Project 2 Lessons

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Functions can be abstractions

- Hide details from their “callers”
- In our case: we are hiding the details of the analog interface and how to interpret the analog values
- Functions should adhere to their specification and do no more

Hovercrafts

Have been delivered!

- Every group has two batteries. Use only one at a time
  - Working on new mounts for the batteries
  - Common battery chargers are being installed in the lab. Play nice
- New top plates have been installed
  - You will need to add Velcro tape to mount your circuit boards

Hovercrafts

Battery + switch on = system is energized

- 3 chassis LEDs turn on
- Thick red/black wires: +9V connection to the battery (keep these capped for now)
- Think red/black wire pair: +5V
  - We will connect to Vin soon, but have Jack convert your Teensy over to be able to use this power (else could damage your laptop)
  - After conversion: can only power Teensy from battery

Safety

- Only (un)plug batteries with the switch turned off
- Keep fingers off the lower deck
- Fuse should protect you from short circuits
  - We are using 10A fuses for now. Extras will be in the spare parts bin
- If you see smoke: inform one of us
  - And don’t keep popping new components into your circuit…

Project 3: Lateral Velocity Sensing

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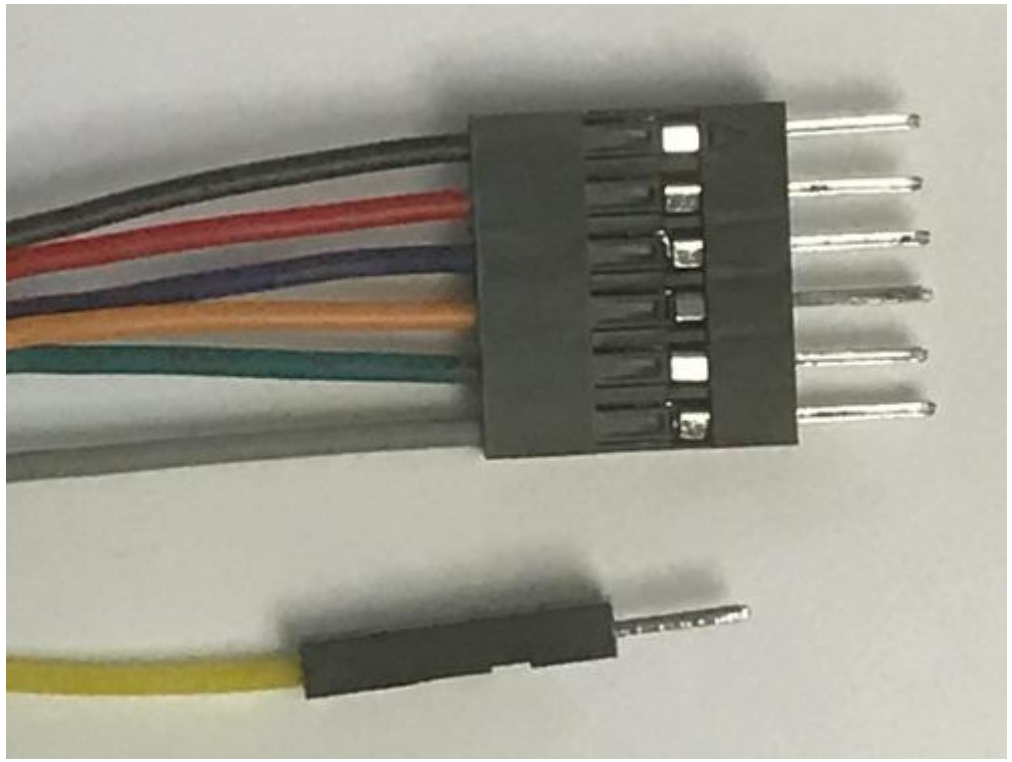
Each hovercraft has 3 downward-looking cameras at different angles

- Connect to a Serial Peripheral Interface (SPI)
  - High-speed serial bus
- When you query a camera, it will tell you how many pixels of “slip” have happened since the last time you asked
  - Both X and Y components
- With two or more cameras, we can estimate how far the craft has moved in three dimensions

Component 1: Physical Interface

Common across all cameras:

- Black: Ground
- Red: +5V Power
- Blue: MISO (Arduino pin 12)
- Orange: MOSI (Arduino pin 11)
- Green: SCL (Arduino pin 13)
- Gray: Reset (choose an unused digital pin)



Each camera has a yellow select line (choose a unique, unused digital pin)

Component 2: Interface Function

Implement the function:

```
void accumulate_slip(int32_t adx[3], int32_t ady[3])
```

- Queries each of the cameras
- If there is slip, then it adds the latest slip to the accumulated slip

Component 3: Data Collection

- Record 10 repetitions of the accumulated values for three types of movement: forward 1m, leftward 1m, rotate clockwise 360 degrees
- Store in a table

Component 4: Sensor Model

- We are estimating the parameters of functions of the forms of:

```
X = a0 + a1 * adx1 + a2 * ady1 + a3 * adx2
       + a4 * ady2 + a5 * adx3 + a6 * ady3
```

- where a0 ... a6 are the coefficients of our function, and adx?/ady? are the accumulated slip values

Sensor Model

Use “Multi-Regression” to compute the parameters

- Handle dX, dY and dtheta separately
- Use all 30 data points to fit each of the three parameter sets

Part 5: Implement the Model

Implement the function:

```
void compute_chassis_motion(int32_t adx[3], int32_t ady[3],
                            float[3] motion);
```

- Translate adx and ady into hovercraft motion

Part 6: Testing

Loop():

- Accumulate slip values
- Occasionally compute and report motion

Take five more samples of each motion type

- Graphically report mean, standard deviation of each dimension

Hints

- Start this project early
- Keep things simple