

## → Sensors

Sensorial information: self perception (how am I doing), location (where am I), environment perception (where can I go).

### ↳ Navigate:

- follow fixed path: line sensors reflection on an object, detection depends on the color of the object.

- react to surroundings: mechanically actuated switch, ultra-sound (based on reflection  $d = \frac{1}{2} c \cdot t_{echo}$ ) or infrared (sharp sensor, distance info).

- follow a path in a map: laser range finder (laser scans space ahead/around, measuring obstacle distance), position (GPS - absolute position, relative, requires line of sight), mobile phone location (based on services).

- sense myself:

- position (odometry): use of data from motion sensors to estimate change in position over time; relative position, errors accumulate

- optical encoder: pulses generated by the interference of two patterns of stripes. Encoder categorized by P.P.R (pulses per revolution), where number

of pulses is proportional to displacement. Signal is converted to digital and **Quadrature** allows to detect the orientation of the movement and multi-step encoder resolution.

**wheels/motors** - **absolute encoder**: optical disk with Gray Code, output is shaft position (angle) in binary code.

**wheels/motors** - **magnetic encoder**: similar to optical using magnets (unaffected by dust, moisture, shock). Bicycle computers work in similar fashion.

- **hall effect**: based on hall effect, production of voltage difference, permanent magnet attached to shaft, orientation of the magnetic field is detected by an array sensor.

- **accelerometers**: inertial mass principle. Detection by changes on capacity and resistance.

**Orientation** - **compass**: magnetic field detection in 2 axes with the use of trigonometry.

**orientation** - **gyroscope**: based on inertia principle. Detect changes in orientation.

- use external references

- **RFID location**: set of RFID tags installed in the floor, allowing position & orientation.

- **Chaining and location**: coils on floor can change and locate.

- **triangulation**: computing position by measuring distance to 3 reference points.

- **visible light positioning (VLP)**: widespread use of LED for illumination, uses perspectives.

## → Sensor classification

### • Proprioceptive / exteroceptive:

- proprioceptive information internal to the robot (ex: motor speed, battery voltage, ...)
- exteroceptive info external to the robot (distance to objects, light intensity, ...).

### • Passive / active:

- Passive: have no explicit source of energy, energy required comes from the measurement process itself (ex: temperature probes).
- Active: have internal power source, necessary for the measurement process, uses that energy to interact with environment (ex: laser range finder).