3DY4 Lab 3 Report

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TH1:

In take-home one we were tasked with replacing the functionality of impulse response generation (**firwin**) and digital filtering (**lfilter**) from SciPy in fmMonoBasic.py. To do this we reused the function we created in lab 1 that replaced the functionality of SciPy's firwin function (Lowpass), and a separate function to replace SciPy's lfilter (convolve) using the multiplication properties of convolution in the time and frequency domains.

TH2:

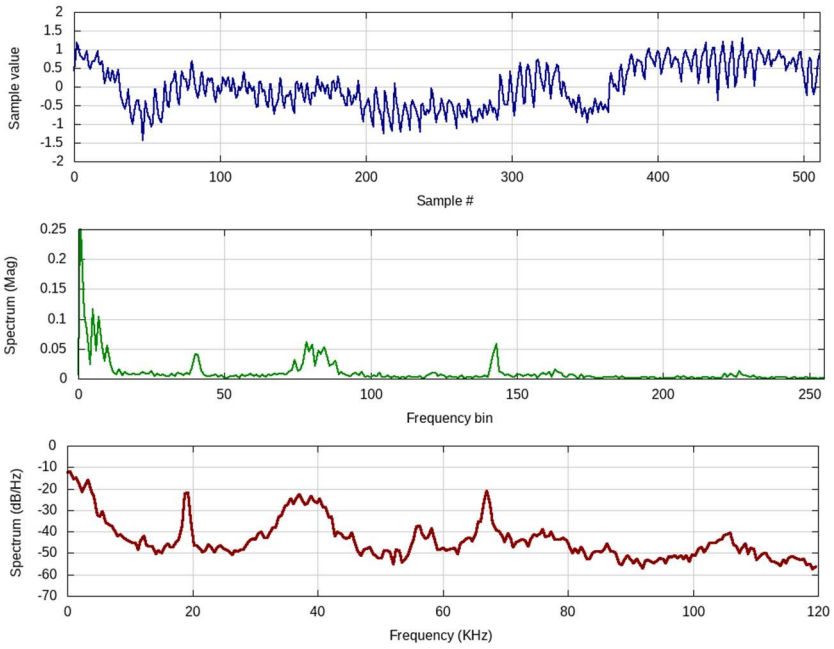
In take-home 2we had to repeat the same task for **fmMonoBlock.py**, we used the functions from lab 1 similarly to the **fmMonoBasic** implementation. We were also tasked with replacing the demodulation functionality of the current **fmDemodArctan** function, which uses arctan to demodulate the incoming FM signal, with an equivalent demodulation algorithm that is less computationally intensive than the arctan method. To do this we implemented the given demodulation equation into code in the function **fmDemodFormula**. Using the formula provided [Image 1] and taking any derivative to be equal to the difference of consecutive values, the function was implemented into the **fmSupportLib.py** file [Image 2]. Block convolution is also implemented using a function from lab 1, implemented into the **fmMonoBlock.py** file. These functions result in the graph shown, which plots both block 10 and block 11 (of 233 blocks) on the same graph.

$$\Delta\theta(n) = \frac{i(n)\frac{d[q(n)]}{dn} - q(n)\frac{d[i(n)]}{dn}}{i^2(n) + q^2(n)}.$$

Image 1

```
for k in range(1,len(I)-1):
        fm_demod[k] = ((I[k] * (Q[k+1] - Q[k])) - (Q[k] * (I[k+1] - I[k]))) / (I[k] ** 2 + Q[k] ** 2)
```

Image 2



TH3:

Take-home 3 tasked us with converting the **estimatePSD** function from Python to C++. After implementing the function in C++ we processed and graphed the binary data from fmMonoBlock.py using the new C++ **estimatePSD** function. In order to create the graph (Graph 2) using gnu plot, we had to edit the provided .gnuplot file, adding in another plot line using a new .dat file that was created, and changing the scale of the y and x in order to better visualize our data.

During this take home we ran into some challenges with the scale of our resulting PSD estimation but figured out that it was due to using log base e instead of log base 10.