

Assignment 4

CS 407

Due May 2nd, 2013 5pm

1 Introduction

The goal of this assignment is to better understand wireless characteristics using an audio channel. We will be using a system called Audiocom, which sends encoded data using a microphone/speaker as a transmitter/receiver. With Audiocom, you can alter various characteristics of the transmitter and see how that affects reception. The fact that transmissions are done over the audio channel also makes it easy to introduce interference.

2 Installation Instructions

Audiocom requires that the following dependencies are installed: Python 2.6/2.7, PyAudio (and portaudio), NumPy, SciPy, and Matplotlib. Follow the appropriate steps for your platform.

2.1 Ubuntu Linux

Run the following command: `sudo apt-get install python-numpy python-matplotlib python-scipy python-pyaudio`

2.2 Mac OS X

It's a little more involved to install on Mac. It is recommended you use homebrew to install most of the packages <http://mxcl.github.io/homebrew/>. After installing homebrew, run the following commands

1. edit your path to include `/usr/local/bin` and `/usr/local/sbin` (a simple way to check is run `brew doctor`)
2. `brew install python`
3. run `python` to ensure you are running the version that was just installed
4. `pip install nose`
5. `brew tap homebrew/science`
6. `brew tap samueljohn/homebrew-python`
7. `brew install gfortran scipy` (Note: if you receive a gfortran error while installing scipy, run `brew uninstall gfortran` and download an installer from here: <http://gcc.gnu.org/wiki/GFortranBinaries#MacOS> for an older version (i.e., 4.6.2) and run `brew install scipy` again)

8. `brew install portaudio --HEAD`
9. `pip install pyaudio matplotlib`

2.3 Windows

The following packages have installers for Windows:

- Python: <http://www.python.org/download/> (2.7.4)
- PyAudio: <http://people.csail.mit.edu/hubert/pyaudio/>
- NumPy/SciPy: <http://www.scipy.org/Download>
- Matplotlib: <http://matplotlib.org/downloads.html>

2.4 Verify Python Dependencies

Run the python interpreter and run the following commands:

```
import pyaudio
import scipy
import scipy.signal
import matplotlib
import matplotlib.pyplot
import numpy
```

2.5 Download Audiocom

Download Audiocom here: <http://research.cs.wisc.edu/~suman/courses/407/s13/audiocom.zip>. Unzip the archive and rename `preamble_27.pyc` to `preamble.pyc` and `demodulate_audiocom_27.pyc` to `demodulate_audiocom.pyc`

3 Audiocom Basics

A simple transmission can be sent using the following command: `python sendrecv.py -n 100 -c 1000 -S 1 -H -s 256`. This will send 100 bits (all ones) on carrier frequency 1000 Hz with 256 samples per bit, meaning that each bit will be replicated 256 times for redundancy. In this assignment we will want to vary the number of bits sent (-n) and the sample rate (-r). The former should be self-explanatory, but the latter is less clear. The default sample rate is 48000, meaning it will take $\frac{1}{48000}$ of a second to transmit one bit. Increasing the number will allow you to send more bits per second, and fewer bits when decreased.

4 Experiments

For this assignment you are required to run two different experiments and plot your results.

1. For this experiment we want to plot message length with respect to the minimum volume a given message can be reliably decoded (i.e., more than once). The plot's y-axis should be volume and the x-axis should be message length (in bits). Experiment with 5-6 message lengths between 10 and 1000 bits. Use a sample rate of 8000 (-r 8000) for this experiment. Include your group's explanation of the plot's trend.

2. The next experiment should plot message length with respect to the maximum sample rate a given message can be reliably decoded. The plot's y-axis should be sample rate (samples/sec) and the x-axis should be message length (in bits). Use the same message lengths you used for the first experiment, and keep the volume fixed. Include your group's explanation of the plot's trend.

In addition, include anything the group may have thought to be interesting, or any challenges the group encountered in your writeup.

5 Troubleshooting

You can find troubleshooting steps and more about Audiocom in general here: <http://audiocom602.blogspot.com/>

6 Grading

The two plots will be worth 66% (33% each), with your explanations being worth 33%.

7 Collaboration Policy

This assignment is to be done in groups.

8 Handin

Handin a written/typed copy with plots/answers to Mike Griepentrog's mailbox by 5pm on the 2nd of May.