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LIDAR: A Technology Overview and the Role of Diffuse Reflectance Targets in Testing & Calibrating Advanced Driver Assistance Systems (ADAS)

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LIDAR is an established technology that is being increasingly deployed in consumer products and in driverless vehicles. LIDAR is an acronym for Light Detection and Ranging. LIDAR systems have been used for over 50 years but until recently the costs for such systems have kept them from being viable in mass market applications.

Although Radar is a popular technology used in autonomous vehicle technologies, for example in adaptive cruise control systems, LIDAR is considered the sensor of choice in driver assisted cars when it comes to accuracy of mapping positions and distances, enabling detection of small objects and 3D imaging. It uses pulsed laser and solid-state light with time of flight sensing to measure distances. Characterization of LIDAR systems requires compensating the sensor response to the pulsed laser or solid-state light levels over a broad dynamic range of reflectance levels. This in turn requires the use of large area reflectance targets of known and stable reflectance. Labsphere's Permaflect diffuse reflectance coated targets, ranging from 5% to 94% reflectance, enable automaker OEMS and their suppliers to characterize and calibrate their LIDAR systems over a broad range of environmental conditions.

The Technology of LIDAR

The most basic form of LIDAR is the laser rangefinder which has been widely used in military applications since the 1980s. Laser rangefinders consist of a pulsed laser (emitter) and a photodetector (receiver). The rangefinder is designed to allow for distances to be accurately measured (so-called "ranging") and they rely upon measurement of the time taken for the laser pulse to be reflected and received back at the detector (this is referred to as a "time of flight" measurement).

The rangefinder is directed at a target and a laser pulse is emitted. The laser light strikes the target, is scattered and a proportion of the reflected light is measured by the detector. As the speed of light is very precisely known, the distance between the rangefinder and the target can be measured very accurately. More advanced LIDAR systems use the same principle but use optics and moving or multiple detectors to map targets in two dimensions. These systems typically pulse thousands of times a second, allowing for thousands of points to be detected each second. Analysing the data of this point cloud creates accurate maps of the target area. The way LIDAR works is analogous to Radar and Sonar, which use radio waves and sound waves, respectively. The data from Radar and Sonar can be used to map surroundings in a similar way, but LIDAR systems employ shorter wavelength infrared radiation compared to longer wavelength radio waves. As a consequence of the shorter wavelengths used, LIDAR measurements are more accurate than Radar.

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LIDAR is a key enabling technology together with camera systems and other sensors in automation applications. This white paper instructs on the role of diffuse reflectance targets in testing and calibrating LIDAR systems used in consumer electronics products and autonomous vehicles.

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