# Introduction to Mobile Robotics

# Proximity Sensors

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# Sensors of Wheeled Robots

Perception of the environment

Active:

- Ultrasound
- Laser range finder
- Infrared

Time of flight

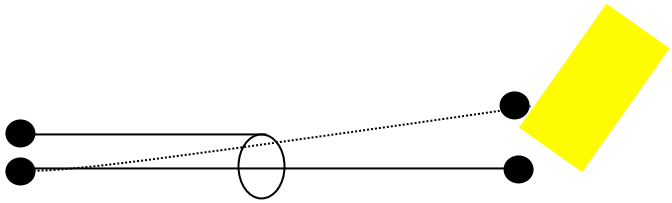
Passive:

- Cameras
- Tactiles

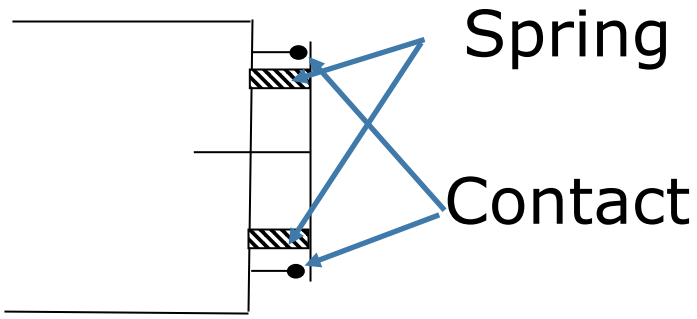
Intensity-based

# Tactile Sensors

Measure contact with objects



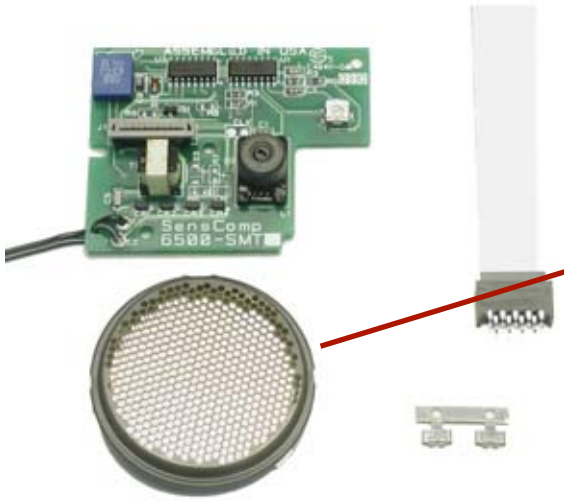
Touch sensor




Bumper sensor

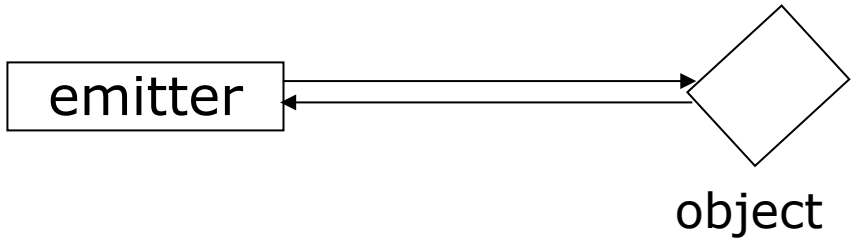
# Ultrasound Sensors

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




Polaroyd 6500

# Time of Flight Sensors



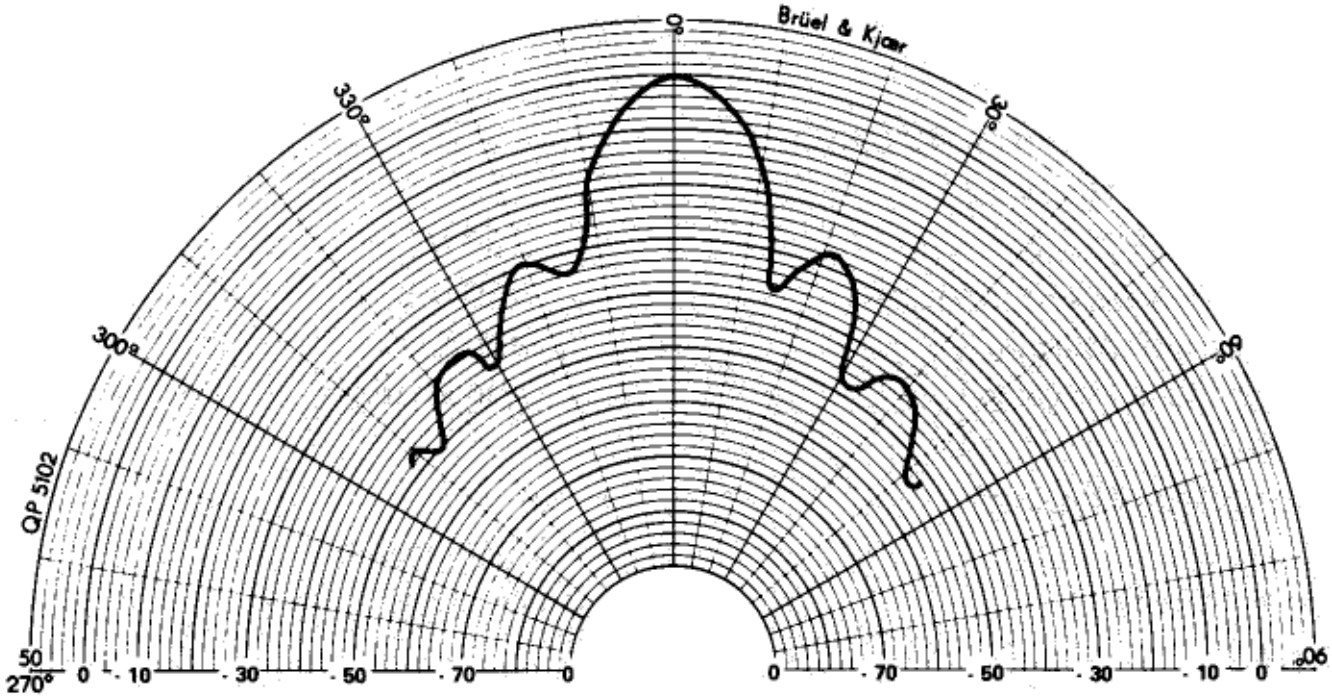

$$d = v \times t / 2$$

$v$: speed of the signal

t: time elapsed between broadcast of signal and reception of the echo.

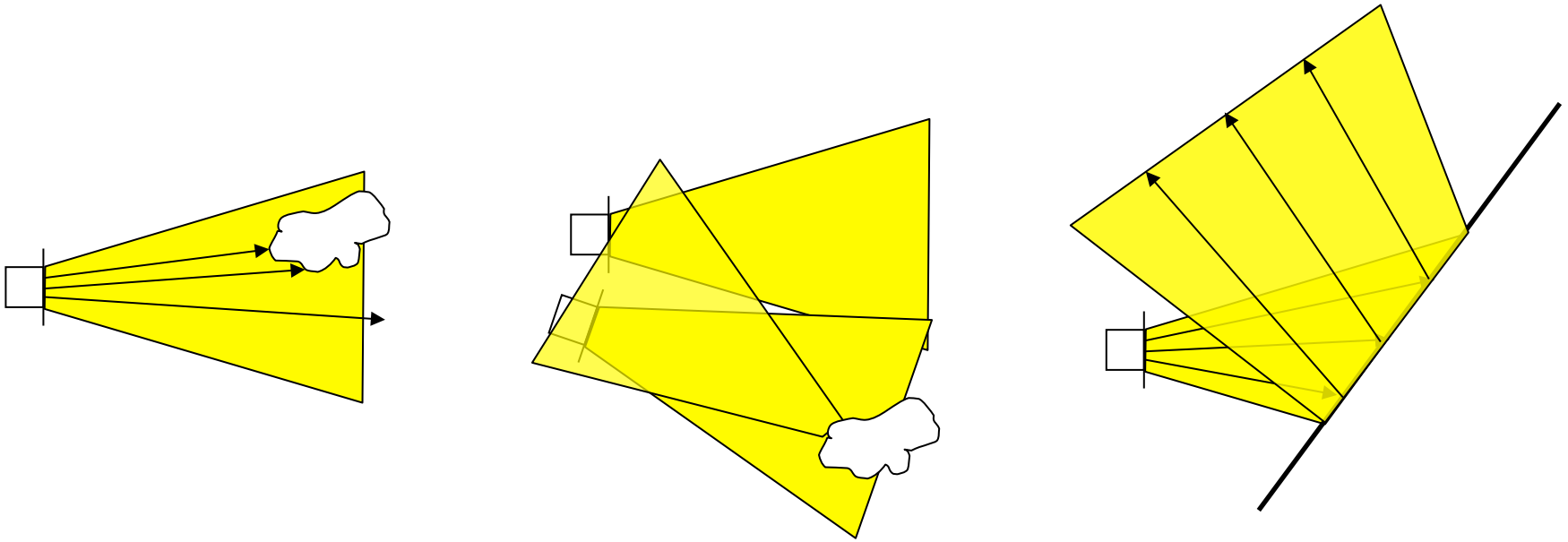
# Properties of Ultrasounds

- Signal profile [Polaroid]

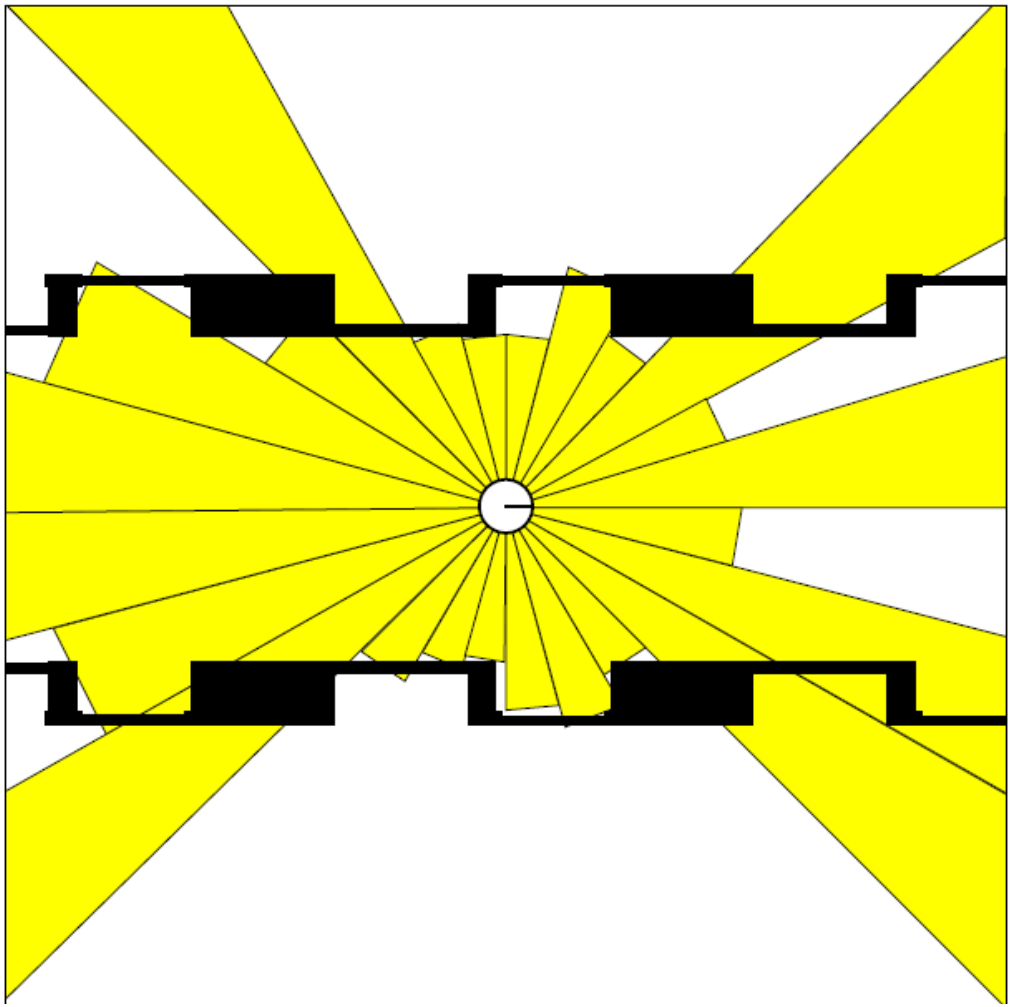


# Sources of Error

- Opening angle
- Crosstalk
- Specular reflection



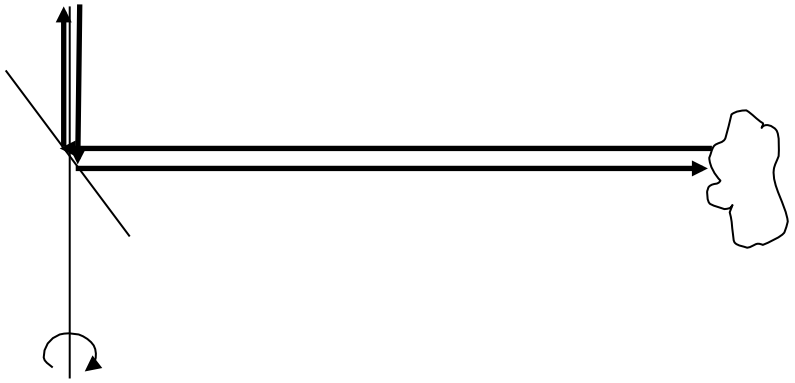
# Typical Ultrasound Scan



# Parallel Operation

- Given a 15 degrees opening angle, 24 sensors are needed to cover the whole 360 degrees area around the robot.
- Let the maximum range we are interested in be 10m.
- The time of flight then is 2*10/330 s=0.06 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

# Typical Scans