Servos

- Input desired angle
- Built-in electronics drive motor in order to achieve that position
- How do they do that?
Servos

- Automatically seek a given position
  - You provide angle, they do the rest.

Servo Dissection
Servo Dissection (2)

Classic RC Servos

- Controlled via pulse-width modulation

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Pulse period: 20-35 ms
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Pulse width: angle command.
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For MPI MX-400:
600us = minimum position
2500us = maximum position

- Simple, inexpensive.
- No feedback to user… is it working?
AX12 Servo

- New generation of “smart” servos
- Communicate via serial protocol
  - Send packets to command angle position
  - Or adjust maximum torque
  - Or adjust maximum speed
  - Daisy-chainable
- And servo sends back useful information!
  - Actual position
  - Current
  - Temperature
  - Error codes
- About $50 each…
  - Two or three times the price of “RC” servos.
  - Slightly unfair: AX12 has more torque than cheapest of RC servos, and comes with useful mounting hardware.

Servo hacking

- Continuous rotation
  - Inexpensive and compact (reasonably) high-torque motors
  - RC servos: fool potentiometer into thinking the shaft isn’t moving, remove any physical stops.
  - AX12s: supported directly by firmware.

- Custom firmware
  - Community to develop open-source replacement firmware for AX12s
IR Beacons

- Omni-directional beacons
- Highly-directional receiver
  - Note baffling
  - Can measure bearing to beacons

Triangulating with IR Beacons
IR Range Finders

- IR LED + Position Sensitive Device (PSD)

- Narrow Field of View

IR Range Finders: Geometry

f, b: Properties of device

d: quantity (distance) we want to know

v: voltage (proportional to position) that we observe
IR Range Finders

- Add in a few parameters to fit non-idealities of the device, we get the observation model:

\[ V = \frac{K_m}{d + K_d} + K_b \]

- Covariance model?

IR Range Finders
Sharp IR Range Finder Family

Ultrasound

- Time-of-flight of sound
  - Linear response
  - Fairly accurate.
- Wide lobes (and side lobes!)
  - Can't see details
Ultrasound