LIDAR

LiDAR is a method for distance measurement. The name stands for Light Detection and Ranging. Basically, it’s a version of radar but instead of radio waves, it uses light. That would be the most basic explanation.

The LiDAR device consists of a range measurement sensor that repeatedly emits a pulse of light. After the light hits a target, it is reflected back to the sensor which then determines the distance to the object by measuring how long the light needs to meet the target and return.

In addition, the range measurement sensor is placed on a rotating platform which enables the device to take readings at multiple points within 360 degrees. As the sensor spins, range measurements are taken quickly (up to about 10000 samples per second), providing a two-dimensional view of the entire robot’s surroundings.

The result of a 360-degree view sweep along with taking multiple range samples is a raw map. The next step in this process is to take the 360-degree scans and gather them into a more complete map. When the robot moves in its environment, it can determine where it is in relation to the present and previously scanned data (the localization process) and then, performs new scans and adds them to the map. This is where the process’ name came from, that is, “Simultaneous Localization and Mapping” (SLAM).

Combined with mechanisms that move the laser in a plane or another pattern, users are provided with a series of distance readings at different angles and/or directions. Based on this 2D or 3D range data, users can convert radial coordinates to Cartesian ones and, as a result, create a 2D or 3D contour map of the scene.

Long story short – the way most LiDARs work is calculating the distance to an object by illuminating it with a number of transceivers. Each transceiver rapidly sends pulsed light and measures the reflected pulses in order to determine distance and position.

**Pros and cons of the LiDAR device**

Now that we’ve covered the basics, let’s find out what some pros and cons of LiDAR are.

The incredible speed at which light travels requires highly accurate laser operation to track the distance from the robot to each target with utmost precision. That’s what makes LiDAR perfectly suited for both **fast and accurate scanning** (accuracy of 0.15-0.25 m). But, it only applies to what it is able to see. One of the major cons of 2D LiDAR is that if one object is obscured by another at LiDAR height, or an object has an inconsistent shape that doesn’t have the same width throughout the body, **this information will be lost**.

A considerable advantage of the LiDAR device is its **independence of lighting conditions and weather**, except for fog and heavy cloud cover. Unfortunately, the device also absorbs laser pulses by water, asphalt, and tar. The absorption and dispersion of LiDAR waves by atmospheric aerosols is in turn an advantage from the meteorological point of view.

Also, LiDAR one-ups structured light techniques such as triangulation or stereo vision as it **can read data from very long distances** without the need for a big baseline between cameras or emitter/detector pairs, which can be significant for smaller vehicles.

Some of the LiDARs are able to specifically detect reflectors in laser scanning, delivering a **low computational power triangulation system for localization**. However, the use of reflectors and triangulation comes with the **complication of having to see three or more reflectors** at any point while the robot is moving. It is challenging when the operating area is divided by some shelving, machinery, and other objects.

A large volume of data sets is another LiDAR drawback.