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Velodyne's 3D LiDAR Sensor Helps European Commission Joint Research Centre Win Indoor Localization Competition

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JRC Outshines 27 Others at Microsoft Event; Velodyne HDL-32E Sensor Showcased in System Designed to Inspect Nuclear Facilities Worldwide

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A team of researchers from the Joint Research Centre (JRC), the European Commission's in-house science service, has outperformed a global mix of 27 teams from academia and industry, achieving the best overall result at a recent Microsoft-sponsored indoor localization competition in Seattle – and 3D, real-time LiDAR sensor technology from Velodyne proved to be key to the victory.

JRC's backpack-mounted STeAM system featuring Velodyne HDL-32E

Velodyne is the worldwide leader in the development of real-time, 3D LiDAR sensors for robotics, autonomous vehicles and an array of other applications, including mobile mapping and UAVs. With a continuous 360-degree sweep of its environment updated up to 20 times per second, Velodyne's lightweight sensors capture data at a rate of almost a million points per second, within a range of 100 meters.

The competition, organized annually by Microsoft, gathers teams to evaluate the performance of various localization systems. Providing accurate position information on people and objects indoors, where GPS signals are not available, has long been a challenge for governments and industry. The competition was carried out in two categories -- infrastructure-based systems, pegged to installed radio beacons, and infrastructure-free systems, which rely only on

sensor readings. The JRC competed in the infrastructure-free category, where it finished in the top spot, with a localization error of 0.2 m, which also surpassed the best result in the infrastructure-based category.

For the competition, the JRC used its proprietary Sensor Tracking and Mapping (STeAM) system, a backpack-mounted device that integrates Velodyne's HDL-32E real-time, 3D LiDAR sensor, which acquires 10 frames per second as the user explores the environment. The on-board software processes the 3D data, generating the current location and a map of the environment in real-time. A patent application for JRC's technology is pending.

The JRC developed STeAM for nuclear safeguards applications to provide location information and change monitoring inside nuclear facilities. The system can enable nuclear inspectors to associate all measurements and observations made during an inspection with the corresponding location within the nuclear facility and thereby facilitate subsequent analysis and future inspections. Furthermore, by comparing the 3D maps generated at two subsequent facility inspections, STeAM can highlight structural changes that might be indicative of undeclared modifications or additional capacities within this facility. The JRC creates tools for inspectors from Euratom, Europe's nuclear monitoring agency, and the International Atomic Energy Agency (IAEA), which inspects some 700 facilities worldwide each year. For more than a decade, the JRC has been working with 3D laser scanning technology, to verify design information within nuclear facilities.

"With the LiDAR-equipped backpack system, our team was able to gather and process 3D data in real time, for immediate feedback– and that's why it was possible to win the Microsoft competition," said Erik Wolfart, Scientific Officer at the European Commission, Joint Research Centre, in Ispra, Italy. The STeAM system will be deployed for a facilities inspection in November 2015 for the first time. "In the past, it took a team of eight inspectors one week, using scanners in fixed positions. Enlisting a two-person team for a single day will be so much faster and more efficient."

"As this application shows, mobile 3D LiDAR is the new, critical element to effective and efficient inspections of nuclear facilities all over the world," said Wolfgang Juchmann, Ph.D., Velodyne Director of Sales & Marketing. "The mobility of our sensors – the HDL-32E and especially the VLP-16 LiDAR Puck – means faster inspections, and the 360 degrees of freedom our sensors deliver is ideal for mobile/backpack based data-gathering inside large closed rooms. While Velodyne is already the established leader for vehicle based mobile mapping, backpack based indoor mapping, without GPS accessibility, opens the door to scanning buildings from the inside, and leads to an array of new and exciting applications."

About Velodyne LiDAR
Founded in 1983 and based in California's Silicon Valley, Velodyne Acoustics, Inc. is a diversified technology company known worldwide for its high-performance audio equipment and real-time LiDAR sensors. The company's LiDAR division evolved after founder/inventor David Hall competed in the 2004-05 DARPA Grand Challenge using stereovision technology. Based on his experience during this challenge, Hall recognized the limitations of stereovision and developed the HDL-64 high-resolution LiDAR sensor. Velodyne subsequently released its compact, lightweight HDL 32E sensor, available for many applications including UAVs, and the new VLP-16 LiDAR Puck, a 16-channel real-time LiDAR sensor that is both substantially smaller and dramatically less expensive than previous generation sensors. Market research firm Frost & Sullivan has honored the company and the VLP-16 with its 2015 North American Automotive ADAS (Advanced Driver Assistance System) Sensors Product Leadership Award. Since 2007, Velodyne's LiDAR division has emerged as the leading

developer, manufacturer and supplier of real-time LiDAR sensor technology used in a variety of commercial applications including autonomous vehicles, vehicle safety systems, 3D mobile mapping, 3D aerial mapping and security. For more information, visit http://www.velodynelidar.com. For the latest information on new products and to receive Velodyne's newsletter, register here.

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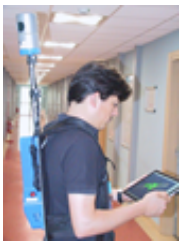
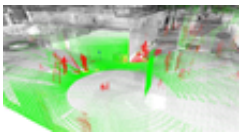


Tablet and backpack working in tandem, in an indoor facility

Deployment of the Velodyne LiDAR-based STeAM localization system



STeAM-generated real-time map of the facility, using LiDAR data

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