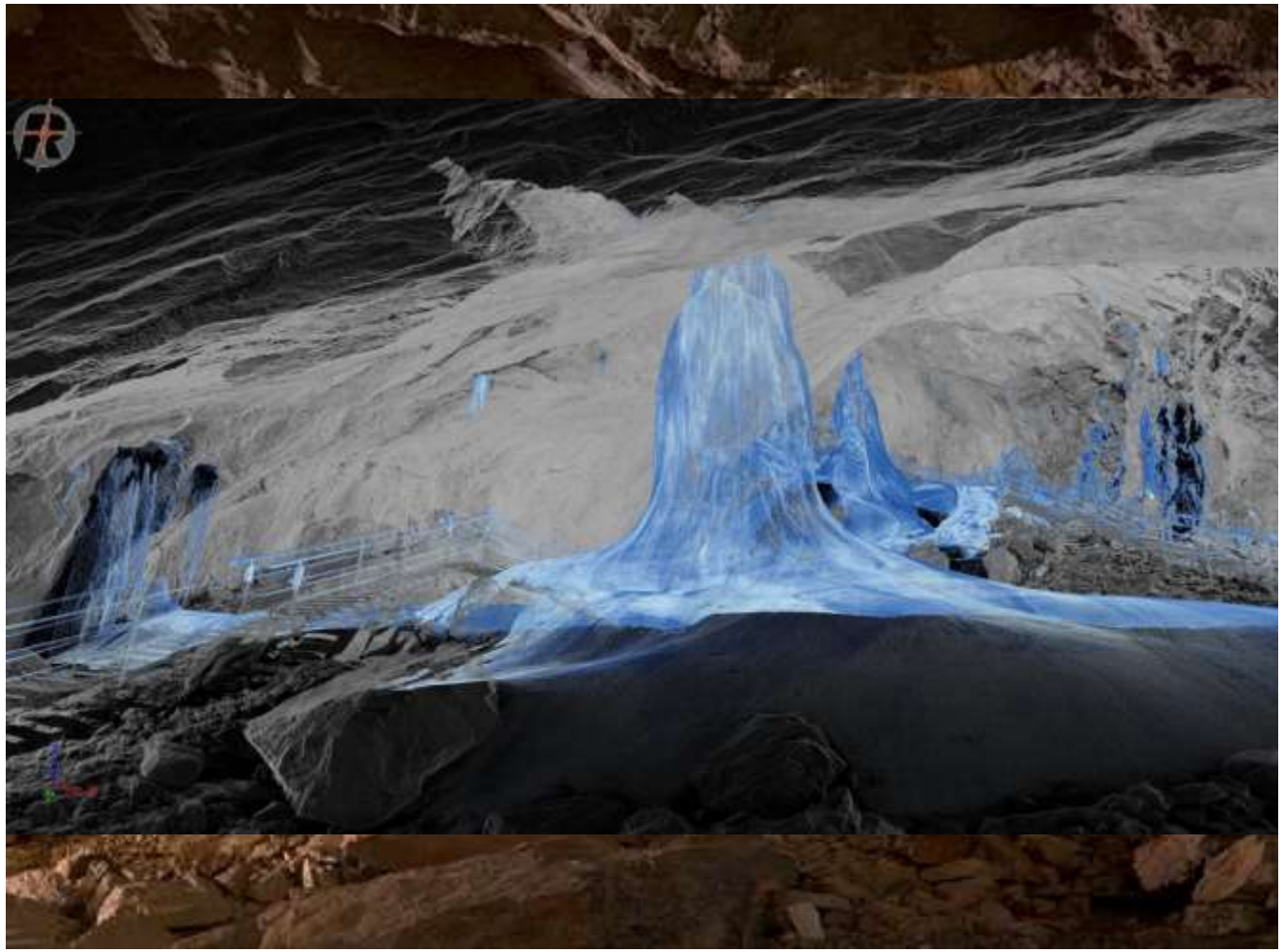


- scan-data
- planes – normal vectors
- planes - size
- planes – number of points
- planes – standard deviation

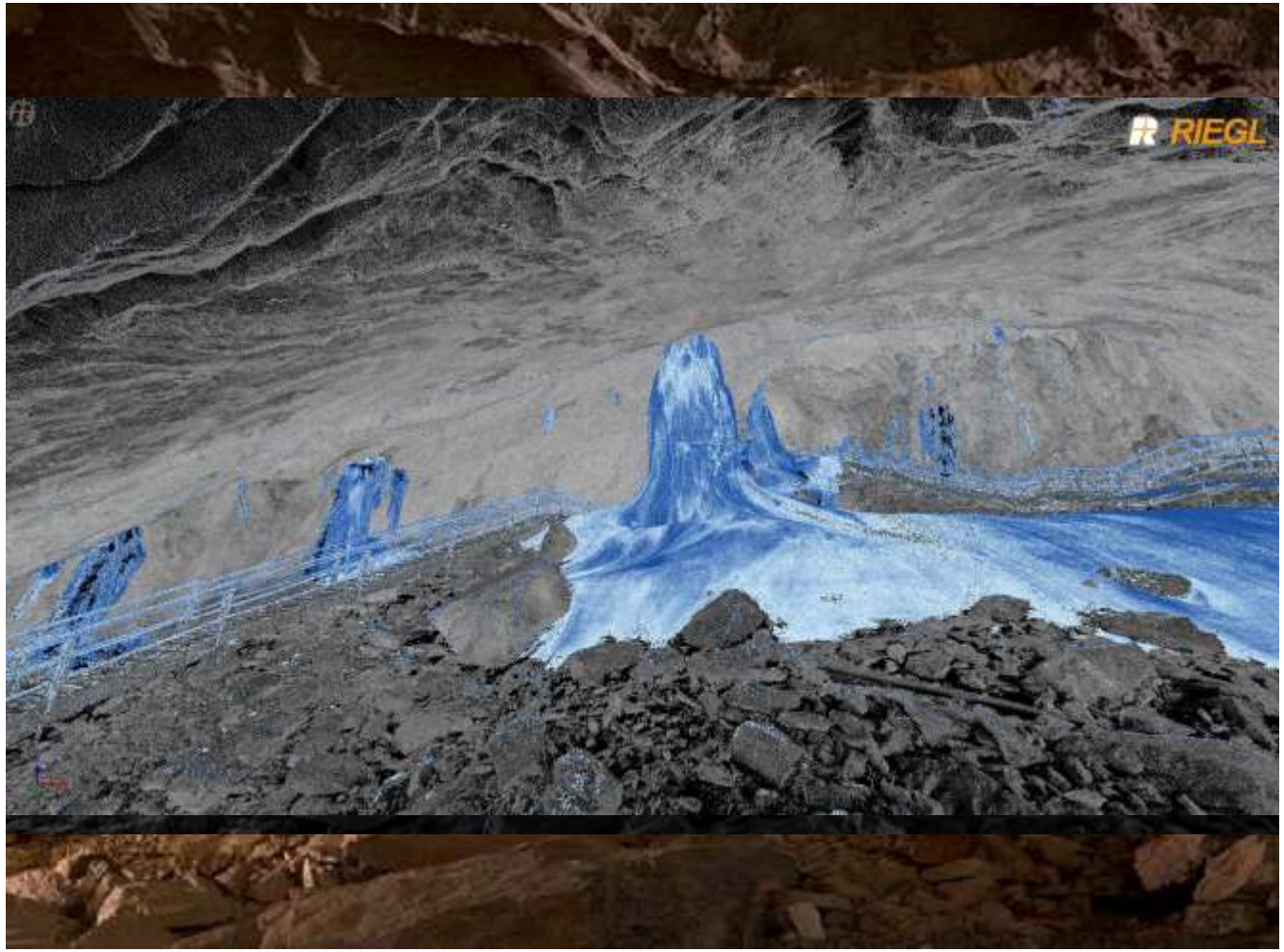
Automatic Onboard Registration Example Ice Cave



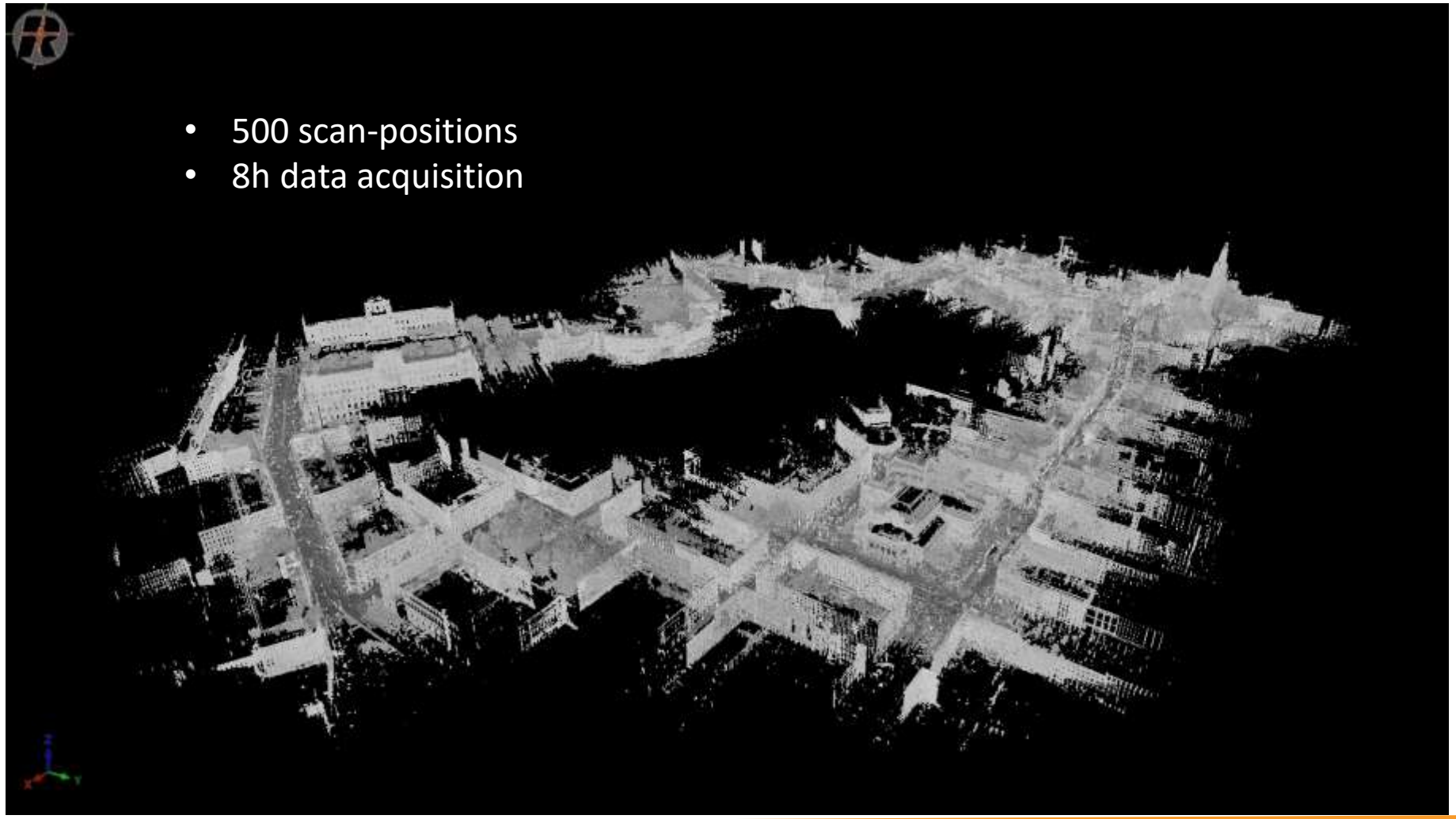
Automatic Onboard Registration Example Ice Cave



Automatic Onboard Registration Example Ice Cave

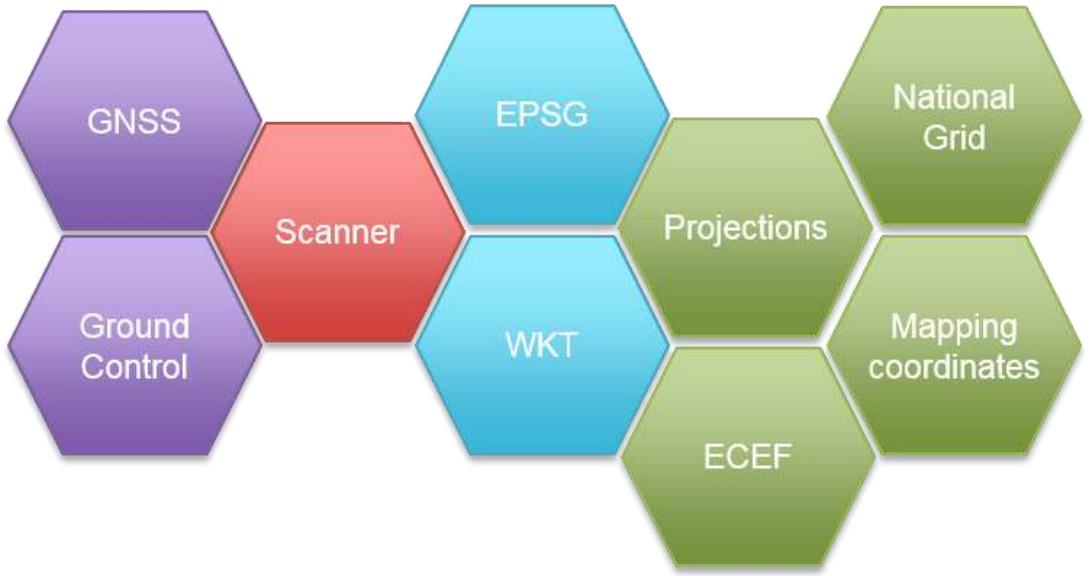


Automatic Onboard Registration Example City Scans



post-processor runs libraries and executables

- RDBLibrary
- RiMTA-TLS
- Registration Module
- GeoSysManager

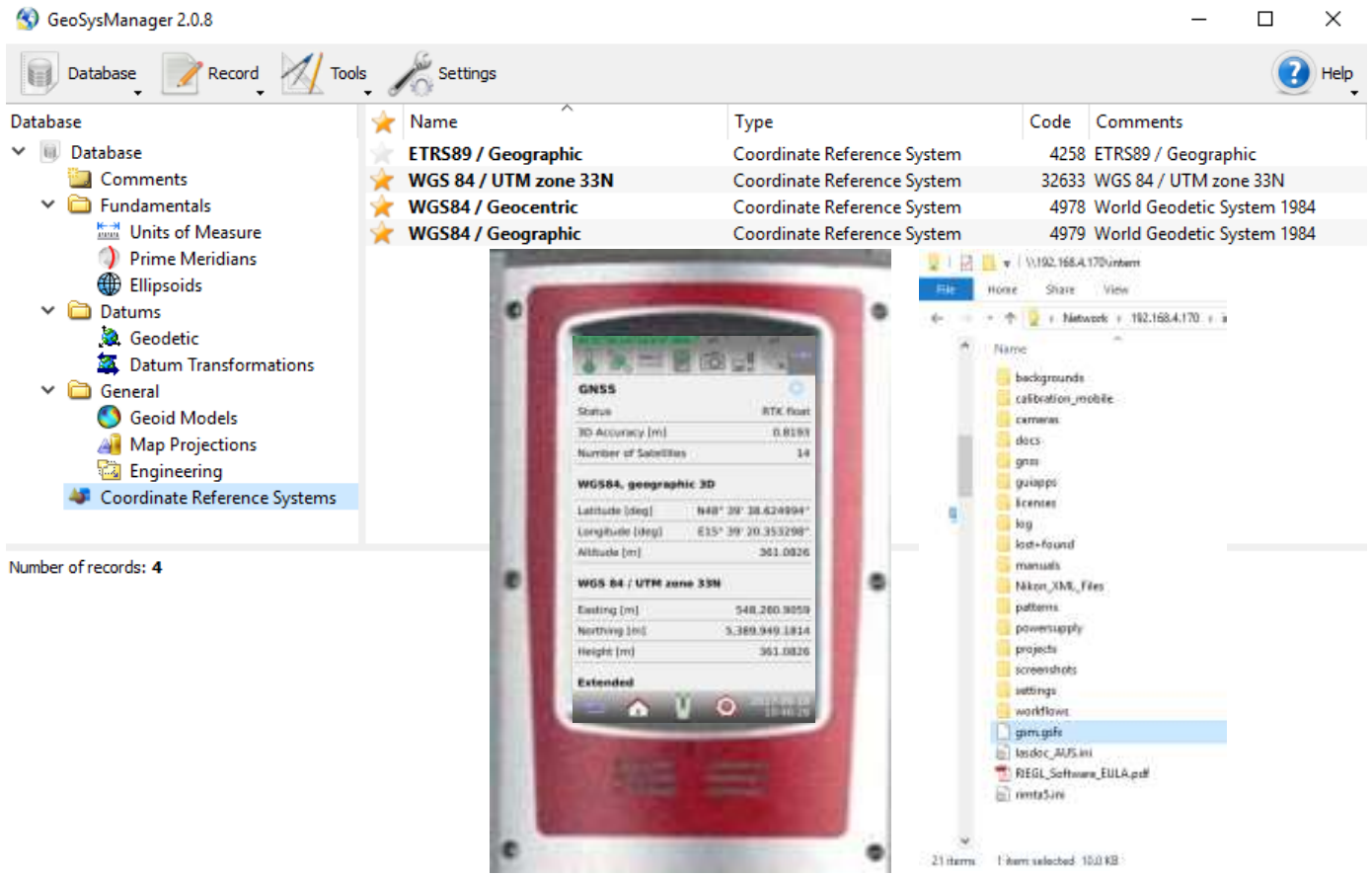


- online EPSG database access
- fully customizable definitions
- Import/Export of any well-defined Coordinate Reference System

VZ-400i / VZ-2000i LIDAR System software

post-processor runs libraries and executables

- RDBLibrary
- RiMTA-TLS
- Registration Module
- GeoSysManager



VZ-400i / VZ-2000i LIDAR System software

post-processor runs libraries and executables

- RDBLibrary
- RiMTA-TLS
- Registration Module
- GeoSysManager
- Customizing your Scanner with APPS
  - Files - File Browser for data transfer between int. harddrive, SD-card, and USB-stick
  - Uploads - Tool for uploading data into the cloud
  - RiMOTE – Tool for scanner remote control
  - Tasks – lists and shows progress of tasks running in the background
  - Registration – Tool for onboard automatic registration
  - Scheduler – Tool for planning and scheduling scans
  - Timer – simple tool for acquiring scans every xx seconds
  - Screenshot – creates screenshots of the GUI every xx seconds

VZ-400i / VZ-2000i LIDAR System software

RDBLibrary	rawdata to 3d pointcloud processing
RiMTA-TLS	solving range ambiguities
Registration Module	combining scandata in one PRCS (**P**roject **C**oordinate **S**ystem)
GeoSysManager	transformation into any CRS (**C**oordinate **R**eference **S**ystem)
On Board Apps.	customizing the scanner according to your demands