

# RiM<sup>i</sup>TA

for Automated Resolution of Range Ambiguities

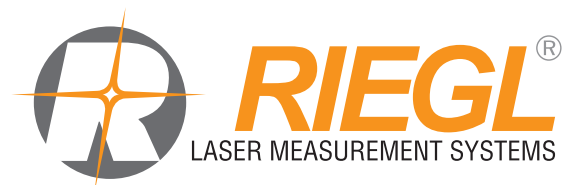
- *automatic resolution of range ambiguity in time-of-flight ranging*
- *unlimited number of MTA zones*
- *processes data acquired with RIEGL laser scanners with MTA-processing capabilities*
- *smoothly integrated into the RIEGL data processing workflow*

Acquiring data in laser scanning with high measurement rates over long ranges frequently results in range ambiguities. Instruments with multiple-time-around capability (MTA), include information in the acquired data which the RiM<sup>i</sup>TA software utilizes to resolve these ambiguities. Instead of requiring users to manually specify the correct MTA zone for each data set or even subset of data, RiM<sup>i</sup>TA automatically calculates the MTA zone for each measurement.

In order to correctly determine the range to a target with a LiDAR instrument using time-of-flight measurements with short laser pulse intervals, it is necessary to correctly determine the correlation of each received echo pulse to its causative emitted laser pulse. At high pulse repetition rates (PRR) and large target ranges this definite allocation becomes ambiguous due to a limiting factor which may not be tweaked by engineer's skills: the speed of light.

Today's RIEGL LiDAR instruments provide extremely high measurement rates as well as long measurement ranges. In such cases, target echoes received may not necessarily be associated with the immediately preceding laser pulse emitted (MTA-zone 1). Instead they may be associated with any of the previous laser pulses emitted. Therefore it is necessary to correctly identify each pulse echo with its correct originating laser emission. This is automatically done by RiM<sup>i</sup>TA in a smoothly integrated data processing workflow.

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## RiMTA - For Automated Range Ambiguity Resolution in ALS

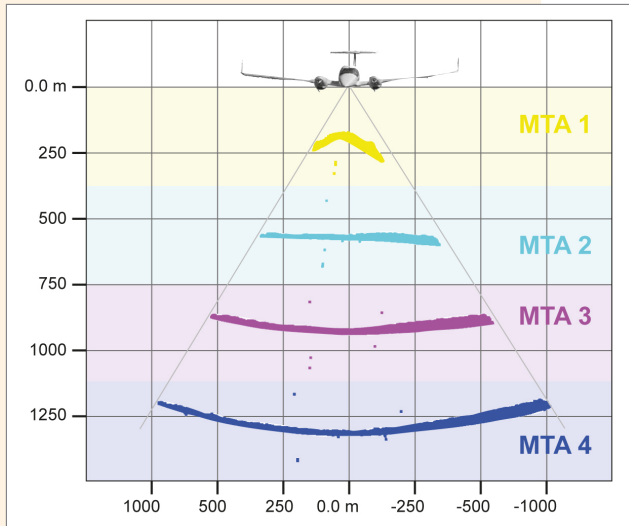


Fig. 1 Profile of scan data processed in MTA zones 1 to 4 (data acquired by a RIEGL airborne laser scanner)

Figure 1 provides a visual demonstration of ALS (Airborne Laser Scanning) data where each target echo has been calculated utilizing four of the immediately previous laser pulses emitted. This means that each single echo is represented by a measurement range calculated in MTA zone 1, 2, 3 and 4 respectively. In reality only one of the four realizations represents the true point cloud model of the scanned earth surface. The chosen example shows that the scan data is correctly allocated to MTA zone 2, where the earth surface appears consistently flat. This result stands in contrast to the typical spatial characteristics of incorrectly calculated ambiguous ranges in MTA zones 1, 3 and 4.

Unique techniques in high-speed signal processing and a novel modulation scheme applied to the train of emitted laser pulses permit range measurements without any gaps at any distance within the instrument's maximum measurement range. The specific modulation scheme applied to the train of emitted laser

pulses avoids a total loss of data at the transitions between MTA-zones and retains range measurement at approximately half the point density. The correct resolution of ambiguous echo ranges is accomplished using RiMTA in tandem with SDCImport and RiANALYZE for an optimized workflow that maintains fast processing speed for mass data production.

## RiMTA - For Automated Range Ambiguity Resolution in TLS & MLS

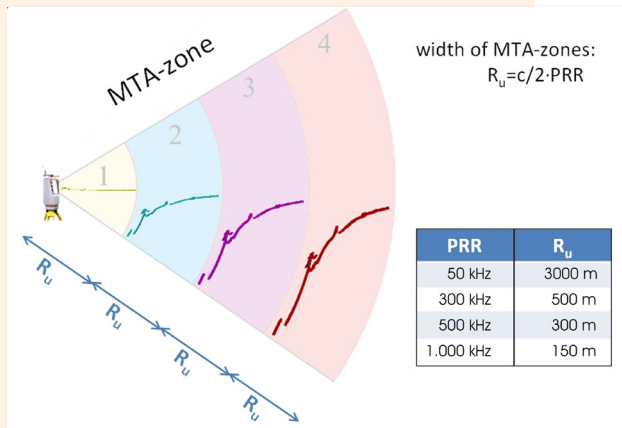
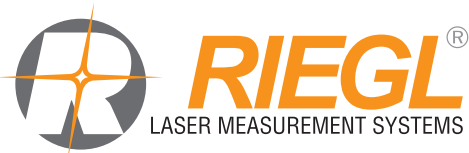


Fig. 1 Profile of scan data physically present in MTA zone 1 shown as manually processed in MTA zones 1-4

TLS (Terrestrial Laser Scanning) and MLS (Mobile Laser Scanning), in contrast to ALS, introduce an additional level of complexity in the resolution of such ranging ambiguities. It is possible that a single laser pulse encounters multiple targets, e.g., in the near field and far field, which results in multiple echoes in multiple MTA zones from a single emitted pulse. Therefore, the resolution of these ambiguities has to be carried out strictly on an echo-to-echo basis and not simply on a laser shot basis. In a final automatic step, outliers are removed according to a confidence filtering test for each resulting point.

For an optimized workflow in TLS, RiMTA is seamlessly integrated into RISCAN PRO, maintaining fast processing speeds for mass data production.

In MLS, the correct resolution of ambiguous echo ranges is accomplished using RiMTA in tandem with SDCImport and RiANALYZE to provide reliable data in mass data production.



RIEGL  
Laser Measurement Systems GmbH  
Riedenburgstraße 48  
3580 Horn, Austria  
Phone: +43 2982 4211  
office@riegl.co.at | www.riegl.com

RIEGL USA Inc. | info@rieglusa.com | www.rieglusa.com  
RIEGL Japan Ltd. | info@riegl-japan.co.jp | www.riegl-japan.co.jp  
RIEGL China Ltd. | info@riegl.cn | www.riegl.cn  
RIEGL Australia Pty Ltd. | info@riegl.com.au | www.riegl.com

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