Introduction to Mobile Robotics

Proximity Sensors
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

Contact

Bumper sensor
Ultrasound Sensors

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

\[ d = \nu \times t / 2 \]

\( \nu \): 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 $2 \times 10/330 = 0.66\text{sec}$
• A complete scan requires 1.45 secs
• 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