



1 With underwater infrastructure growing rapidly, efficient and reliable technology for infrastructure monitoring is in demand.

2 The laser scanning system ULi can be mounted on a broad range of carrier platforms for inspecting underwater infrastructure.

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UNDERWATER LIDAR SYSTEM ULi

Underwater infrastructure is being expanded worldwide, with construction complexity and the safety requirements constantly increasing. Against this backdrop, solutions for precise and highly resolved underwater infrastructure monitoring are in great demand. Optical ranging systems offer the possibility to capture the seabed and complex underwater structures. The laser-based mapping system ULi (Underwater LiDAR System) from Fraunhofer IPM inspects large underwater structures using the time-of-flight (TOF) method, which has been adapted for use in turbid water.

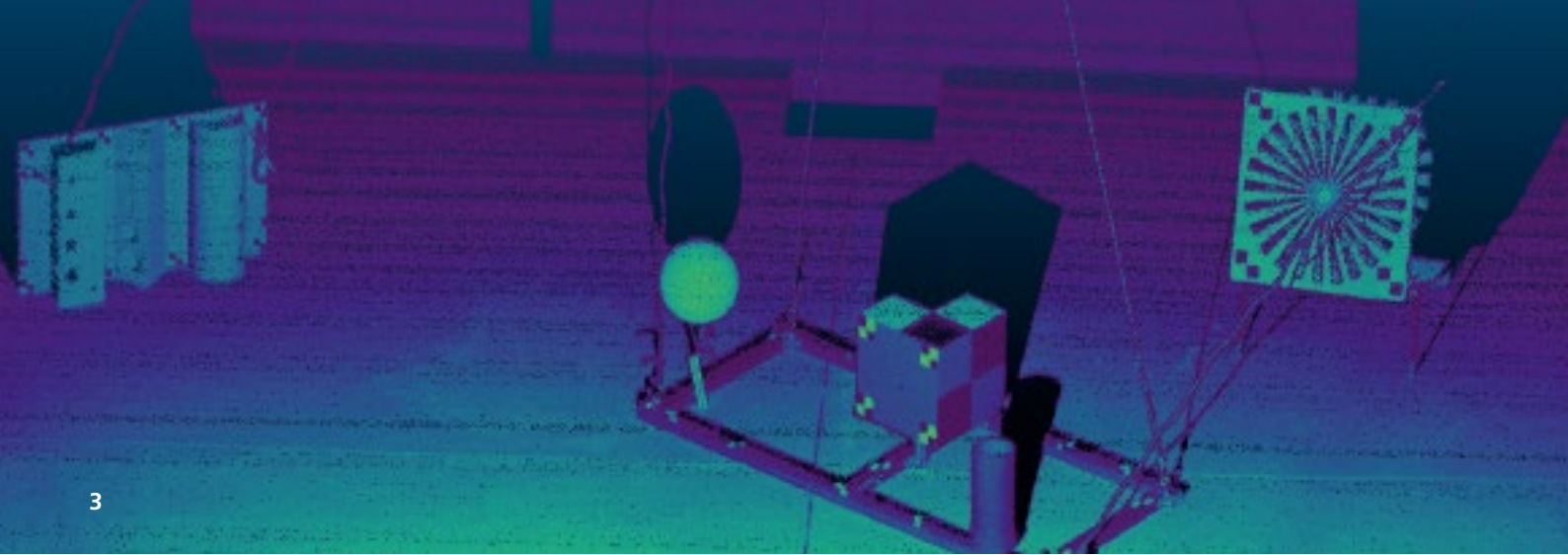
Long range and high resolution even in turbid water

The measurement system records 3D structures over distances of up to several tens of meters. This means that the range of ULi in turbid water is at least three times larger compared to other optical systems. The resolution is in the centimeter range, i.e. at least ten times higher than the resolution of sonar

systems. In addition to the measurement technology, the scanning system includes novel algorithms for fast and reliable data evaluation and data interpretation.

Efficient static and dynamic scanning of large areas

The ULi sensor can be operated statically or on underwater inspection vehicles such as ROVs or ships. A rotating mirror projects a laser beam on the surroundings and detects the returning light. Pulsed TOF technology is used to measure the distance from the scanner to the object. 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 ROV's motion provides the third dimension. The system works at scanning frequencies in the range of 10 to 800 Hz with a sampling frequency of up to 40,000 points per second and a scanning angle between 70° and 110°. In its current



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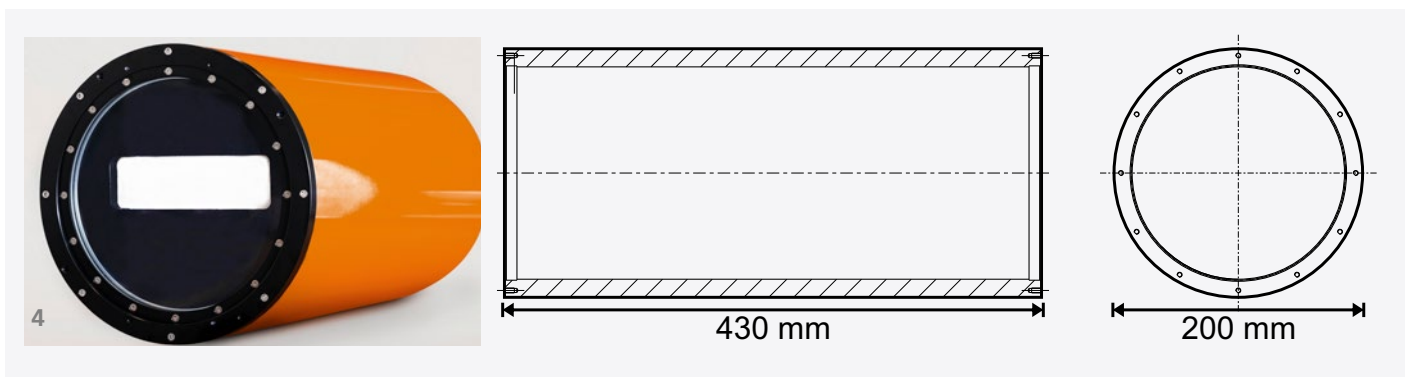
version, ULi records 1,000 points per square meter at a distance of 10 m. This results in a typical lateral resolution of 2 cm in the moving direction and 5 cm along the scan line. Range and precision strongly depend on the water quality. In clear water, up to 50 m scanning range and 6 mm precision are achievable. In turbid water, a measurement range of at least two times the Secchi depth is feasible.

Customization and implementation

The system is eye-safe above sea level (class 1). Upon request, ULi is customized according to the application by adapting the scanner's opening angle, the measurement or scanning rate. The system is implemented in close cooperation with the end user. Design and integration are carried out in coordination with the ROV manufacturer.

3 Test objects in a testing tank. ULi measures with a precision of approx. 6 millimeters.

4 The ULi underwater LiDAR system in its robust housing. The plug-and-play system can be mounted on various platforms.



Technical specifications

Measurement range	1 – 50 m, > two times the Secchi depth
Distance precision (one sigma)	6 mm
Laser class	Class 1 in air, class 3B subsea
Laser wavelength	~ 530 nm
Scanning angle	70° – 110°
Scanning frequency	10 – 800 Hz
Measurement rate	up to 40,000 measurements per s
Number of measurements per profile	400 at 100 profiles per s
Point distance at 10 m	5 cm at 100 profiles per s and 90° scanning angle
Profiling density at 2 m/s	one profile each 2 cm (at 100 rev. pers)
Power consumption	170 W in operation
Ambient temperature	0 °C to + 50 °C

All specifications and features are subject to modification without notice.