

RiUNITE

for *RIEGL* Scan Data

RiUNITE is the core software module for LiDAR data processing in *RIEGL*'s RiPROCESS point cloud management suite for kinematic laser data.

It facilitates the four main tasks required for accurate point cloud generation.

Waveform Analysis

RiANALYZE Functionality

RiUNITE extracts discrete targets from the digitized echo signals by means of Full Waveform Analysis (FWA). It also handles Online Waveform Processed (OWP) targets.

Multiple-Time-Around Resolution

RiMTA Functionality

High measurement rates over long ranges typically result in range ambiguities. The data of instruments with Multiple-Time-Around capability (MTA) include information which is used by RiUNITE to resolve these ambiguities.

Coordinate Transformation

RiWORLD Functionality

RiUNITE combines the laser scan data in the Scanner's Own Coordinate System (SOCS) with the recorded position and orientation data (POS) to a dataset in a geocentered coordinate system (e.g. WGS 84, ITRS, ETRS).

Point Cloud Storage

RiUNITE reads and writes the *RIEGL* Data Base (RDB). RDB is the central data storage format for visualization, filtering, and adjustment, that serves all major RiPROCESS software modules.

Multiple-Time-Around



Target Extraction



Coordinate Systems



Point Cloud Storage



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LASER MEASUREMENT SYSTEMS



Input & Output

RIUNITE's core functionality is the processing of point cloud data. It supports reading from all *RIEGL* raw point cloud data formats and writing to all point cloud related data formats based on RDB. The table below provides an overview of the supported input & output files:

Description	Direction	Filetype
<i>RIEGL</i> extended packet format for V-Line scanners	IN	RXP
Sample data files for Q-Series scanner	IN	SDF
Scan data in Scanner's Own Coordinate Systems (SOCS) in the scan data converted data format	IN & OUT	SDCX
Spatially sorted point cloud	IN & OUT	RDBX
Point cloud in chronological order	IN & OUT	WDCX
Shot origin and direction	OUT	SODX
Mapped voxel	OUT	MVX
Mapped pixel	OUT	MPX
Housekeeping data	OUT	HKX
Trajectory position and attitude information	IN & OUT	POFX
Trajectory quality information	IN & OUT	POQX
Atmospheric conditions	IN	ACL



Target Extraction

For the input files with recorded full waveforms or smart waveforms, one of three types of target extraction can be selected:

Disable:

Additional waveform processing is disabled and datasets with OWP targets are unchanged.

Gaussian Pulse Fitting (GPF):

In case of Full Waveform scan data a full GPF is performed and the extracted targets are provided for further processing. In case of Smart Waveform scan data the existing OWP targets are combined with the additional extracted GPF targets.

System Response Fitting (SRF):

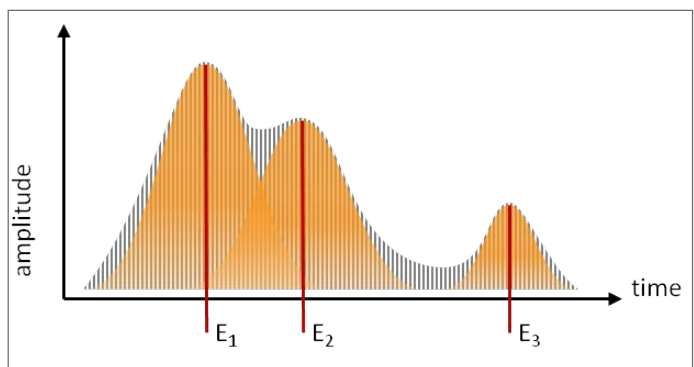
An additional waveform analysis method comparable to OWP algorithm available for scan data from certain Topo-Bathy LiDAR systems.

Exponential Decomposition (XDC):

Waveform analysis for bathymetric waveforms that accounts for backscatter from the water column. Available for certain Topo-Bathy LiDAR systems.

Waveform Averaging:

For subsurface waveforms acquired by bathymetric *RIEGL* LiDAR systems, Waveform Averaging enhances the probability of seafloor detection and reduces the probability of false target extraction.



RiUNITE provides a number of filters and dividers to customize the extracted point clouds according to user requirements.

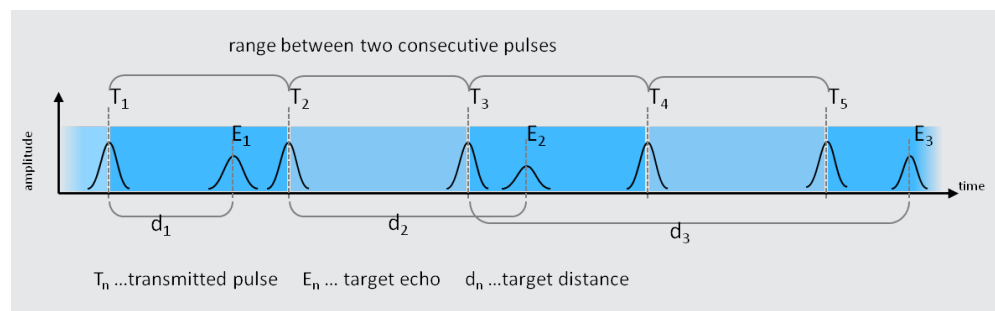
Option	Description
Gate filters Time Range Angle Deviation Amplitude Reflectance	Filters output to a certain interval of specific point attributes. Multiple activated filters define logical AND conditions.
Divider Shot Line	Thins the output to every n^{th} measurement

Multiple-Time-Around



Various MTA processing methods are implemented into RiUNITE:

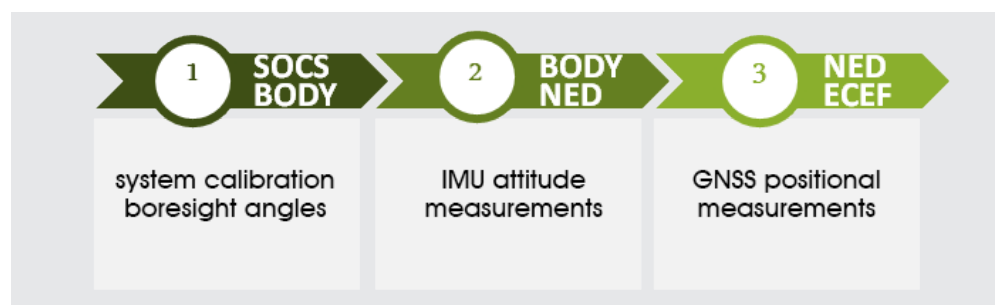
1. **Automatic** MTA processing is based on RiMTA code correlation, vicinity, or maximum likelihood methods.
2. **"Fixed in zone"** mode processes the scan data in a user defined MTA zone.
3. **Semi-autodetect** or range based MTA processing is based on a user defined range gate to process the MTA zones.



Coordinate Transformations



For further analytics and merging with other spatial data, point clouds need to be processed in a well defined coordinate reference system. Within RiPROCESS this is an Earth Centered Earth Fixed (ECEF) coordinate system. Laser scanners provide measurements within a local Scanner's Own Coordinate System (SOCS). RiUNITE comes with a built-in coordinate transformation chain to provide the required coordinate conversions from SOCS to the BODY coordinate system of the vehicle, to a local North-East-Down (NED) compensation for IMU attitude angles, and a final NED to ECEF transformation according to the GNSS position information.



System Requirements RiUNITE

Operating Systems:

Windows 11

Memory Requirements:

(available for RiUNITE,
not used by other programs)

Minimum: 24 GB RAM

Recommended: 64 GB RAM or more

CPU Requirements:

Minimum:

Modern multi-core processor with high single-core performance
Intel Haswell or AMD Excavator architectures or newer

Recommended:

Intel Core i or Ultra processors with:

High Core Base Frequency

High Max Turbo Frequency

High number of Performance Cores

Disk Requirements:

Program: Approximately 100MB of free disk space

Project Data: SSD storage (recommended: fast NVMe drives)

Network Interface

(if processing over network)

Ethernet/LAN with $\geq$ 1Gbit network speed

Graphics Requirements:

NVIDIA® GPU Geforce 8xx or higher

NVIDIA® Compute Capability Version 3.6 or higher required for GPF
(Gaussian Pulse Fitting) on GPU

NVIDIA® CUDA Compute Capability Version 5.0 or higher required
for RiMTA (vicinity) on GPU

Recommended:

NVIDIA® GeForce 10-series or higher (Pascal architecture),
at least 8 GB dedicated GPU memory



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