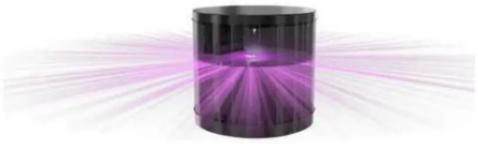
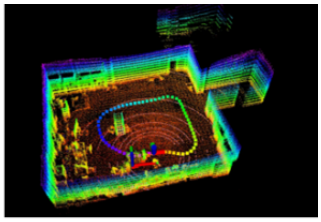
6.SLAM overview

1. Introduction to SLAM

The full name of SLAM is Simultaneous Localization and Mapping, real-time positioning and map construction, to solve the problem of autonomous navigation of robots.

People don't know how to move in an unknown environment, and we don't know how to walk with our eyes closed.
Robots, like humans, also need an "eye" to interact with the environment to know their position, and to be able to build a map for the robot to navigate autonomously.

As shown in the figure below, the camera is equivalent to our eyes, the lidar is like thousands of long walking sticks to detect obstacles, and the map is equivalent to the navigation map we use every day. With these things, the robot can walk (decision-making, planning, control).


Over the past decade, the solution to the SLAM problem has been one of the most notable achievements in the robotics community. As a theoretical method, SLAM has been proposed and solved in many different ways. It has been widely used in indoor, outdoor, underwater and aerial environments. At the same time, SLAM technology is an essential technology for driverless driving. In environments where GPS accuracy is poor and signals are unstable, SLAM technology is the prerequisite for autonomous navigation.

Now all you need to know is that the SLAM problem can be divided into the following two parts:

Positioning: Estimating the robot's pose given a map;

Mapping: Estimating the environment map given the robot pose;

2. Types of SLAM

The types of SLAM are closely related to the development of sensors, from image SLAM at the beginning to laser SLAM later. In recent years, with the rapid development of sensors such as lidar, cameras, and inertial measurement units, SLAM technology has emerged. Common SLAM classifications include laser SLAM, visual SLAM, multi-sensor fusion SLAM and deep learning-based SLAM.

The characteristics of each sensor also determine the characteristics of various SLAM algorithms. The advantages and disadvantages of common sensors will be briefly introduced below.

1. Lidar: mechanical, solid state, hybrid

Advantages: high accuracy, fast frequency, not affected by light, small amount of calculation

Disadvantages: high cost, limited amount of information, high power consumption

2. Camera: monocular, binocular, RGB-D camera, panoramic camera

Advantages: cheap, small, rich in information

Disadvantages: large amount of calculation, susceptible to interference, strong environmental assumptions

3. Inertial measurement unit: IMU, wheel speedometer

Advantages: It can measure the acceleration and angular acceleration of the carrier, and quickly calculate the position and attitude information of the carrier using mathematical methods.

Disadvantage: drift error will occur as time increases