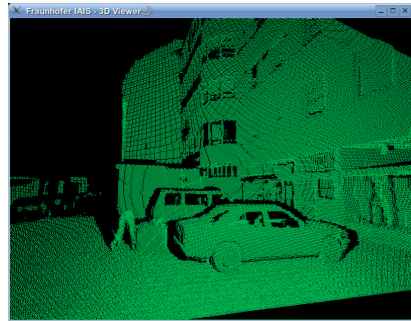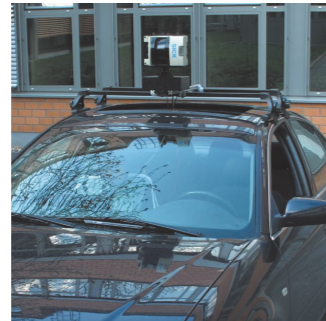## 3DLS-K Software and Applications

3D Viewer, scatter plot

3DLS-K on a car

3DLS-K on VolksBot®
www.volksbot.de

3DLS-K Configurations:
The 3DLS-K can be equipped with on (K1) or two (K2) 2D scanners.

3DLS-K Technical Data

Dimensions (mm)	500 x 320 x 500 (W x H x D)
Weight	K1: 8,5 kg; K2: 13 kg
Power supply	24 V DC; K1: 1,3 A; K2: 2,2 A
Horizontal scan angle	360° (full range)
2D scan angle	180°
Scanner mounting	0° (horizontal) to 90° (vertical)
Number of data points (K2)	16,200 with 4° resolution, 1,036,800 with 0,25° resolution
3D scan time (K2)	variable: from: 0,6 s (4° res.), to: 38,4 s (0,25° res.)

Product Highlights

Hardware	Powder-coated mounting system with a Maxon motor 2 USB to serial converter for scanner connection serial RS232 interface for motor control
Scanner options	SICK LMS-200 (indoor) SICK LMS-291 (outdoor)
Software	3D scanner API and application examples 3D Viewer
System requirements	Linux Windows XP

A player driver for 3DLS is in the process of being developed. Player is a popular open source robot control software framework that allows for easier integration and application development. For more information about Player please visit http://playerstage.sourceforge.net/

Sales, Research and Development

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Informationssysteme

IAIS

3DLS-K*
Continuously rotating 3D Laser Scanner

Sensor module for indoor and outdoor 3D sensing applications:
Cost effective exploration, mapping and surveillance

www.3d-scanner.net

3D Laser Scanners-K

… capture surfaces in the form of three-dimensional point plots. They provide quick, precise and cost-effective three-dimensional scanning of scenes and objects. The fields of application include map building, surveying of rooms and spaces, building surveillance, tunnel or mine inspection and many more. Mounted on mobile robot platforms our 3DLS-K can capture dangerous or unreachable space automatically or teleoperated.

3DLS-K

www.3d-scanner.net

The 3DLS-K Concept

- continuously rotating 2D laser scanner for indoor and outdoor applications
- applicable with one or two 2D laser scanner
- Range: 360° horizontal, 180° vertical
- generates 3D point clouds with up to 1,036,800 distance values per 360° turn
- generates reflectance values for visualization and pattern recognition
- generates reflectance values and distance values simultaneously in one 3D scan
- designes for robotic applications

3DLS Sensor Modalities

The range and reflectance data (see images on the left) have been recorded during one single 3D scan. The upper image shows grey coded distance values, close regions in bright colors. The lower image shows the same scene but here bright regions correspond to high reflectance data while dark regions correspond to low object reflectance within the spectral range of the scanner. The nearly photographic reflectance image is almost fully independent of external lighting conditions which support pattern recognition tasks. Since each pixel in the reflectance image directly correspond to a distance and a 3D value, the scanner offers new possibilities to multi-modal object recognition.

Captured in one scan: Range values plus…

The regular spherical distortion is caused by the rotating scanner mirror and by the inclining movement of the scanner and can be corrected using our 3DLS software.
The 3D Viewer shows corrected point clouds. The maximum range of the scanner can be limited to improve the discretization e.g. typically to 8 m for indoor applications. For outdoor applications, we recommend the outdoor version of the SICK scanner. This version has a maximum range of 320 m and is typically used for distances between 32 and 80 m.

… photograph like reflectance image

3DLS R&D Services

In our capacity as a leading research institute in the field of robotics and three-dimensional scanner-based methods and applications we offer a wide array of services including: Fast scan matching, closedloop 3D map generation, 6D simultaneous localization and mapping (6D SLAM) as well as consulting and R&D services for customized development of 3D sensing and 3D software for use in both mobile and stationary applications.

3DLS Software

The 3DLS software comes with all the tools for configuring the SICK scanner and application programmer interfaces (APIs) that are required for integrating the 3DLS control software into the customer's own applications. The scope of delivery also includes application examples of how to use the APIs and a 3D Viewer (see image on the right) for displaying 3D scatter plots from selectable viewing positions. This provides an easy way of moving a virtual camera through the virtual 3D "world". Software and hardware documentation is included on CD-ROMs. Up-to-date information on new software releases is available at www.3d-scanner.net
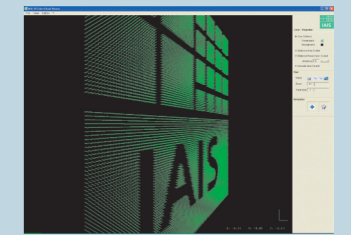
3D-Viewer

3DLS-K for Robot Platforms

3DLS can be integrated into any robotic platform that is capable to carry the payload, that provides the necessary power supply and that has an onboard computer able to run the 3DLS software. 3DLS has been integrated on the VolksBot® (www.volksbot.de) and KURT2 (www.kurt2.de) platforms. KURT2 with the standard version of the 3DLS won the vice world championship at the 2004 RoboCup Rescue Competition.

Automatic 3D map building with the mobile robot VolksBot and the 3DLS-K

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3DLS-K Connector Pane

1 or 2 USB uplink connector	for scanner data
1 RS232 9 pin Sub-D connector	for motor control signals, (turning speed)
1 5-pin M12 round connector	for 24 V DC

The 3DLS offers a varierty of connection options

3DLS Applications in Robotics

… covers from map building, map based autonomous navigation to simultaneous localization and mapping (SLAM). Robots like VolksBot® or KURT2 drive through the enviroment and acquire overlapping 3D scans with the 3DLS. Based on the robot odometry data, the different 3D scans are automatically registered in a common coordinate system and the robot position estimation is updated.

Roundtrip of an IAIS-Robot and…

the corresponding closed-loop 3D map seen from above, generated online from dozens of individual 3D scans