Measuring geometrical changes of structure gauge

Shifting ballast beds or objects infringing the clearance profile pose hazards for rail vehicles. Railroad operators have to carry out inspections regularly to avoid rail vehicles being obstructed or being put at risk. The Clearance Profile Scanner CPS records clearance profiles fast and non-tactile. The optical system provides three-dimensional data in real-time using the track’s center line as reference. Tunnel surfaces or objects infringing the gauge profile are recorded and identified by software. Thus, maintenance teams receive very detailed information on the infrastructure.

Up to two million measurements per second

The CPS sensor is mounted at the inspection car’s front or back. A rotating mirror projects a high frequency modulated laser beam on the surroundings and detects the returning light. Phase shift technology is used to measure the time of flight (TOF) for determining the distance. The exact position of each measurement point is calculated from the measured distance value and the angle of the scanning mirror. A two-dimensional image is derived from the mirror’s rotational movement, the inspection car’s motion provides the third dimension. The system works at scanning frequencies in the range of 10 to 200 Hz with a sampling frequency of up to 2 million measurements per second. A computer, located inside the inspection car, evaluates and visualizes the data before sending it to the inspection car’s PC network.

Robust housing

The sensor unit comprises a fixed optical window and is located in a hermetically sealed housing. When not in operation, a...
A casing protects the sensor head from dirt or vandalism. Buffered vehicles can have a sensor head mounted on a slide, which is moved automatically into measurement position.

**Complete solution**

Additional sensors for compensating the vehicle’s roll are not required since the CPS itself identifies its position in relation to the track’s center line. This feature is provided by an additional software package. The CPS has been successfully deployed on measurement trains around the world for more than 15 years. The system is continuously being enhanced.

The clearance profile scanner’s design is in accordance with DIN EN 60825-1:2008. Internal calibration before every scan leads to precise and stable results – even at extreme temperatures and over long periods. The Clearance Profile Scanner CPS is eyesafe according to IEC60825.

### Technical Specifications

- **Measurement range**: 1 – 10 m (up to 30 m using a reduced bandwidth)
- **Distance resolution**: about 1 mm
- **Intensity resolution**: 12 bit
- **Uncertainty at an object reflectivity of 50 %**: 3 mm at 5 m (σ-value)
- **Uncertainty at an object reflectivity of 10 %**: 7 mm at 5 m (σ-value)
- **Scanning angle**: ≈ 350°
- **Scanning speed**: 10 – 200 revolutions per sec.
- **Measurement rate**: up to 2 million measurements per second
- **Number of measurements per profile**: 5000 (at 200 rev/s)
- **Point distance at 5 m**: 6.2 mm
- **Profiling density at 50 km/h**: one profile each 7 cm (at 200 rev/s)
- **Ambient temperature**: –20 °C to + 50 °C (in operation; temperature control included)

All specifications and features are subject to modification without notice.

### Railway Measurement Technology at 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 turnkey 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. Railroad measurement systems made by Fraunhofer IPM:

- High-Speed Profiler HSP
- Contact Wire Recording System CRS
- Contact Wire Inspection System CIS-LS
- Laser Pole Detection System LPS
- Wire Wear Monitoring System WWS
- Sector Profile Scanner SPS
- Rail Track Scanner RTS