Presented By:
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GEDO Applications Overview

Trimble GEDO solutions for track planning, design, construction and maintenance applications

Trimble

Speakers

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Agenda

Trimble Track Survey and Scanning Overview

01 **Introduction**

Introduction to Trimble and Geospatial Track Survey & Scanning division

02 **Review of primary railway applications**

Track information for railway engineering works

03 **Relative track quality inspection**

GEDO solutions for relative track quality inspection

04 **Track survey and control in absolute coordinates**

GEDO solutions for existing track survey in absolute coordinate system

05 **Railway scanning and point cloud analysis**

GEDO kinematic railway scanning and point cloud analysis solutions

06 **Configurations & Productivity Examples**

Summary of available Trimble GEDO solutions and productivity

07 **Questions & Answers**

Ask your Questions

Railway infrastructure

High speed

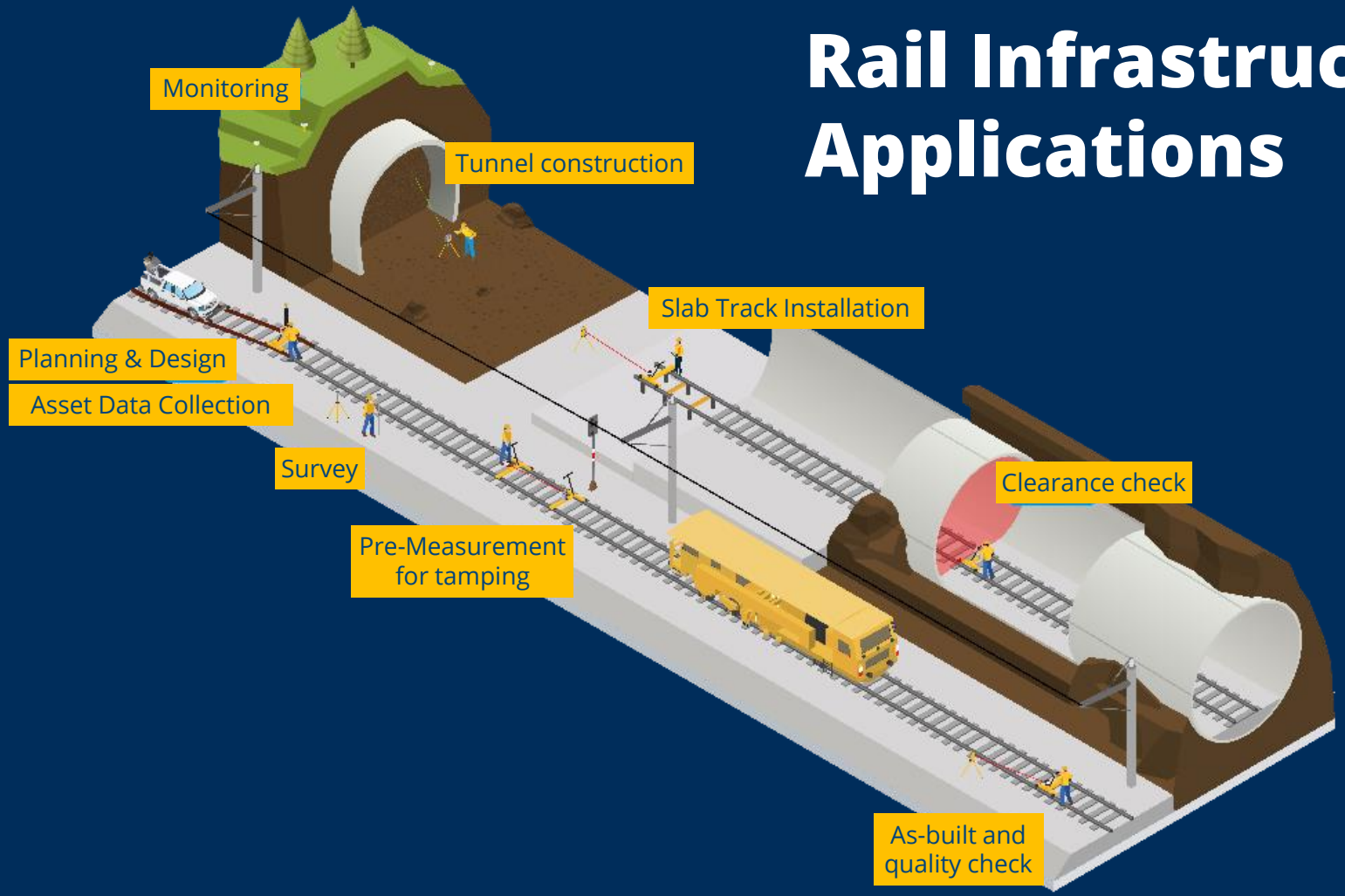
Freight

Tramway

Intercity & LRT

Metro

Rail Infrastructure Applications



Classic Approach to Track Surveying

Survey rail coordinates with rail shoe and track bar

Source: www.gleisbau-welt.de

Survey rail chords/versines

GEDO Hardware

Modular system which grows with your tasks and requirements

- GEDO CE 2.0 base unit
  - Precise cant and gauge sensor
  - Odometer
  - Communication
  - Illumination
- Gauge adapter
- Total station, GNSS and adapter
- Scanner tower
- Profiler
- Compatible with Trimble instruments

Key track survey applications

- **Track Quality** - Operation

  TA Rail – GEDO Doc
  GEDO IMS

  - Gauge/Cant/Twist
  - Full relative

- **Track Survey** - Design/As-built

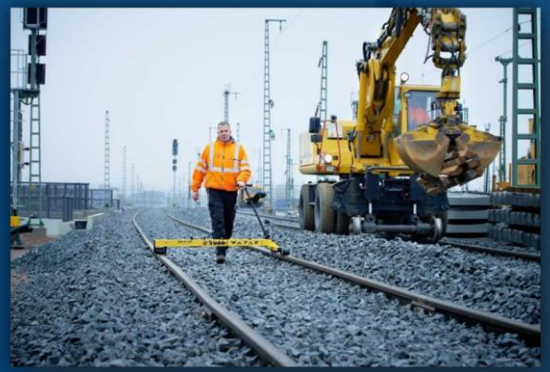
  TA – Track Gauge Survey
  TA Rail – GEDO Track trolley
  TA Rail – GEDO Rec trolley
  GEDO IMS TS/GNSS

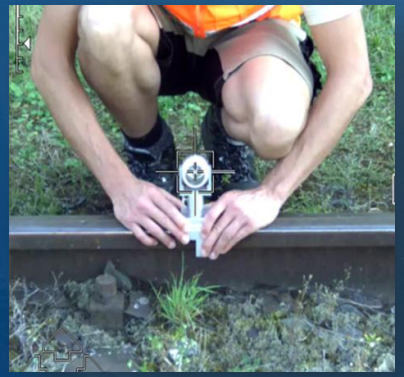
  - Design
  - As-built check
  - Quality check (relative)
  - Monitoring

- **Stakeout** - Construction

  TA Rail – Stakeout
  TA Rail – GEDO Track trolley

  - Stakeout
  - Track positioning
  - As-built check



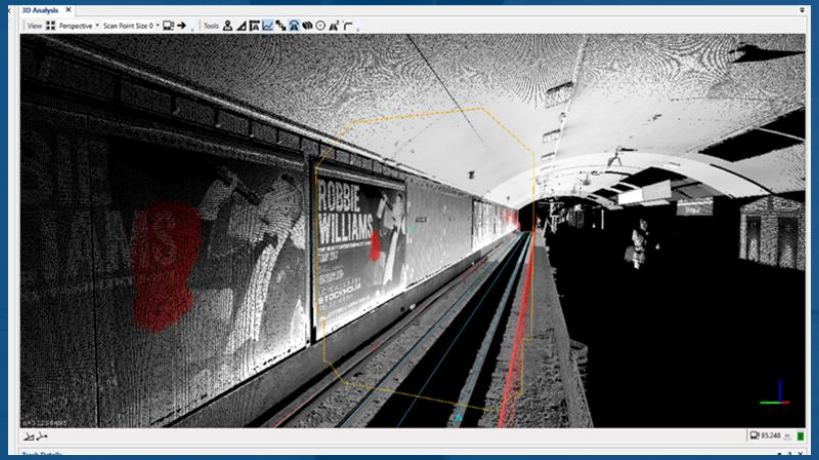


Key track scanning applications

- **Hi-Res track survey** - Design / As Built

GEDO Rec-Scan
GEDO IMS-Scan

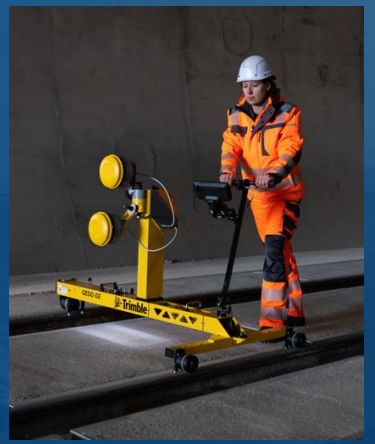
- Design
- 3D Modeling
- As-built check



- **Clearance** - Design / Construction / Operation

GEDO Scan
GEDO Rec-Scan
GEDO IMS-Scan

- Operations
- Re-Design
- New rolling stock

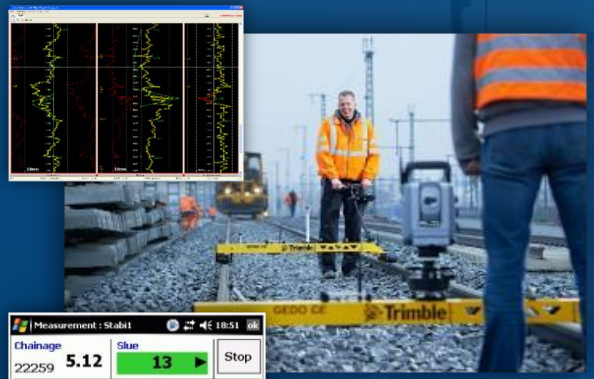


Key track pre-measurement applications

- **Pre-Measurement** - Construction

  TA Rail – GEDO Track trolley
  GEDO Vorsys
  GEDO IMS

  - New construction
  - Re-construction
  - Tamping data



- **Slab Track** - Construction

  TA Rail – GEDO Track trolley
  GEDO IMS

  - New construction
  - As-built documentation
  - Quality check

- **Re-Construction** - Construction

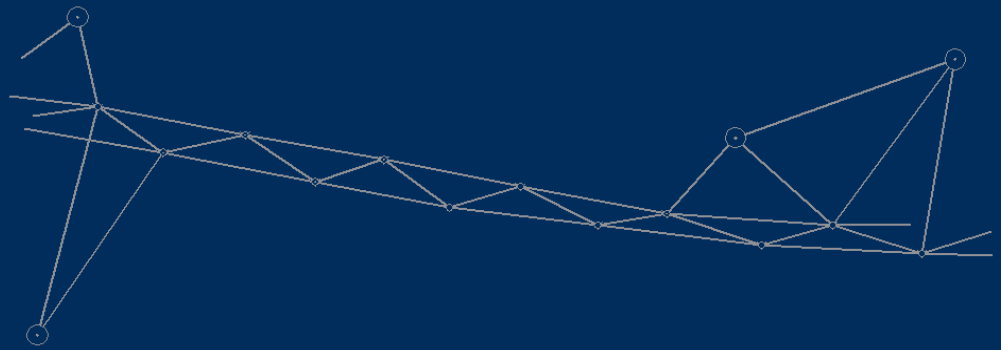
  GEDO IMS-GNSS

  - Line upgrade
  - High Output trains
  - Tamping

Trimble GEDO solutions
Survey supportive infrastructure

Production reference point network

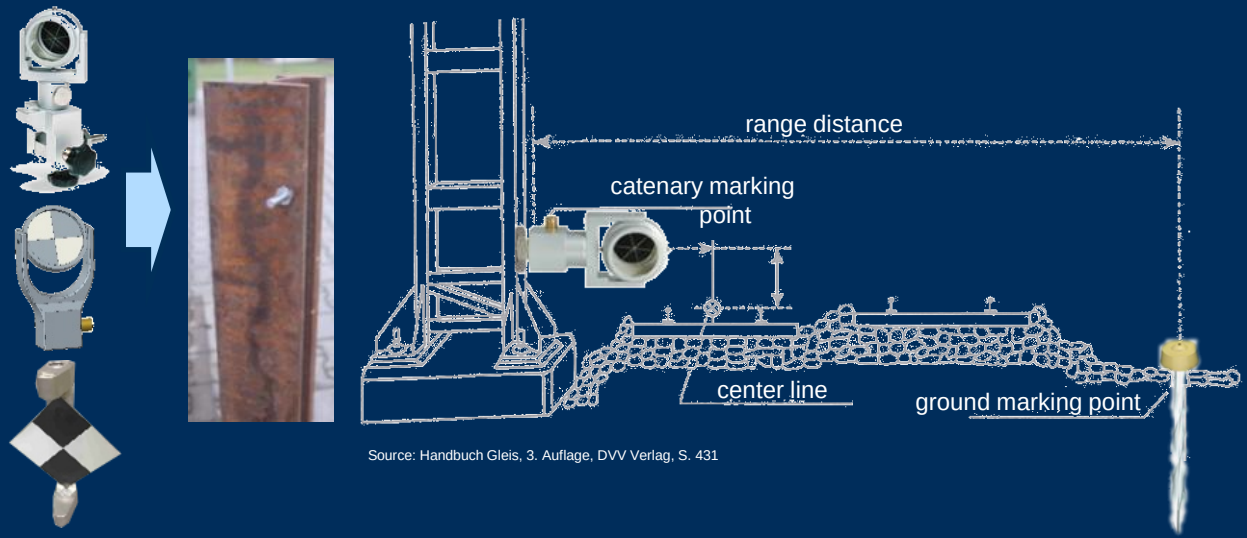
- Ground or mast/ catenary marking
- Distance between connecting ref. point pairs – 4-5 km (CP2)
- Distance between pair reference points – 60-200 m (CP3)



Trimble GEDO solutions
Survey supportive infrastructure

Production reference point network

- Marking points at the catenary masts
- Ground marking points
- Typically every ~ 65 m (other regions every 100 - 300m)



Source: Handbuch Gleis, 3. Auflage, DVV Verlag, S. 431

Track realignment – GEDO NovaTrack

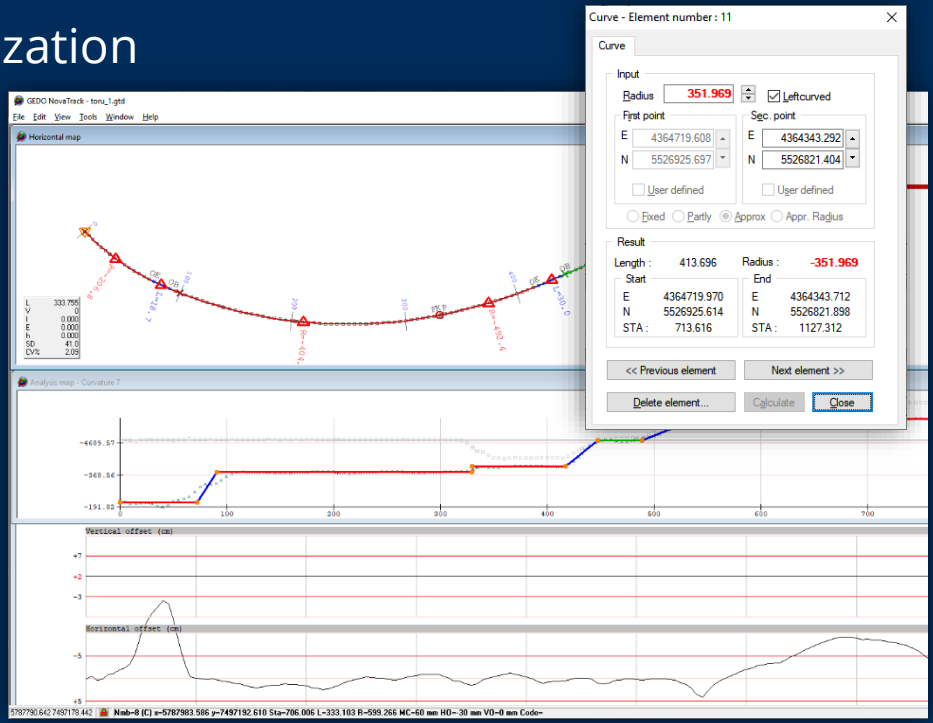
Alignment calculation for track optimization

FEATURES

- Automatic or semi-automatic reverse calculation of alignments in absolute
- Advanced track analysis using regression
- Alignment element calculation with Best-fit-to-Limitations option

APPLICATIONS

- Track alignment reconstruction for design and tamping
- Track geometry assessment
- Track condition monitoring

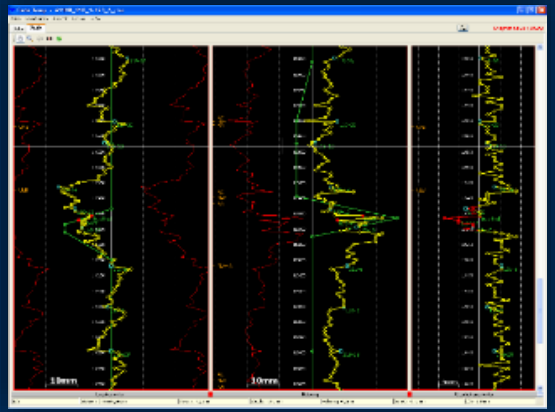


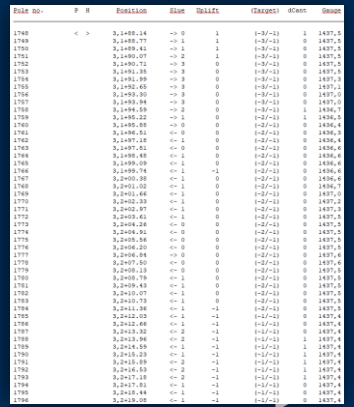
Pre-Measurement for Tamping

Improve tamping quality and productivty

DATA PREP & ANALYSIS FEATURES

- Tamping data preparation
- Definition of tamping transitions - ramps
- Export to all relevant tamping machines and guidance systems (Plasser, Matisa, Harsco, etc.)





Productivity compared

Estimated survey productivity based on system configuration

GAINING THE PRODUCTIVITY WITH IMS

- Eliminated time for totalstation setup
- No need for line of sight
- Refraction and environment conditions are irellevant
- Reduced time for accessing the track
- Flexible work during night time

System	Measurement Speed [m / h]	Survey crew
GEDO Rec	600 – 1.000	2
GEDO Track	600 – 1.000	2
GEDO Vorsys	~ 1.600	2
GEDO IMS	3.500	1
GEDO IMS + Profiler	2.500	2
GEDO IMS + GNSS	3.000	1-2
GEDO IMS + GNSS + Profiler	2.500	1-2
GEDO IMS + TS (resection)	1.500	2-3
GEDO Rec + GEDO Scan	500 – 1.000	2-3
GEDO Vorsys + GEDO Scan	> 1.200(*)	2-3
GEDO IMS + GEDO Scan	> 2.000(*)	2

(*) Depending on Scan resolution

GEDO track survey solutions for planning, design and construction

Track Survey
Re-Design
As-Built mapping
Quality Check
Track installation
Tamping

- **Trimble GEDO Rec / Track**
  Geodetic Trolley Setup

- **Trimble GEDO Vorsys**
  Twin Trolley Setup

- **Trimble GEDO IMS**
  Based on inertial positioning
  (without or with GNSS or total station)

- **Customized GEDO solutions (GEDO SPS)**
  Installation of Slab Track plates

Inertial GEDO IMS track survey solutions

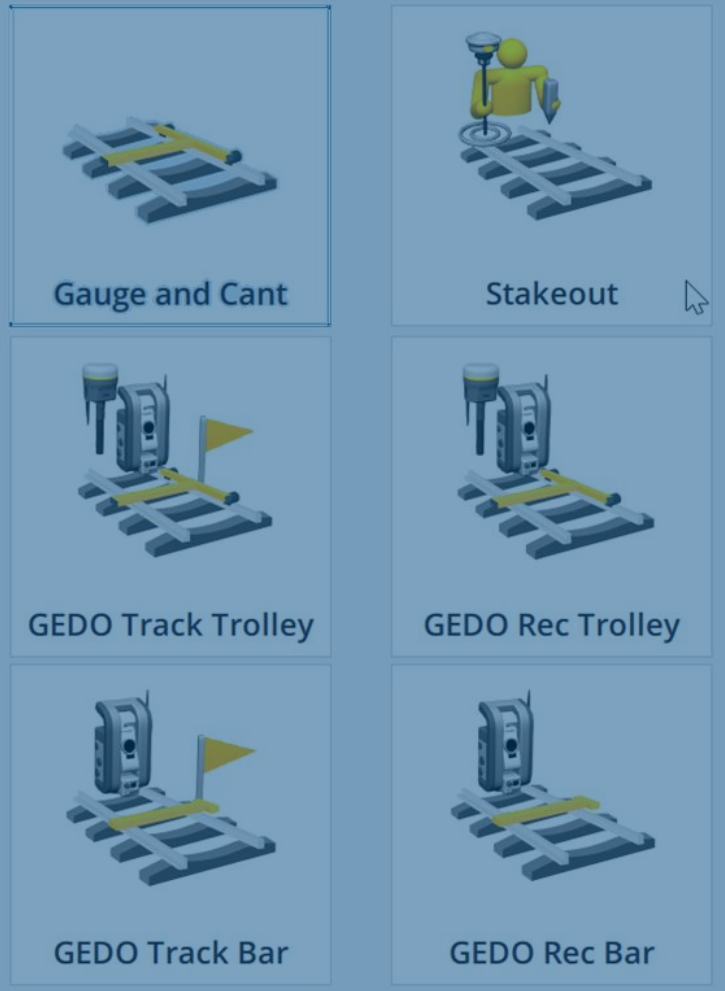
- **Trimble GEDO IMS Profiler**
  Referencing using profiler
  60 – 300 meters between ref. points
  With/ without known coordinates

- **Trimble GEDO IMS GNSS**
  Mixed referencing
  60 – 300 meters between ref. points
  Track and topo survey
  Ideal for track without ref.points

- **Trimble GEDO IMS TS**
  High accuracy geodetic referencing
  Resection ≥ 3 points
  Totalstation as profiler

Trimble Access goes on Rails

From track stakeout and survey to construction and as-built control

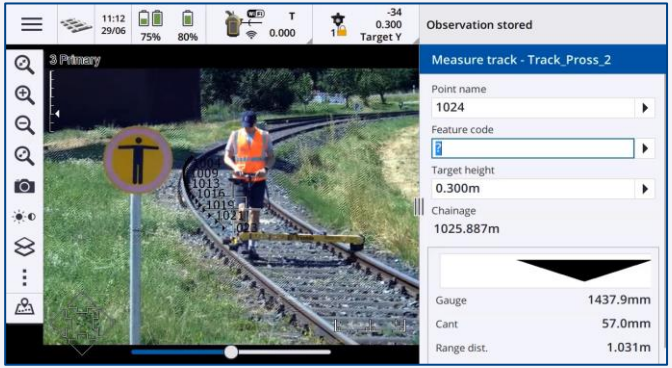


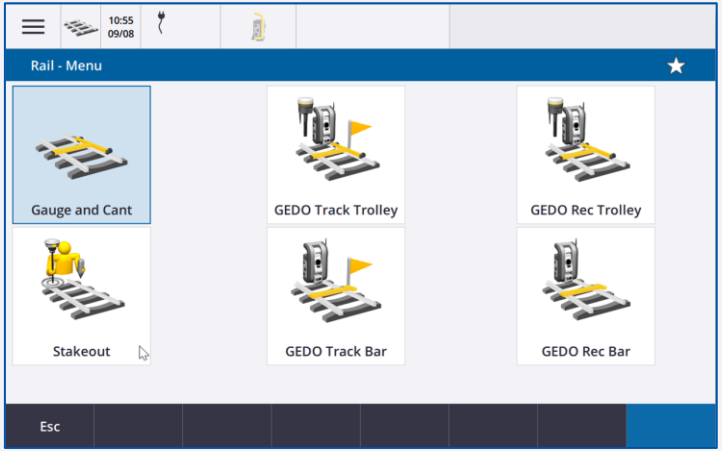
New TA modules for Rails

Track survey

New track survey and control applications released for Trimble Access:

- TA Rail – GEDO Rec
- TA Rail – GEDO Track
- TA Rail – Stakeout
- TA – Track Gauge and Cant

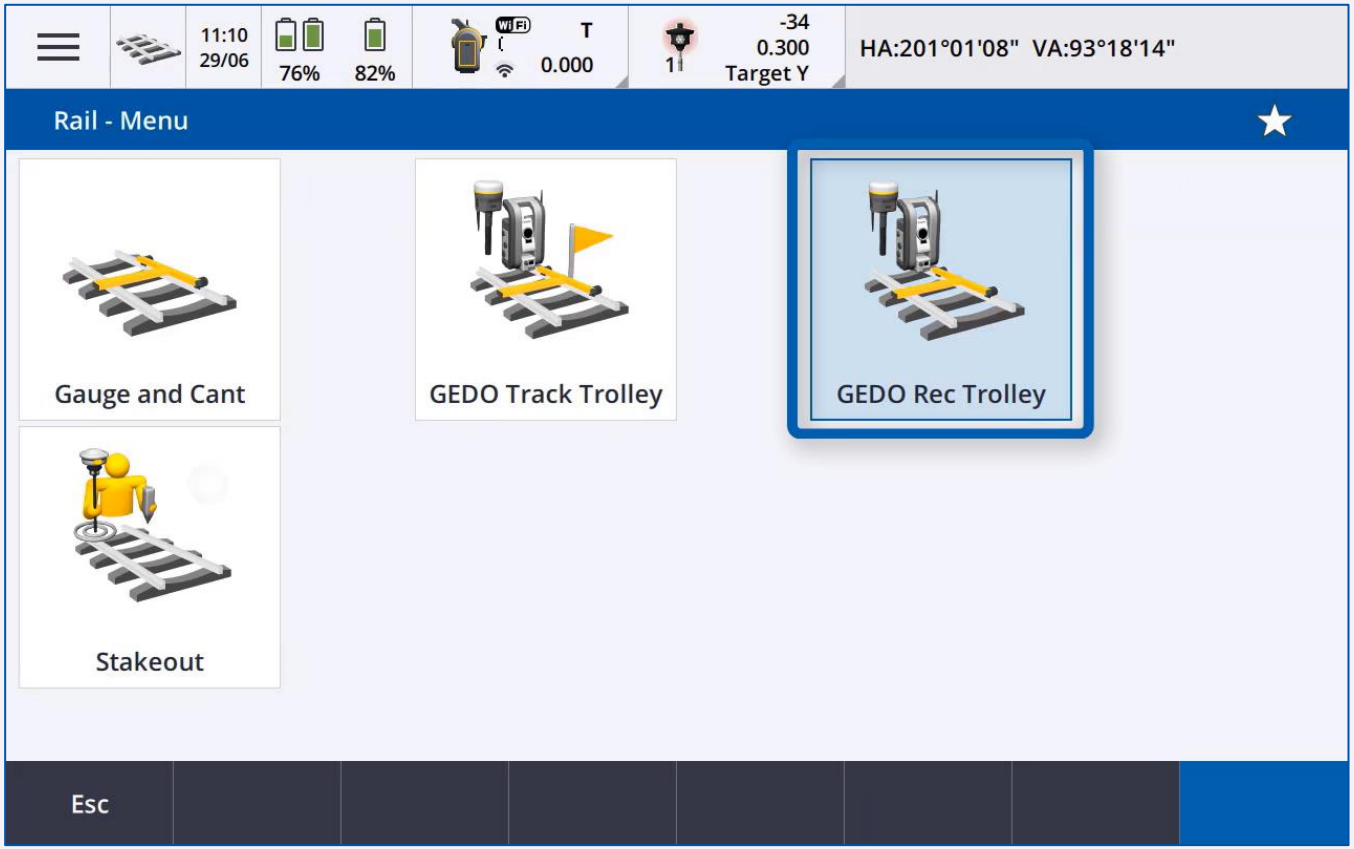




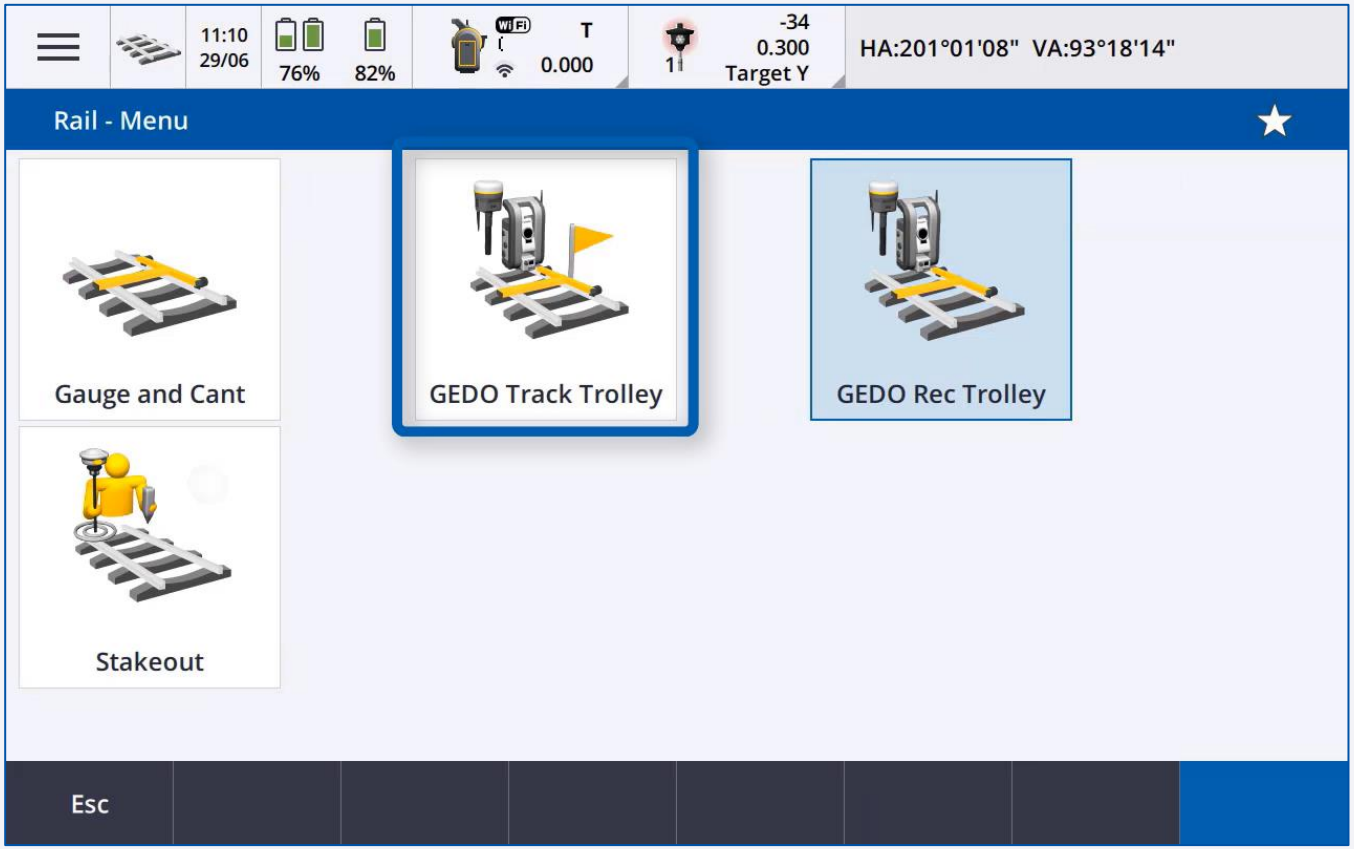
Benefits

- Compatible with TA Windows and Android
- Compatible with GEDO trolley and Track Bar
- Support of Trimble S, SX and R instruments
- Support of Vision Technology
- Support of railway track design alignments
- Live survey and stakeout results
- Track quality reporting in field and .JXB

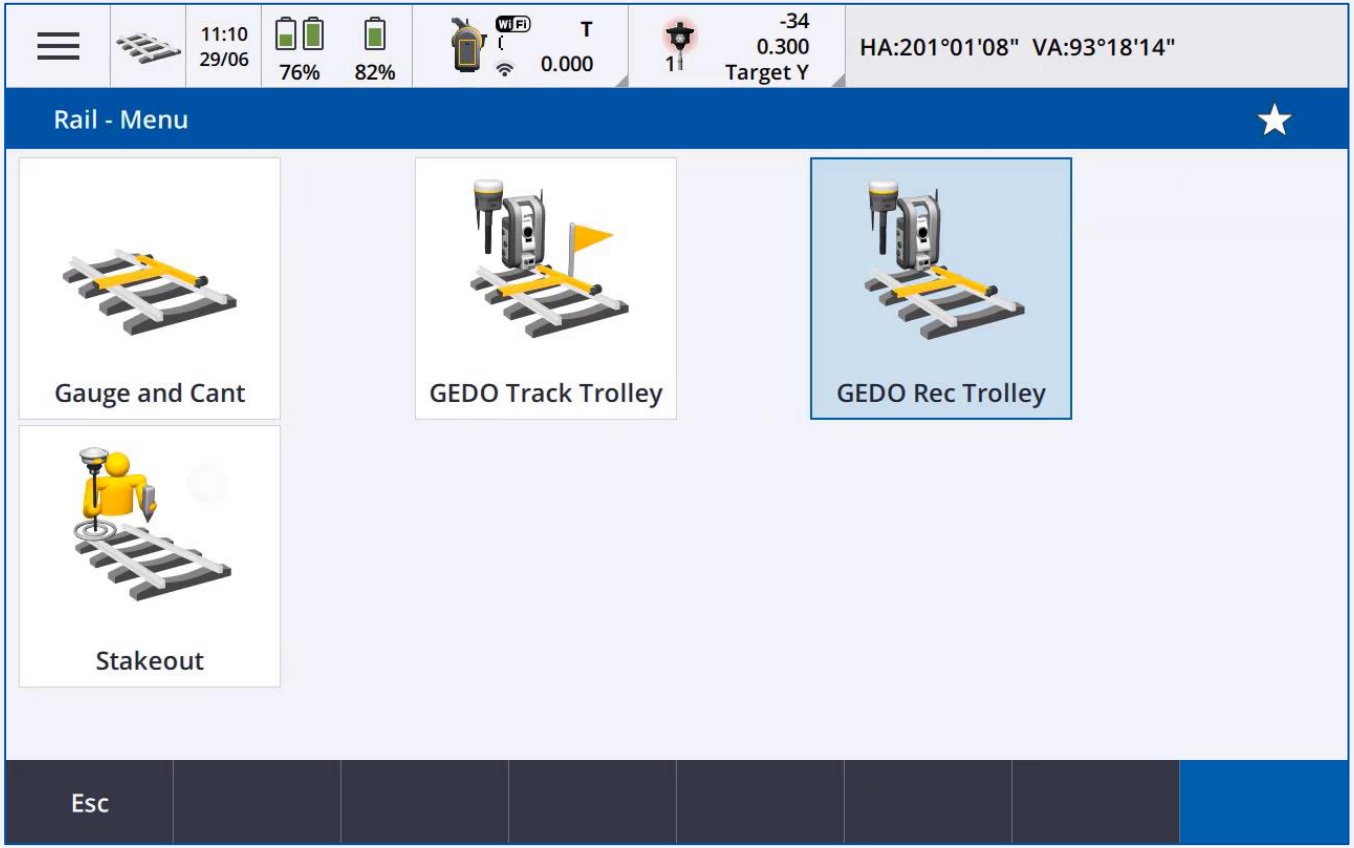
New TA Rail module – GEDO Rec



New TA Rail module – GEDO Track



New TA Rail module – Gauge & Cant



GEDO railway scanning solutions

Applications and configurations

Trimble Scanning and Mapping Portfolio for Railway Applications

Trimble Terrestrial Scanning

X7

Trimble GEDO Scan Systems

Trimble Mobile Mapping

MX

Track Corridor scan – GEDO Scan

Highly accuracy track corridor scanning

TRACK/CORRIDOR DATA

- Coordinates (L,C,R)
- Cant/Gauge/Twist
- Curvature
- 3D point cloud

APPLICATIONS

- Planing/design
- As-built check
- Safety modeling
- Rail inventory for GIS

Trimble GEDO GX50 Configuration Options

Single Head

Entry level configuration with one scanner

Dual Head 90° Orientation

Highest accuracy for clearance analysis

Dual Head 80° Orientation

Good object visibility and high accuracy

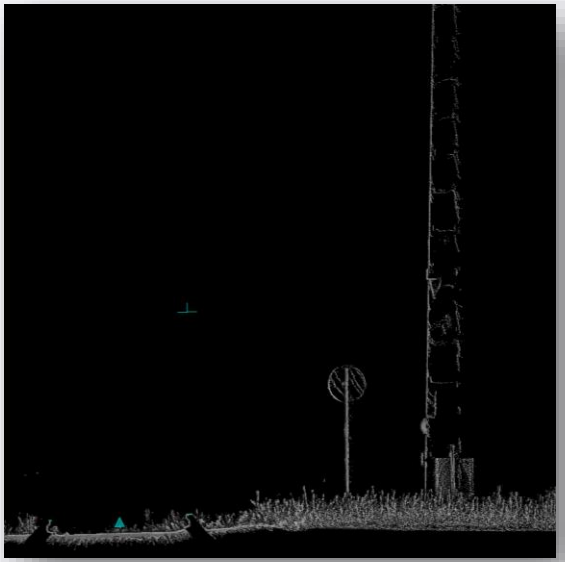
Dual Head Butterfly Orientation

Best object visibility

Trimble GEDO GX50 Head Orientation & Coverage

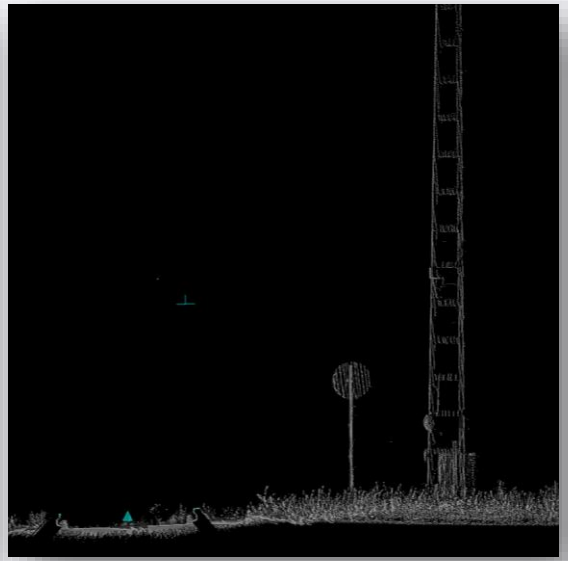
Dual Head 90° Orientation

Flat & thin objects



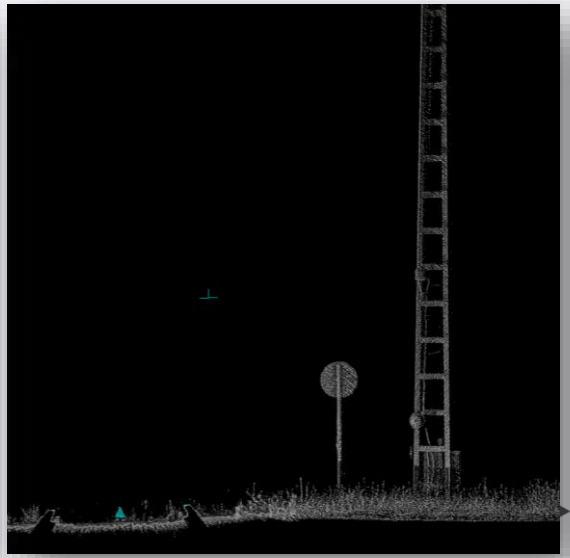
Dual Head 80° Orientation

Flat & thin objects

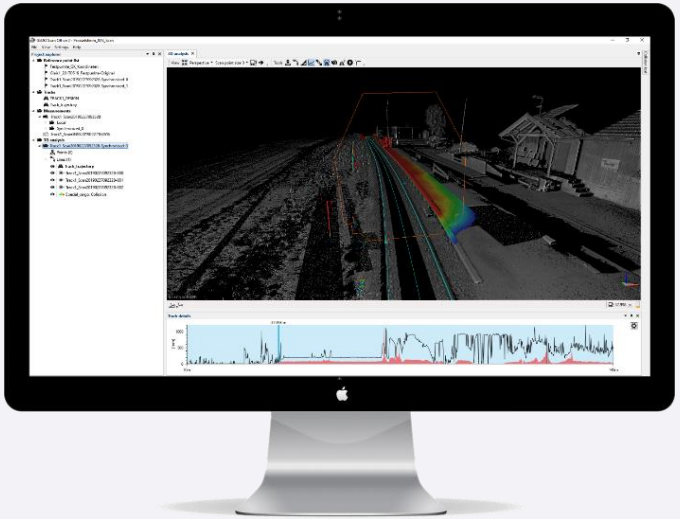


Dual Head BF Orientation

Flat & thin objects



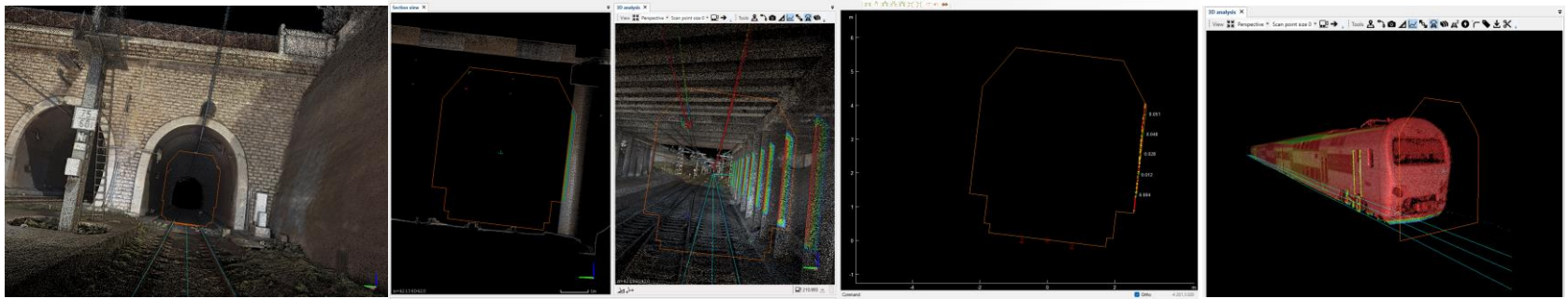
Trimble GEDO GX50 Laser Scanning System



Trimble GEDO Scan Office – solution for handling rail point cloud data

Key functionality and features:

- Single and uniform project environment
- Highly intuitive UI and clear workflows working within railway corridors
- Trajectory locked navigation and 360° field of view
- Special engines for rail data extraction, modeling and classification
- Support of rail specific entities – OHL, tracks, linear objects and chainages
- Support of a large volume point cloud projects - 100 km and more
- Data interoperability based on CAD, point cloud and report formats



GEDO Scan Office.
Dataflow and vertical applications

GEDO SCAN OFFICE

Measure/Scan	Processing	Data model	Analysis	Reporting

GEDO REC
GEDO IMS
GEDO VORSYS

Ctrl. Point data
As-built tracks

GEDO SCAN FIELD
GEDO IMS SCAN

Pt Cloud

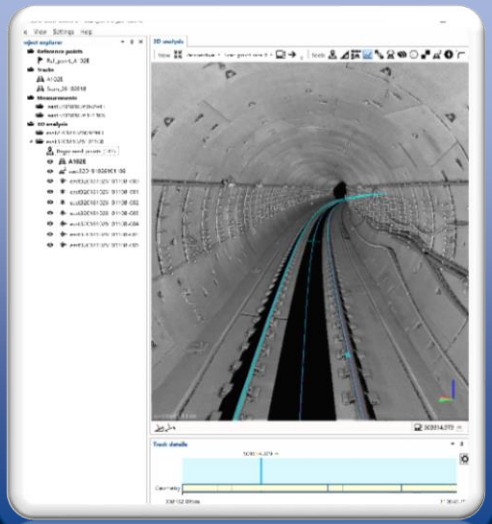
MOBILE MAPPING /
TERRESTRIAL SCANNING

Ref. Pt Cloud

GEDO NovaTrack /
TBC / QUADRI BIM

Design
Alignments

Single data model



Rail Application

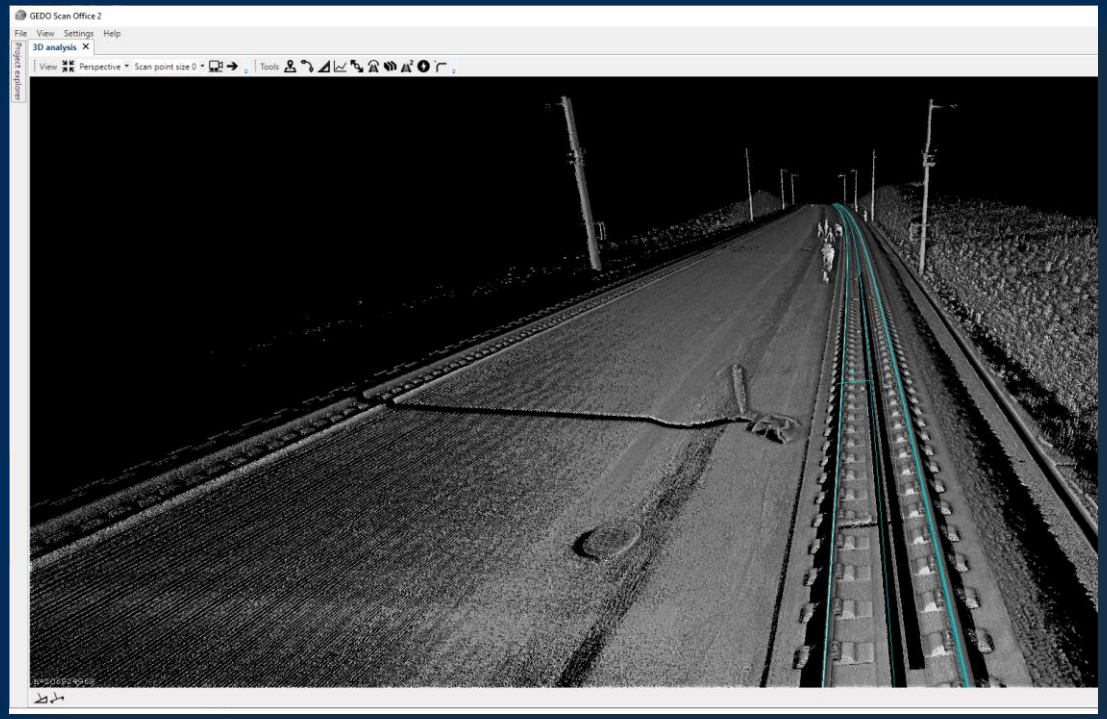
- Object registration
- As-built track extraction
- Platform/edge extraction
- OHL extraction
- Clearance analysis
- Sectioning
- Clearance documentation

External files

- Registered point data
- 2D/3D clearance profiles
- As-built track trajectories
- 3D OHL lines
- Platform/edge point data
- Point cloud data
- Clearance reports

Trajectory based navigation

- Track trajectory-based navigation and object selection
- 360° view around the current position at the track
- Actual or design track as reference
- Global & local coordinate system

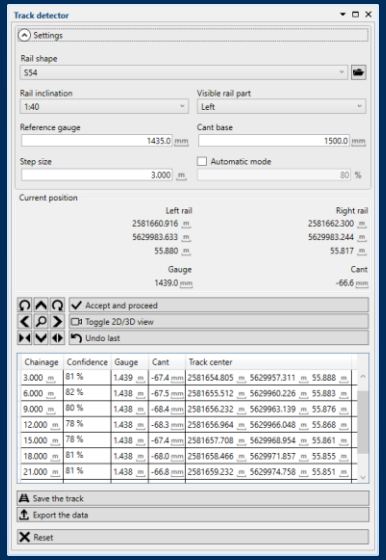


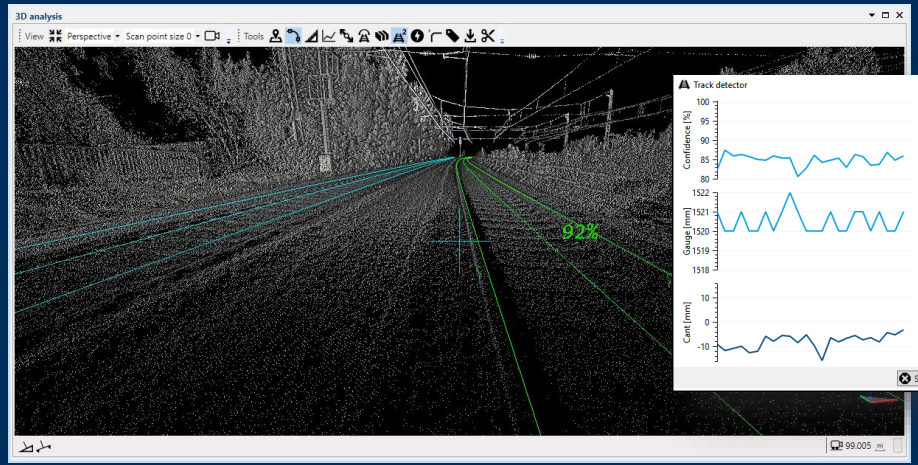
Colorized visualization

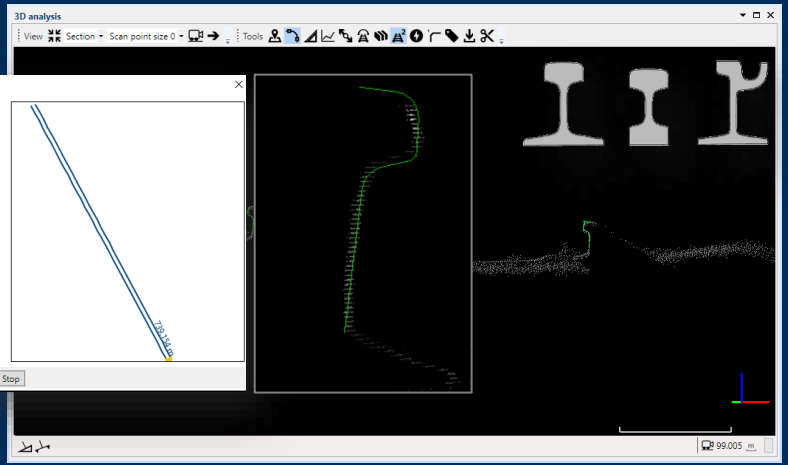
- Supported RGB and grey-shade colourization
- Possible to switch between intensity and color mode
- Independent colourization for collision and classification point cloud groups

Mapping track trajectory

- Automatic track geometry extraction from the point cloud
- Rail shape matching based on IPC approach
- Gauge fitting based on a user defined settings
- Accuracy depends on rail distance, visibility and definition:
  - Height ~ 3-7 mm
  - Lateral ~ 5 mm

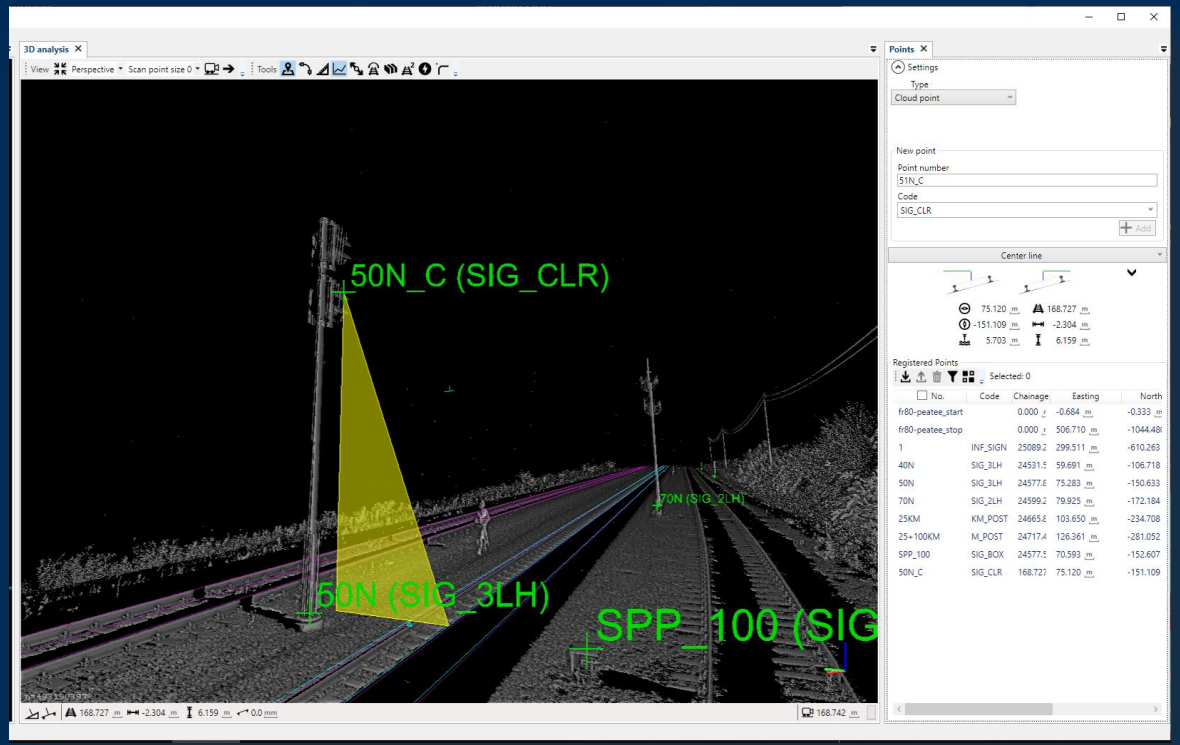






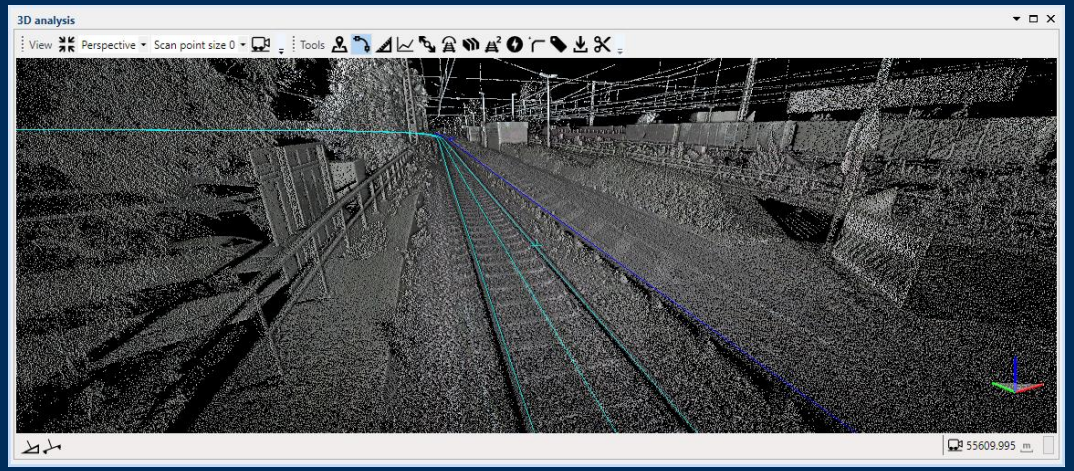
Mapping rail specific objects

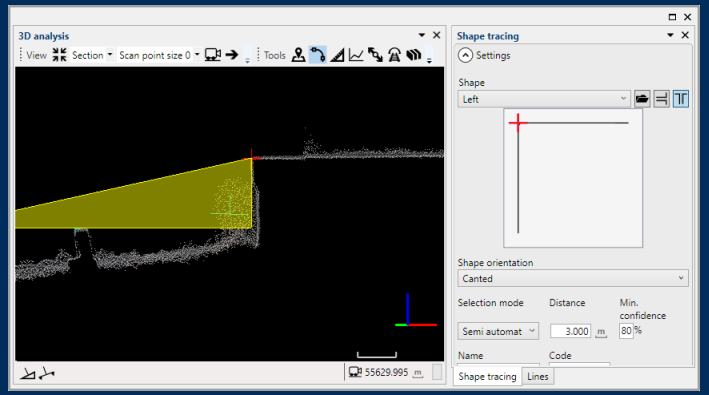
- Offsets between track and objects
- Perpendicular and vertical deviations
- Relative information to the track
- Referencing to existing or design track trajectory
- Snapping to the plane, SP, CT and single point



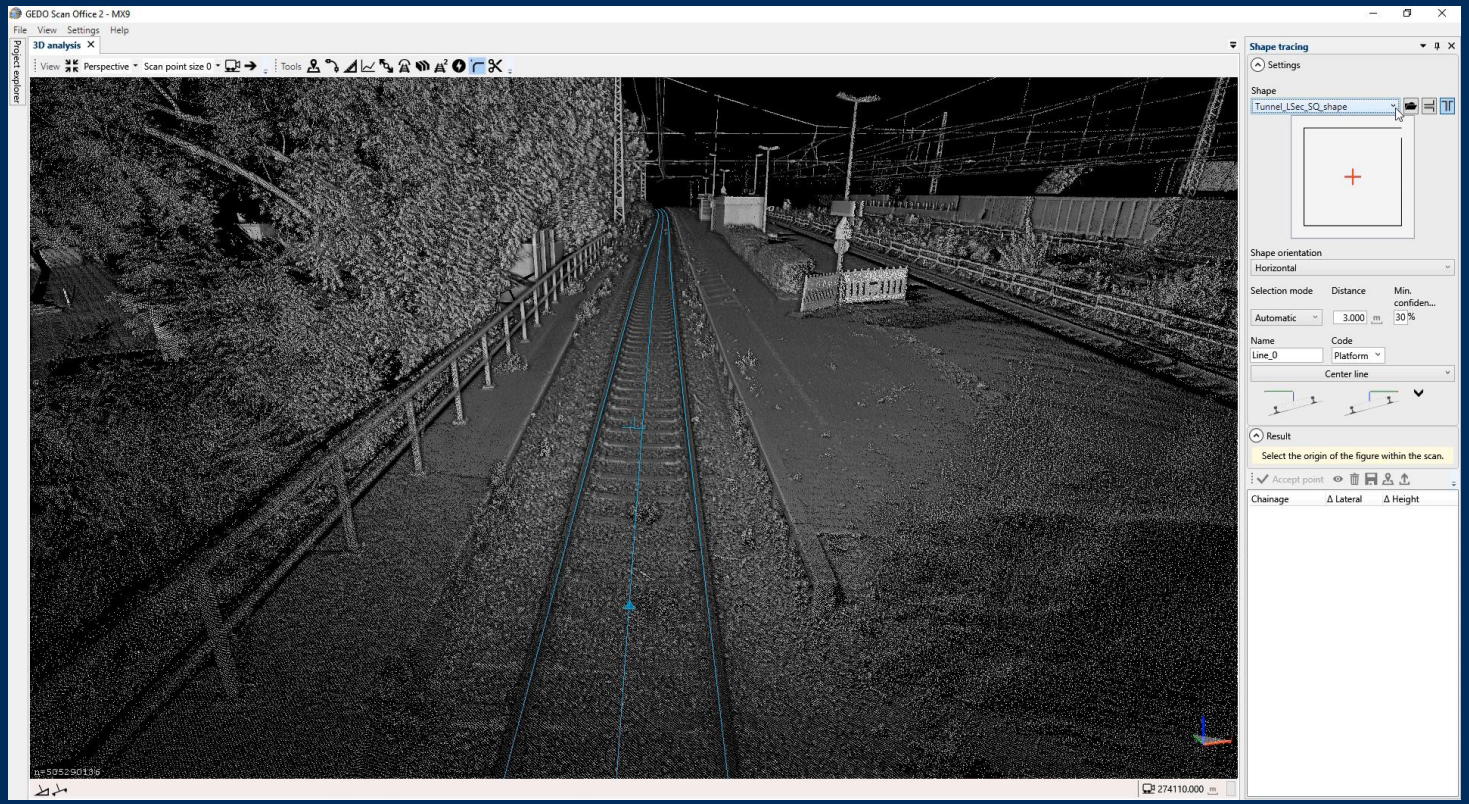
Extracting shapes and breaklines

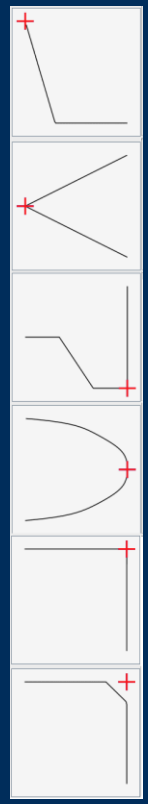
- Automated surface edge/break recognition and extraction
- Extraction is guided by user defined object shapes and QA index
- Extracted data is referenced to the track
- Result export to .DXF and .CSV file formats





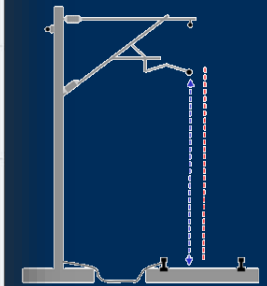
Extracting shapes and breaklines



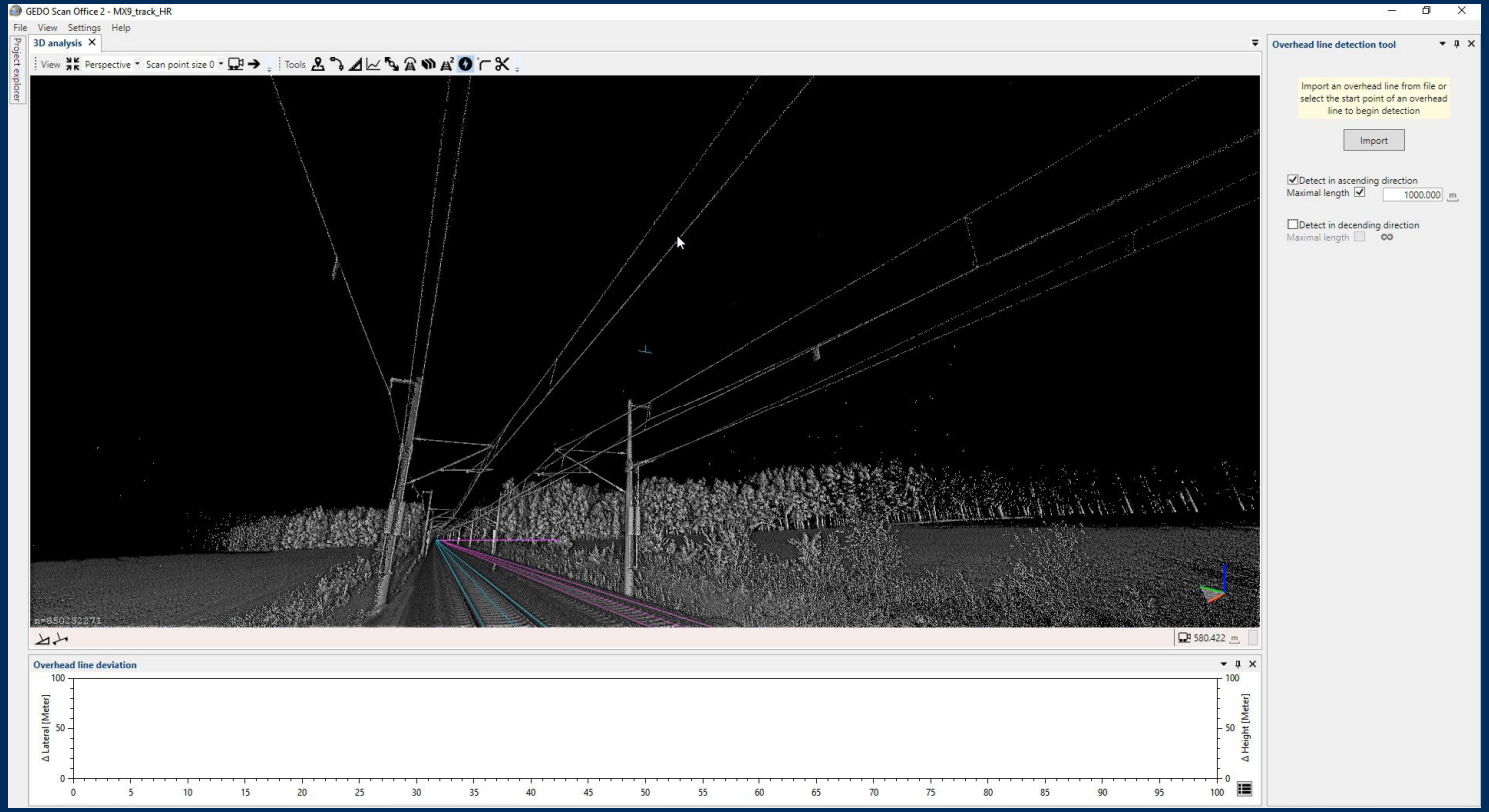


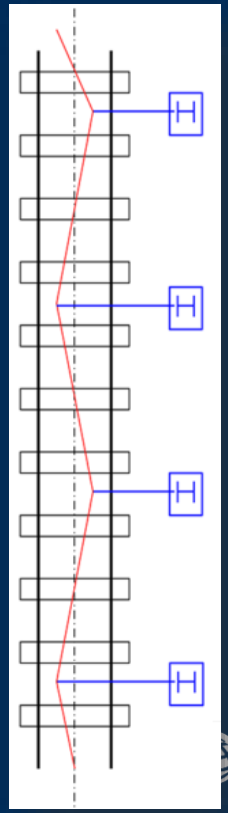
Extracting overhead lines (OHL)

- Automated OHL contact wire tracing
- Absolute and relative OHL referencing to the selected track
- Detection of OHL mounting points
- Result export to .DXF and .CSV file formats

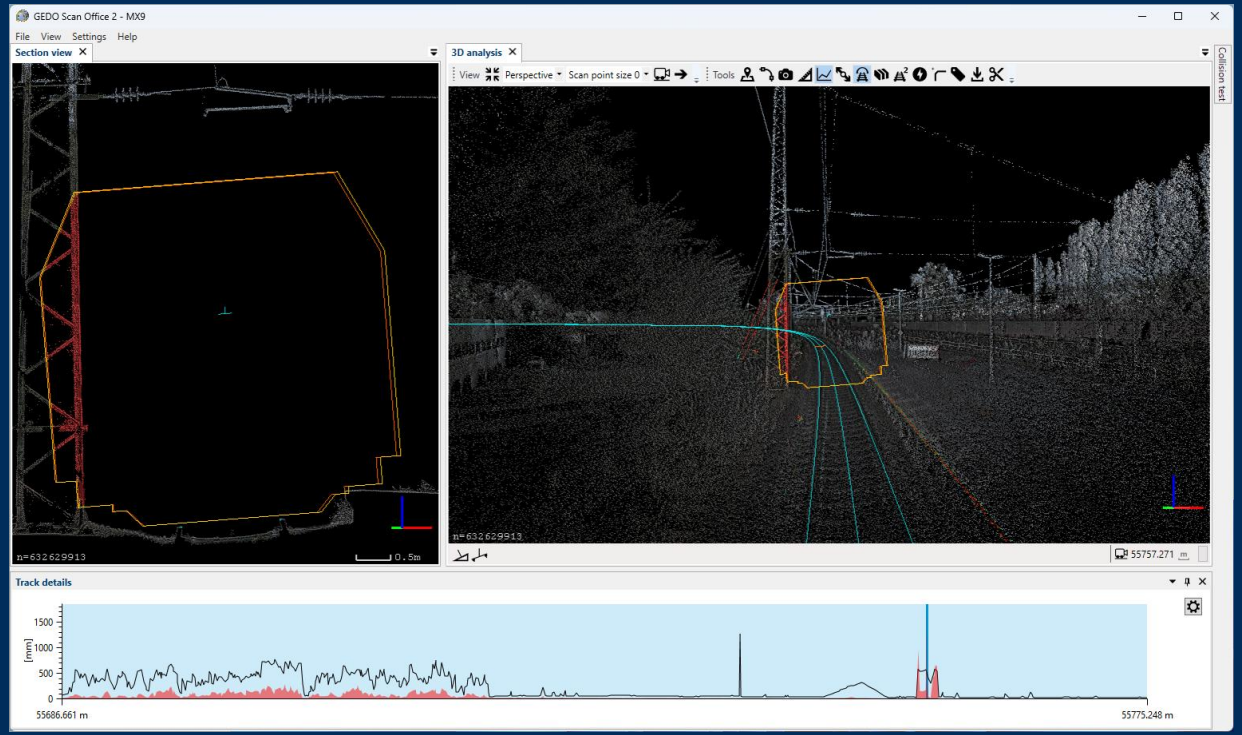


Extracting overhead lines (OHL)

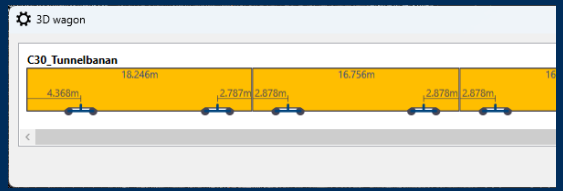




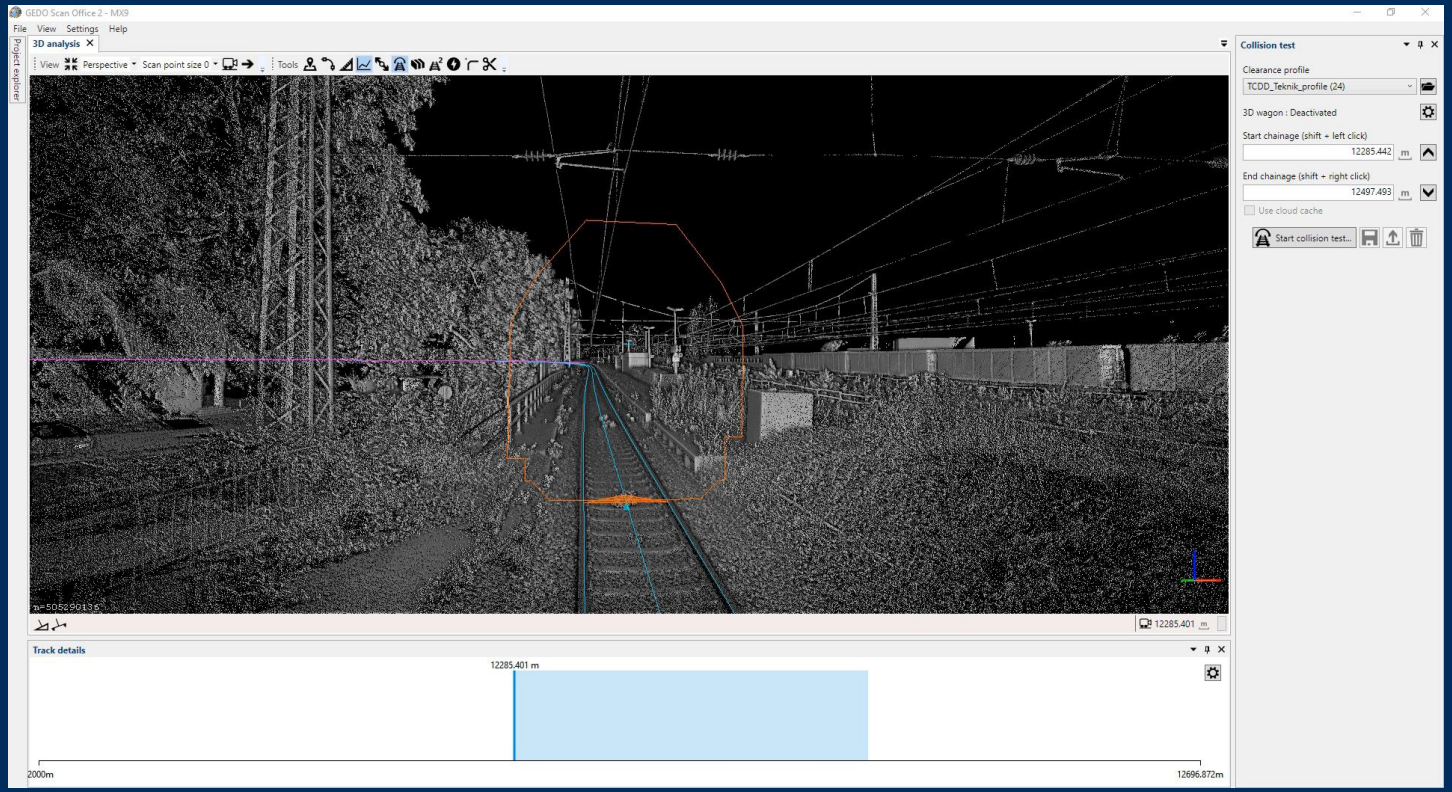
Safety and kinematic clearance



- Automated clearance check based measured or design trajectory
- 3D dynamic profile based on cant and curvature
- Automated collision profiles
- Rolling stock library

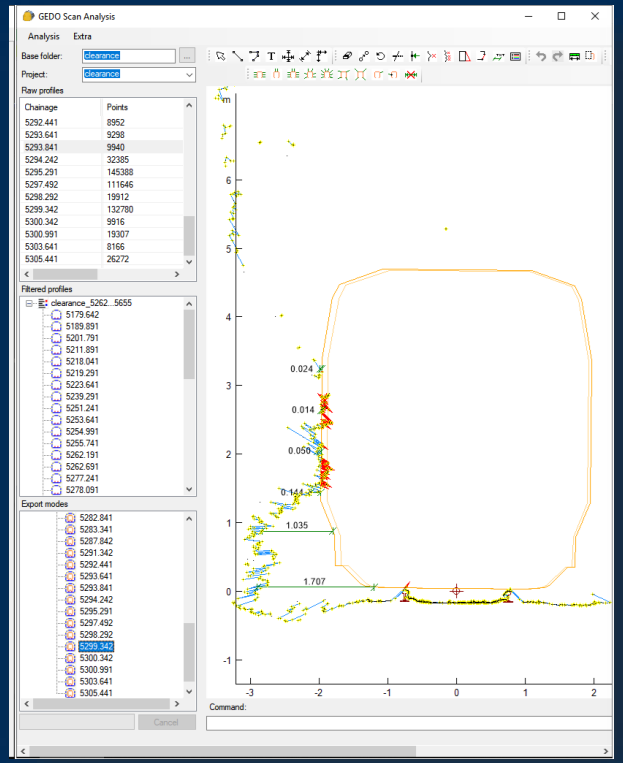


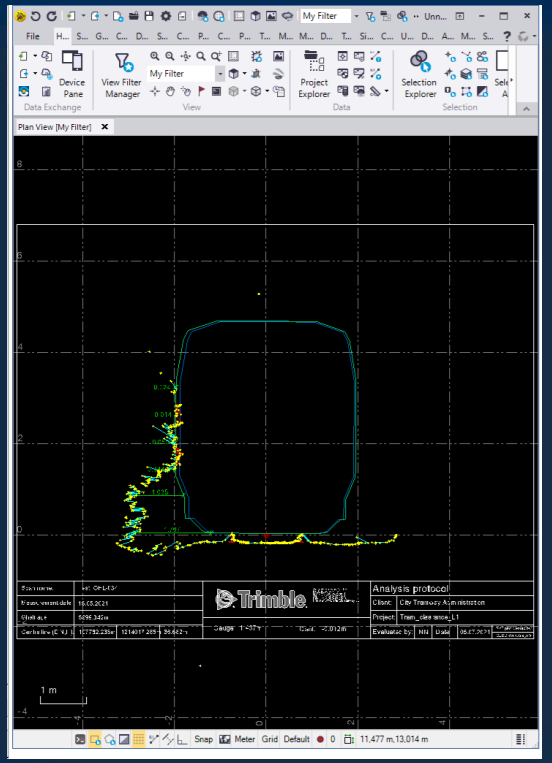
Safety and kinematic clearance



Clearance reporting

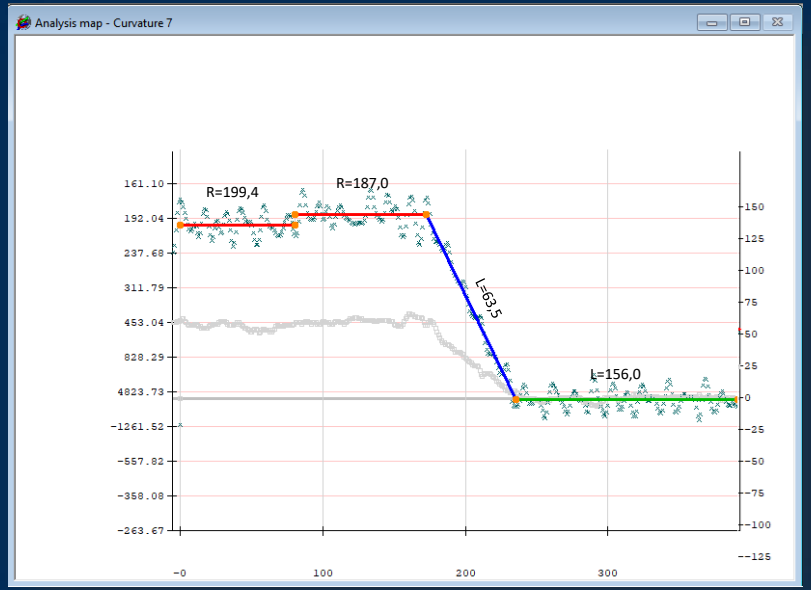
- Vectorized collision sections
- Automated infringement dimensions
- Report export to 2D, 3D DXF and .CSV format
- Special reports for DB, BaneDenmark, NetworkRail, Stockholm Lokaltrafik

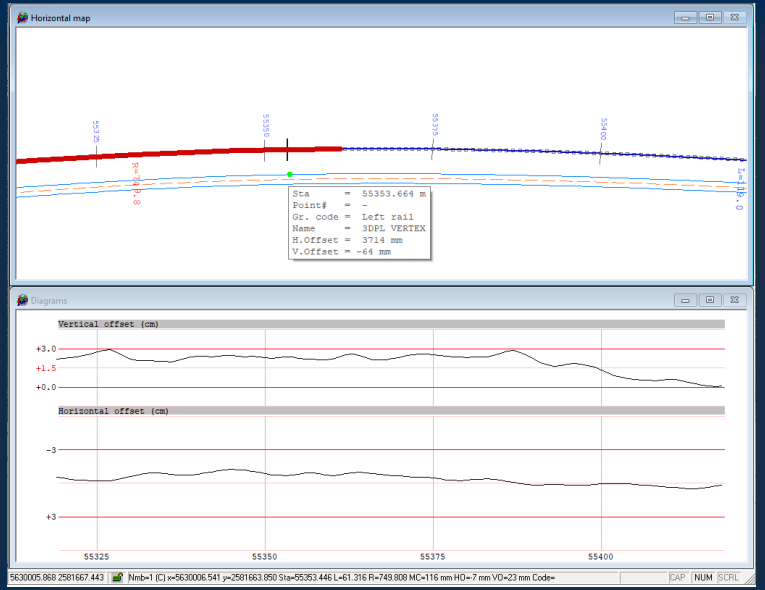




Optimal track alignment fitting

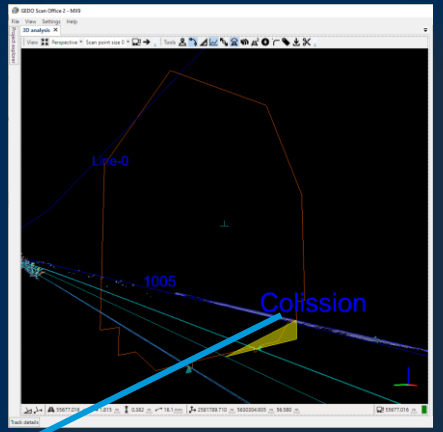
- Retro-fitting design alignment in the GEDO NovaTrack
- Adjacent map data for further constrain and alignment lateral and height offset control

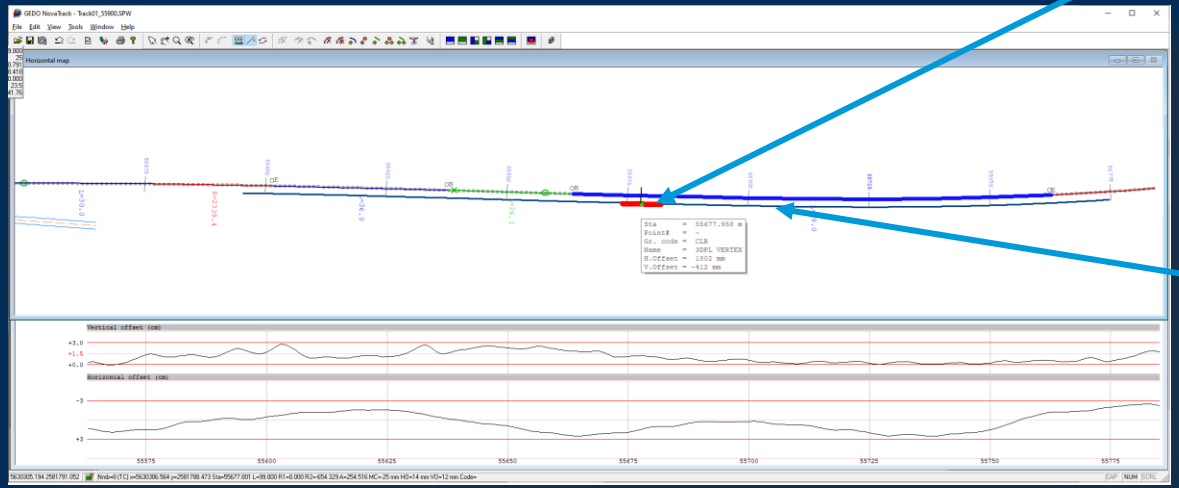




Colission data for design

- Vectorization of the collision point cloud areas
- Exchange collision results with Quadri/Novapoint or GEDO NovaTrack software to correct HAL/VAL/CANT





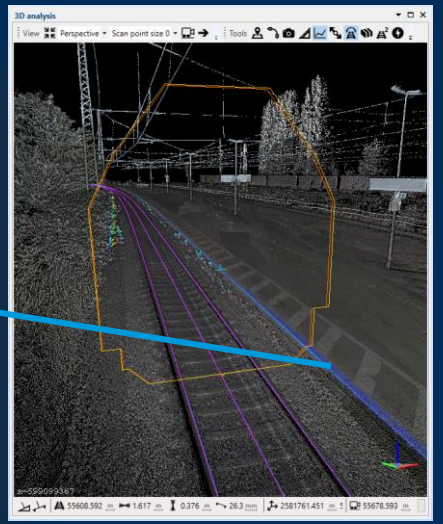
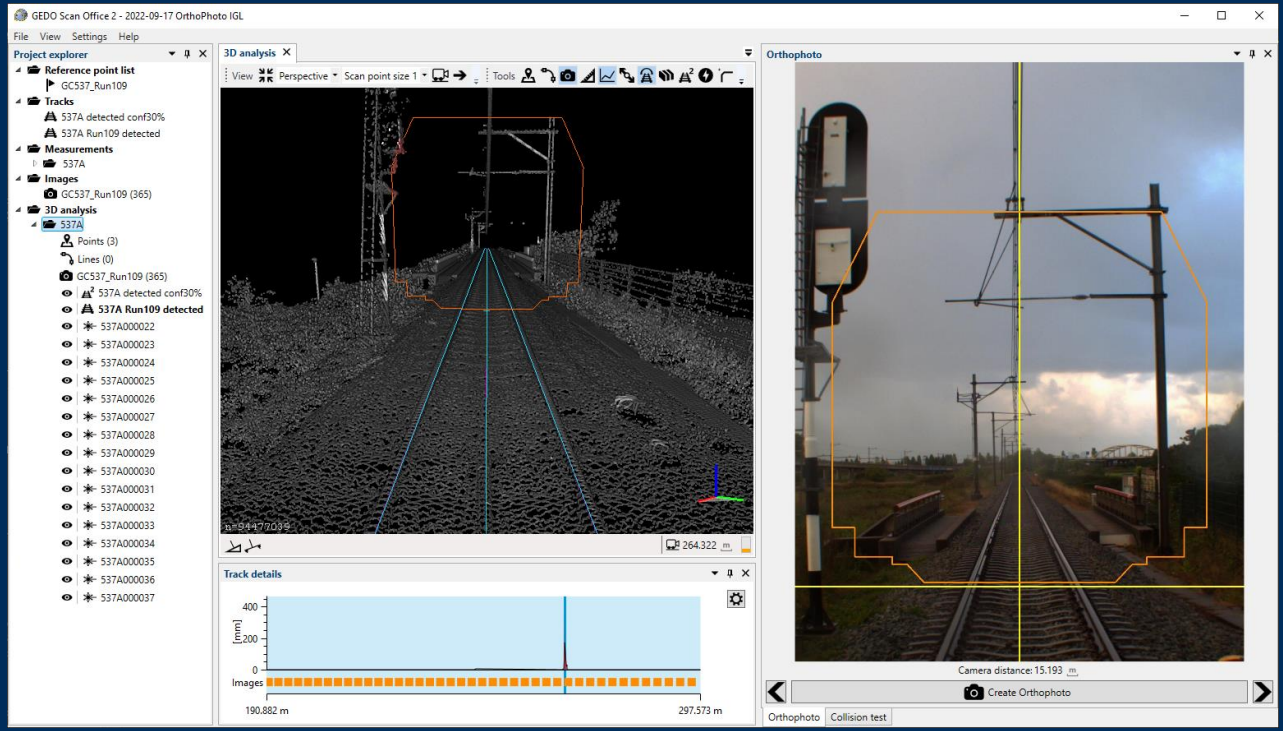


Image support and orthophoto

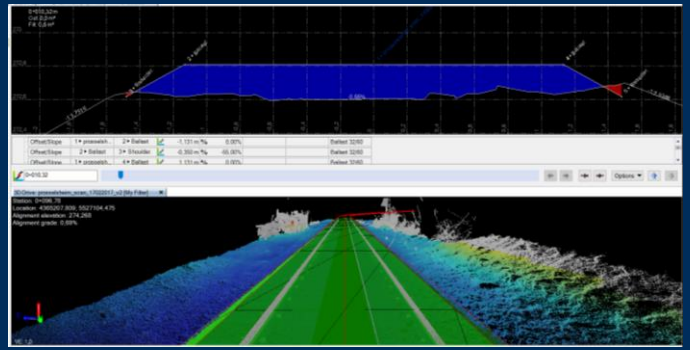
- Orthophoto at position of the collision
- Combined image
- Images from Mobile Mapping systems(*)

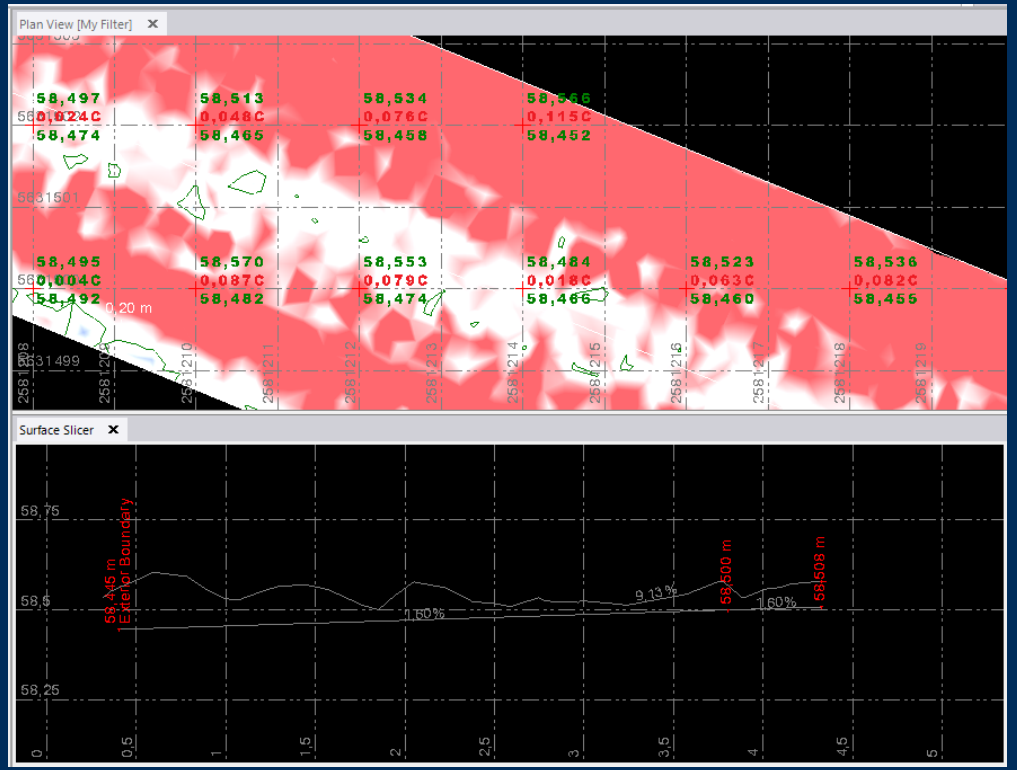


(*) Image from mobile mapping system from terra vermessungen AG

Ballast volume & cut/fill calculation

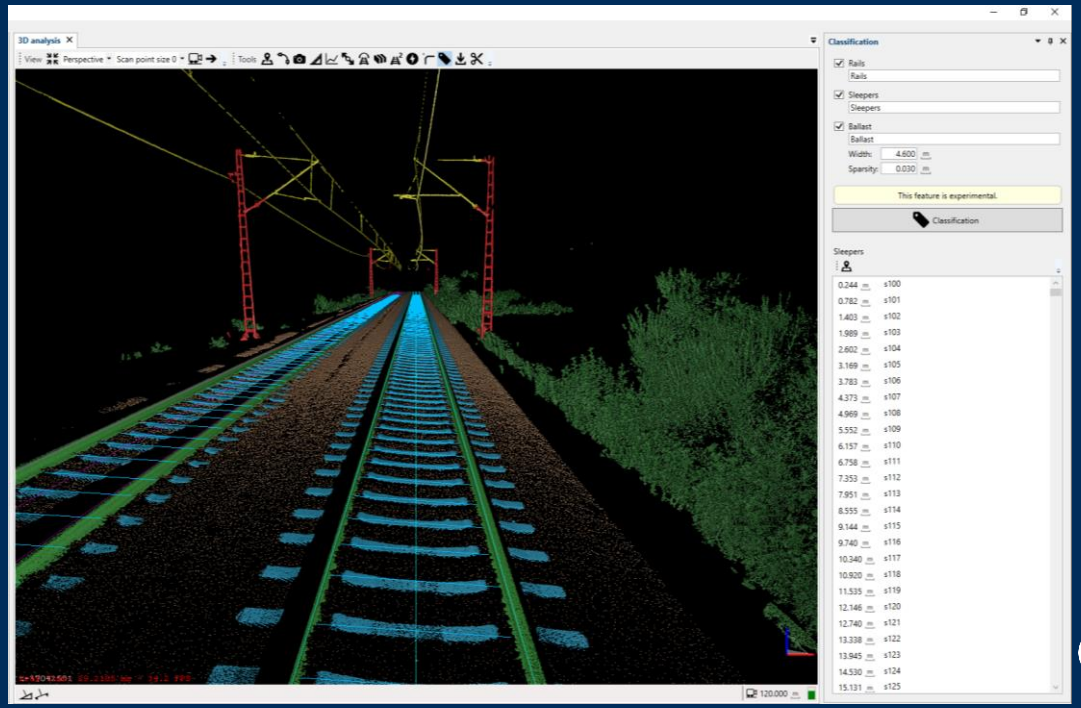
- Ballast classification point cloud
- Import design ballast DTM from GEDO Office
- Ballast Cut/Fill map and volume reports in TBC





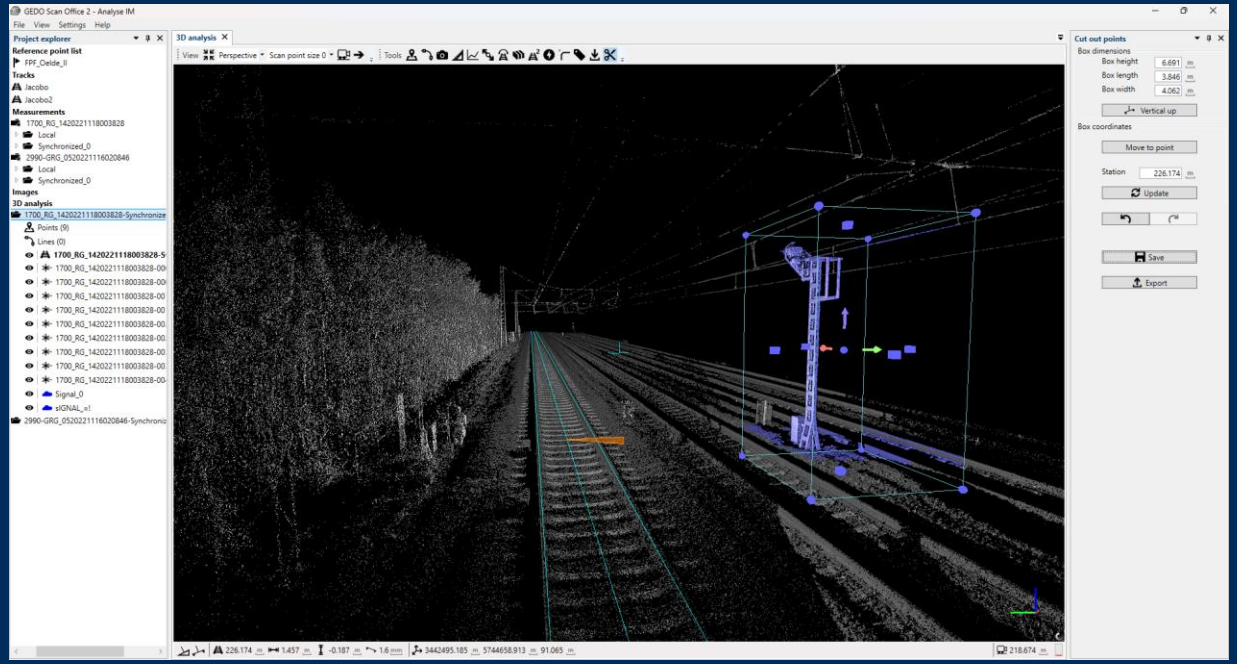
Railway specific classification

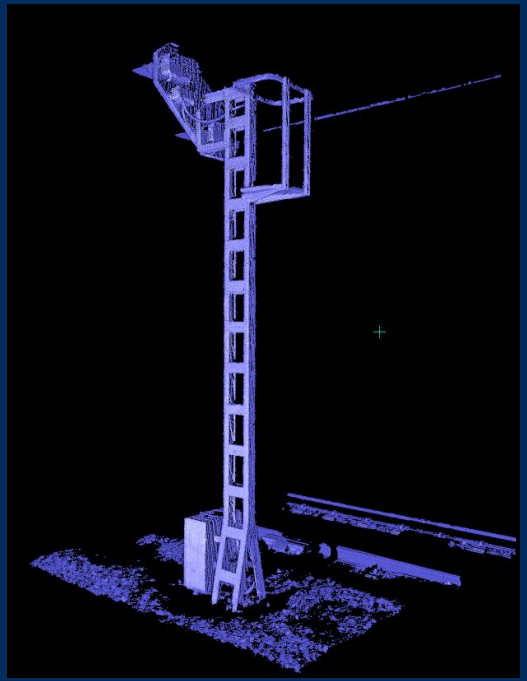
- Automated classification process along the track corridor
- Parametrical control
  - Width
  - Density
  - Selectable groups
- Classification groups
  - Sleepers with positions
  - Ballast
  - Rails
  - Poles (catenary)
- Machine learning and AI algorithm



Box filtering for modelling

- Select area and share with modelling software





GEDO Scan
Scan2BIM for a railway station

GEDO GX50 track corridor scanning solutions

GEDO Scan

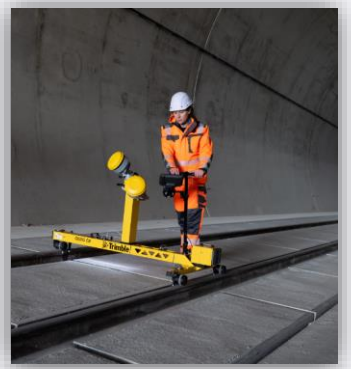
- Relative positions only
- Entry level solution

GEDO Rec-Scan

- Geodetic solution
- With Total Station or GNSS

GEDO IMS-Scan

- Highly productive & versatile
- Optional GNSS



Questions & Answers

Ask your Questions

Thank You

Trimble Track Survey & Scanning

For Questions or Feedback please contact:
info_railway@trimble.com