Fraunhofer IPM

Laser Pole Detection System

Determining the position of poles at 250 km/h

Typical arrangement of LPS sensor heads next to pantograph. The sensors provide location information to complement GNSS data and help locate defective sections.

For railroad network condition monitoring, various types of data are collected simultaneously. To easily find defective sections, maintenance teams need precise information on their location. The Laser Pole Detection System (LPS) by Fraunhofer IPM provides this exact information, complementing GNSS data.

Targeted condition monitoring and maintenance of rail networks involves measuring position and wear of wires, condition of tracks and contact force of pantographs. To find the identified defective sections, maintenance teams need precise location information. The LPS provides this information, complementing GNSS (Global Navigation Satellite System) data, which can experience local coverage problems.

Locating defective sections

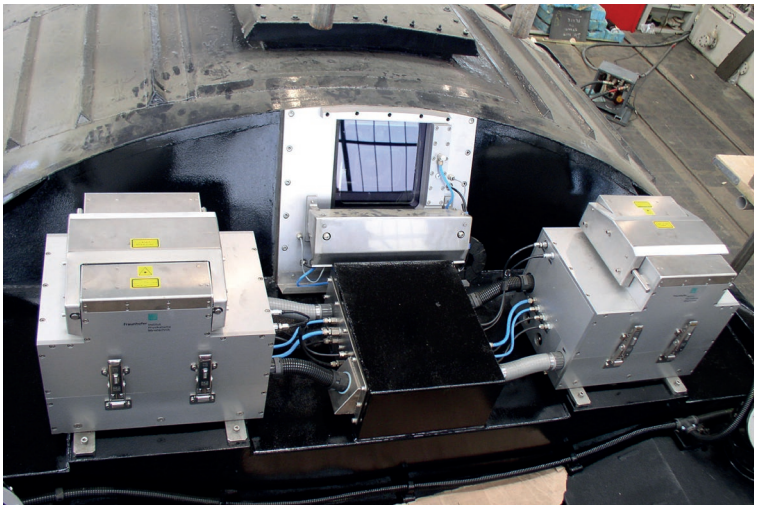
A defective section can be located by identifying the two poles that confine it. The LPS continuously detects the catenary wire support structure along the tracks, thus complementing other measurement data with precise pole locations.

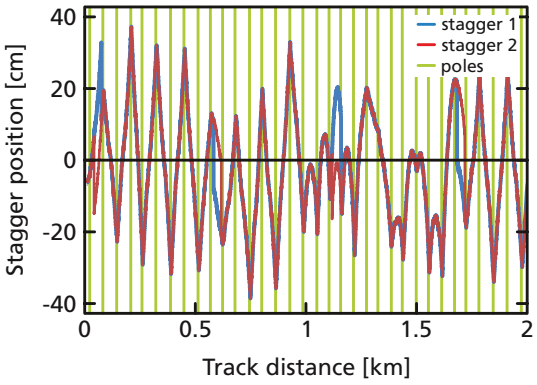
A laser distance measurement system forms the core of the LPS. The light from a high-frequency, modulated laser beam is reflected by objects and collected by a lens onto a detector. The phase of the detected signal differs from the emitted signal due to the time of flight of the light. The distance to the object is deduced from this phase shift.

The LPS consists of two acquisition units mounted side-by-side on the rooftop of the inspection car. Each unit contains two distance measurement systems, with beams directed vertically upward. A pole is detected when both laser beams from an acquisition unit are reflected simultaneously. This double reflection is caused by the pole's anchor arms, side holders, or cantilevers. In addition, the two sensors determine the distance to distinguish such objects from others objects further above. The values are digitized and transmitted as a serial data flow to the data processing unit inside the car.

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.





Left: The LPS sensor heads feature a robust housing and a remote controlled cover. Right: Exemplary measurement performed by the LPS on a section of 2 km.

Optimized protective design

The LPS does not require daylight and can carry out measurements in tunnels, under bridges, and in train stations without additional lighting. The system is fully encased and actively kept at a specific temperature to minimize climatic effects. Cleaning of the glass window is controlled from inside the inspection car. The sensor is protected by a pneumatically activated cover in case of extremely rough weather and when parked. Thus, the system does not require any maintenance over long periods.

Operation

The LPS is available as a standalone device or as part of the Contact Wire Inspection System (CIS). The CIS multi-sensor system combines measurement technology for wire wear and wire position.

The LPS is in operation in many countries around the world, including Austria, Belgium, Brazil, Finland, Great Britain, Hong Kong, Indonesia, Malaysia, the Netherlands, and Romania.

Technical specifications

Measurement method	Laser distance measurement
Measurement range	0.5 – 4 m
Diameters detected (e.g. of anchor arms)	12 – 200 mm
Measurement rate	> 62,000 measurements per s
Vehicle velocity range	5 – 250 km/h
Application area	Open sky, bridges, tunnels, regular catenary or conductor rails
Ambient temperature	–20 °C to 50 °C (in operation) –20 °C to 70 °C (in storage)
Laser class	III R
Eye safety	Laser is automatically switched off at speeds below 5 km/h

All specifications and features are subject to modification without notice.

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