STEP 1 – First Test

* Vary parameters
  + Steps in signal processing
    - Hilbert Transform of samples
    - Findpeaks
* Conclusions: Detector is not going to work as is, need to make changes
* Can process 166 days in 24 hours

STEP 2 – Teager Keiser

* Does Teager Keiser even work?
  + Small, Proof of Concept
  + Steps in Signal Processing
    - Hilbert Transform of samples
    - Teagan Keiser Energy
    - Findpeaks
* Can process 166 days in 24 hours
* Conclusions: Teager Keiser does work.

STEP 3 – Samples v Seconds

* Do I really need to find peaks of every sample or can I average samples to .1 second increments?
* Samples
  + Signal Processing
    - Highpass ellip(0-100Hz)
    - Hilbert Transform samples
    - Teagan Keiser Energy
    - Findpeaks
  + Conclusions: Accuracy and Duration still aren’t where they need to be
  + Can process 166 days in 24 hours
* Seconds
  + Signal Processing
    - Highpass ellip(0-100Hz)
    - Hilbert Transform samples
    - Average every .1 second without overlap
    - Teagan Keiser Energy
    - Findpeaks
  + Something weird happened here, I made a dumb mistake somewhere
* Can process 650 days in 24 hours
* Conclusions: Averaging to seconds really speeds up the calculations

STEP 4 – Fine Tune

* Thought I was done with Detector ,Fine Tuning Parameters
  + Signal Processing
    - Highpass ellip(0-100Hz)
    - Hilbert Transform samples
    - Average every .1 second without overlap
    - Teagan Keiser Energy
    - Findpeaks
  + Can process 650 days in 24 hours
  + Conclusions: Not done, need to make more changes

STEP 5 – DB Filter

* Motivation: While looking in SeeLoggedCalls, I noticed that there was a lot of noise surrounding the call, and if I could filter out all noise except for the call then the call would be much clearer
  + Signal Processing
    - Highpass ellip(0-100Hz)
    - DB Filter
    - Hilbert Transform samples
    - Average every .1 second without overlap
    - Teagan Keiser Energy
    - Findpeaks
* Cam process 500 days in 24 hours
* Conclusions: Getting better but still not there

STEP 6 – Butter Filter

* While looking at the data in SeeLoggedCalls noticed the ellip filter was spilling over, so changed to a butter filter.
* Butter Filter
  + Signal Processing
    - Highpass Butter(0-100Hz)
    - DB Filter
    - Hilbert Transform samples
    - Average every .1 second without overlap
    - Teagan Keiser Energy
    - Findpeaks
* Can process 450 days in 24 hours
* Conclusions: Butter is better than ellip, also varied chunkduration in this test and decided on 15 seconds as being the best. I wont go smaller than 15 seconds because we have calls that are as long as 10 seconds and I don’t want them to be whitened away.
  + Important assumption I am making while whitening and with the threshold in general
    - The call is small enough in reference to the chunk duration that its impact on the average in negligible.

STEP 7

* Series of tests, that would work like a tournament to determine which detector and parameters are the best
* In all of these tests be sure to look at the excel spreadsheet for the exact parameters and data
* All parameters are not help constant from test to test, so be sure to pay attention to them when looking through the excel spreadsheet.
* Test 1
  + Testing which PSD Summation Method works best
  + Method 1 : converting every cell in the psd to decibels then summing columns to get Spectra
  + Method 2: summing columns then converting to decibels to get spectra. Mathematically correct.
  + Motivation of this test was when checking out the two methods in SeeLoggedCalls, Method 2 looked much better.
  + The Test
    - M1H= Method 1 with only a Hilbert transform
    - M2T= Method 2 with Hilbert and Teagan
    - M1T = Method 1 with Hilbert and Teagan
    - M2H = Method 2 with only Hilbert
  + The results:
    - M1H had to best results with 86%
    - M2T at 84%
  + Concluded: MT2 was a small enough compromise to be mathematically correct
  + Can process 450 days in 24 hours
* Test 2
  + Repeat test 1 because the results surprised me
  + Results were the same
  + Also cool because it shows that there is basically no variation in my detector between trials
  + Can process 450 days in 24 hours
* Test 3
  + Do I even need to convert from DB to power
    - MT1= Method 1 with Hilbert and Teagan
    - MT2= Method 2 with Hilbert and Teagan
    - MT3= No converting back to DB with Teagan
  + Results=
    - MT2-84%
    - MT3- 76%
  + Conclusions: I do need to convert back to DB
  + Can process 450 days in 24 hours
* Test 4
  + Does my DB Filter even help?
    - I forgot which summation method I used for the NO BD trial
    - Results
      * MT2-84%
      * MT3-76%
      * NoDB – 75%
      * Concluded that the DB filter does help
      * For theory on why it helps check out my picture explanation
  + Can process 450 days in 24 hours
* Met with Dr. Hodgkiss, The HTests are me testing some of his suggestions and me expanding on those suggestions
* I stopped converting back to DB here because I realized that since it is mathematically incorrect to add db, I shouldn’t be calculating my average noise level (averaging) in db.
* HTest1
  + Dr.Hodgkiss said that using a filtering function (ellip,butter,etc…) was pointless if I was already looking at the psd. He said I should just block out the rows of the psd matrix that I didn’t care about
  + This is testing if Hilbert and Teagan help or hurt with the new type of highpass filtering
    - FilterHodg- just blocking out the rows with Hilbert and Teagan
    - FilterHodgNTNH- blocking out the rows without Hilbert and Teagan
    - FilterHodg-76.9%
    - FilterHodgNTNH-77.1%
  + Conclusions: Hilbert and Teagan were not helping, so got rid of them
  + Can process 773 days in 24 hours
* HTest2
  + Butter Filter v Just getting rid of the rows
    - MT3-Butter Filter with Hilbert and Teagan and no converting back to DB
    - HodgNTNH- ignoring the rows, no Teagan, no Hilbert
    - MT3- 76%
    - FilterHodgNTNG-82%
  + Conclusions: Ignoring the rows was faster and better
  + Can process 773 days in 24 hours
* HTest3
  + Can I replace chaining with matrix operations?
    - Chaining- see picture
    - Matrix operations (popcorn)
    - Results: Yes I can Matrix operations get exactly the same results and are much faster
  + Conclusions: Matrix operations are better
  + Can process 811 days in 24 hours
* HTest4
  + Does Whitening Help?
    - Whitening-86%
    - NoWhitening – 82%
  + Conclusions: Whitening does help
  + Can process 741 days in 24 hours
* HTest5
  + Finding magical combination of parameters
    - Here I am balancing Accuracy Duration and Multiple Call%
    - I decided to go with
    - ChunkDuration=15 sec
    - Threshold=1.5
    - Interval=1.5
    - EnergyPercentile=95
    - Accuracy=89.9% (lets round up to 90% and say we met our goal)
  + Conclusions: Close to meeting the goals
  + Can process 741 days in 24 hours
* HTest6
  + Trying to squeeze more accuracy out of the calls by fine tuning highpass filter
    - Each Number at the end of the file name corresponds to how many rows I blocked.
    - The frequencies aren’t exact because of how spectrogram bins the data but Each row about corresponds to 10Hz roughly
    - 0rows-88.2%
    - 5rows-87.5%
    - 7rows-87.6%
    - 10rows-88.1%
  + Conclusions: ended up sticking with 10 rows because felt the .1% increase in accuracy wasn’t worth the increase in total points.
  + Can Process 741 days in 24 hours
* HTest7
  + When whitening should I normalize to the average noise level or zero
  + Conclusions: They produce the same results
  + Can process 741 days in 24 hours