Can a laser scanner drive a car?

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A car that navigates city streets without a driver – steered only by a computer? That might seem impossible to many. But researchers from Fraunhofer and the FU Berlin are presenting such an automated vehicle at this year's Hannover Messe on April 21 through 25, 2008. Its core element is a three-dimensional laser scanner.

Can a computer steer a car through a city without a driver's help? The 'Spirit of Berlin', a vehicle developed jointly by researchers at the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS in Sankt Augustin and their colleagues at the Freie Universität Berlin, proves that it is possible.

The vehicle, which will be on display at this year's Hannover Messe, made it to the semi-finals of the 'DARPA Urban Challenge' competition entirely alone –without a driver or a remote control. The Urban Challenge for unmanned vehicles is organized by the Defense Advanced Research Projects Agency (DARPA), the research arm of the United States Department of Defense. In November 2007, the third edition of the event was held at the site of a former air force base in California for the first time.

One of Spirit of Berlin's most important sensors is a rotating 3-D laser scanner that was developed at the Fraunhofer IAIS. The scanner classifies the navigable route and is able to distinguish the street from footpaths, parking lots, houses and pedestrians. "The scanner, which is fixed to the roof of the car, constantly moves laser beams back and forth through a mirror on a vertical axis – it moves the laser beam from top to

bottom and back again," explains IAIS project manager Dr. Hartmut Surmann. "If anything gets in the way, such as a pedestrian, the laser beam is reflected and sent back to the scanner. The software analyzes the information while the car is in motion and steers the vehicle in the right direction. The system comprises two back-to-back laser scanners that rotate in the same way as the flashing lights on police cars and are thus able to 'see' all of the car's surroundings." The lasers can record two complete images per second. One of the challenges involved is to keep adjusting the recorded values to allow for the distance covered. "At a speed of 36 kilometers per hour, the car moves 10 meters per second. Consequently, the measured data must constantly be adjusted to the car's current position," Surmann explains.

Does the new automated vehicle mean that the driver's license will one day become a thing of the past, and that people can sit back and enjoy the ride without taking notice of traffic? "That's quite unlikely," Surman says. "At a price of 17,800 euros, the scanner is much too expensive for use in private vehicles, even though it is significantly cheaper than conventional models. The main purpose of taking part in this competition was to show what computers are capable of doing when they have the right sensors, such as laser scanners and cameras."

But where are these laser scanners in use today? "Among other things, our laser scanners are applied to assess the visibility of advertising billboards," says the scientist. The scanner determines from which perspective the billboard is visible, and whether the view is partially obscured by a tree or a streetlight. It also identifies the point from which someone driving by can see the billboard. Within seconds, the laser beam scans the entire area and delivers the desired information at an aperture angle between 120 and 180 degrees – similar to a panoramic photograph. The difference is that a picture does not provide the observer with any information on spaces and distances, but a laser scan does. "This makes it possible to determine quality criteria for the

placement of a billboard, which could be reflected in the price. A billboard that can be seen in its entirety from any angle can be rented at a higher price than a board that passers-by can only see from one angle," says Surmann.

3-D laser scanners can also be beneficial in the realm of freight transport, as they can help determine how much space a transporter has, where street lights are in the way, which bridges are too low and which tunnels are too narrow. While digital street maps do exist, they provide no information about available space. By driving the transport route beforehand in a car that is equipped with a laser scanner, it easy to create an exact model of the surroundings.

According to Surmann, the IAIS 3-D scanner's biggest advantage is its price: The device only costs a third of what conventional 3-D scanners cost. This has made a number of new applications possible that were previously unprofitable for cost reasons.

Source: Fraunhofer-Gesellschaft