Differential Drive

The differential drive is a popular locomotion method for wheeled robots that utilizes two active wheels that can be independently controlled to steer the robot. If you are interested in learning about the design and kinematics of the differential drive, you may find the resources provided by the University of Freiburg for their Introduction to Mobile Robotics course helpful. The course was instructed by Prof. Burgard, and you can access the materials, such as slides and recordings, through this link:

http://ais.informatik.uni-freiburg.de/teaching/ss17/robotics/slides/03-locomotion.pdf

http://ais.informatik.uni-freiburg.de/teaching/ss17/robotics/recordings/03-wheeled-locomotion-part1.mp4

http://ais.informatik.uni-freiburg.de/teaching/ss17/robotics/recordings/03-wheeled-locomotion-part2.mp4

The provided materials offer an overview of the fundamental concepts of differential drive robots and their kinematics.

To gain a better understanding of the field of wheeled drives, it is important to study not only the differential drive but also other forms of locomotion such as the Ackermann drive, synchronous drive, Mecanum wheels, and more. A comprehensive overview of these methods can be found at :

http://www.robotplatform.com/knowledge/Classification_of_Robots/wheel_control_theory.html

Range sensing using a LiDAR

Range sensors are essential in mobile robotics, providing critical distance measurements for obstacle avoidance, localization, and navigation. One type of range sensor is the laser range scanner or LiDAR, which uses the time-of-flight principle to accurately measure distances.

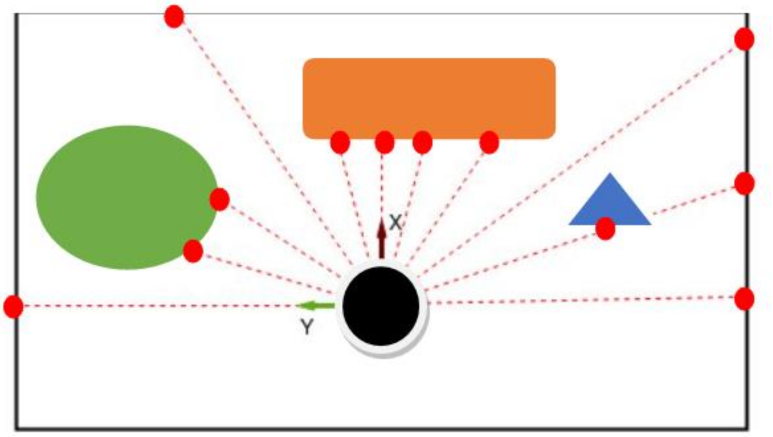
LiDARs provide highly reliable distance measurements at distances up to 100 meters, but their high hardware costs can be a limitation. Other range sensors, such as stereo cameras and ultrasound sensors, have their own advantages and limitations and are chosen based on the specific needs of the robot's task and deployment environment

LiDARs emit a laser beam that reflects off surfaces and is registered by the sensor. The distance to the surface can be calculated using the speed of light (c) and the time between emission and registration, as shown in the following formula:

distance = $(\Delta T \, . \, C)/2$

The direction of the laser beam is controlled by a spinning mirror, allowing the sensor to sample the range at different angles. The field of view (FoV) of a LiDAR is the difference between the starting angle θ_{start} and the end angle θ_{end} , with the other angles θ_i being uniformly sampled between these bounds.

The figure below illustrates a scan of a LiDAR with a 180 degree FoV:



A raw LiDAR scan produces an array of range measurements $[R_0, R_1, \ldots, R_n]$, which can be used to compute the coordinates of the beam endpoints. The coordinates (x, y) of the nth measurement can be calculated using the following formulas:

$x = R_n . \sin\theta_n$

$y = R_n . \cos\theta_n$