EE16A Lecture 15: Introduction to Locationing

Elad Alon, Babak Ayazifar, Gireeja Ranade, Vivek Subramanian, Claire Tomlin

Questions/Discussion
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Design Process

- **Step 1:** Concretely state your goal for the system
- **Step 2:** Describe (e.g. with a block diagram) a strategy for achieving your goal
  - Often involves reviewing what you can measure vs. what you wanted to measure, and how they relate to each other
- **Step 3:** Implement the components within your strategy
  - Think about what pieces you might already know how to build, or how to extend building blocks you know about
- **Step 4:** Verify your design meets the original requirements
  - Checking interfaces between blocks often the most critical
- Iterate through these more than once…

Design Process: C Touchscreen Sensor

- **Step 1:** Concretely state your goal for the system
  - “I want my circuit to indicate if a finger is touching the screen (at a certain position) or not”

- **Step 2:** Describe a strategy for achieving your goal
  - Can’t measure the state of the finger directly
  - But do know that it can affect a capacitor in my circuit
  - So, let’s measure this capacitance as a proxy for the finger touch
  - As long as we know what the capacitance should be with a finger touch
    - Checking whether the capacitance is more or less than this should tell us whether or not the finger touched
Design Process: C Touchscreen Sensor

- Step 3: Implement the components within your strategy
**Locationing**

- Picture from Elad’s phone this morning
- How does my phone know where it is all?
- And what causes the circle of uncertainty?

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**Global Positioning System (GPS)**

- Developed by US Dept. of Defense, started 1973
- Fully operational in 1995
  - Continued improvements since then
  - Several other similar systems exist or in development (GLONASS, Galileo, etc.)
**Key Idea Behind GPS**

- Measure distance between you and some other objects in known positions
- How many known objects/positions do we need?

**Effect of Distance Errors**

- Will learn in this module how to use more known positions than the bare minimum to reduce sensitivity to errors!
How Is Distance Actually Measured?

- Need a way to communicate between the known objects (beacons) and the thing you are locating (GPS receiver)

- GPS uses electromagnetic waves
  - In our lab we will use acoustic waves (sound waves)

- So what is a “wave”?

Waves

- Disturbance that travels through a “medium” from one location to another
  - E.g., grabbing the end of a slinky and letting it go
  - This disturbance has some energy associated with it

- Our “medium” is generally air
  - For sound, disturbance is in the pressure of local regions of the air
  - (EM waves can actually travel through free space)

- Many of the waves we will be dealing with are periodic
  - I.e., the disturbance behaves in a repetitive manner in time, space, or both
Important Properties of Waves

Important Properties of Periodic Waves
Aside: Amplitude vs. Distance

Locationing System So Far
Key Idea: Cross-Correlation