Introduction to Mobile Robotics

Proximity Sensors

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Sensors of Wheeled Robots

Perception of the environment

Active:
- Ultrasound
- Laser range finder
- Infrared

Passive:
- Cameras
- Tactiles

Time of flight
Intensity-based
Tactile Sensors

Measure contact with objects

Touch sensor

Spring

Bumper sensor
Ultrasound Sensors

- Emit an ultrasound signal
- Wait until they receive the echo
- Time of flight sensor

Polaroyd 6500
Time of Flight Sensors

\[ d = \frac{v \times t}{2} \]

\( v \): speed of the signal  
\( t \): time elapsed between broadcast of signal and reception of the echo.
Properties of Ultrasounds

- Signal profile [Polaroid]
Sources of Error

- Opening angle
- Crosstalk
- Specular reflection
Typical Ultrasound Scan
Parallel Operation

- Given the 15 degrees opening angle, 24 sensors are needed to cover the whole 360 degrees area around the robot.
- Given the maximum range of a measurement is 10m.
- The time of flight then is $2 \times \frac{10}{330} \text{ s} = 0.06 \text{ s}$
- A complete scan requires 1.45 s
- To allow frequent updates (necessary for high speed) the sensors have to be fired in parallel.
- This increases the risk of crosstalk
Laser Range Scanner
Properties

- High precision
- Wide field of view
- Approved security for collision detection
Robots Equipped with Laser Scanners

Zora:  

Groundhog:  

Herbert:
Typical Scans
The DARPA Grand Challenge