Fraunhofer IPM

Track Geometry Measurement System

Measuring track geometry with submillimeter precision

Based on the light section method, the Track Geometry Measurement System TGM generates high-resolution digital 3D data from tracks and key track components.

Railroad tracks have to cope with heavy loads, particularly from freight traffic and long-distance trains, which causes changes in the rail track geometry over time. The Track Geometry Measurement System (TGM) measures the rail track geometry at high speed – automatically, precisely and contactless.

Digital measurement data for smart maintenance

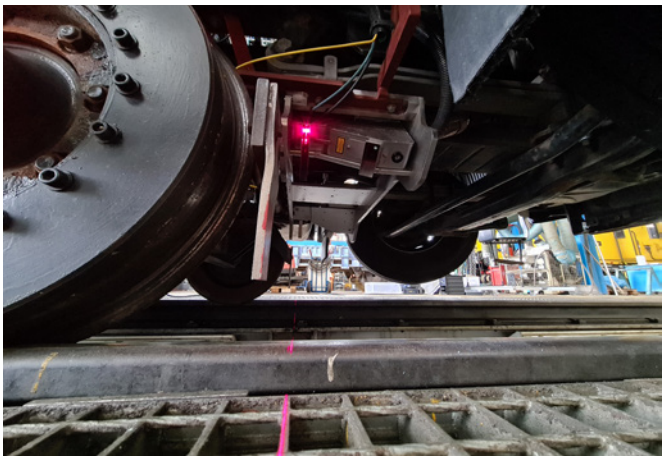
Predictive railroad infrastructure maintenance includes regular checks of the rail track geometry. Rail track geometry faults cause rails, fixings and sleepers – and not least also train wheels – to wear prematurely. Detecting rail track geometry faults before they cause any damage to track components requires frequent and very precise measurements. The Track Geometry Measurement System (TGM) measures rail track geometry with millimeter precision at high speed, doing away with the need to close tracks for inspection. A measurement accuracy in the submillimeter range can be achieved if the driving speed is reduced. The system records the track position, ballast bed, sleepers and fixings in a single measurement run and delivers digital 3D data. In addition to the rail track geometry itself, information on various track components can be automatically extracted from the 3D point clouds. The digital measurement values from individual field measurements can be compared automatically, which enables the long-term status monitoring of the track infrastructure.

Light section method for high-precision 3D profiles

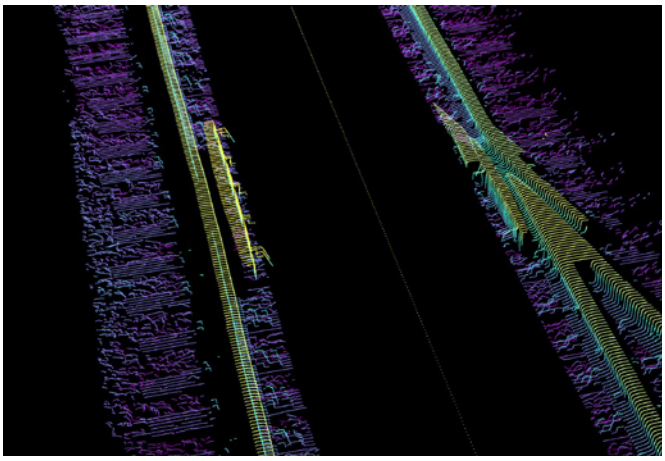
The TGM is based on the light section method, which is an optical 3D measurement technique for sheet beam projection, with a laser projecting a line across the entire width of a rail. Cameras record the beam from a spatially offset angle and "see" the optical distortion of the laser line caused by the surface of the object. Using the principle of triangulation, the 3D coordinates of the points on a single laser line can be calculated on the basis of the geometric position of the laser and the cameras. Many individual light sections are recorded

Railroad measurement systems
by Fraunhofer IPM

Fraunhofer IPM develops optical measuring systems for monitoring the condition of rail infrastructure. Experts in measuring techniques and optics, designers, electrical and software engineers work together on supplying turn-key solutions for the special requirements of infrastructure operators and providers of surveying services. The robust measuring systems are deployed throughout the world and are characterized by their speed, precision and reliability.



TGM underneath a measuring train: Cameras record the laser line transversing the tracks.



As the train moves forward, a detailed 3D elevation profile of the track environment is created as a 3D point cloud.

while the measuring train moves forward, creating a detailed elevation profile of the track.

Compact, robust and eye-safe

The compact and robust TGM is installed underneath the survey vehicle. The measuring sensors are arranged transversely to the direction of travel and are firmly mounted on the vehicle frame. The center of the track and the angle of the vehicle to the normal of the track plane are calculated on the basis of the light section measurements. In spite of the relatively large measuring distances, the light section cameras enable very high profile rates paired with excellent accuracy and high resolution. Thanks to its wide dynamic range, the system is able to measure rail surfaces of varying reflectivity (from dark to highly reflective). Pulsed line lasers are used for the illumination. Protective funnels ensure compliance with the prescribed nominal ocular hazard distance (NOHD) and prevent contamination of the outlet windows.

Perfectly coordinated measuring systems

The measurement data from the TGM is referenced to the center of the track and can be used both for status assessment and to record the rolling motion of the measuring train. Measurement data from all other systems used on the train can then be adjusted to account for the rolling motion. Fraunhofer IPM tailor-makes the TGM, combining it with other measuring systems, if needed, to determine the position and wear of contact wires as well as the position of poles, ensuring the perfect coordination of hardware and data evaluation. All measuring systems are adapted to country-specific requirements. The service also includes system maintenance and staff training.

Technical specifications

Measuring principle	Light section method
Data recording rate	
Profiles (maximum)	up to 7000 /s
Individual points (maximum)	approx. 17,9 Mio pts/s
Resolution (travers to the direction of travel)	2,560 pts/sensor
Distance resolution	approx. 50 µm
Active illumination	by line laser
Profile density	One profile every 5 mm at 120 km/h

All specifications and features are subject to modification without notice.

Contact

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