

# Underwater LiDAR System

## Optical inspection of underwater infrastructure

**Long range, high precision 3D mapping**


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. The Underwater LiDAR System ULi from Fraunhofer IPM inspects large underwater structures using the pulsed time-of-flight (ToF) method.

### Long range and high resolution even in turbid water

Optical ranging systems offer the possibility to capture the seabed and complex underwater structures. For the Underwater LiDAR System ULi, the pulsed time-of-flight (ToF) method has been adapted for use in turbid water. The measurement system captures 3D structures over distances of up to several tens of meters. This means that its range in turbid water is up to three times larger compared to other optical systems. With precision in the millimeter range, the sensor outperforms conventional sonar systems by a factor of ten. In addition to the measurement technology, the scanning system includes algorithms for data processing.

### Efficient static and dynamic scanning of large areas

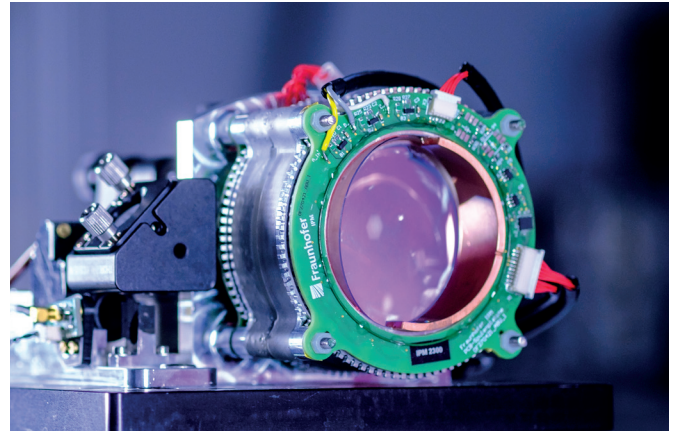
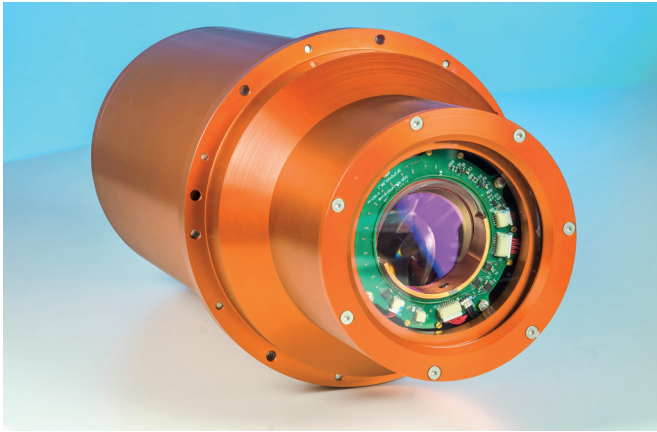
The ULi sensor can be operated statically or on underwater inspection vehicles such as ROVs or ships. Two rotating wedge prisms project a laser beam on the surroundings and detect the returning light. Pulsed ToF technology is used to measure the distance from the scanner to the object. The exact position of each measurement point is calculated from the measured distance value and the angle of the scanning prisms. The backscattered signal is recorded at the detector in its full signal form in order to perform sophisticated analyses in post-processing.



*The Underwater LiDAR System ULi can be mounted on a broad range of carrier platforms for inspecting underwater infrastructure.*

### Advantages at a glance

- High precision 3D mapping of underwater structures
- Precision in the mm range
- For use on ROVs or ships
- Measuring distances of up to several ten meters
- Static or mobile application
- Customized according to individual application



*The Underwater LiDAR System ULi with and without its robust housing. The plug-and-play system can be mounted on various platforms.*

The system works at scanning frequencies in the range of  $2 \times 25$  Hz with a sampling frequency of up to 100,000 points per second and a scanning angle of up to  $44^\circ$  in water. The rotating prisms allow the entire field of view (FoV) to be captured without moving the ULi sensor. The shape of the FoV can be linear, circular or planar. It can be dynamically adapted to the individual application. Range and precision strongly depend on the water quality. In clear water, several tens of meters scanning range and submillimeter precision are achievable. In turbid water, a measurement range of two times the Secchi depth is feasible.

### Customization and implementation

Upon request, the ULi sensor can be customized according to the application by adapting the scanner's opening angle, the measurement or scanning rate. Housing size and diving depth are also customizable. Fraunhofer IPM adapts the system for either stationary or mobile use on ROVs or ships in close cooperation with the end user. Adjustable interfaces allow for application-specific design and integration.

### Technical specifications

Laser	532 nm wavelength; Class 3B laser product according to EN 60825-1:2014
Laser pulse repetition rate	100 kHz
Scanning unit	Rotating double wedge prism ( $44^\circ$ field-of-view)
Scan pattern	Adjustable: linear, circular, planar
Depth rate	300 m (higher depth feasible depending on housing)
Housing	Suitable for operation underwater, customizable
Dimensions	$\varnothing$ 172 mm, L 375 mm (w/o connectors)
Weight	10 kg in air, approx. 4 kg in water
Interfaces	Ethernet control interface, PTP or PPS + NMEA time synchronization, power supply (6 s LiPo battery), connector as required

*All specifications and features are subject to modification without notice.*

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