IROS 2009 Tutorial: Filtering and Planning in I-Spaces
PART 2: PHYSICAL SENSORS

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What Is a Sensor?

- Light-dependent resistor
- GPS unit
- Wireless card
- Toilet float mechanism

We know it when we see it, but will not try to formally classify.
Where Might We Want to Use Sensors?

Shopping mall

Control room

Assisted living

Coral reef
Where Might We Want to Use Sensors?

Roomba

CMU Boss

UAV

Protein
What Physical Quantities Are Sensable?

Spatial: displacement, velocity, acceleration, distance to something, proximity, position, attitude, area, volume, level/tilt, motion detection

Temporal: clock, chronometer (elapsed time), frequency.

Electromagnetic: voltage, current, power, charge, capacitance, inductance, magnetic field, light intensity, color. These may operate within a circuit or within open space.

Mechanical: solid (mass, weight, density, force, strain, torque), fluid (acoustic, pressure, flow, viscosity), thermal (temperature), calories.

Other: chemical (composition, pH, humidity, pollution, ozone), radiation (nuclear), biomedical (blood flow, pressure).

See CRC Measurement, Instrumentation, and Sensors Handbook
What Sensors Are Available?

Contact sensor

Sonar

Compass

Microphone
What Sensors Are Available?

- Wheel encoder
- Stopwatch/timer
- Occupancy detector
- Safety beam
What Sensors Are Available?

- Camera
- Wii remote
- Pressure mat
- SICK laser scanner
Common Sensor Characteristics

- **Transfer function** converts physical phenomenon to sensor reading: 
  \[ g : \mathbb{R} \rightarrow \mathbb{R}. \]

- Domain of \( g \) may be **absolute** vs. **relative**.

- \( g \) itself may be **linear** or **nonlinear**.

- **Resolution** is given by set of possible \( g(x) \).

- **Sensitivity** is set of stimuli that produce same reading.

- **Repeatability** is producing same readings under same phenomena.

- **Calibration** eliminates systematic errors.

You will find these notions in sensor handbooks.