

# Clearance Profile Scanner

**Precise, fast, robust, and non-contact**

*The CPS can be mounted on mobile platforms for different applications. Its compact sensor head is encapsulated in a robust housing for reliable operation under harsh environmental conditions.*

Capturing the 3D geometry of road environments is key to urban planning. For railroad operators, measuring structure gauge is part of predictive maintenance. Laser scanning is the ideal technology for these tasks and is widely used in mobile mapping. The Clearance Profile Scanner (CPS) by Fraunhofer IPM operates from mobile platforms and quickly and contactlessly records 3D data. The CPS-Plus version of the system provides data on surface moisture in addition to geometrical data.

## Infrastructure data in real time

The CPS quickly and precisely measures clearance profiles in road and rail environments. The optical system is typically mounted on the front or back of an inspection vehicle (e.g., a road car or train car) to provide three-dimensional data on gauge profiles. For railroad applications, the center line of the track is extracted from the data, and potential infringements are identified. In urban environments, the laser scanner collects valuable 3D data for infrastructure planning.

## Up to two million measurements per second

The CPS uses a rotating mirror to project a high-frequency, modulated laser beam onto the surroundings and detect the returning light. Phase shift technology is used to determine the distance. The exact position of each measurement point is calculated using the measured distance

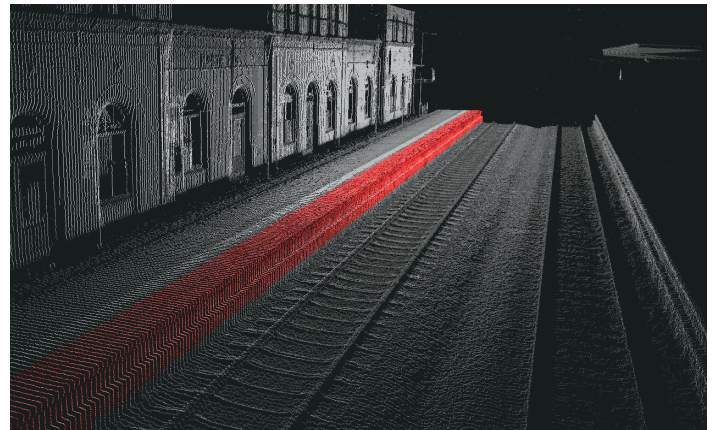
value and the angle of the scanning mirror. A two-dimensional image is derived from the mirror's rotational movement; the inspection car's motion provides the third dimension. The system operates at scanning frequencies ranging from 10 to 200 Hz, with a sampling frequency of up to two million measurements per second. Internal calibration before every scan guarantees precise and stable results, even at extreme temperatures and over long periods. A computer located inside the inspection car evaluates and visualizes the data before sending it to the PC network in the inspection car.

## Robust housing

The sensor unit contains a fixed optical window and is located in a hermetically sealed housing. The casing protects the sensor head from dirt and vandalism when it is not in operation. For buffered vehicles, the sensor head can be mounted on a slide that moves automatically into the measurement position.

## Railroad measurement systems by Fraunhofer IPM

Fraunhofer IPM develops optical measurement systems for monitoring and mapping rail infrastructure. Experts in optics, system designers, and electrical and software engineers work together to supply turnkey solutions for the special requirements of infrastructure operators, planners, and providers of surveying services. The robust measurement systems are used around the world and are characterized by their speed, precision, and reliability.



Above: The CPS's scanning data shows objects that interfere with the clearance profile (marked in red).

Left: (a) Exemplary grayscale point cloud section based on the intensity return of the LiDAR system. (b) The same section, but colored using moisture values ranging from blue (dry) to white to red (high moisture).

### CPS-Plus: Additional moisture detection

The extended version of the scanner, CPS Plus, uses two different wavelengths to measure the clearance. The difference in the signals allows the water content on the surface to be extracted at every measurement point without compromising the precision of the measured distance. This allows for reliable identification of vegetation and simultaneous detection of water ingress, a critical issue for the safety of civil engineering structures.

The CPS's design complies with DIN EN 60825-1:2008. It is eye-safe according to IEC 60825.

The system has been successfully deployed on measurement vehicles around the world for over 15 years and is continually being improved.

### Technical specifications CPS and CPS-Plus

|                                               |                                                     |
|-----------------------------------------------|-----------------------------------------------------|
| Measurement range                             | 1–10 m (up to 30 m, depending on reflectivity)      |
| Distance resolution                           | About 1 mm                                          |
| Intensity resolution                          | 12 bit                                              |
| Uncertainty at an object reflectivity of 90 % | 3 mm at 5 m ( $\sigma$ -value)                      |
| Uncertainty at an object reflectivity of 10 % | 7 mm at 5 m ( $\sigma$ -value)                      |
| Scanning angle                                | $\approx 350^\circ$                                 |
| Scanning speed                                | 10–200 rev./s                                       |
| Measurement rate                              | Up to 2 million measurements per s                  |
| Number of measurements per profile            | 10,000 (at 200 rev./s)                              |
| Point distance at 5 m                         | 3.1 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; temp. control incl.) |
| Moisture detection (CPS-Plus)                 | 10 levels of moisture                               |

All specifications and features are subject to modification without notice.

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