



- 1 3D data of an area of several 100 square meters are detected, processed and visualized in less than 10 minutes.
- 2 Mounted on UAVs, laser scanners and cameras measure large, complex surface structures fast and precisely from the air.



## LIGHTWEIGHT AIRBORNE PROFILER LAP

Due to the rapid technical progress unmanned aerial vehicles (UAVs) are becoming more and more attractive for the civil sector. Measurement systems carried by UAV capture large areas and complex structures.

module. Power consumption of the integrated system is below 30 W.

### Eye-safe laser scanner detects up to 1000 measurement points per profile

The system's core component is an eye-safe laser scanner with a working range of 300 m. The lower operating range is fixed at 2.5 m. Relative accuracy of the laser scanner is 15 mm at a resolution of 1 mm for a single scan, at averaging over 16 scans relative accuracy is about 4 mm. The scanning angle can be changed to any value up to 90°. The angular resolution is at about 0.09°. With each profile, up to 1000 points can be detected. Up to 32 profiles are recorded within one second.

By using the pulsed time-of-flight (TOF) technique, several backscattered echoes can be detected, which allows for the separation of objects hidden one behind

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### Fast and efficient: 3D detection via UAV

The Lightweight Airborne Profiler LAP was developed by Fraunhofer IPM for application on airborne platforms. Local orientation of the LAP is based on a combination of IMU (inertial measurement unit) and GNSS (global navigation satellite system). Cameras are used to ensure orientation in case of shaded and complex structures with poor or no GNSS reception. The precision achieved depends on the system's respective components and typically lies in the range of a few centimeters. To guarantee synchronous data acquisition and recording, the LAP comprises a fast processing unit and a removable storage



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the other. Since the divergence of the laser beam in horizontal direction roughly corresponds to the angle of aperture, the field of view is scanned completely. The laser footprint has a size of 2.8 cm × 5.6 cm at a distance of 40 m.

### Combination of cameras in a special set-up

The system's two cameras provide image information in addition to the data acquired by the laser scanner. The cameras with a resolution of 9 MP each are positioned on a slant, inclined towards each other, capturing the measurement area with a small overlap. The image data is combined with

the scan data, which allows generating so-called depth images. Employing two cameras results in a combined aperture angle of 45°. A resolution of 1.1 cm per pixel is achieved at a flight altitude of 80 m.

### Customization and implementation

Upon request, the LAP is customized according to the application by adapting cameras (resolution/spectral range), positioning and orientation systems. The system is implemented in close cooperation with the end user. Design and integration are carried out in coordination with the UAV manufacturer.

3 Point cloud of Black Forest landscape acquired by LAP.

4 Laser scanner and cameras are integrated into a compact housing.

### Open interfaces

All LAP sensors create data in open data formats (such as LAS). Additionally, all software interfaces can be adjusted individually, so that fast and easy-to-handle control of all components with proprietary programs is guaranteed. This makes LAP the ideal basis for application in research and development.

#### Technical data: scanner

**CLASS 1  
LASER PRODUCT**

Operating range	2.5–300 m (at 100% remission) 2.5–95 m (at 10% remission)
Resolution	1 mm
Precision (1σ)	4 mm (strong signal), 15 mm (weak signal)
Laser	905 nm (wavelength), laser class 1
Measuring frequency	up to 60 kHz
Divergence	0.5 mrad × 1.67 mrad (0.028° × 0.093°)
Laser footprint	12 × 18 mm <sup>2</sup> (spot near window)
Scanning angle	up to 90° (adjustable)
Angular resolution	0.09° or 0.18° adjustable
Scanning frequency	min. 30 Hz/1 000 px (normal mode); min. 60 Hz/500 px (fast mode)

All specifications and features are subject to modification without notice.

#### Technical data: camera

Number of cameras	2
Resolution	4 112 px × 2 176 px
Opening angle	adaptable acc. to lens, typ. 31,7° horizontal, 17,1° vertical
Image frequency	typ. 1 Hz (max 5 Hz)
Acquisition mode	RGB

#### Integrated system

Dimensions	276 × 178 × 154 mm <sup>3</sup>
Total weight	approx. 2 300 g (depending on selected components and type of housing)