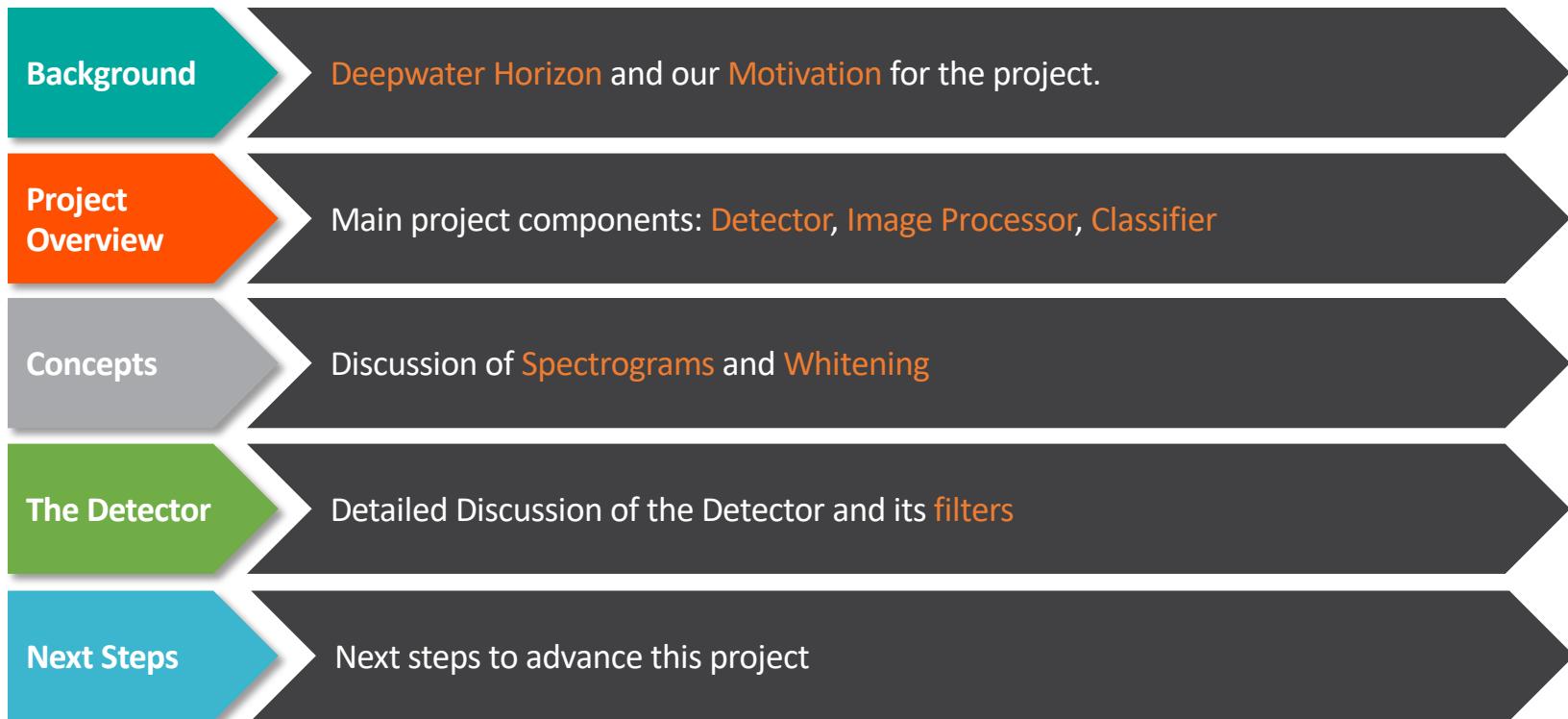


Detecting Life

A power and amplitude threshold detector for fish calls
in the Gulf of Mexico

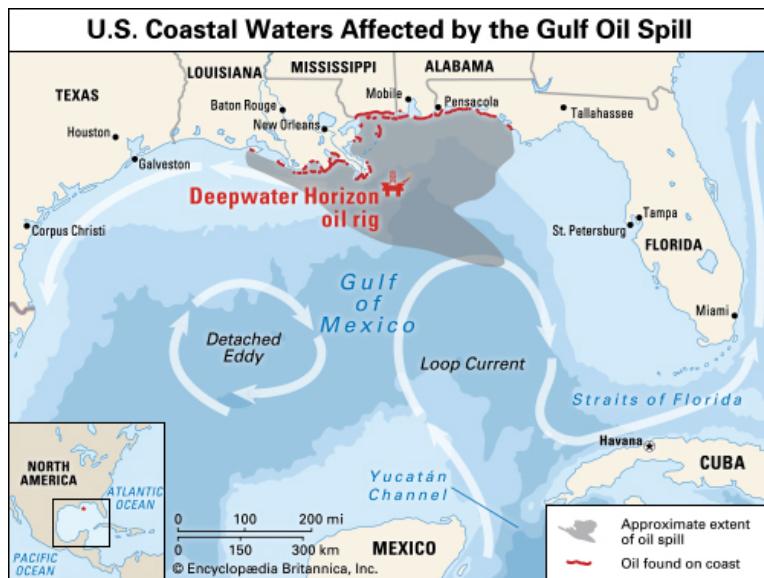
Nicolas Jeffress
Marine Bioacoustics Laboratory
Marine Physical Laboratory Internship

Outline



Deep Water Horizon

Background



Richard Pallardy, Deepwater Horizon oil spill of 2010, Encyclopædia Britannica,
<https://www.britannica.com/event/Deepwater-Horizon-oil-spill-of-2010>

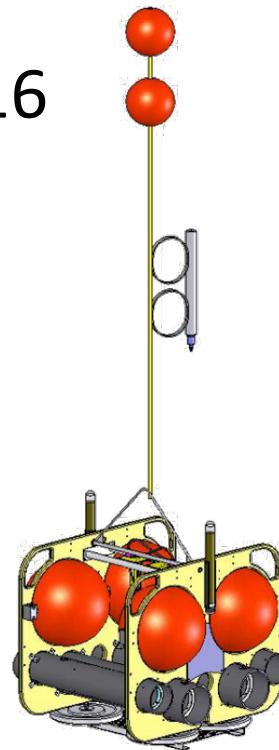


By Unknown - US Coast Guard - 100421-G-XXXXL- Deepwater Horizon fire (Direct link), Public Domain
<https://commons.wikimedia.org/w/index.php?curid=10089914>

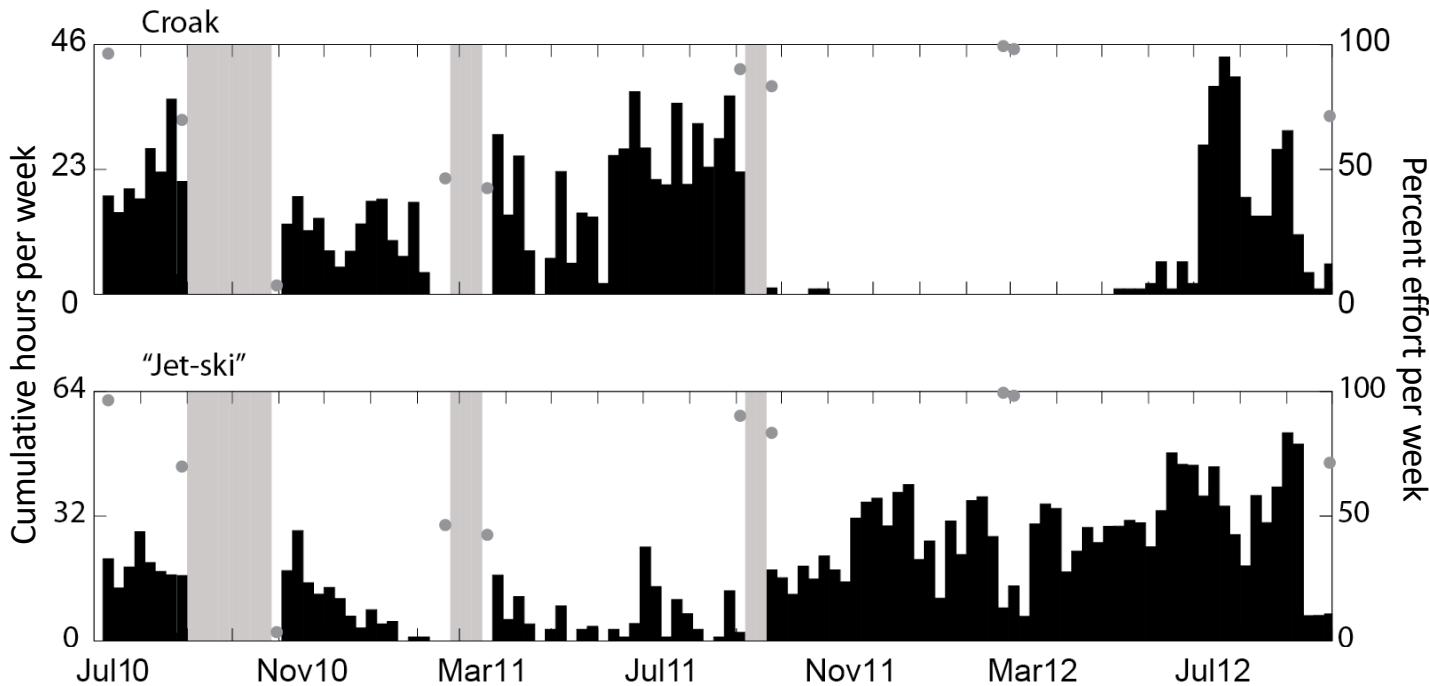
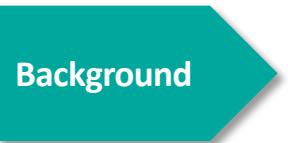
Acoustic recordings

- High-frequency Acoustic Recording Package
- Data collection: July 2010 – April 2016

Background



Motivation



Project Overview



Detector

Purpose

Computationally search six years of acoustic data and identify potential marine life calls.

Mechanism

Use data chunking and filtering to assist in call identification



Image Processor

Purpose

Turn start and end times from the detector into similarly sized spectrogram images

Mechanism

Image plots



Classifier

Purpose

Classify the Images as a call type or noise.

Mechanism

Convolutional Neural Network

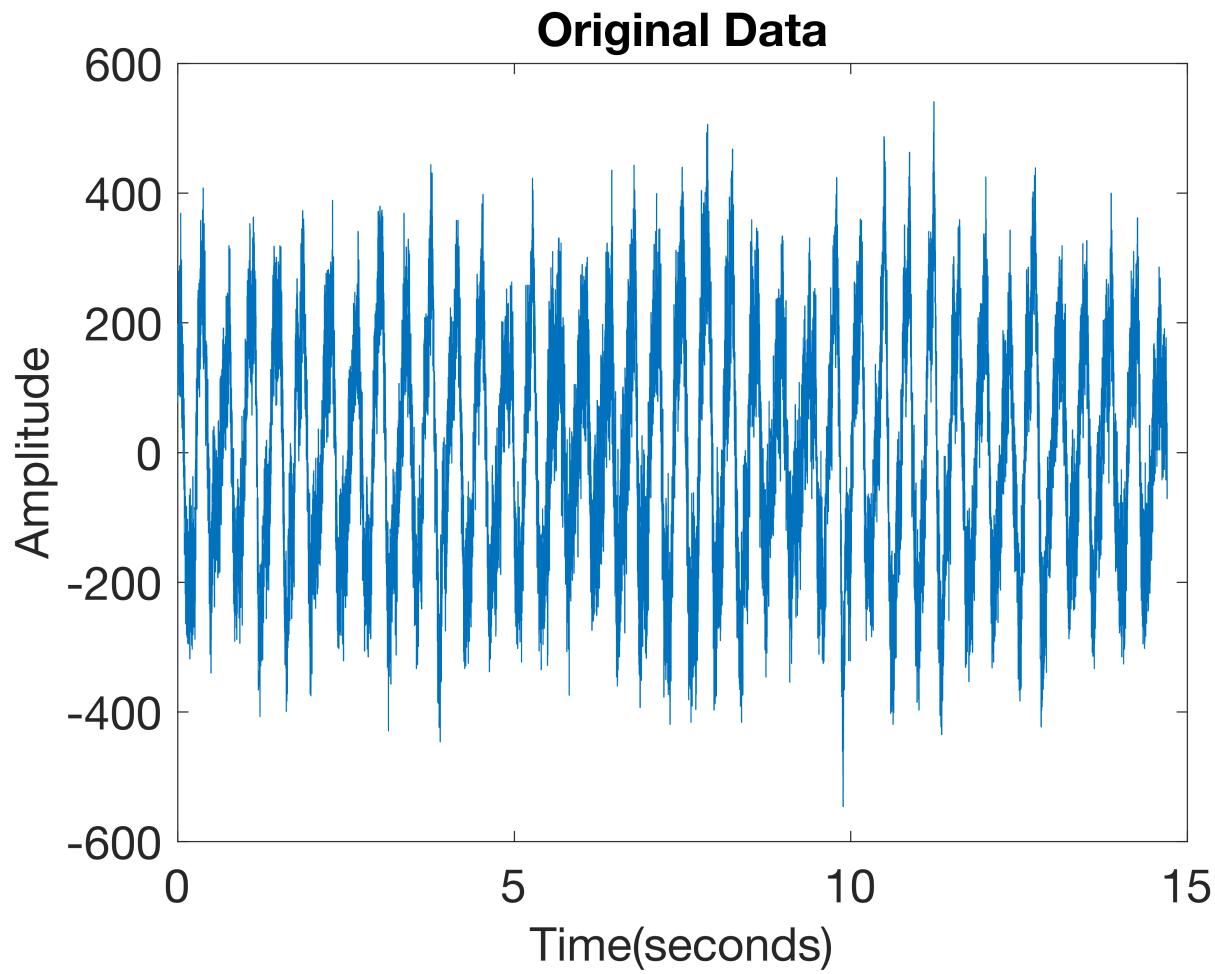
What is a Detector?

Concepts



- Many different types of detectors
- This Detector is a threshold detector
 - Any time that the sound level is greater than a certain threshold sets off the detector
 - Very important that the fish call is the loudest thing in the recording
- Goal 90% accuracy of detecting logged calls

Original Data



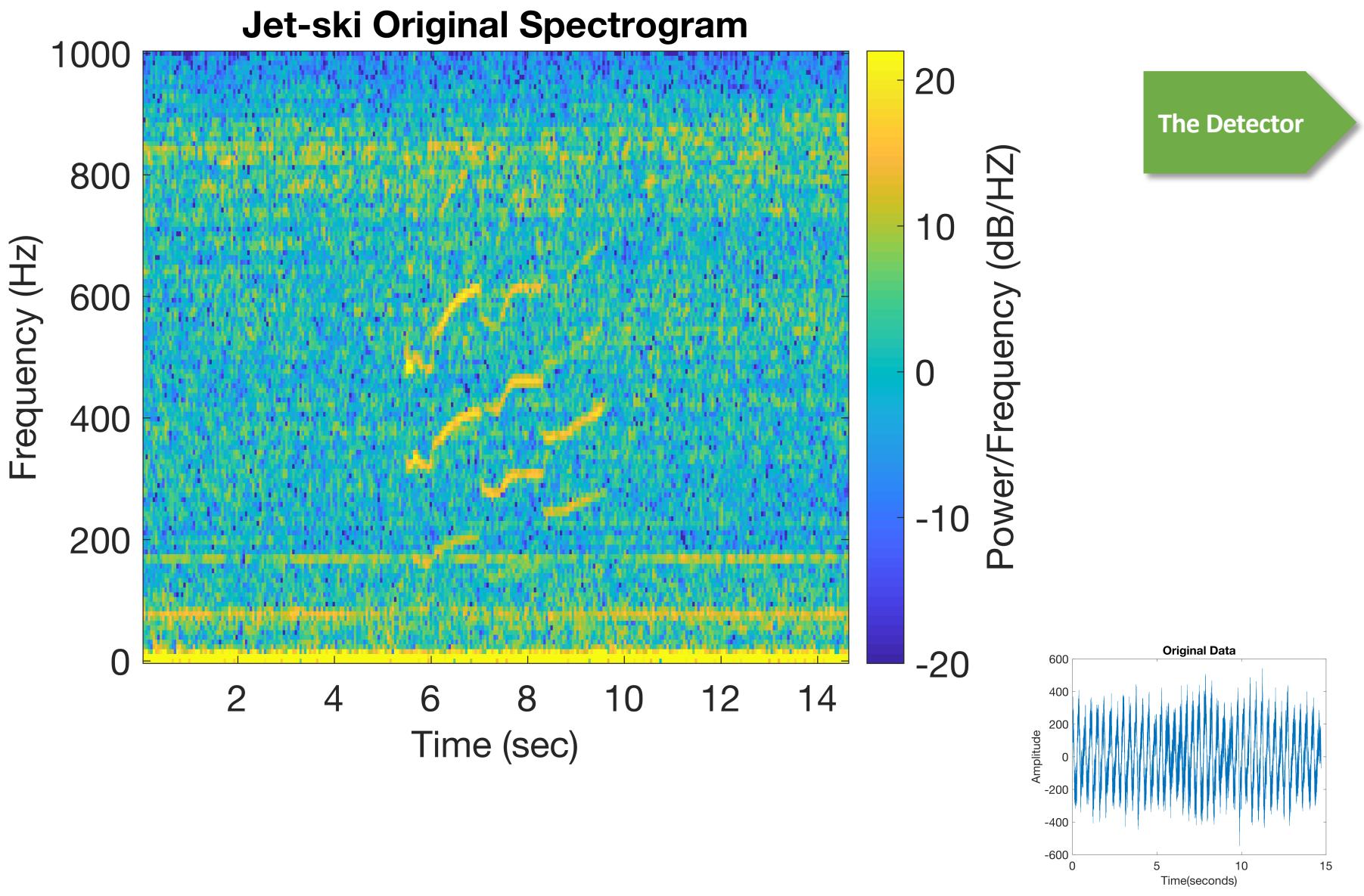
What is a Spectrogram?

Concepts



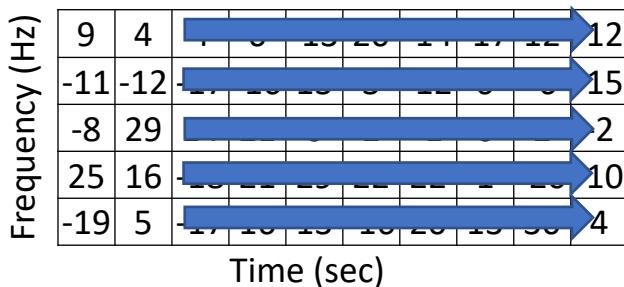
- X axis = Time
- Y axis = Frequency
- Each cell = Energy
- Each number corresponds to a color

*Values were randomly generated for this example



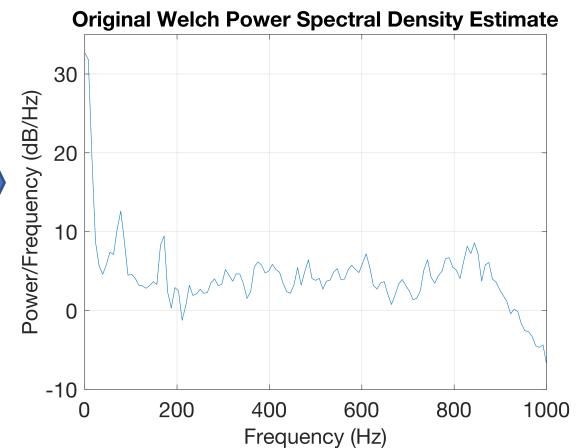
Making a Welch Power Spectral Density Estimate

Concepts

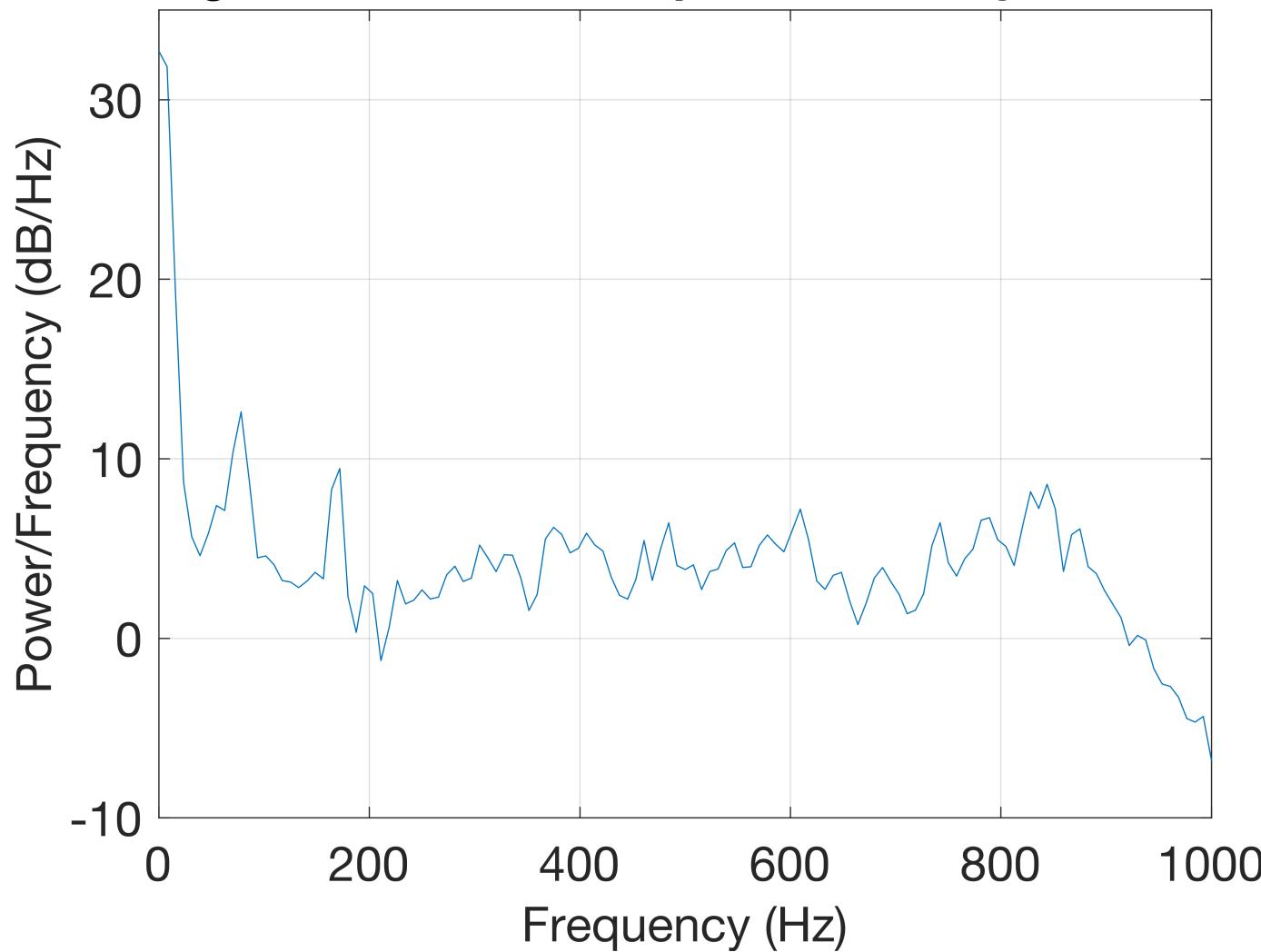


*Taking average across each row

Frequency (Hz)	Average Energy
800	-.1
600	-7.3
400	6.9
200	8.8
0	4.9



Original Welch Power Spectral Density Estimate



Whitening

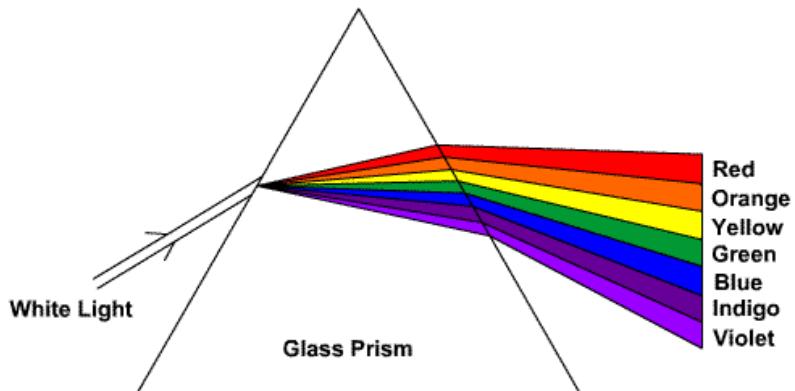
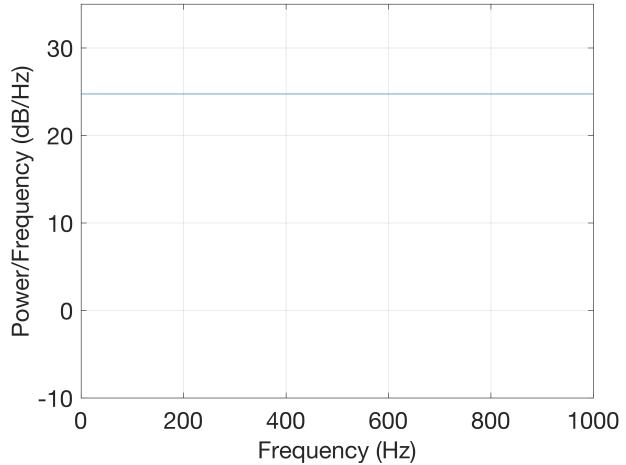
Concepts

9	4	4	6	-13	20	-14	-17	12	-12
-11	-12	-17	-16	13	3	-12	0	-6	-15
-8	29	14	21	6	2	-1	6	2	-2
25	16	-18	21	29	22	22	1	-20	-10
-19	5	-17	16	13	-16	20	13	30	4

Average Energy

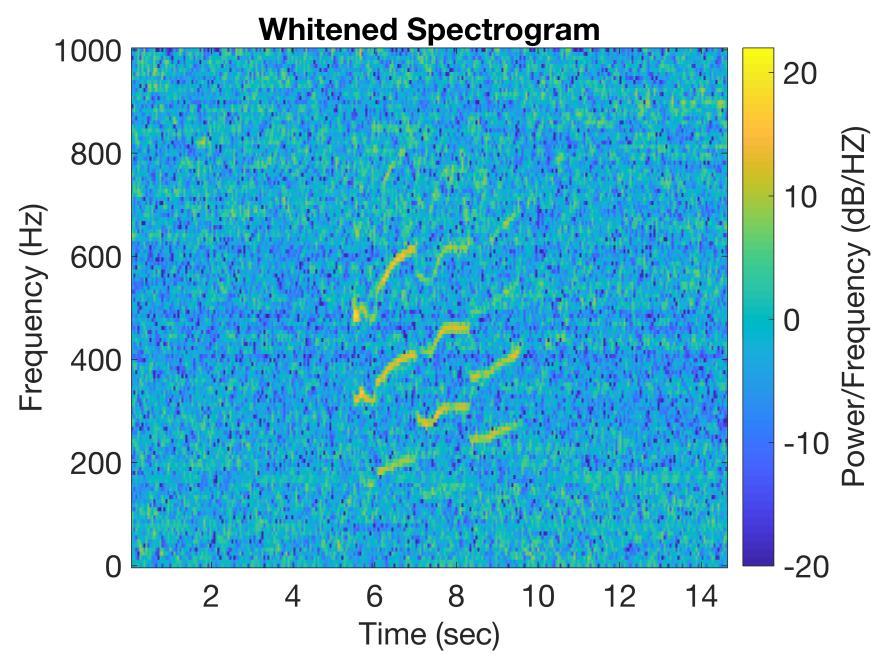
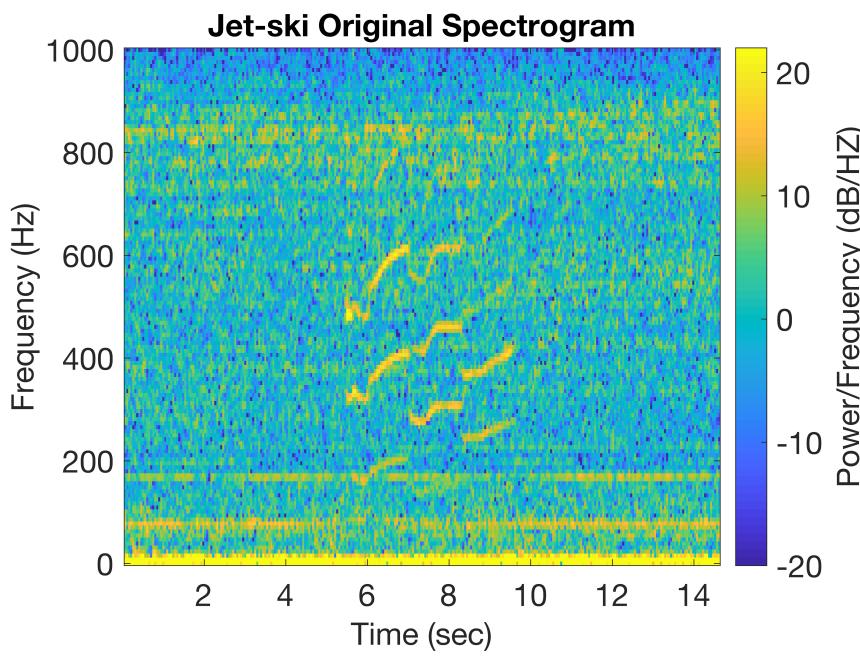
$$\begin{array}{r} \boxed{-1} \\ \div \\ \boxed{-7.3} \\ \boxed{6.9} \\ \boxed{8.8} \\ \boxed{4.9} \end{array}$$

Whitened Welch Power Spectral Density Estimate



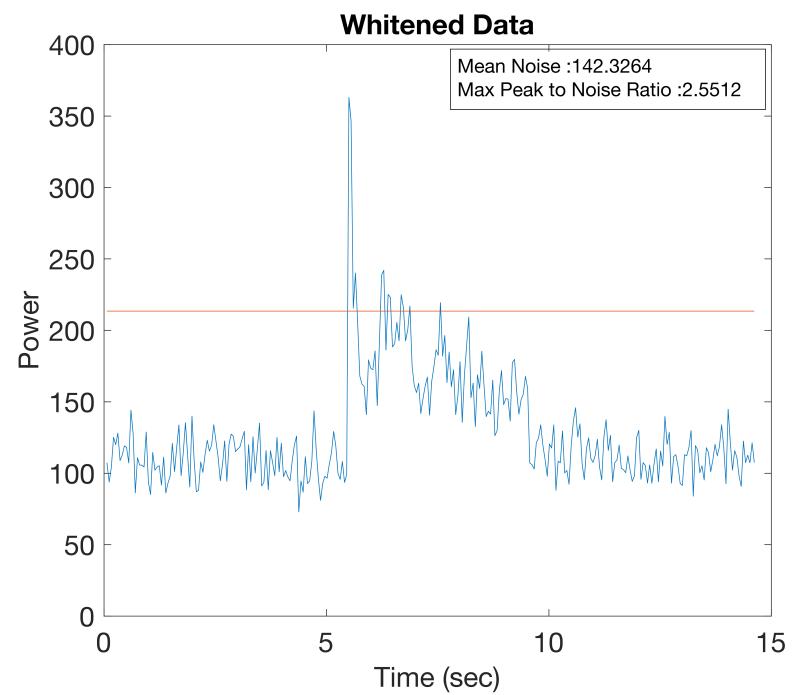
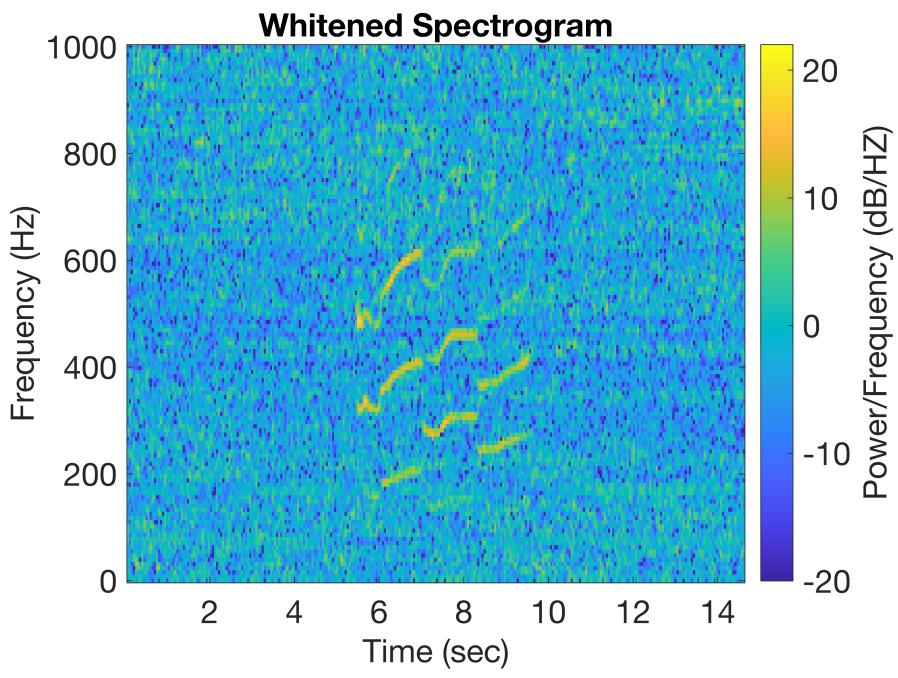
Whitened vs Original Spectrogram

The Detector



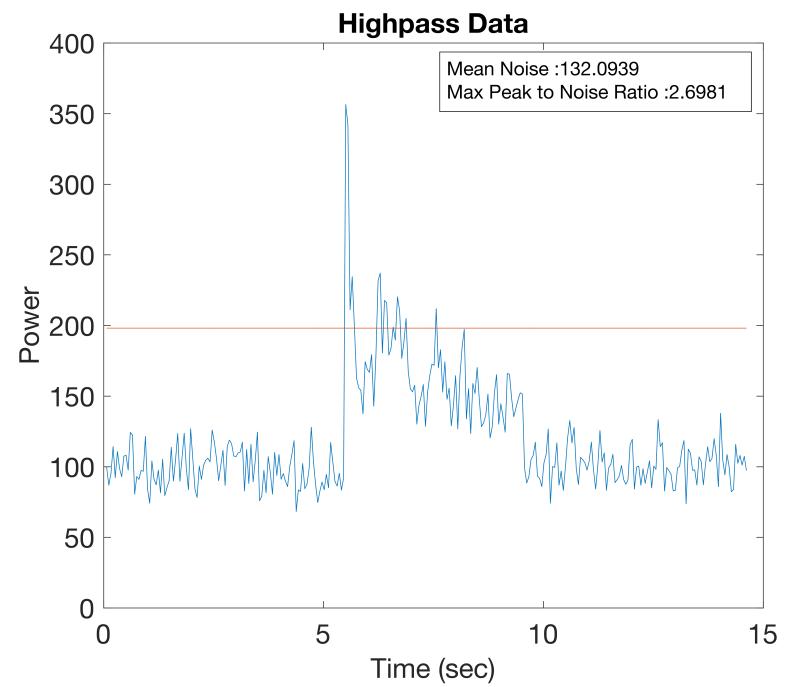
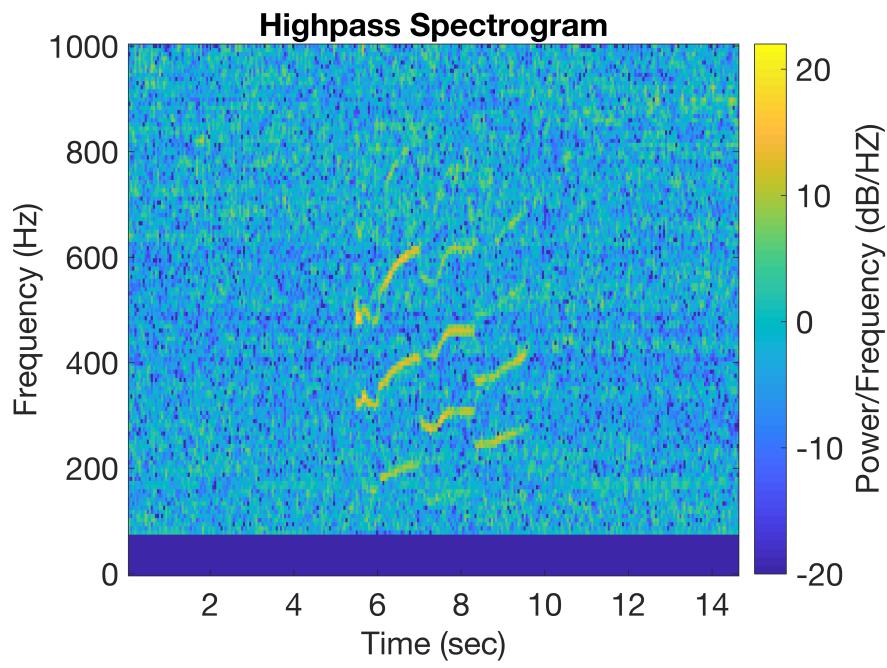
Step 1: Whitened Data

The Detector



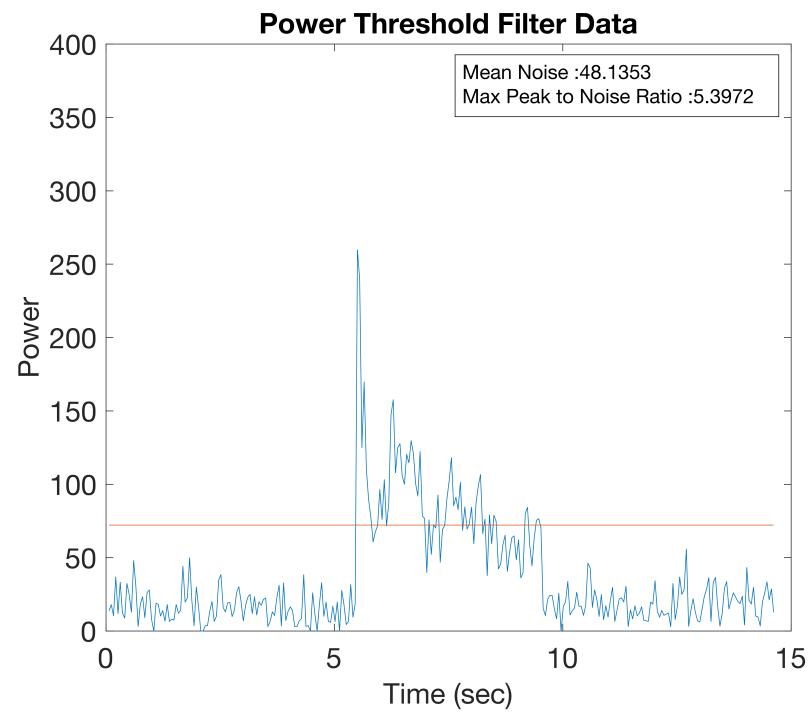
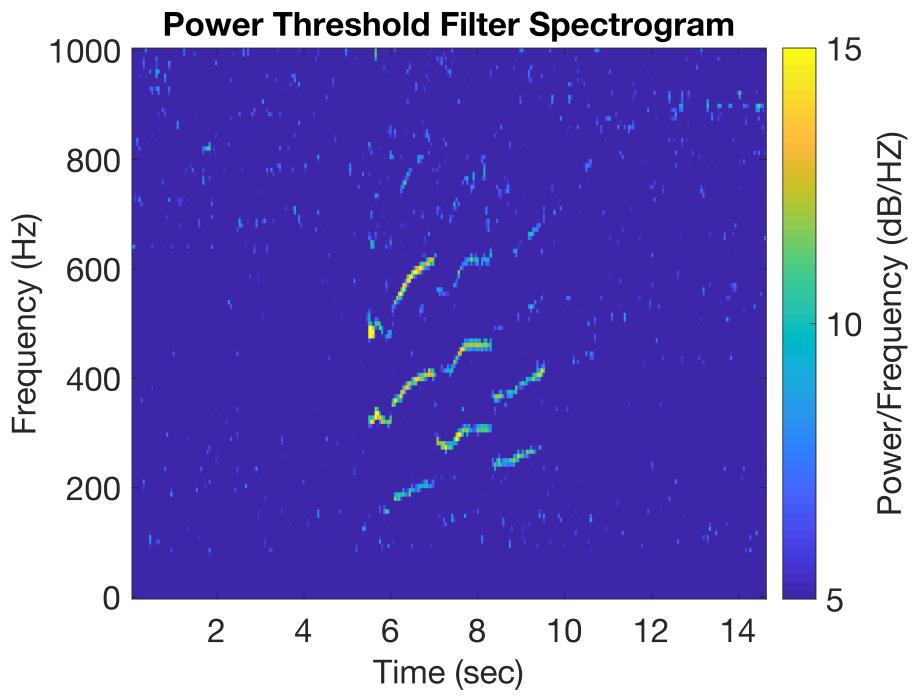
Step 2: Highpass Filter

The Detector



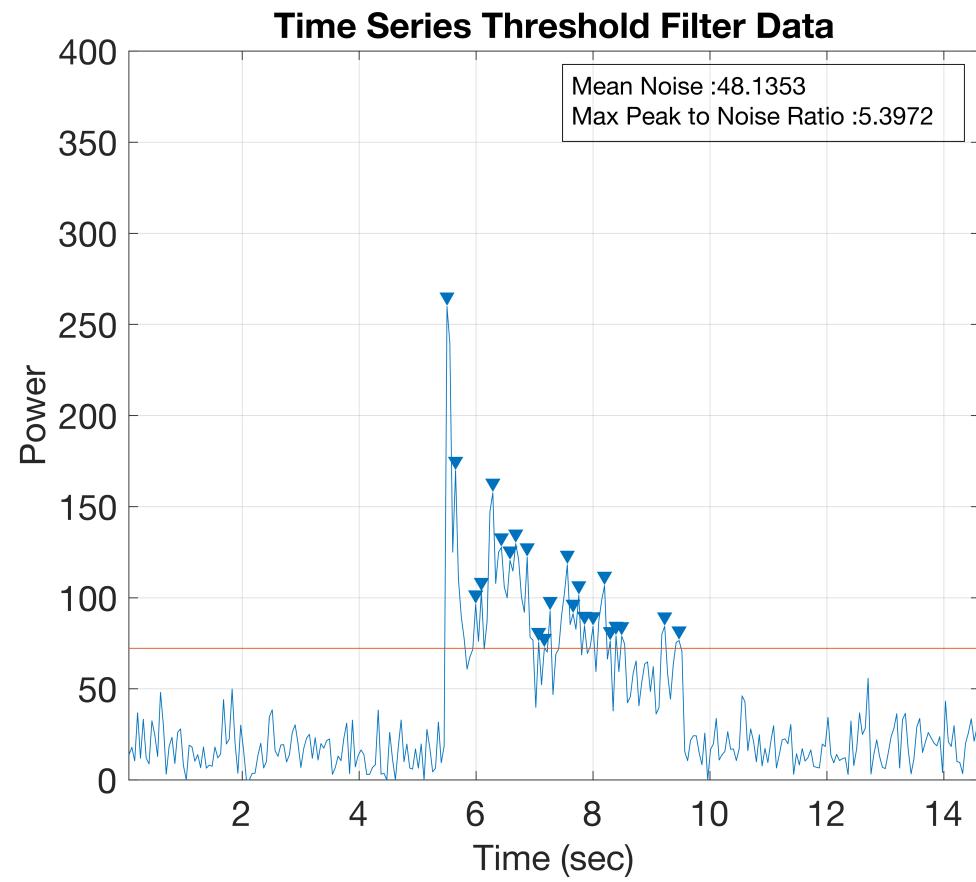
Step 3: Power Threshold Filter

The Detector



Step 4: Amplitude Threshold Filter

The Detector



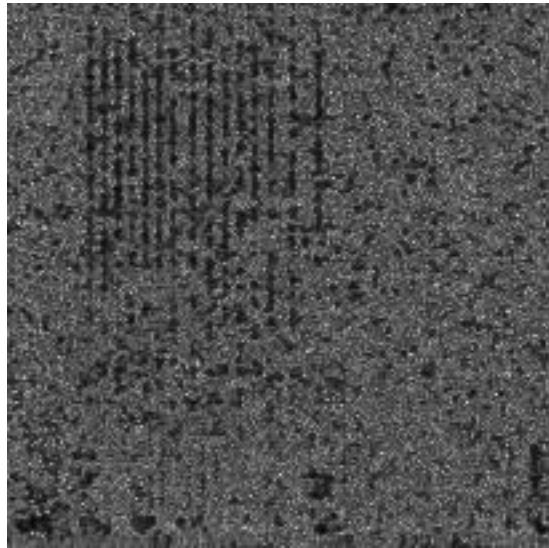
Detector stats

The Detector

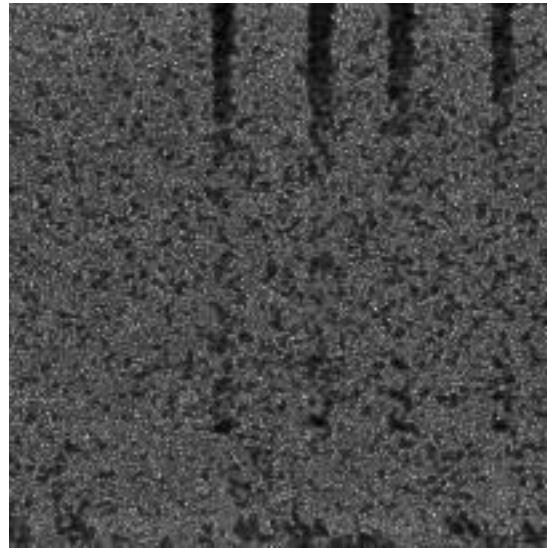
Type	Detected	Present in Log	Accuracy (%)
Beats	4	17	23
Buzz	51	83	61
Click Train	316	321	98
Croak	205	221	92
Downsweep	11	19	58
Jet-Ski	99	109	91
Pulse Train	22	52	42
Total	708	822	86

Can process 2 years of data in 24 hours

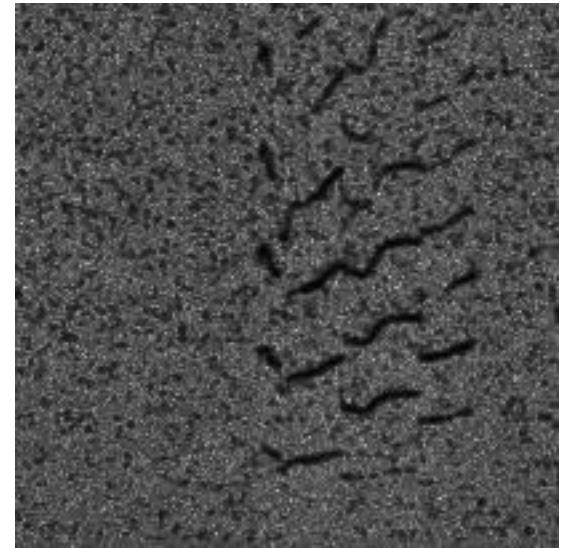
The Good



Click Train 98%

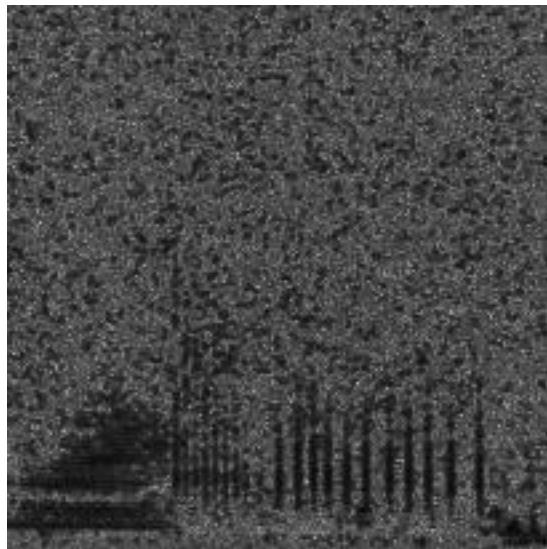


Croak 92%

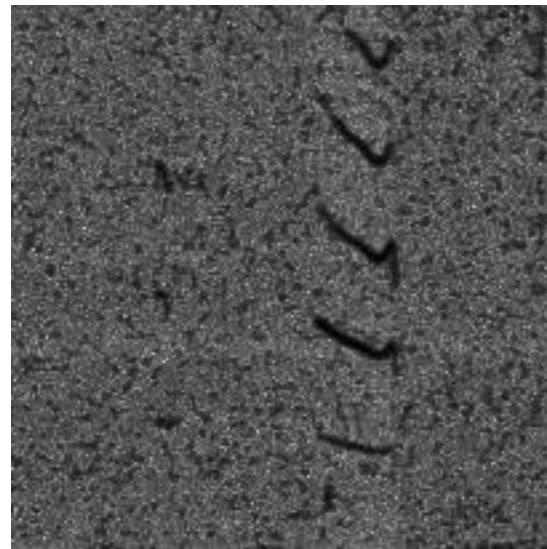


Jet-Ski 91%

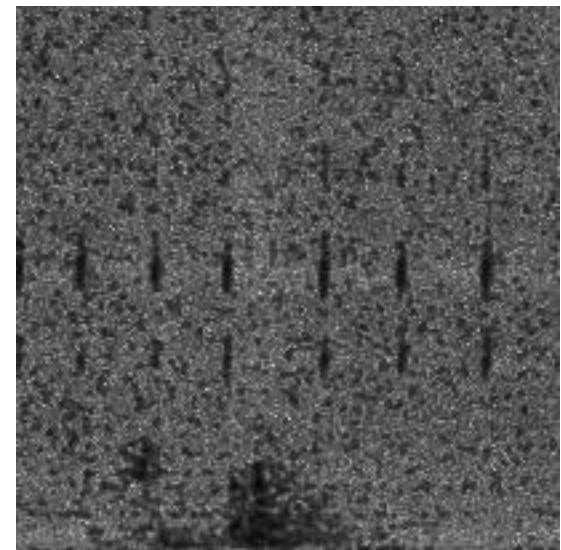
The Bad



Buzz 61%

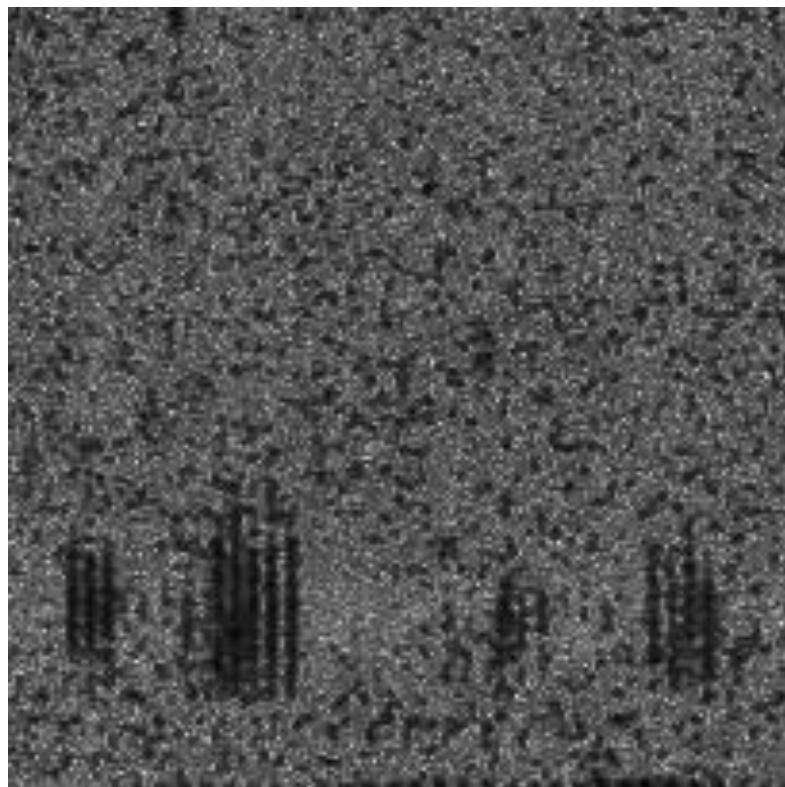


Downsweep 58%



Pulse Train 42%

The Ugly



Beats 23%

Next Steps



Next Steps

- Debug Classifier
- Run Detector on all Data
- Make images of detections so everything is ready to go by the time classifier is debugged

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