

Pavement Profile Scanner

Measuring road surfaces

Fast, precise and robust

The laser scanner PPS creates a high-resolution 3D image of the road surface at high traveling speeds.

Good condition of road surfaces is important for the safety and comfort of road-based traffic. The Pavement Profile Scanner PPS by Fraunhofer IPM provides high-resolution 3D-data for pavement management systems.

Pavement management systems (PMS) prove to be valuable tools for constantly monitoring the road condition and planning repairs or renewals. These systems operate based on highly precise measurement data of the road surface. The laser-based system for road surface measurement PPS provides measurement data for PMS, detecting small irregularities on the pavement's surface even at high traveling speed.

Unachieved precision at high speed

The core of the PPS is a laser scanner that measures with hitherto unachieved precision, resolution and speed. Mounted on a measuring vehicle about three meters above the road surface, it scans over a width of approximately four meters with submillimeter precision, even at 80 km/h. The scan provides a three-dimensional image of the road's surface, from which conclusions on its condition can be drawn. The PPS' high performance is made possible by the

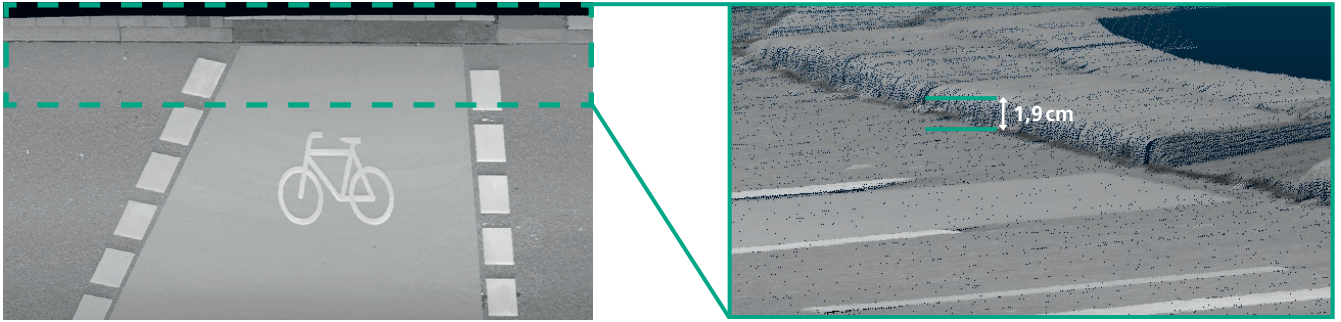
use of phase shift technology. This technology, used in many mobile scanning applications, allows for higher measurement rates if compared to e. g. pulsed time-of-flight (TOF) technology. The scanner is integrated into a robust, shock proof IP67 housing, so that 24/7 use even in harsh environments is possible.

800 profiles per second

In road surface measurement, precision requirements are high: Averaged over small surface elements, typically of 2 cm × 2 cm or 10 cm × 10 cm, extreme height resolution of a few tenths of a millimeter is required. Only by combining high accuracy, high measurement rates and high scanning speeds can these requirements be met. The PPS scans the street surface crosswise from the measuring vehicle's forward movement using a rotating polygon mirror. In this way, it creates 800 transverse profiles per second. The distance to the street surface is measured up to

3D data acquisition: Comprehensive process

Fraunhofer IPM develops optical measuring systems for infrastructure monitoring. The systems are designed for examining the condition of road surfaces (PPS) and mapping urban surroundings (CPS). Integrated into one single system (MUM), the measuring vehicles enable efficient digitization of urban planning processes. This also comprises AI-based tools for automated data interpretation (3D-AI) adapted to the hardware employed and designed for specific application scenarios.



Left: The dense point cloud acquired by the PPS provides a photorealistic image of the road surface (grayscale value = backscattered intensity). Right: The 3D data allows precise measurement of the road surface.

two million times per second, resulting in up to 1,800 measuring points per profile. Even at a speed of 80 km/h, a surface element of 10 cm × 10 cm still contains up to one hundred 3D measurement points. No other laser scanner currently on the market offers such a high point density together with precision, while still categorized laser class 1.

The Pavement Profile Scanner PPS is eye-safe according to IEC60825. Since May 2012, the PPS is certified by the German Federal Highway Research Institute (BASt) for the measurement of transverse road evenness.

Technical specifications PPS

Acquisition range	
• Unambiguous measurement range	1.2 m
• Within a distance of minimum	1.0 m
• Within a distance of maximum	10 m
Sampling rate: distance / intensity	2 MHz / 2 MHz
Resolution of intensity measurement (at 80 km/h driving speed, 3 m mounting height)	4.5 mm × 28 mm
Standard deviation (distance measurement) of the mean value of 100 points (3 m mounting height)	
• 80 % reflection	< 0.15 mm
• 20 % reflection	< 0.3 mm
Acquisition angle	70°
Scanning frequency	25–800 Hz
Data interface / Scanner status indication	Gigabit Ethernet (optical) / LED upon request
Other interfaces	
IP class	67

All specifications and features are subject to modification without notice.

**CLASS 1
LASER PRODUCT**

Contact

Prof. Dr. Alexander Reiterer
 Head of Department
 Object and Shape Detection
 Phone +49 761 8857-183
alexander.reiterer@ipm.fraunhofer.de

Dr. Philipp von Olshausen
 Group Manager Mobile Terrestrial Scanning
 Phone +49 761 8857-289
philipp.olshausen@ipm.fraunhofer.de

**Fraunhofer Institute for Physical
 Measurement Techniques IPM**
 Georges-Köhler-Allee 301
 79110 Freiburg, Germany
www.ipm.fraunhofer.de

