Pseudo-Doppler Direction Finder - Project Checklist

Project Overview

The goal of our project is to emulate a pseudo-Doppler radio direction finder using acoustic signals. The completed device will determine and display the direction of arrival of sound received by a microphone array.

For our project, we have chosen to divide up the labor in the following manner:

- Jimmy will be designing the signal acquisition and microphone array control
- Amanda will be designing the FM demodulation and phase detectors
- Melissa will be designing the offset correction and display blocks

The Commitment

At minimum, we hope to accomplish the following individual tasks:

Jimmy:
- Working microphone input stage and processing
  - Successfully amplify and display microphone waveform on oscilloscope
- Working compressor
  - Demonstrate constant amplitude audio signal with varying sound level
- Working control unit
  - Generate phase shifted triangular control waveforms

Amanda:
- Working phase comparison stage
  - Demonstrate mixing of the generated control signal and signal of interest
- FM Demodulation
  - Working Loop Filter
  - Working Voltage Controlled Oscillator
  - Working Mixer

Melissa:
- Scaling
  - Successfully scaling a voltage to an angle value between -pi to pi
• X&Y functions
  o Demonstrate cosine and sine calculation of the angle (from 0-90°)
• Sawtooth Generator
  o Demonstrate a sawtooth waveform starting from 0V
• Voltage Controlled Amplifier
  o Successfully amplify the sawtooth waveform to oscillate from 0V to \sin(x) and \cos(x)

The Goal

Our goal is to build a working pseudo-Doppler direction finder system. All individual modules should be integrated into the complete system. The system should be able to indicate the direction toward a sound source with reasonable accuracy.

Jimmy:
• Working signal acquisition module
  o Synthesize the pseudo-Doppler FM signal from microphone inputs

Amanda:
• Phase comparison stage
  o Successfully demonstrate -90° to +90° phase conversion to DC voltage signal
• Working Phase-Locked Loop / FM receiver
  o Demonstrate demodulation of FM signal

Melissa:
• 180° direction viewer
  o Successfully displaying the direction of a signal from 0° to 180°

While completion of each of the above tasks can be verified by using simulated inputs or outputs (for instance, using a PLL chip to verify the pseudo-Doppler signal), the goal is for modules to be compatible. That said, the best demonstration of goal achievement is a working direction finder as described in the Project Overview.

The Stretch Goal

Beyond the goal of a working pseudo-Doppler direction finder, we hope to achieve the following stretch goals:

Jimmy:
• PCB
- Design, order, populate, and test a PCB for the microphone signal front-end
- **Ultrasonic**
  - Make appropriate design changes for direction finding at ultrasonic frequencies

**Amanda:**
- **Phase comparison stage**
  - Successfully demonstrate -180° to +180° phase conversion to DC voltage signal
  - Create an all-pass filter to generate an addition control signal 90 out of phase with other control signal
- **FM Modulation**
  - Make appropriate adjustments to phase lock loop for ultrasonic frequencies.

**Melissa:**
- **360° direction viewer**
  - Successfully displaying the direction of signal for full 0° to 360° range
- **LED display**
  - Displaying direction with 16 LEDs and comparators