Online Proceedings

Poster Session 2

MGH 241, Easel 108

1:00 PM to 2:30 PM

Localizing Crow Vocalizations in Social Aggregations

Derek William Flett, Senior, Mechanical Engineering (Bothell)
Undergraduate Research Conference Travel Awardee
Virdie William Guy, Fifth Year, Mechanical Engineering (Bothell)
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Derek Delizo, Senior, Electrical Engineering (Bothell)
Mentor: Shima Abadi, School of Oceanography
Mentor: Douglas Wacker, School of STEM, Division of Biological Sciences, University of Washington Bothell

The North Creek Wetlands Restoration on the University of Washington Bothell campus is home to a large nocturnal American crow (Corvus brachyrhynchos) roost. Each day from Autumn to Spring, crows form pre- and post-roost aggregations, which consist of between tens and hundreds of crows. Crows on these aggregations are often highly vocal, but the functions of their vocalizations are not well understood. Identifying any context-dependent patterns in these vocalizations is critical to fully understand communication in this highly social and intelligent species. Previous studies have shown the presence of human observers near large groups of crows may disrupt natural vocal and non-vocal behavior. In this study, the potential confound of these observer effects are eliminated by recording crow vocalizations using a remotely activated, time-synched microphone array. Simulations are undertaken to study the performance of the Time Difference of Arrival (TDOA) method to localize individual callers. A parametric study is used to analyze the effects of number of receivers, signal frequency and duration, and crow location on the performance of TDOA. In addition to the simulation, different types of previously recorded crow vocalizations are used to design robust playback experiments in order to fine-tune our localization technique for use in actual crow aggregations in future.

Poster Session 2

Balcony, Easel 109

1:00 PM to 2:30 PM

Machine Learning on Seismic Streamer Data

Ellory D (Ellory) Freneau, Senior, Electrical Engineering
Mentor: Shima Abadi, School of Oceanography

Seismic reflection surveys use acoustic energy to image the structure beneath the seafloor by broadcasting broadband impulsive sound signals (called airguns) that reflect off the sea floor and are recorded through long arrays of hydrophones (called seismic streamers). During these surveys it is important to have a model to predict how much noise will be added to the ocean environment. The complexity of local geology, seafloor topography, and uncertainty in water properties makes it difficult to mathematically model acoustic propagation in ocean. However, ocean data like many other branches of science is experiencing an explosion in the amount of data collected and available for analysis. The goal of this research is to use previously recorded ocean data to (1) calculate the sound power levels generated by airguns during seismic reflection surveys and (2) use machine learning to create a predictive model of airgun noise considering various variables such as ocean depth and distance from the airgun. Several regression methods in Python were used and the method that resulted in the most accurate regressor was chosen. The data used in this experiment spanned a wide range of water depths from the continental shelf (∼40thinsp;m) to deep water (∼2600thinsp;m). In this presentation, the performance of a machine learning algorithm trained by the sound power levels calculated through one track line of this cruise is investigated.

Poster Session 3

MGH 258, Easel 192

2:30 PM to 4:00 PM

Underwater Recording Device

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Michael Conrad Cook, Senior, Mechanical Engineering (Bothell)
Mentor: Shima Abadi, School of Oceanography

Underwater noise pollution has increased greatly in recent years due to human activities. Such noises have adverse effects upon marine life. However, there is limited information on long term exposure to low-intensity man-made noise such as bridge traffic as well as how man-made noise propagates through water. The main goal of this study is to learn about the impact of the noise pollution generated by the SR-520 and I-90 bridges on Lake Washington. To record samples of the noise an underwater recording packing was engineered, this system possesses a hydrophone that records ambient noise levels, a Raspberry Pi to serve as a microcontroller with remote access capabilities, and an integrated cellular device to upload all relevant data to Microsoft Azure's cloud computing database. The Audio was recorded during predefined intervals of the day and can be easily accessed from the cloud for further analysis. Along with this the user is able to remotely control the system giving them a low maintenance device to work with. To make this package self-sustaining, solar panels were installed on the buoy to recharge the deep cell batteries and super capacitors which were used to power this system. The goal when engineering this device was to design a low maintenance durable machine that could accurately record audio underwater. With these features the user could explore the long-term effects of underwater sound resulting from human activities and their potential effects on aquatic life. Once the acoustical data is collected, a compound analysis will involve studying the ambient noise levels and possible ecological effects of low intensity, constant traffic at multiple distances from the source.

Poster Session 4

Commons West, Easel 30

4:00 PM to 6:00 PM

Scattering from a Distribution of Rough Plates

Max Apollo Bright, Senior, Electrical Engineering
Mentor: Yasuo Kuga, EE
Mentor: Akira Ishimaru, Electrical Engineering

Modeling how electromagnetic waves scatter from a distribution of rough plates poses many applications. Certain systems may be easy to approximate with planar geometry, but use of numerical field solvers to determine the radiated fields could take a long time for nontrivial structures. We propose an iteration on existing formulas based on the Kirchhoff approximation. This iteration will consider the case of multiple rough, finite-sized rectangular plates. We developed software to determine the scattering of waves off of a distribution of rough plates, of arbitrary position and orientation between a transmitter and receiver. The method considers each plate individually, calculating the coherent and incoherent scattered fields. Provided all plates and the transmitter and receiver are sufficiently spaced, we calculate the total fields by summing the result from each individual plate. We verified this method via comparison to numerical data. This model can then be used for determining the radiated fields from unwanted reflectors in urban environments such as buildings or car rooftops. The software could be additionally used to optimize a distribution of reflective plates to achieve a desired radiation pattern.