2:40

3pID2. Hot topics in structural acoustics and vibration: Advances in vibroacoustic modeling and novel materials. Robert M. Koch (Chief Technol. Office, Naval Undersea Warfare Ctr., Code 1176 Howell St., Bldg. 1346/4, Code 01CTO, Newport, RI 02841-1708, Robert.M.Koch@navy.mil)

Two major areas of current research focus in Structural Acoustics and Vibration (SAV) are in (1) the development of advancements in the Physics-Based Modeling (PBM) and simulation of real-world, large-scale vibroacoustic systems and also in (2) the development and incorporation of novel engineered materials to improve structural acoustic response performance from a broad array of perspectives. This paper presents examples from a wide survey of recent SAV computational PBM research, from the inclusion of additional complex, coupled modeled phenomena, to improvements in modeling efficiency, accuracy, and/or full frequency spectrum response prediction, through computational advances in the ability to solve extremely large-scale, previously intractable, structural acoustics models. Related to the second materials-based SAV research concentration, recent advancements and innovations in SAV-relevant materials including acoustic metamaterials, zero- and negative-Poisson's ratio materials, single crystal ceramics, nanomaterials, etc., are also presented.

3:00

3pID1. Model-based Bayesian signal processing in acoustics. Ning Xiang (School of Architecture, Rensselaer Polytechnic Inst., Greene Bldg., 110 8th St., Troy, NY 12180, xiangn@rpi.edu)

Bayesian signal processing has been increasingly applied to a wide variety of acoustical research and engineering tasks. Bayesian probability theory provides acousticians with an elegant framework for inferential data analysis which facilitates learning from acoustic experimental investigations that provide an improved understanding of the underlying theory. In these inferential analysis tasks, certain prior knowledge is often available about the acoustical phenomena under investigation, based either on the underlying physical theory or on certain phenomenological relationships. Bayesian probability theory allows this available information to be incorporated in the processing and analysis and exploited in the Bayesian framework as physical or phenomenological models. Many analysis tasks in acoustics often include two levels of inference, the model selection and the parameter estimation. Bayesian signal processing provides solutions to these two levels of inference by extensively using Bayes' theorem within this unified framework. This talk will discuss various model-based approaches recently applied to signal processing and analysis in acoustics using either one or both levels of inference.

WEDNESDAY AFTERNOON, 9 MAY 2018 GREENWAY J, 1:00 P.M. TO 3:05 P.M.

Session 3pPA

Physical Acoustics, Biomedical Acoustics and Psychological and Physiological Acoustics: Ultrasound and High Frequency Sound in Air in Public and Work Places: Applications, Devices, and Effects

Timothy Leighton, Cochair
Craig N. Dolder, Cochair
Institute of Sound and Vibration Research, University of Southampton, Highfield Campus, Southampton SO17 1BJ, United Kingdom

Chair's Introduction—1:00

Invited Papers

1:05

3pPA1. Ultrasound, human health, safe levels, and Cuba: What do we know? Timothy Leighton (Inst. of Sound and Vib. Res., Univ. of Southampton, Highfield, Southampton, Hampshire SO17 1BJ, United Kingdom, tgl@soton.ac.uk)

While definitive statements are impossible, a slim evidence base suggests the following on weight-of-probabilities regarding ultrasonic adverse effects in humans. One study at extremely high intensities reports physical effects (notably burning between fingers/nostrils). At lower intensities, adverse psychological effects occur in only a subset of the population (susceptibility possibly decreasing with age), are restricted to frequencies below ~25 kHz, probably result from the extraordinary sensitivity of our hearing/balance systems, and can be difficult to separate from (and may be causally related to) adverse effects of anxiety and annoyance. This does not remove the need for protection, especially for increasingly common public exposures, where the exposure and exposed person are often uncharacterised. Only one interim guideline from 1984 addresses maximum permissible levels (MPLs) for public exposure. It is based on scant evidence, and may or may not be appropriate. All other guidelines relate to occupational exposure. These MPLs are a legacy of decades of copying previous guidelines, which were themselves based on inadequate sampling (usually a small cohort of adult men), and averaging practices which obscured the particular sensitivities of a subset of the population. Against this background, the likelihood, or not, of an ultrasonic weapon in Cuba will be discussed.

1:25

3pPA2. Adverse effects of very high-frequency sound and ultrasound on humans. Mark D. Fletcher (Inst. of Sound and Vib. Res., Univ. of Southampton, 15 Consort Rd., Eastleigh So50 4JD, United Kingdom, mdf1f15@soton.ac.uk), Sian Lloyd Jones (Dept. of Audiol. and Hearing Therapy, Royal South Hants Hospital, Southampton, United Kingdom), Craig N. Dolder, Paul White, Timothy Leighton, and Ben Lineton (Inst. of Sound and Vib. Res., Univ. of Southampton, Southampton, Hampshire, United Kingdom)

For many years, workers have reported adverse symptoms resulting from exposure to very high-frequency sound (VHFS) and ultrasound (US), including annoyance, dizziness and difficulty concentrating. Recent work showing the presence of a new generation of VHFS/US sources in public places has reopened the debate about whether adverse effects can be caused by exposure to VHFS/US. Our field measurements of VHF/US sources in public places have identified devices producing up to 100 dB SPL at 20 kHz. Nearly all of the sources measured, including those in places occupied by tens of millions of people each year, are likely to be clearly audible to many young people. We have conducted two studies. The first looked at adverse symptoms resulting from exposure to audible VHFS/US, and the second was a double-blind study of adverse symptoms resulting from exposure to inaudible VHFS/US. In each study, both symptomatic participants, who reported previously experiencing symptoms, and asymptomatics participants, who did not, were tested. We found evidence that symptoms were produced by exposure to audible VHFS/US but not by inaudible sound. It is possible that the substantial effects reported for inaudible VHFS/US exposure were not reproduced because of ethical restrictions on stimulus level and duration.

1:45

3pPA3. Measurement of ultrasound radiated from rodent repellents used in an occupational space, and auditory evaluation of the sound. Mari Ueda (Information Technol., Gent Univ., 4-9-1 Shiobaru, Fukuoka, Minami-ku 815-8540, Japan, m-ueda@design.kyushu-u.ac.jp)

In order to clarify the emission levels and hearing status of ultrasound used in an occupational spaces by pest control companies, three surveys were performed. The results of the acoustic field measurement showed that the rodent repellent device had a peak level and frequency of approximately 100 dB and 19 kHz, respectively. The results of an auditory evaluation experiment with 51 adult workers showed that younger workers recognized the ultrasound from the electronic rodent repellent device more clearly than the elderly workers.

2:05

3pPA4. Ultrasound measurements in the work environment. Jan Radosz and Dariusz Pleban (Central Inst. for Labour Protecion - National Res. Inst., Czerniakowska, 16, Warsaw 00-701, Poland, jarad@ciop.pl)

For the frequency range above 20 kHz, there is no clear and complete information on the factors influencing the result of a measurement of sound pressure level. Moreover, there are no current international standards for performing measurements of ultrasound at work stations. The authors presents a possibility for the adaptation of the existing measurement methods, in particular, the requirements for measuring instruments, procedures to be followed while performing measurements, the application of a correction to measurement results, and the determination of measurement uncertainty. The development of a consistent method of ultrasound measurement is of utmost importance in carrying out an assessment and reducing the risk of exposure to this physical factor in the work environment.

2:25

3pPA5. Low power wireless communication between personal electronic devices and hearing aids using high frequency audio and ultrasound. Jonathon Miegel (ARC Training Ctr. in Biodevices, Swinburne Univ. of Technol., 545 Burwood Rd, Hawthorn, VIC 3122, Australia, jmiegel@swin.edu.au), Philip Branch (Dept. of Telecommunications, Elec., Robotics and Biomedical Eng., Swinburne Univ. of Technol., Hawthorn, VIC, Australia), and Peter Blamey (Blamey Saunders hears, East Melbourne, VIC, Australia)

Hearing aids continue to be the main intervention for hearing loss but their ease of use and control is of concern due to their small size. While technological advances in Bluetooth Low Energy have allowed for improved wireless control, in particular, between personal electronic devices, its use for communication with hearing aids is problematic due to their limited battery life. This research investigates the implementation of acoustic wireless communication between personal electronic devices and hearing aids using multiple modulation schemes utilizing frequencies between 16 and 20 kHz. The performance of each modulation scheme is assessed over a 3 metre range and the power consumption compared to that of Bluetooth Low Energy.

2:45

3pPA6. A scavenger hunt using ultrasonic geocaches. Craig N. Dolder (Inst. of Sound and Vib. Res., Univ. of Southampton, Highfield Ave., Southampton, Hampshire SO17 1BJ, United Kingdom, dolder@utexas.edu)

Sound is commonly used for either communication or navigation. An ultrasonic scavenger hunt was designed that does both and is designed to raise awareness about acoustics. This scavenger hunts utilizes ultrasonic geocaches to both give information to the participants and educate them on topics including, the fact that sound may not be audible, the concept of hearing loss, other animals hear at different frequencies, and general facts from the hosting event. The geocaches use the frequency band above typical human hearing but still within the bandwidth of most personal electronics, 20 kHz–22 kHz. This band can be picked up by common smartphones and tablets and viewed using free spectrogram applications. The maximum sound pressure level output by the geocache devices falls below maximum public exposure recommendations but the signal is still visible on a spectrogram. The scavenger hunt was trialed at a science engagement event at the University of Southampton with over 6000 in attendance.