Environmental Acoustics Team

Vito Murillo, Laurie Prinz, Anthony Bianco, Raúl Huertas



This material is based upon work supported by the U.S. Department of Homeland Security under Grant Award Number 2014-ST-061-ML0001. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security.

Overview

- 1. The A Team
- 2. Objectives and Implications
- 3. Equipment
- 4. Calibration and dBA
- 5. U.S. Merchant Marine Academy
- 6. Penn Plaza
- 7. Anechoic Chamber
- 8. Hoboken Pier
- 9. Conclusion



The A Team

- Alexander Sutin
 - Mentor
- Yegor Sinelnikov
 - Environmental Acoustics Mentor
- Vito Murillo
 - Project Manager, Programming support, Writer support
- Anthony Bianco
 - Matlab and Equipment Technician
- Laurie Prinz
 - Data Organizer and Writer
- Raúl Huertas
 - Matlab and Equipment Support



Environmental Acoustics Objective

- The objectives of the Environmental Acoustics team were to:
 - Collect empirical data from several locations (Penn Plaza, Acoustic Chamber, USMMA, Hoboken Pier).
 - Determine sound pressure level.
 - Identify sound events and sound sources.
 - Detect acoustic signatures over distance.



Implications of our research

- Characterize urban noise in spectral and temporal domains.
- Extract specific event acoustic signatures.
- Assess the ability to detect specific events that could potentially be harmful in urban and maritime environments.



Equipment

•Zoom F8 Multitrack

•Behringer B-5





•MatLab 2015a

•Digital Sound Level Meter

•ND9 Sound Calibrator



What is dBA?

- dBA is the resulting unit of sound pressure level after the A-Weighting has been applied.
- This process of weighting different frequencies results in a unit that is more representative of the perception of human hearing.



Determining Calibration

 Microphones convert Pascals from sound to Volts to be recorded as signal.

$$L_p = 20 \times log\left(\frac{P}{P_0}\right), P_0 = 20\mu Pa$$

 The Pressure Calibration Factor was used to correct all microphone Sound Pressure Level readings to be in line with the Digital Sound Level Meter.

Calibration Verification Plot



Experiments

- United States
 Merchant Marine
 Academy
- Penn Plaza Pavilion
- Stevens Institute of Technology Anechoic Chamber
- Hoboken Pier Joint Research









United States Merchant Marine Academy

- Objective was to observe acoustic signature of a boat at different distances.
- Data collected:
 - 11 Recordings (28 minutes)
 - 18.8 GB of Audio and Spectrogram synchronization
 - GPS Track



Boat Detection





Time: 360 - 390 seconds NFFT: 8192 Frequency Range: 0 to 2 kHz dB Range: 0 to 100 dB

* Frequencies from 0.4 kHz and up begin to fade away around 385 seconds.

* Boat is 533 meters away.

GPS Track



Penn Plaza Pavilion



- The objective was to record urban noise.
- Data collected:
 - 11 recordings (110 minutes)
 - 78.1 GB of Audio and Spectrogram synchronization

Location



* Precise measurements were taken of the surroundings.

* Distances to buildings, streetlight intervals etc.

Data Gathered

Time Start	8:30 AM				
Time End	8:41 AM				
Temperature (F)	72				
Humidity (%)	76				
Wind speed (mph)	11				
Noise Level start (dBA)	71.7				
Recording Length:	10:01				
Time:	Event:	Time:	Event:		-
0:14-0:23	Sirens	8:31 AM	police sirens		
0:25	Washing Car Machine near Mic4	8:31 AM	long car horn		
0:50-1:10	Rolling bucket, janitor	8:32 AM	janitor rolling trash can		
1:20	Police Whistling	8:33 AM	loud car horn, coughing man		
1:40	Talking on phone, 1m	8:34 AM	coughing man		
2:00	Rolling luggage, 8m	8:35 AM	man still coughing		
2:22	Washing Machine near Mic4	8:36am - 8:38am	man coughing		
2:38	Multiple Whistling (Police Traffic)	8:38 AM	man walked in front of mic		
3:00-3:10	Caughing, 12m	8:38 AM	security guard radio		
3:45	3 People Walking talking, 5m	8:39 AM	cement washer		
4:25	Walking person, 1m	8:39 AM	man walked by pushing tank of water		ater
5:08	Police Whistling				
5:10-5:15	Caughing, 12m				
6:00	Walking person, 2m				
6:40-6:45	Caughing, 12m				
7:01	Two people walking, 2m				
7:22-7:30	Radio going off				
7:44	Caughing, 12m				

Sound Pressure Level vs. Time



Police Sirens at Penn Plaza





Anechoic Chamber

- The objective was to isolate the acoustic signature of specific objects.
- Data collected:
 - 16 recordings (20 minutes)



GunShot







Scream



Male yelling

Female yelling

Hoboken Pier

- The objective was to collect empirical data that could later be synchronized with Buoy Team's data.
- Data collected:
 - 9 recordings (3.8 hours)



Helicopter



Conclusion

- Four successful research experiments.
- Sound pressure levels determined.
- Specific acoustic signatures were identified.
- Detection of an acoustic signature over distance was achieved.



Thank you.