Meeting of Accredited Standards Committee (ASC) S2 Mechanical Vibration and Shock

A. T. Herfat, Chair ASC S2
Emerson Climate Technologies, Inc., 1675 West Campbell Road, PO Box 669, Sidney, OH 45365-0669

C. F. Gaumond, Vice Chair ASC S2
Naval Research Laboratory, Code 7142, 4555 Overlook Ave. SW, Washington, DC 20375-5320

Accredited Standards Committee S2 on Mechanical Vibration and Shock. Working group chairs will report on the status of various shock and vibration standards currently under development. Consideration will be given to new standards that might be needed over the next few years. Open discussion of committee reports is encouraged.

People interested in attending the meeting of the TAG for ISO/TC 108, Mechanical vibration, shock and condition monitoring, and four of its five subcommittees, take note—that meeting will be held in conjunction with the Standards Plenary meeting at 9:00 a.m. on Tuesday, 23 October 2012.

Scope of S2: Standards, specifications, methods of measurement and test, and terminology in the field of mechanical vibration and shock, and condition monitoring and diagnostics of machines, including the effects of exposure to mechanical vibration and shock on humans, including those aspects which pertain to biological safety, tolerance and comfort.

WEDNESDAY AFTERNOON, 24 OCTOBER 2012 JULIA LEE A/B, 1:00 P.M. TO 3:00 P.M.

Session 3pAB

Animal Bioacoustics: Vocalization, Hearing, and Response in Non-Human Vertebrates II

Michael A. Stocker, Chair
Ocean Conservation Research, P.O. Box 559, Lagunitas, CA 94938

Contributed Papers

1:00

3pAB1. Aerial hearing sensitivity in a southern sea otter (*Enhydra lutris nereis*). Asila Ghoul and Colleen Reichmuth (Institute of Marine Sciences, Long Marine Laboratory, University of California, Santa Cruz, 100 Shaffer Rd., Santa Cruz, CA 95060, asila@ucsc.edu)

The lack of information concerning auditory sensitivity in sea otters has been recognized by biologists and resource managers as a priority research need for this threatened species. Noise-generating human activity in near-shore marine environments occurs as a result of construction, transportation, exploration and recreation. These activities may degrade critical habitat or cause behavioral or auditory effects that are harmful to individuals. As direct measures of hearing are not presently available for sea otters, we obtained psychophysical hearing thresholds from a trained individual. Audiometric testing was conducted with an adult male sea otter using 500 ms frequency-modulated narrow-band sweeps under quiet conditions. Absolute aerial thresholds were collected at eleven frequencies ranging from 0.125 to 45 kHz. The sea otter showed a broad functional range of hearing, extending from 0.250 to ~40 kHz, with best sensitivity between 2 and 16 kHz. The lowest measured threshold was -1 dB re 20 μPa at 8 kHz. The high-frequency hearing data was similar to that of terrestrial carnivores, while hearing thresholds below 1 kHz showed a relative decrease in sensitivity. Measurements of underwater sensitivity in the same sea otter are ongoing, and will inform explorations of amphibious hearing capabilities in marine mammals, as well as provide insight into the effects of anthropogenic noise on this vulnerable species.

1:15

3pAB2. Auditory thresholds in marine vertebrates conform to natural ambient noise levels. Michael A. Stocker (Ocean Conservation Research, P.O. Box 559, Lagunitas, CA 94938, mstocker@OCR.org) and John T. Reuterdahl (Ocean Conservation Research, Mill Valley, CA)

Auditory thresholds are often displayed in a manner that reveals what is commonly called a “U-curve.” But if the threshold curves are displayed on the x axis on a true Log10 scale the profile is shaped differently. For marine mammals the shape is more like a “hockey stick.” If these curves are overlaid on the “Wenz ambient noise spectra curves” there appears to be shape conformance. This makes sense as auditory sensitivity would naturally evolve to exclude ambient environmental noise. This paper evaluates 120 legacy auditory threshold curves from 18 species of marine mammals and 60 threshold curves from 32 species of fish. The auditory threshold curves from the fish do not conform to the Wenz curves. Given that both the auditory thresholds and the Wenz curves were expressed as pressure gradient energy it is possible that the profile of the fish threshold curves express

sound in either the particle velocity, or both particle velocity and pressure gradient energy. This paper extrapolates the particle velocity data from the fish threshold conditions to determine if there is some conformity to ambient noise levels in either or both the particle and pressure gradient realms.

1:30

3pAB3. High-frequency hearing in seals and sea lions and the implications for detection of ultrasonic coded transmitters. Kane A. Cunningham (Department of Ocean Sciences, University of California at Santa Cruz, 100 Shaffer Rd., Santa Cruz, CA 95060, kacunningham413@yahoo.com), Sean A. Hayes (Fisheries Ecology Division, NOAA National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, CA), Michelle W. Rub (Fish Ecology Division, NOAA National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA), and Colleen Reichmuth (Institute of Marine Sciences, Long Marine Laboratory, University of California, Santa Cruz, CA)

In order to better understand the ability of pinnipeds to detect acoustic signals from ultrasonic coded transmitters (UCTs) commonly used in fisheries research, high-frequency hearing thresholds were obtained from a trained Pacific harbor seal (*Phoca vitulina*) and a trained California sea lion (*Zalophus californianus*). Using a 69 kHz, 500 ms, narrow-band FM sweep stimulus, detection thresholds for the harbor seal and the sea lion were determined to be 106 dB and 112 dB re 1 μPa respectively. While the harbor seal threshold falls within the range of existing data, the sea lion threshold is 33 dB lower than expected based on previous reports. This finding indicates that sea lions may be more sensitive to the output of UCTs than previously thought, and allows for the possibility that acoustically tagged fish may be selectively targeted for predation by sea lions as well as seals. These hearing thresholds, combined with ongoing work on the effect of signal duration on high-frequency hearing, will help estimate the ranges at which certain UCTs can be detected by these species. Detection range estimations, in turn, will allow fisheries researchers to better understand how fish survivorship data obtained using UCTs may be skewed by pinniped predation.

1:45

3pAB4. Animal-borne active acoustic tags: A new paradigm to conduct minimally invasive behavioral response studies? Holger Klinck (Cooperative Institute for Marine Resources Studies, Oregon State University and NOAA Pacific Marine Environmental Laboratory, Hatfield Marine Science Center, 2030 SE Marine Science Drive, Newport, OR 97365, Holger.Klinck@oregonstate.edu), Markus Horning, David K. Mellinger (Oregon State University, Newport, OR), Daniel P. Costa (University of California, Santa Cruz, CA), Selene Fregosi (Oregon State University, Newport, OR), David A. Mann (Loggerhead Instruments, Sarasota, FL), Kenneth Sexton (The Sexton Company, Salem, OR), and Luis Huckstadt (University of California, Santa Cruz, CA)

In 2011 a pilot study was begun to evaluate the potential of animal-borne active acoustic tags for conducting minimally-invasive behavioral response studies on pinnipeds. A basic prototype tag was developed and tested on juvenile northern elephant seals (Mirounga angustirostris) during translocation experiments at Año Nuevo State Park, CA, USA in spring 2012. The principal scientific questions of this pilot study were these: (1) do sounds emitted from an animal-borne low acoustic intensity tag elicit behavioral responses, and (2) are potential animal responses related to signal content (e.g., threatening vs. non-threatening). Although the sample size was small, preliminary results indicate that (1) low-intensity sounds emitted by animal-borne tags elicit distinct behavioral responses, (2) these responses appear related to signal content, and (3) the responses may differ based on depth, bathymetry, and location. The results of the conducted study show the promise of this approach as a minimally-invasive and cost-effective method to investigate animal responses to underwater sounds, as well as a method to develop mitigation strategies. Future efforts would increase the sample size, range of acoustic stimuli, and age/sex classes of tagged seals. [Funding from NOAA/NMFS Ocean Acoustics Program.]

2:00

3pAB5. Tracking calling depths and movements of North Atlantic right whales using multipath localization. Robert D. Valtierra (Mech. Engineering, Boston University, 110 Cummington St., Boston, MA 02215, rvaltier@bu.edu), Sofie M. VanParijs (Northeast Fisheries Science Center, National Oceanic and Atmospheric Administration, Woods Hole, MA), R. G. Holt (Mech. Engineering, Boston University, Boston, MA), and Danielle M. Cholewiak (Northeast Fisheries Science Center, National Oceanic and Atmospheric Administration, Woods Hole, MA)

The track and calling depths of a North Atlantic right whale (NARW) recorded by 10 bottom-mounted Autonomous Acoustic Recording Units (ARUs) in the Stellwagen Bank National Marine Sanctuary was determined using the Direct Reflected Time Difference of Arrival (DRTD) localization method. An autocorrelation technique was used to extract direct-reflected time difference of arrival information from recorded NARW up-calls containing several overlapping multipath signal arrivals. The method's feasibility was tested using data from play back transmissions to localize an acoustic transducer at a known depth and location. The method was then used to track an hour of movements and depths of a single NARW using periodic up-calls for localization purposes.

2:15

3pAB6. Passive acoustic monitoring on the North Atlantic right whale calving grounds. Melissa Soldevilla, Lance Garrison (NOAA-NMFS Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149, melissa.soldevilla@noaa.gov), and Christopher Clark (Bioacoustics Research Program, Cornell University, Ithica, NY)

Shallow water environments, such as the North Atlantic right whale calving grounds, pose a challenge to cetacean passive acoustic monitoring due to high variability in ambient noise and environmental conditions. In this region of high shipping traffic and increased ship-strike risk, passive acoustic monitoring may reduce right whale ship strikes. This study describes temporal variability in right whale call detections, ambient noise sources, and environmental conditions on the right whale calving grounds during 2009-2010 and 2010-2011. Right whale detections occurred between November 19 and March 11, on up to 25% of days per deployment with increased nocturnal call detections, and increased acoustic presence off Jacksonville, FL during 2010-2011. Shipping noise was most common off Jacksonville, detected in up to 74% of minutes, with a diurnal peak, while tidally-associated broadband impulses were detected in up to 43% of minutes off Savannah GA. Environmental conditions including SST, wind, waves, and tidal height varied on daily and semi-diurnal scales. While sightings were higher in 2009-2010, the fewer sightings in 2010-2011 were more narrowly distributed within the depth range of the acoustic instruments. Passive acoustic monitoring is effective for detecting right whales in this environment, especially at night when they cannot be seen.

2:30

3pAB7. Comparison of the first-year response of beaked and sperm whale populations to the Northern Gulf oil spill based on passive acoustic monitoring. Natalia Sidorovskaia (Physics, Univ. of Louisiana, P.O. Box 44210, Lafayette, LA 70504-4210, nas@louisiana.edu), Azmy Ackleh (Mathematics, Univ. of Louisiana, Lafayette, LA), Christopher Tiemann (Applied Research Laboratories, UT Austin, Austin, TX), Juliette Ioup, and George Ioup (Physics, Univ of New Orleans, New Orleans, LA)

This paper continues a discussion on using passive acoustic methods to study the environmental impact of the recent oil spill in the Northern Gulf of Mexico on resident populations of marine mammals. The Littoral Acoustic Demonstration Center, possessing several broadband acoustic datasets collected near the spill site before and after the event, is in a unique position for monitoring long-term environmental impacts in the vicinity of the incident The pre-spill recordings provide a baseline which, when combined with post-spill measurements, give important indicators of changes in the local populations. Ackleh et al., J. Acoust. Soc. Am. 131, 2306-2314, provide a comparison of 2007 and 2010 measurements showing a decrease in acoustic activity and abundance of sperm whales at the 9-mile distant site, whereas acoustic activity and abundance at the 25-mile distantsite has clearly increased. This may indicate that some sperm whales have relocated farther away from the spill subject to food source availability. This paper reports on applying

developed population estimation techniques to monitor beaked whale response that appears to be different from that of sperm whales. Follow-up experiments will be critical for understanding the long-term impact on different species. [Research supported by SPAWAR, NSF, and Greenpeace.]

2:45

3pAB8. Population density of sperm whales in the Bahamas estimated using non-linked sensors. Elizabeth T. Küsel (Northwest Electromagnetics and Acoustics Research Laboratory, Portland State University, 1900 SW 4th Ave., Portland, OR 97201, kusele@alum.rpi.edu), David K. Mellinger (Cooperative Institute for Marine Resources Studies, Oregon State University and NOAA Pacific Marine Environmental Laboratory, Newport, OR), Len Thomas (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews, St. Andrews, Fife, United Kingdom), and Tiago A. Marques (Centre for Research into Ecological and Environmental Modelling, University of St. Andrews, Campo Grande, Lisboa, Portugal)

Estimates are presented of sperm whale click detection probability and sperm whale population density at the U.S. Navy's Atlantic Undersea Test and Evaluation Center (AUTEC) in the Bahamas. The estimation of the probability of detecting whale echolocation clicks at multiple non-linked sensors uses estimates of sperm whale source level distribution, beam pattern of click emission, distribution of whale locations and orientations with respect to the sensors while clicking, acoustic transmission loss from source (whale) to receiver (bottom hydrophone), and noise levels at the receiver. These data are combined in a Monte Carlo model that propagates simulated clicks from whales at various random positions to each receiving hydrophone to estimate the signal-to-noise ratio at the receiver and the detection function, the probability of detecting clicks as a function of distance. The estimated detection function for each receiving hydrophone is then combined with information on the detector's rate of missed calls and false detections as a function of signal-to-noise ratio, average sperm whale click rates, and the actual number of clicks detected in a given period of time in order to estimate population density. Results are compared to multi-sensor cases where detection functions were estimated analytically.

WEDNESDAY AFTERNOON, 24 OCTOBER 2012 — TRUMAN A/B, 1:00 P.M. TO 3:00 P.M.

Session 3pBA

Biomedical Acoustics: Best Student Paper Award Poster Session

Kevin J. Haworth, Chair
University of Cincinnati, Cincinnati, OH 45209

The ASA Technical Committee on Biomedical Acoustics offers a Best Student Paper Award to eligible students who are presenting at the meeting. Each student must defend a poster of her or his work during the student poster session. This defense will be evaluated by a group of judges from the Technical Committee on Biomedical Acoustics. Additionally, each student will give an oral presentation in a regular/special session. Up to three awards will be presented to the students with $500 for first prize, $300 for second prize, and $200 for third prize. The award winners will be announced at the meeting of the Biomedical Acoustics Technical Committee. Below is a list of students competing, with their abstract numbers and titles listed. Full abstracts can be found in the oral sessions associated with the abstract numbers.

All entries will be on display and all authors will be at their posters from 1:00 p.m. to 3:00 p.m.

2aBA6. Modeling acousto-optic sensing of high-intensity focused ultrasound lesion formation. Student author: Matthew T. Adams

2pBA14. Compound manipulation of micro-particles using a single device: Ultrasonic trapping, transporting and rotating. Student author: Kun Jia

3aBA7. Focused, radially-polarized shear wave beams in tissue-like media. Student author: Kyle S. Spratt

3aBA8. Shear wave generation using hybrid beamforming methods. Student author: Alireza Nabavizadeh

3aBA13. Rayleigh wave propagation method for the characterization of viscoelastic properties of biomaterials. Student author: Siavash Kazemirad

4aBA1. Effects of encapsulation damping on frequency dependent subharmonic threshold for contrast microbubbles. Student author: Amit Katiyar

4aBA2. Pulse duration dependence of cavitation emissions and loss of echogenicity from ultrasound contrast agents insonified by Doppler pulses. Student author: Kirthi Radhakrishnan

4aBA3. Echogenicity and release characteristics of folate-conjugated echogenic liposomes for cytosolic delivery of cancer drugs. Student author: Shirshendu Paul

4aBA4. High-frequency harmonic imaging with coded excitation: Implications for the assessment of coronary atherosclerosis. Student author: Himanshu Shekhar

4aBA6. Acoustic emissions associated with ultrasound-induced rupture of *ex vivo* blood vessels. Student author: Cameron L. Hoerig

4aBA7. Cavitation mechanisms in ultrasound-enhanced permeability of *ex vivo* porcine skin. Student author: Kyle T. Rich

4aBA8. Laser-induced-cavitation enhanced ultrasound thrombolysis. Student author: Huizhong Cui

4aBA9. Ethanol injection induced cavitation and heating in tissue exposed to high intensity focused ultrasound. Student author: Chong Chen

4pBA1. Effect of skull anatomy on intracranial acoustic fields for ultrasound-enhanced thrombolysis. Student author: Joseph J. Korfhagen

4pBA6. Histological analysis of biological tissues using high-frequency ultrasound. Student author: Kristina M. Sorensen

4pBA8. Parametric imaging of three-dimensional engineered tissue constructs using high-frequency ultrasound. Student author: Karla P. Mercado

WEDNESDAY AFTERNOON, 24 OCTOBER 2012 BASIE A1, 1:30 P.M. TO 2:20 P.M.

Session 3pED

Education in Acoustics: Acoustics Education Prize Lecture

Preston S. Wilson, Chair
Applied Research Lab., Univ. of Texas at Austin, Austin, TX 78712-0292

Chair's Introduction—1:30

Invited Paper

1:35

3pED1. Physclips: Multimedia, multi-level learning, and teaching resources. Joe Wolfe and George Hatsidimitris (University of New South Wales, School of Physics, University of New South Wales, Sydney, NSW 2052, Australia, j.wolfe@unsw.edu.au)

Physclips provides multimedia resources to physics students and teachers at the levels of senior high school to introductory university. Completed volumes cover mechanics, waves and sound. Each chapter includes a rich multimedia lesson of about 10 minutes, including film clips, animations, sound files and images of key experiments and demonstrations. Contextually embedded links lead to html pages providing broader and deeper support and, where needed, to tools such as calculus and vectors. The ongoing development of the interface reflects learner feedback and our own experience and research. The architecture and presentation of Physclips is largely consistent with evidence-based guidelines in the field of educational multimedia. Often, animations and labeling are superimposed on film clips to indicate abstract quantities, thus providing the novice with the insight of the expert's 'mind's eye'. The scrollbar is indexed with keywords and images to assist learners to find and to relocate conceptually discrete segments, which facilitates revision and reference usage. Together with extensive cross-linking, this allows students to construct individual learning pathways. Teachers download animations singly or in compressed folders for inclusion in lessons, blogs etc. Physclips is supported by Australia's Office of Learning and Teaching and the University of New South Wales.

Session 3pID

Interdisciplinary: Hot Topics in Acoustics

Lily M. Wang, Chair
Durham School of Architectural Engineering and Construction, University of Nebraska - Lincoln, Omaha, NE 68182-0816

Chair's Introduction—1:30

Invited Papers

1:35

3pID1. Hot topics in speech communication: Listening to foreign-accented speech. Tessa Bent (Department of Speech and Hearing Sciences, Indiana University, 200 S. Jordan Ave., Bloomington, IN 47405, tbent@indiana.edu)

There are currently more non-native English speakers in the world than there are native speakers. Most of these second language users will speak with a detectable foreign accent. Foreign-accented speech differs from native language norms along many acoustic-phonetic dimensions including the realization of vowel, consonant, and prosodic features. An important question for researchers in the field of speech communication is how this type of language variation influences speech perception and perceptual processing. Numerous findings have shown that foreign-accented speech is generally less intelligible, receives lower comprehensibility ratings, and is processed more slowly than native-accented speech. Further, these negative perceptual effects can be exacerbated by noisy listening conditions or listener variables such as age or hearing loss. However, research over the past several years has shown the amazing flexibility of the speech perception mechanism in its ability to adapt to this form of variability. Through experience and training, listeners can improve their word identification skills with specific foreign-accented talkers, particular foreign accents, and foreign-accented speech in general. New directions in this research area include perception of foreign-accented speech by infants and children as well as how a foreign accent may influence memory.

2:00

3pID2. New directions for manipulation of sound using acoustic metamaterials. Christina J. Naify, Gregory J. Orris, Theodore P. Martin, and Christopher N. Layman (Code 7160, Naval Research Laboratory, 4555 Overlook Ave SW, Washington, DC 20375, christina.naify.ctr@nrl.navy.mil)

Manipulation of sound waves using acoustic metamaterials has expanded significantly in recent years. Acoustic metamaterials are a class of materials that use sub-wavelength structures to achieve effective bulk properties under acoustic excitation. Unusual effective physical properties, including negative bulk modulus, negative mass density, and negative index have been achieved using metamaterials. Additionally, the development of structures based on transformational acoustics has resulted in designs for scattering reduction and sound focusing. Current research emphases include expansion from narrowband, resonant structures to broadband structures, as well as the design and construction challenges of three-dimensional structures. Active or tunable structures are also being explored. Examples will be given of negative index and three-dimensional metamaterial structures. [Work is supported by the Office of Naval Research.]

2:25

3pID3. Photoacoustic tomography: Ultrasonically breaking through the optical diffusion limit. Lihong Wang (Department of Biomedical Engineering, Washington University, One Brookings Drive, P.O. Box 1097, St. Louis, MO 63130-4899, lhwang@biomed.wustl.edu)

Photoacoustic tomography (PAT), combining optical and ultrasonic waves via the photoacoustic effect, provides in vivo multiscale non-ionizing functional and molecular imaging. Light offers rich tissue contrast but does not penetrate biological tissue in straight paths as x-rays do. Consequently, high-resolution pure optical imaging (e.g., confocal microscopy, two-photon microscopy, and optical coherence tomography) is limited to depths within the optical diffusion limit (~1 mm in the skin). In PAT, pulsed laser light penetrates the tissue and generates a small but rapid temperature rise, which induces emission of ultrasonic waves due to thermoelastic expansion. The ultrasonic waves, ~1000 times less scattering than optical waves in tissue, are then detected to form high-resolution images at depths up to 7 cm, breaking through the optical diffusion limit. PAT is the only modality capable of imaging across the length scales of organelles, cells, tissues, and organs with consistent contrast. Such a technology has the potential to enable multiscale systems biology and accelerate translation from microscopic laboratory discoveries to macroscopic clinical practice. PAT may also hold the key to the earliest detection of cancer by in vivo label-free quantification of hypermetabolism, the quintessential hallmark of cancer. The technology is commercialized by several companies.

Session 3pNS

Noise, ASA Committee on Standards, and Psychological and Physiological Acoustics: Passive and Active Noise Reduction in Hearing Protection

Richard L. McKinley, Cochair
Air Force Research Lab., Wright-Patterson AFB, OH 45433-7901

Hilary L. Gallagher, Cochair
Air Force Research Lab., Wright-Patterson AFB, OH 45433-7901

Chair's Introduction—1:00

Invited Papers

1:05

3pNS1. Development of an advanced hearing protection evaluation system. Kevin Shank and Josiah Oliver (Adaptive Technologies Inc., 2020 Kraft Dr Ste 3040, Blacksburg, VA 24060, kevin@adaptivetechinc.com)

Acoustic Test Fixtures (ATFs) are practical and often necessary tools for testing Hearing Protection Devices (HPDs) especially with extremely loud impulsive and/or continuous noise, for which the use of live subjects might not be advisable. Although there have been various standardized and laboratory ATFs from past research, there still exists large uncertainty in the correlation between the attenuation results obtained from ATFs and those obtained from actual human subject tests, particularly for intraaural HPDs. It is suspected that one of the main factors contributing to the discrepancy may be insufficient fidelity in the circumaural/intraaural flesh and bone. Human subject testing was performed to obtain median parameters of ear canal geometry and eardrum reflectance, which are considered to be critical parameters for circumaural/intraaural HPD attenuation performance. This presentation discusses the research methodologies and design implementation of these important subsystems in this advanced Hearing Protection Evaluation System (HPES).

1:25

3pNS2. Two case studies for fit testing hearing protector devices. William J. Murphy, Christa L. Themann, Mark R. Stephenson, and David C. Byrne (Hearing Loss Prevention Team, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH 45226-1998, wjm4@cdc.gov)

Hearing protection devices (HPDs) are typically selected based upon the Noise Reduction Rating (NRR) and, until recently, were rarely tested for attenuation in real-world environments. The National Institute for Occupational Safety and Health has developed a fit-testing system (HPD Well-Fit^{TM}) that performs attenuation tests with a large circumaural earmuff, a portable computer and a computer mouse with a scroll wheel. HPD Well-Fit was used to estimate the attenuation of employees working in two different settings: inspectors for off-shore drilling rigs and sandblasters at a hydroelectric facility. The highest exposure levels for the inspectors and sandblasters were estimated to be 110 and 130 dBA, respectively. Fit testing and training were used to achieve a 25-dB Personal Attenuation Rating (PAR) for the inspectors. Fit testing before and after the sandblaster work shift demonstrated PARs of 30 to 42 dB using HPD Well-Fit. The average time to complete the fit tests was 10 minutes. If retraining was necessary, then an additional 3 to 6 minutes were required.

1:45

3pNS3. Continuous and impulsive noise attenuation performance of passive level dependent earplugs. Richard L. McKinley, Hilary L. Gallagher (Air Force Research Laboratory, 2610 Seventh Street, Wright Patterson AFB, OH 45433, richard.mckinley@wpafb.af.mil), Melissa Theis (Oak Ridge Institute for Science and Education, Dayton, Ohio), and William J. Murphy (National Institute for Occupational Safety and Health, Cincinnati, OH)

Level dependent hearing protectors, earplugs and earmuffs, have advanced in technology due to the needs of military personnel and others to reduce the risk of hearing damage from impulsive noise. These hearing protectors were developed to preserve ambient listening capabilities therefore improving situational awareness while reducing the risk of noise induced hearing loss by attenuating both continuous and impulsive noise. Four commercially available passive level dependent earplugs were assessed for both continuous noise attenuation and impulsive insertion loss performance. The continuous noise attenuation results were collected using American National Standard Institute (ANSI) S12.6-2008 Methods for Measuring the Real-Ear Attenuation of Hearing Protectors while the impulsive insertion loss results were collected using ANSI S12.42-2010 Methods for the Measurement of Insertion Loss of Hearing Protection Devices in Continuous or Impulsive Noise Using Microphone-in-Real-Ear (MIRE) or Acoustic Test Fixture Procedures. The presentation will include the passive noise attenuation performance of level dependent earplugs for both continuous and impulsive noise. The impulsive insertion loss results for these particular hearing protectors will be applied to impulsive noise damage risk criteria for an estimate of allowable impulsive noise exposure.

2:05

3pNS4. Effective attenuation performance of passive hearing protectors: A temporary threshold shift study. Richard L. McKinley, Hilary L. Gallagher (Air Force Research Laboratory, 2610 Seventh Street, Wright Patt AFB, OH 45433, richard.mckinley@wpafb.af.mil), and Melissa Theis (Oak Ridge Institute for Science and Technology, Dayton, Ohio)

Passive hearing protectors have been used for decades to reduce the risk of noise induced hearing loss. Hearing protectors (earmuffs, earplugs, helmets) have traditionally been the first line of defense for personnel working in hazardous noise environments. According to ANSI S12.68-2007, the “gold standard” method of estimating effective A-weighted sound pressure levels when hearing protectors are worn is the classical octave band method. The octave band method subtracts the hearing protector noise attenuation from the ambient noise level for each relevant octave band to estimate the noise exposure at the ear, under the hearing protector. ANSI S12.6-2008 Methods for Measuring the Real-Ear Attenuation of Hearing Protectors was used to measure the attenuation of the hearing protectors. The purpose of this study was to measure the effective attenuation of a hearing protector in terms of temporary threshold shift (TTS) response for individual human subjects with and without hearing protection. This presentation will include the TTS response curves for subjects exposed to various noise levels and durations in a controlled laboratory environment. The passive hearing protectors evaluated in this study included an earplug, earmuff, and a headphone with minimal attenuation as determined by REAT.

Contributed Papers

2:25

3pNS5. Measurements of bone-conducted impulse noise from weapons using a head simulator. Odile H. Clavier, Anthony J. Dietz, Jed C. Wilbur (Creare Inc., 16 Great Hollow Rd, Hanover, NH 03755, ohc@creare.com), Edward L. Zechmann, and William J. Murphy (Hearing Loss Prevention Team, National Institute for Occupational Safety and Health, Cincinnati, OH)

High-intensity impulse sounds are generally considered to be more damaging than continuous sounds, so understanding the attenuation performance of hearing protection devices against impulse noise is key to providing adequate protection for exposed persons. The maximum attenuation of hearing protection devices is limited by bone-conducted sound. Weapon fire noise in the form of short duration impulses can reach peak levels of 170 dB SPL at the shooter’s ear, a sound level for which maximum hearing protection is recommended and for which bone-conducted sound will be a significant factor. However, current acoustic test fixtures do not capture the bone-conducted sound paths. In this study, an anatomically correct head simulator built specifically to measure bone-conducted sound was used to evaluate the effects of impulse noise generated by hand guns and rifles at several peak sound pressure levels ranging between 120 dB SPL and 170 dB SPL. Time histories of the acceleration of the temporal bones and the sound pressure transmitted into the cranial cavity were recorded. Results investigating the linearity of the bone-conducted response to impulse noise at high peak levels and the effects of hearing protection on the sound level and vibrations inside the head are presented.

2:40

3pNS6. Adaptive feedforward control for active noise cancellation in-ear headphones. Sylvia Priese, Christoph Bruhnken (Institute of Measurement and Automatic Control, Leibniz Universität Hannover, Nienburger Straße 17, Hannover, 30167, Germany, sylvia.priese@imr.uni-hannover.de), Daniel Voss, Jürgen Peissig (Technology and Innovation, Sennheiser Electronic GmbH & Co. KG, Wedemark, NI, Germany), and Eduard Reithmeier (Institute of Measurement and Automatic Control, Leibniz Universität Hannover, Hannover, NI, Germany)

Noise can be disturbing, stressful or even harmful. Headphones with active noise cancellation (ANC) can enhance the user’s comfort, especially when travelling. On a plane or a train, in the street or at work, these headphones give the possibility to reduce unwanted noise. The range of ANC headphones on the market is constantly increasing. Circumaural and supra-aural headphones with different control strategies have been available for a long time; over the last few years the product lines have been expanded to in-ear headphones. These headphones already have quite a good passive attenuation and are equipped with feedforward control for active noise cancellation. The best results in attenuation are achieved by semi-adaptive digital controls, which choose the best filter depending on the noise spectrum and can be manually adapted to the user. A fully adaptive control has already been proven to be very effective in aviation headsets and other ANC applications. Besides the market analysis of ANC headphones we would like to present an adaptive feedforward control for in-ear headphones and highlight the advantages compared to a static feedforward control.

2:55

3pNS7. Design of a feedback controller for active noise control with in-ear headphones. Christoph Bruhnken, Sylvia Priese (Institute of Measurement and Automatic Control, Leibniz Universität Hannover, Nienburger Straße 17, Hannover, 30167, Germany, christoph.bruhnken@imr.uni-hannover.de), Hatem Foudhaili, Jürgen Peissig (Technology and Innovation, Sennheiser Electronic GmbH & Co. KG, Wedemark, NI, Germany), and Eduard Reithmeier (Institute of Measurement and Automatic Control, Leibniz Universität Hannover, Hannover, NI, Germany)

Nowadays mobility is an important factor in many jobs. Therefore, there is an increased use of planes, trains and cars, and the associated exposure to noise. Good acoustic insulation is often hard to realize due to the involved extra weight. Ear protection or headphones with active noise control (ANC) may be a possible solution. Today circumaural and supra-aural ANC headphones with good attenuation are commercially available. However, their weight and the necessary headband can impair the wearing comfort. ANC in-ear headphones do not have these disadvantages and, therefore, there is a need of further research in the field of ANC. In ANC headphones, disturbing noise is minimized by an out-of-phase anti-noise. Therefore, the noise is recorded by microphones next to each ear, and filtered by an analog or digital platform to generate the anti-noise. There are two main control strategies depending on the position of the microphones, feedforward control with an external reference microphone and feedback control with an internal error microphone. The presentation will focus on the design of feedback controllers and the main problem regarded to in-ear headphones, interpersonal variances, which make the design of stable controllers with high noise attenuation difficult. A model-based solution will be presented.

Session 3pUW

Underwater Acoustics and Signal Processing in Acoustics: Advances in Underwater Acoustic Communication

Hee-Chun Song, Chair
Scripps Institution of Oceanography, La Jolla, CA 92093-0238

Contributed Papers

1:15

3pUW1. Active average intensity based on single vector sensor. Pengyu Du, Xiao Zhang, Jingwei Yin, and Xiao Han (College of Underwater Acoustic Engineering, Harbin Engineering University, Harbin, Heilongjiang 150001, China, yinjingwei@hrbeu.edu.cn)

Code divided multiple access underwater communication based on single vector sensor is studied in this paper. The most common methods to estimate azimuth with self-directivity of single vector sensor are average sound intensity method and complex sound intensity method, however, for the same frequency band multi-users, theoretical limitation for these methods is only two users.Spread spectrum communication is featured with strong anti-multipath, anti-interference, secret-keeping and communication web composing ability. Active average intensity method, which measures azimuths of multi-users simultaneously with the excellent correlative characteristics of pseudo-random code in spread spectrum communication, is proposed in this paper. Simulation and experiment for same frequency band spread spectrum multi-user communication testify the feasibility and utility of active average sound intensity method. With the estimated azimuth, vector combination can be generated to adjust the directivity of vector sensor, achieve multi-user beam communication, inhibit multi-path interference, and enhance processing gain and lower error rate. Key words: underwater acoustic communication; CDMA; single vector sensor; active acoustic intensity average

1:30

3pUW2. The application of differential spread spectrum technology in underwater acoustic communication. Xiao Han, Jingwei Yin, Pengyu Du, and Xiaoyu Guo (College of Underwater Acoustic Engineering, Harbin Engineering University, Mudanjiang, Harbin, Heilongjiang 150001, China, yinjingwei@hrbeu.edu.cn)

In underwater acoustic channel, the Doppler effect produced by relative movement between Source and information destination is very complex. Currently, the spread spectrum system typically uses PSK modulation. As the transmission characteristic in water sound channel is phase rapid changing, spread spectrum systems based on PSK modulation need high precision in estimating the carrier and need continuous tracking of the carrier, which make the performance in practical applications limited. Differential spread spectrum acoustic communication technology is studied in this paper. Using differential coherent demodulation method at the receiving end, which solves the problem of estimating the carrier in underwater acoustic communication, can overcome the frequency and phase error due to the drift of the carrier in transfer process. This method is verified Through computer simulation studies and Lake test.

1:45

3pUW3. Research on multilevel differential amplitude and phase-shift keying in convolution-coded orthogonal frequency division multiplexing underwater communication system. Yuheng Zhang, Chi Wang, Jingwei Yin, and Xueli Sheng (College of Underwater Acoustic Engineering, Harbin Engineering University, Harbin, Heilongjiang 150001, China, yinjingwei@hrbeu.edu.cn)

With the increasing demands of underwater source development and the increase of users, underwater transfer information has also greatly increased and high-bit-rate underwater acoustic communication has become a hot topic in underwater acoustic communication research. MDAPSK (Multilevel Differential Amplitude and Phase-shift Keying) is a modulation technique having high efficiency in spectrum utilization, which transfers information by using differential amplitude and phase code, demodulates information by adopting coherent demodulation. It reduces the difficulty of system, and improves the speed of transmission. While OFDM (Orthogonal Frequency Division Multiplexing) has advantages including high efficiency in spectrum and faster communication speed. After describing the schemes of the two technologies, a design scheme which concerns application of MDAPSK in the OFDM based underwater communication was given. The convolutional codes are also used in this system to realize the effectiveness and reliability in high-bit-rate underwater wireless communication. The computer simulation and the channel pool experimentation show that the system has a better performance. Key words: MDAPSK; OFDM; convolution coding; high-bit-rate communication

2:00

3pUW4. Application of orthogonal frequency division multiplexing in cognitive underwater communication. Chi Wang, Jingwei Yin, Pengyu Du, and Longxiang Guo (College of Underwater Acoustic Engineering, Harbin Engineering University, Mudanjiang, Harbin, Heilongjiang 150001, China, yinjingwei@hrbeu.edu.cn)

With the development of underwater acoustic communication in military and commercial field and the urgent need for underwater wireless Ad Hoc networks, developing an intelligent and high-bit-rate underwater communication system is imminent. OFDM(Orthogonal Frequency Division Multiplexing) technology could be a good platform for cognitive underwater communication, which has advantages including high efficiency in spectrum utilization, faster communication speed and flexibility in choosing frequencies. A design scheme of the OFDM based cognitive underwater communication and block diagram are given. The system can intelligently choose NC-OFDM (Non-Contiguous OFDM), DOFDM (Differential OFDM) or Pilot-added OFDM communication schemes in order to meet different channel conditions and different rate requirements and to overcome the problem of data conflict and the waste of spectrum resources in multi-users' competitive communication. Meanwhile, the system also can intelligently choose parameters in each scheme, such as sub-channel, pilot interval and error-correcting codes. The simulation results prove the feasibility and effectiveness of the OFDM based cognitive underwater communication.

2:15

3pUW5. Volterra series-based non-linearity analysis of shallow water acoustic channels. Xiaopeng Huang (Dept. of Electrical and Computer Engineering, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ 07030, xiaopeng.huang0508@gmail.com)

Most of existing underwater acoustic (UWA) communication systems are based on the linear UWA channels. However, some environmental factors (e.g., bubble plumes) in complicated shallow water environments will contribute to the non-linearity of channels. Therefore, In order to fully understand the properties of shallow water acoustic channels, and develop more bandwidth-efficient communication systems in complicated shallow

3p WED. PM

water environments, we adopt the Volterra series to analyze the non-linearity of shallow water acoustic channels for the first time, and its completed theoretical derivations will be presented. Volterra series combines the representations of a nonlinear system without memory and a linear, casual system with memory to describe a nonlinear system with memory. Generally speaking, the central problem in using a Volterra approach to the analysis of nonlinear channels with momory consists of estimating the Volterra kernels, which represent a nonparametric characterization of the channel.

2:30

3pUW6. Shallow water acoustic channel modeling with adaptive communications. Xiaopeng Huang (Dept. of Electrical and Computer Engineering, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ 07030, xiaopeng.huang0508@gmail.com)

The underwater acoustic channel is known to be severely bandwidth limited due to sound attenuation by sea water, and interaction with the ocean surface and bottom. Yet, shallow water acoustic channels at high frequencies are little understood, particularly in shallow water environments, and hence the quest for achieving a viable adaptive communication solution has been a challenge that perplexed scientists for a long time. In this abstract, we first take Hodson River estuary as an example to investigate the characterizations of shallow water environments, which mainly comprises the evaluation of key channel parameters such as the scattering function, Doppler shift, coherent bandwidth, coherent time, 2D (i.e., Time-Frequency) time-variant channel impulse response (CIR). The study will also cover channel fading statistics, and water conditions that affect the CIR (e.g., bubble plumes and mddium inhomogeneities). Finally, the models developed will be used to evaluate the achievable performance of channel estimation and adaptive communication systems in shallow water acoustic media.

2:45

3pUW7. Bidirectional equalization for underwater acoustic communications. Hee-Chun Song (Scripps Institution of Oceanography, 9500 Gilman Drive, La Jolla, CA 92093-0238, hcsong@mpl.ucsd.edu)

The bi-directional decision feedback equalizer (BiDFE) that combines the outputs of a conventional DFE and backward DFE can improve the performance of the conventional DFE by up to 1-2 dB based on simulations. In this paper, the BiDFE concept is extended to multi-channel time reversal communications involving a DFE as a post-processor. Experimental data collected in shallow water (10-20 kHz) show that the performance can be enhanced by 0.4-1.8 dB in terms of output SNR. In particular, a larger improvement (e.g., 1.8 dB) is achieved for time-varying channels where the channel diversity in opposite directions is more profound.

Plenary Session, Business Meeting, and Awards Ceremony

David L. Bradley, President
Acoustical Society of America

Business Meeting

Presentation of Certificates to New Fellows

Peter F. Assmann
Yang-Hann Kim
David A. Eddins
William J. Murphy
John A. Hildebrand
Scott D. Pfeiffer
Peter Howell
John R. Preston
Andrew J. Hull
Ronald C. Scherer

Presentation of Awards

Medwin Prize in Acoustical Oceanography to John A. Colosi

Rossing Prize in Acoustics Education to Joe Wolfe

Silver Medal in Animal Bioacoustics to Richard R. Fay

Silver Medal in Noise to Keith Attenborough

Silver Medal in Physical Acoustics to Andrea Prosperetti

Session 3eED

Education in Acoustics and Women in Acoustics: Listen Up and Get Involved

Marcia J. Isakson, Cochair
Applied Research Laboratories, University of Texas at Austin, Austin, TX 78713

Tracianne B. Neilsen, Cochair
Brigham Young University, Provo, UT 84602

Contributed Paper

5:30

3eED1. Hands-on demonstrations for Project Listen Up: Education outreach Part IV. Jacqueline A. Blackburn and Murray S. Korman (Physics Department, U.S. Naval Academy, Chauvenet Hall Room 295, Annapolis, MD 21402, korman@usna.edu)

Acoustical demonstrations geared to promote a hands-on learning experience for middle- and high-school age Girl Scouts are setup. The participants will be free to explore, control the apparatus and make their own scientific discoveries. The hands-on demonstrations will include (1) a homemade electric slide guitar using easy to find parts, (2) a safe smoke ring generator and (3) a portable ripple tank with plastic eyedroppers for simple excitation of waves.

WEDNESDAY EVENING, 24 OCTOBER 2012 7:30 P.M. TO 9:30 P.M.

OPEN MEETINGS OF TECHNICAL COMMITTEES

The Technical Committees on the Acoustical Society of America will hold open meetings on Tuesday, Wednesday, and Thursday evenings beginning at 7:30 p.m.

These are working, collegial meetings. Much of the work of the Society is accomplished by actions that originate and are taken in these meetings including proposals for special sessions, workshops, and technical initiatives. All meeting participants are cordially invited to attend these meetings and to participate actively in the discussion.

Committees meeting on Wednesday are as follows:

Biomedical Acoustics	Mary Lou Williams
Signal Processing in Acoustics	Lester Young A