



How we build reality



# Case Study

Scanning the "Windbergbahn" in Dresden with the IGI RailMapper®, based on the Z+F PROFILER® 9012



## Company Overview

Z+F is one of the world's leading manufacturers in the field of non-contact laser measurement technology. Due to years of research, development and numerous successful engineering projects, Z+F is the forerunner in this field with a wealth of knowledge, experience and success.

When it comes to implementing future developments Z+F has always encouraged innovative thinking and open-minds. Our loyal and long-standing customers appreciate our continual innovations, support and the services we provide.

In cooperation with IGI mbH, the leading navigation specialist.



## Our Partners

### IGI - Ingenieur-Gesellschaft für Interfaces

IGI is based in Kreuztal in the middle of Germany, in an idyllic countryside with beautiful surroundings. IGI covers a wide variety of expertise in optics, electronics, mechanics, software development, and analytics through a team of highly qualified scientists, engineers and technicians. With 35 years of experience, IGI not only offers integration of various sensors, but also complete sensor systems for airborne and terrestrial survey missions. IGI's goal is to provide durable and easy to use turn-key solutions, which offer high end quality in its outcome at the best possible accuracy.



### Windbergbahn e. V.

In 1982 the Windbergbahn e. V. was founded in Dresden. The incorporated association's goal is to revive the historic rail network from Dresden to Possendorf through different measures and to preserve the monument "Windbergbahn". Since 2010 the association has been independently responsible for operating the track. We thank the association and Michael Topf for providing a lot of pictures for this case study.



### Dresden University of Applied Sciences (HTW)

Prof. Zimmermann and his team of the HTW Dresden are supporting the project with specific know-how and analysis of the data.



## Z+F PROFILER® 9012

The Z+F PROFILER® 9012 has a 360° vertical field of view and is the fastest 2D profiling laser measurement system in the world. With its scan rate of more than 1 million points per second and a maximum scan speed of 200 profiles / sec., very short distances between profiles can be achieved even at high speeds. The high point density ensures that even the smallest objects can be registered and processed by the software.

The new laser measurement system is classified „eye-safe“ in laser class 1. The scanner can be used in urban environments without any restrictions. A hardware-assisted pixel by pixel synchronization, already used and tested in previous models, makes it possible to process external signals to determine the position of the scan data.

Due to its high flexibility the Z+F PROFILER® 9012 is suitable for all kinds of mobile mapping applications.

With its high rotation speed of 200Hz, many details are recorded very quickly and accurately, even at higher speeds of the carrier platform.



The Z+F PROFILER® 9012



## Project & Objectives

It is one objective of Windbergbahn e. V. to preserve the monument "Windbergbahn". This includes documenting the historic train tracks, the surrounding area and buildings next to the tracks, as well as the maintenance of the complete network - for what the association has been responsible since 2010.

IGI started this project to support the association with its objectives. Together with Prof. Zimmermann from HTW Dresden and the Windbergbahn e. V., the survey track from "Dresden-Gittersee" to "Freital-Birkigt" was chosen. This track is very demanding because of  $R_{min} = 80m$  of several curves. The part from "Dresden-Gittersee" to "Possendorf" is out of service.

The following aspects were of great importance:

- Examination of the track's positions
- Calculation of 3D profiles
- Creating digital models of the surrounding area
- Measurement of the clearance gauge



Map of the rail network  
Source: [www.de.wikipedia.org/wiki/windbergbahn](http://www.de.wikipedia.org/wiki/windbergbahn)

## IGI RailMapper®

Based on the world's most accurate mobile mapping system, StreetMapper, the new RailMapper system is applicable for clearance measurement, sign detection, new construction, refurbishment and monitoring of rails and tunnels.

IGI with its partners designed this new system and established a complete solution with related workflow. By using the unique modularity of IGI equipment, one mobile mapping system can be used for various tasks and applications. Using the very latest laser scanning technology, precision navigation and advanced data processing coupled with innovative system design, RailMapper delivers proven accuracies in the most challenging environments.

The system can be equipped with different types of laser scanners which differ in precision and range. A typical solution comprises of 2 to 3 scanners to get the best possible results. In addition different kind of RGB and video cameras for integration are available.

Every system consists of IGI's GNSS/IMU based positioning system of the type as well as TERRAcontrol, delivering the best accuracies available and making the solution successful.



The RailMapper with two Z-F PROFILER® 9012



## Methodology

On October 25<sup>th</sup> 2013 the RailMapper, based on a Nissan Navara, arrived at the Windbergbahn. The vehicle is equipped with a hi-rail system which enables the system to operate both on rail tracks (RailMapper) and roads (Street-Mapper). The RailMapper was rerailed at a railroad crossing and started the survey from "Dresden-Gittersee" to "Freital-Birkigt".

One Z+F PROFILER® 9012 was mounted on the RailMapper. The laser scanner scans the surroundings and forms a land-scape 3D model, using the position information from TERRAcontrol. This 3D model is the basis for many applications, such as clearance measurements and measuring the superelevation.

The survey was done by a train operator of the Windbergbahn e. V. This took about 3 hours because of the maximum speed of 10 km/h (6.25 mph). The low speed was selected to obtain very dense scanning profiles.

After the survey, the RailMapper was presented to an interested expert audience at "Dresden-Gittersee".





## Results

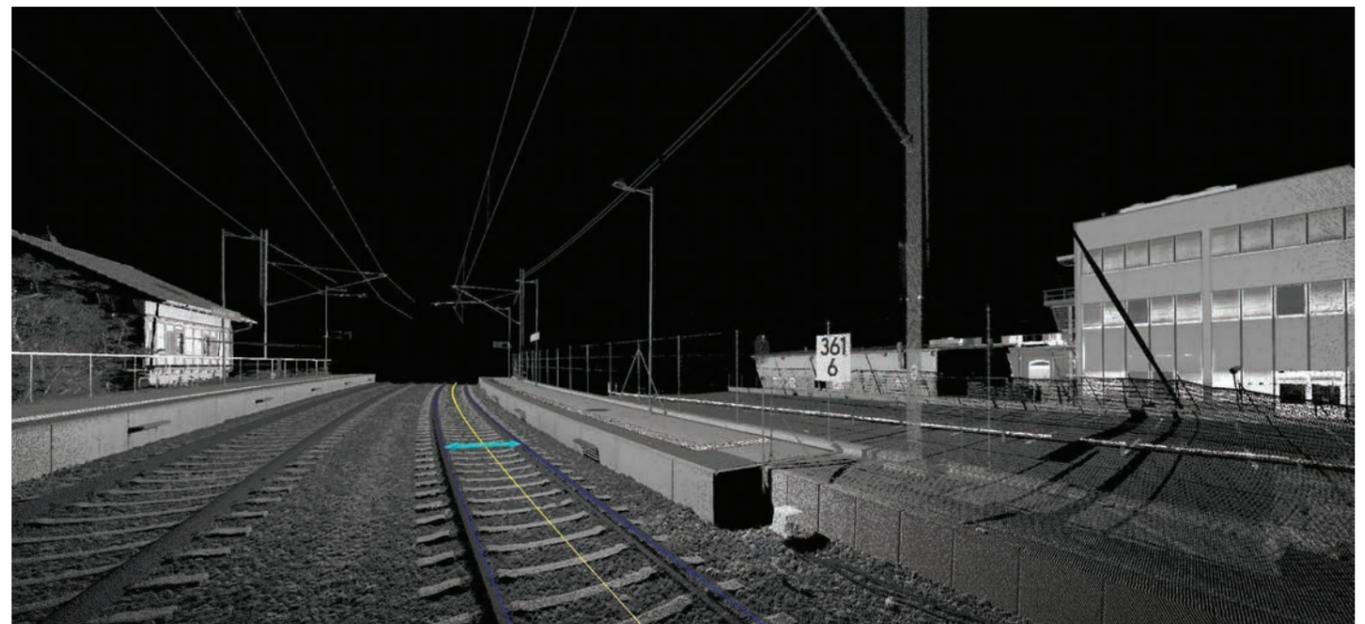
The Z+F PROFILER® 9012 proved to be the ideal laser scanner for this project, due to its flexibility and high data sample rate. By being classified "eye-safe" according to laser class 1, survey missions can be carried out in public areas without any restrictions. This feature creates new possibilities in the field of mobile mapping.

The project could be done without any problems in connection with the RailMapper, which also proved to be very reliable and flexible.

The results of the Windbergbahn measuring run were processed by students of HTW Dresden. The captured data can be used for measuring clearance gauges, examining the track's positions, calculating 3D profiles, creating digital models of the surrounding areas and carrying out interference checks.



*Point cloud of a railway station in Switzerland, scanned with a Z+F PROFILER® 9012 (Picture: IGI).*

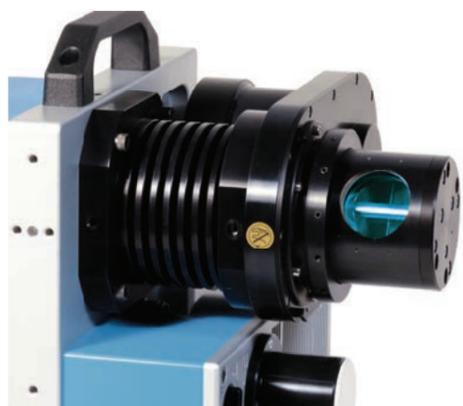


*Point cloud of a track in Switzerland, scanned with the Z+F PROFILER® 9012. The data can be used to measure tracks and to carry out interference checks (Picture: IGI).*



*During the survey: IGI's RailMapper*

## Pictures



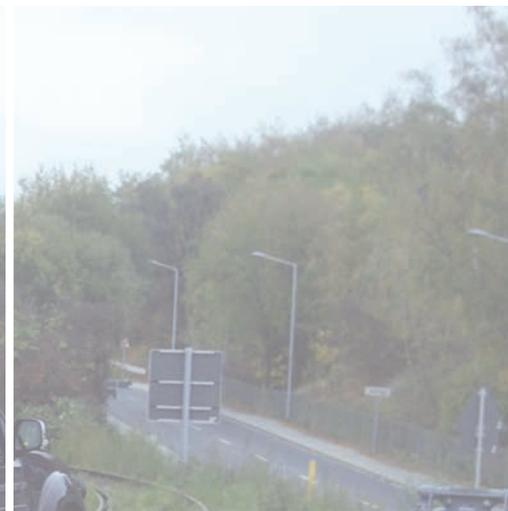
*The Z+F PROFILER® 9012 with detailed view of the ports.*



*IGI Mobile Mapping control unit with uninterruptable power supply.*



*The RailMapper, equipped with a Z+F PROFILER® 9012, is being viewed by an interested group of experts.*



**Z+F**  
**Zoller+Fröhlich**

**Zoller + Fröhlich GmbH**  
Simoniusstrasse 22  
88239 Wangen im Allgäu  
Germany

Tel.: +49 7522 9308-0  
Fax: +49 7522 9308-252

[www.zf-laser.com](http://www.zf-laser.com)  
[info@zf-laser.com](mailto:info@zf-laser.com)