5:00

2pAA12. Insertion loss provided by several commercially available air handling duct wrap materials that are applied to reduce sheet metal duct breakout noise levels. Robert C. Coffeen (Architecture, Univ. of Kansas, Marvin Hall, 1465 Jayhawk Blvd., Lawrence, KS 66045, coffeen@ku.edu)

Noise breaking out of sheet metal HVAC duct is often a significant and disturbing noise source for a building space being served by a supply or return duct or through which the supply or return duct is passing. Reducing breakout noise is often attempted by using heavy loaded vinyl duct wrap applied directly to the duct or applied over glass fiber insulation or foam sheet. Duct wrap insertion loss data were collected using a portion of a sheet metal duct with noise produced by a loudspeaker assembly suspended within the duct. Breakout noise levels were measured on adjacent sides of the duct with and without duct wrap. This approximate insertion loss data were obtained by a University of Kansas architecture student as a portion of work leading to a Master of Arts in Architecture degree.

Contributed Papers

5:20

2pAA13. Simulation of noise propagation through heating ventilation and air conditioning ductwork. David W. Herrin and Kangping Ruan (Dept. of Mech. Eng., Univ. of Kentucky, 151 Ralph G. Anderson Bldg., Lexington, KY 40506-0503, dherrin@engr.uky.edu)

Noise primarily propagates through the airspace or breaks out through the walls of HVAC ductwork. Finite element analysis was used to assess the noise attenuation of each of these paths. Specifically, the insertion loss and breakout transmission loss were assessed for both bare and lined ductwork. Sound absorptive lining was modeled using poroelastic finite elements and the ductwork itself was modeled using shell and beam elements. A diffuse field was approximated at the source using a collection of monopole sources having random phase. Results were compared to measurement with good agreement. Several conclusions can be made regarding noise transmission in large ducts that should be transferable to other industries.

5:35

2pAA14. Noise analysis of heating, ventilating, and air-conditioning systems: Modeling in the Trane acoustics program. Jennifer E. Russell (Siebein Assoc., Inc., 625 NW 60th St., Ste. C, Gainesville, FL 32607, jrussell@siebeinacoustic.com)

Many different acoustical issues can arise in a building as a result of heating, ventilating, and air-conditioning (HVAC) systems. These issues can include excessive duct-borne noise, inadequate sound isolation, loud mechanical equipment, and sound paths between spaces created by connected ductwork. In each case, the Trane Acoustics Program (TAP) software can be used to model sound paths and assess the acoustical impact the HVAC system has on a space. This paper will present several case studies representing common mechanical and architectural noise control issues resulting from HVAC system design that were assessed using the TAPsoftware.

TUESDAY AFTERNOON, 24 MAY 2016 SALON I, 1:00 P.M. TO 3:00 P.M.

Session 2pABa

Animal Bioacoustics and Underwater Acoustics: Cetacean Bioacoustics

Julia Vernon, Chair
Graduate Program in Acoustics, The Pennsylvania State University, State College, PA 16803

Contributed Papers

1:00

2pABa1. What do acoustic tags placed on the back of echolocating dolphins really measure? Whitlow Au (Univ. of Hawaii, P.O. Box 1106, Kailua, HI 96734, wau@hawaii.edu), James J. Finneran (Space and Naval Warfare Systems Ctr., San Diego, CA), and Brian K. Branstetter (National Marine Mammal Foundation., San Diego, CA)

Suction cup deployed acoustic tags have been used to study the echolocation behavior of a number of odontocetes, yet the relationship between the projected biosonar signals and tag recordings are not known. Acoustic data obtained from these tags consist of the number of clicks emitted, the depth at which the clicks are emitted and the inter-click intervals during a biosonar search. In order to understand the relationship between the emitted signals detected in the front of a dolphin and the signals detected by a tag, a spherical hydrophone was mounted on a wooden model of a tag and mounted on the back of a dolphin via a suction cup. The dolphin was involved in a biosonar discrimination task and the signals were measured 1 m from its blowhole along the acoustic axis of the beam and the acoustic tag placed in five different locations on the animal's back. The signals recorded by the tag were complex with the first pulse being a high frequency resonance-like signal followed by clicks resembling the outgoing clicks but experiencing reflective interference. The peak-to-peak amplitude of the signals measured by the tag was between 40 and 50 dB lower than that of the outgoing signal.

1:15

2pABa2. Does depth matter? Investigating the effect of recording depth on delphinid whistle characteristics and classifier performance. Julie N. Oswald (Bio-Waves, Inc., 364 2nd St., Ste. #3, Encinitas, CA 92024, julie.oswald@bio-waves.net), Marc O. Lammers, Anke Kügler (Oceanwide Sci. Inst., Honolulu, HI), Cory Hom-Weaver, and Robyn Walker (Bio-Waves, Inc, Encinitas, CA)

Seafloor acoustic recorders are commonly used to obtain information about cetaceans, as they allow data to be collected for long periods without the presence of a human operator. Recordings collected using seafloor instruments do not have associated visual observations, so species must be identified based on their calls. Visually validated acoustic recordings are necessary for training acoustic species classifiers and so most are trained using data collected near the sea surface. The suitability of using classifiers trained using surface recordings to analyze recordings obtained at depth is unknown. To investigate this, we used a vertical array of four Ecological Acoustic Recorders (EARs) spaced 90 m apart to record delphinids at different depths. The same whistles were measured from each EAR and median values of 17 spectrographic variables were compared among EARs for six acoustic encounters. For five of the encounters, there were significant differences in whistle variables among EARs, most commonly in frequency variables. When a random forest classifier was used to identify these whistles to species, the same five encounters were classified as different species when recorded at different depths. These results suggest that caution should be taken when applying classifiers developed using surface data to whistles recorded at depth.

1:30

2pABa3. There must be mucus: Using a lumped-parameter model to simulate the "thump" and "ring" of a bottlenose dolphin echolocation click. Lester Thode (Los Alamos, NM), Aaron Thode (SIO, UCSD, 9500 Gilman Dr., MC 0238, La Jolla, CA 92093-0238, athode@ucsd.edu), and Whitlow Au (Marine Mammal Res. Program, Hawaii Inst. of Marine Biology, Kaneohe, HI)

Bottlenose dolphin echolocation clicks display a great diversity in temporal and spectral structure, with both unimodal and bimodal spectra observed (Houser *et al*., JASA, 1999). Wavelet scalograms applied to data collected by the Navy Marine Mammal Program and the Bioacoustic Measuring Tool (BMT) (Martin *et al*., JASA, 2005) show that echolocation clicks can display two distinct phases: an initial "thump," followed by an extended "ring" that is adequately modeled by a damped harmonic oscillator. The thump and ring can display either similar or different spectral characteristics, giving rise to a unimodal or bimodal spectrum. A three-mass lumped parameter model, adapted from the speech processing and terrestrial bioacoustics literature, has been used to simulate the oscillation and collision of the dorsal bursae in a dolphin's nasal passage. The three-mass model reproduces many of the time and frequency domain features of entire click trains as well as individual clicks, including unimodal and bimodal spectra. A key insight of the models is that some slight adhesion between the faces of the colliding bursue seems necessary in order to reproduce the high-frequency click structure. A viscoelastic mucus coating could provide one possible mechanism for this required adhesion force. [Data provided by Steve Martin, NMMF.]

1:45

2pABa4. Inter and intra specific variation in echolocation signals among odontocete species in Hawaii, the northwest Atlantic and the temperate Pacific. Tina M. Yack, Kerry Dunleavy, and Julie N. Oswald (Bio-Waves, Inc., 364 2nd St., Ste. #3, Encinitas, CA 92024, tina.yack@bio-waves.net)

Odontocete species use echolocation signals (clicks) to forage and navigate. The aim of this study is to explore inter- and intra-specific variation in clicks among odontocete species in the Northwest Atlantic, Temperate Pacific, and Hawaii. Clicks were examined for seven species of delphinids in the Northwest Atlantic; common dolphin, Risso's dolphin, pilot whale, rough-toothed dolphin, striped dolphin, Atlantic spotted dolphin, and bottlenose dolphin. Newly developed PAMGuard tools were used to automatically measure a suite of click parameters. Five parameters were compared among species; duration, center frequency, peak frequency, sweep rate, and number of zero crossings. Significant differences in duration, center and peak frequency were evident among species within this study area (Dunn's test with Bonferroni adjustment $p < 0.05$). Geographic variation in click parameters among the three study regions was compared for five species; bottlenose dolphin, common dolphin, striped dolphin, pilot whale, and Cuvier's beaked whale. Significant differences in several parameters were found for all species among the regions (Dunn's test with Bonferroni adjustment $p < 0.05$). These results suggest that there are species specific differences in clicks among delphinids and that geographic variation exists for multiple species. The ecological significance of these findings will be discussed along with implications for classifier development.

2:00

2pABa5. Relative abundance of sound scattering organisms in the Northwestern Hawaiian Islands is a driver for some odontocete foragers. Adrienne M. Copeland (Univ. of Hawaii at Manoa, P.O. Box 1106, Kailua, HI 96734, acopelan@hawaii.edu), Whitlow W. Au (Hawaii Inst. of Marine Biology, Kailua, HI), Amanda Bradford, Erin Oleson, and Jeffrey Polovina (Pacific Islands Fisheries Sci. Ctr., NOAA, Honolulu, HI)

Previous studies in the Northwestern Hawaiian Islands (NWHI) focused on shallower communities in and near reefs and did not investigate the organisms living in deeper waters that some apex predators rely on for food, e.g., some odontocetes forage at depths greater than 400 m. To examine the relationship between deep-diving odontocete predators and prey, a Simrad EK60 echosounder operating at 70 kHz collected acoustic abundance throughout the NWHI from May 7 to June 4, 2013. Visual and passive acoustic surveys for marine mammal presence were conducted concurrently with the echosounder. Two broad scattering layers were found, a deep layer from 325 to 670 m and a shallow layer from 0 to 195 m. The highest densities of both deep and shallow scattering organisms were associated with deep slopes of banks and atolls. Beaked and short-finned pilot whale sightings occurred in locations of high scattering density associated with slopes of atolls and banks. It is hypothesized that the high scattering organisms associated with these features are similar to the mesopelagic boundary community found in the Main Hawaiian Islands and support a food web representing the prey of the cetaceans.

2:15

2pABa6. Beaked whale acoustic versus visual detection. Odile Gerard (DGA Naval Systems, Ave. de la Tour Royale, Toulon 83000, France, odigea@gmail.com)

Because of their sensitivity to anthropogenic noise, research on beaked whale habitat is particularly important. During 2010 and 2011, NATO Undersea Research Centre (NURC) conducted sea trials dedicated to marine mammals, in areas of potential beaked whale habitat. The first one took place in North Eastern Atlantic Ocean, Southwest of Portugal, and the second one took place in the Gulf of Genoa, Mediterranean Sea. For both trials: weather conditions allowing, during daylight there were two teams of visual observers, working in two shifts, scanning the horizon and taking note of marine mammal encounters. Acoustic data were collected with the CPAM (Compact Passive Acoustic Monitoring), designed by NURC. The total usable bandwidth is up to 80 kHz. The CPAM was deployed at a depth between 100 and 200 m for about 20 h a day Beaked whale detection obtained by visual observers and by passive acoustic are analyzed. The number of detections and the information obtained by each method are compared. The advantages and drawbacks are highlighted.

2:30

2pABa7. Seasonal variability in distribution of fin whales around Wake Island. Julia A. Vernon and Jennifer L. Miksis-Olds (Graduate Program in Acoust., Appl. Res. Lab, The Penn State Univ., State College, PA 16803, jav232@psu.edu)

Passive acoustic monitoring in population density estimation of marine mammals provides an efficient and cost-effective alternative to visual surveys. However, one challenge that arises with this method is uncertainty in the animal distribution. Information about distribution is needed in order to account for spatial variability in the probability of detection. Consideration also needs to be given as to how distribution varies between seasons, as seasonal variability also needs to be incorporated into the density estimation. This paper presents bearing estimates of fin whales around Wake Island in the Equatorial Pacific Ocean, using low-frequency ambient noise data (5–115 Hz) acquired by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) International Monitoring System. Bearings were initially calculated using time delay information from the cross-correlation of received signals. However, a simple cross-correlation is not a viable option for many calls, due to distortion of the waveform as a result of modal dispersion, and alternate methods of determining time delays of received signals are discussed. Bearings were calculated for individuals detected over a period of three years: May 2007 to May 2010. Seasonal variability in distribution is presented. [This work was supported by the Office of Naval Research.]