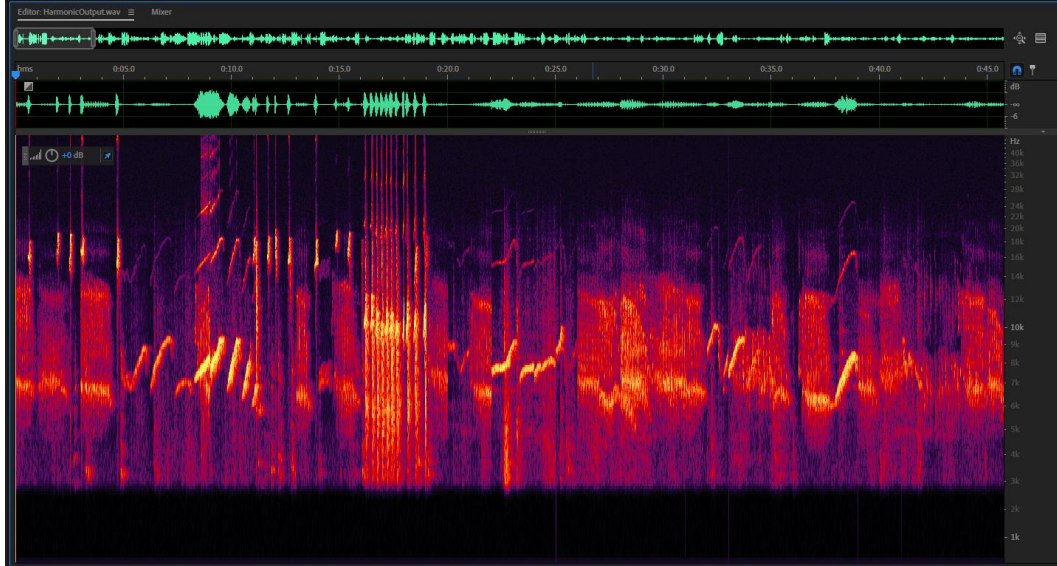
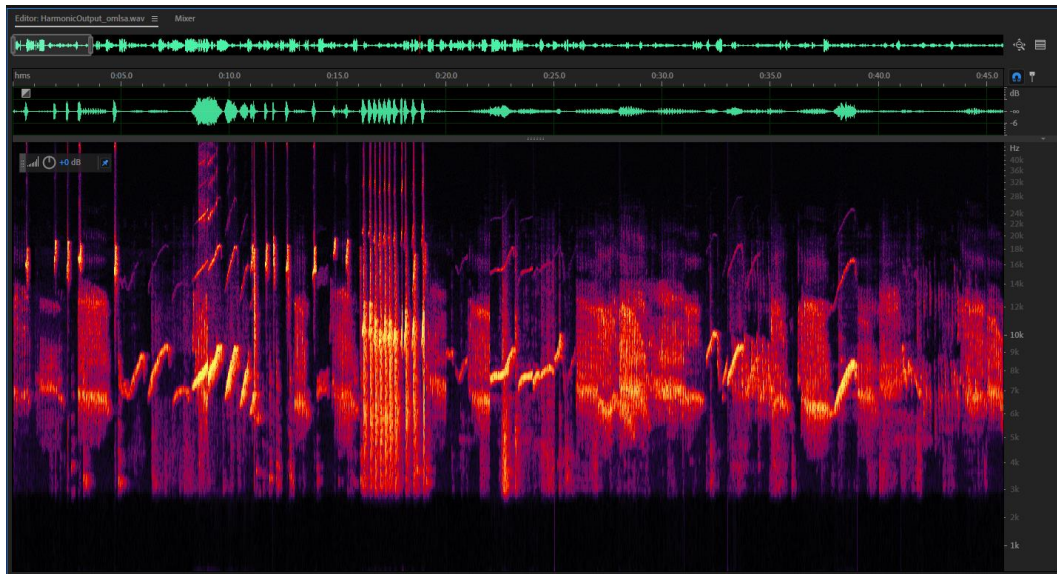


### Minima Controlled Recursive Averaging:

We decided to investigate using techniques such as Minima Controlled Recursive Averaging (MCRA) to pre-process the data and remove unwanted noise. We found open source code by Israel Cohen and ran it against the .wav files on hand. This is the result:



*Figure 1: Before MCRA*



*Figure 2: After MCRA*

Figure 1 is an image of the spectrogram before MCRA, and Figure 2 is after. The performance is leaps and bounds above previous noise removal algorithms we tried last semester. We will attempt to implement our own lightweight version of this algorithm as the initial step in pre-processing.

## Harmonicity investigations:

We also found several good resources on using the call's harmonicity to our advantage. The first thing we attempted was to find the Harmonics to Noise Ratio (HNR). We realized that we could set a threshold of HNR above which a frame would be considered a call, otherwise it is noise. We tried this on a random sample and used a high threshold (0.6) to exaggerate the results. We effectively removed all non-voiced segments, along with some harmonic calls due to the high threshold. Instead of tuning this back and forth, we figured we could use this as a feature in a VAD classifier, and let the classifier determine the best fit threshold for the presence of a call in any given frame.

The second thing we are currently investigating is the use of the harmonic product spectrum (HPS) to highlight the harmonics in any given frame for use as a feature for classification. We are ironing out some issues with our algorithm (see Figure 3).

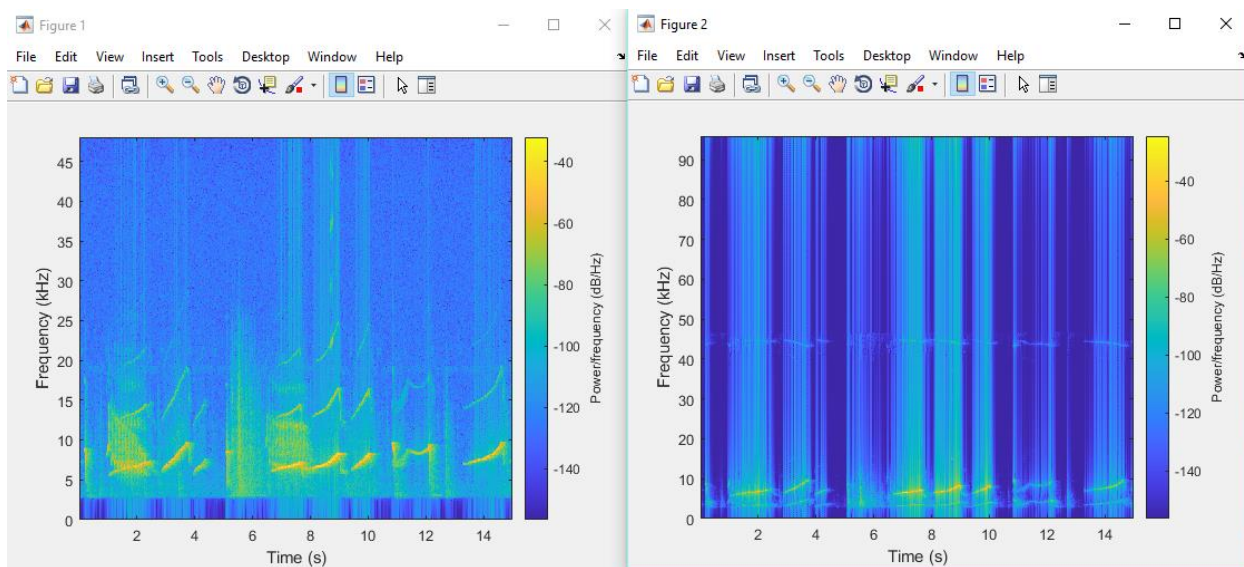


Figure 3: Sample's spectrogram before (left) and after (right) HPS

It seems that there is some spectral smudging occurring that still needs to be investigated. A block diagram for the HPS is below in Figure 4.

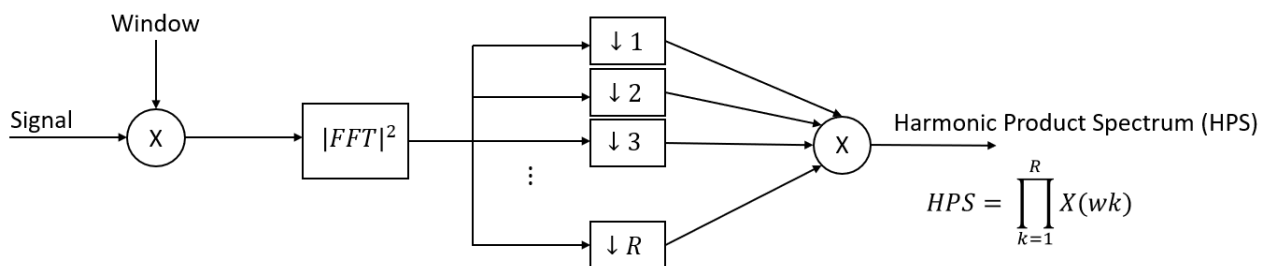


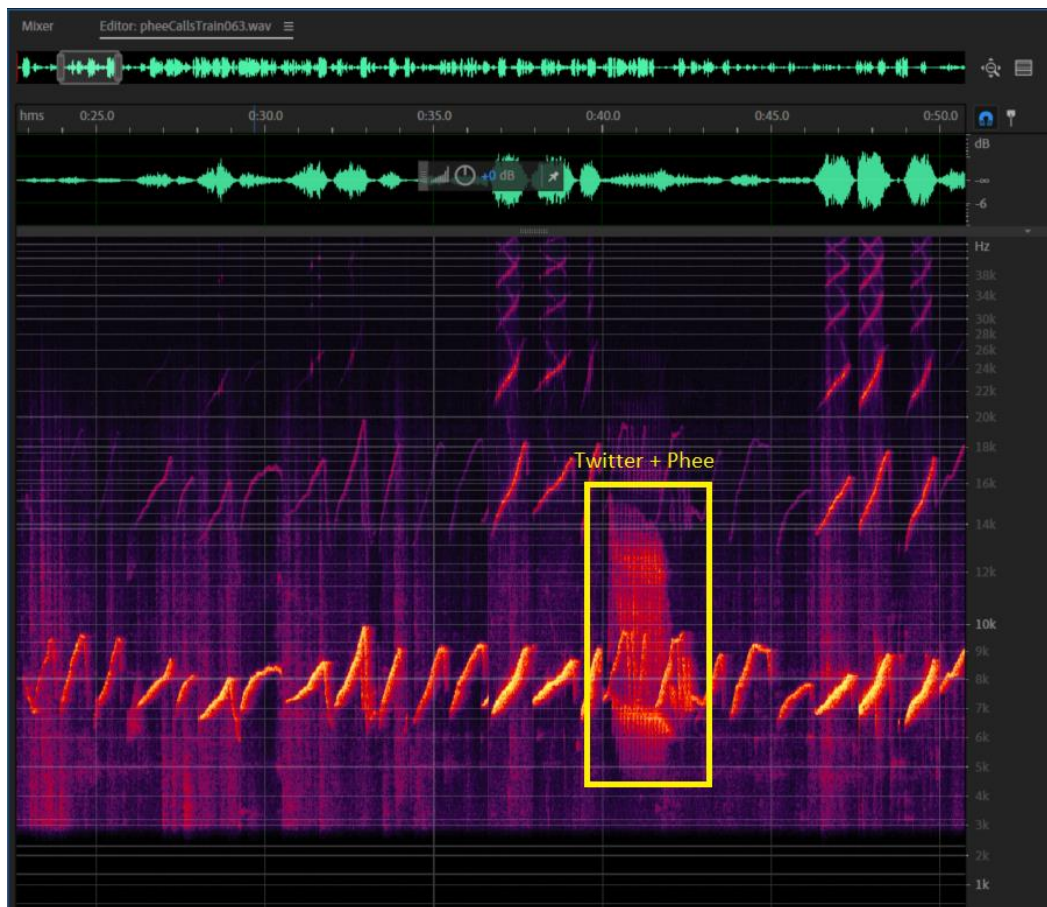
Figure 4: Block diagram of the harmonic product spectrum algorithm

Currently we have investigated setting values of R from 2-4.

### **Other Notes:**

Another note that should be made is that upon further investigation into the training data there are a few instances of miss labeling. In order to make sure that the training data is in order we are going to go through each of the training files in Audition and manually scrub out any inconsistencies.

An example of this is seen in the phee calls from the 063 data set (shown in Figure 5).



*Figure 5: Call labeled as "Phee" incorrectly - Should be a "Combo"*

### **Future Steps:**

Over the next couple of weeks, our plan is to complete the following:

1. Investigate the spectral smudging and aim to remove it effectively.
2. Look at implementing a modified version of the HPS.
3. Implement a lightweight version of the MCRA algorithm.
4. Scrub the data set to fix mislabeled calls.
5. Set up/begin to train a classifier that will take the harmonics as features to identify the call.