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2pPPc25. Rapid learning of sound schema for the cocktail party problem. Kevin Woods (Dept. of Brain and Cognit. Sci., Massachusetts Inst. of Technol., 43 Vassar st, 46-4078, Cambridge, MA 02139, kwoods@mit.edu)

Auditory scene analysis depends on knowledge of natural sound structure, but little is known about how source-specific structures might be learned and applied. We explored whether listeners internalize "schemas"—the abstract structure shared by different occurrences of the same type of sound source—during cocktail-party listening. We measured the ability to detect one of two concurrent "melodies" that did not differ in mean pitch (nor in timbre), ensuring that only the structure of these melodies over time could be used to distinguish them. Target melodies were cued by presenting them in isolation before each mixture, transposed to avoid exact repetition. The task was to determine if the cued melody was present in the subsequent mixture. Listeners performed above chance despite transposition between cue and target. Particular melodic schemas could recur across a subset of trials within a block, as well as across blocks separated by epochs in which the schema was absent. Recurrence across trials within a block facilitated target detection, and the advantage grew over the experiment despite intervening blocks, suggestive of learning. The results indicate that rapid and persistent internalization of source schemas can promote accurate perceptual organization of sound sources that recur intermittently in the auditory environment.

2pPPc26. The effect of sound intensity on lateralization with interaural time differences. Nima Alamatsaz (Biomedical Eng., New Jersey Inst. of Technol., 323 Martin Luther King Blvd., Newark, NJ 07102, nima.alamatsaz@njit.edu), Robert M. Shapley (Ctr. for Neural Sci., New York Univ., New York, NY), and Antje Ihlefeld (Biomedical Eng., New Jersey Inst. of Technol., Newark, NJ)

Previous studies examining the effect of sound intensity on ITD lateralization disagree on whether ITD lateralization changes with increasing sound level. We tested how sound intensity affects lateralization in three experiments. In all experiments, normal-hearing listeners judged the lateralization of band-limited target noise tokens (300 to 1200 Hz, 1 s duration, 10-ms cos-squared ramp, presented with insert earphones). For each ear and target noise, sensation level (SL) was estimated using two-down one-up adaptive tracking. Each target stimulus contained an ITD of 0, 75, 150, 225, 300, or 375 μs and was presented at 10, 25, or 40 dB SL. In experiment 1, listeners matched the ITD of a variable-ITD pointer (25 dB SL, 300-1200 Hz, 1 s duration, 10-ms cos-squared ramp) to each of the target tokens. In experiment 2, in each two-interval trial of a 2-AFC paradigm, the standard stimulus consisted of the same noise token as in experiment 1 and the signal stimulus had a randomly chosen ITD of + /− 0, 25, 50 or 75 μs relative to the target ITD. Listeners reported whether the sound moved to the left or to the right, and thresholds were estimated at the "50%-right" point. In experiment 3, listeners indicated the perceived laterality by visually pointing on a graphical user interface. Preliminary data suggest that sound level affects lateralization, but that individual differences require testing of a greater number listeners than have historically been assessed.

2pPPc27. Influence of source location and temporal structure on spatial auditory saliency. Zuzanna M. Podwinska (School of Computing, Sci. and Eng., Univ. of Salford, The Crescent, Salford M5 4WT, United Kingdom, z.podwinska@edu.salford.ac.uk), Bruno M. Fazenda (School of Computing, Sci. and Eng., Univ. of Salford, Manchester, United Kingdom), and William J. Davies (School of Computing, Sci. and Eng., Univ. of Salford, Salford, United Kingdom)

Hitherto, not many studies have dealt with spatial auditory saliency. Auditory attention studies concerned with spatial aspects generally concentrate on top-down selective or divided attention, e.g., where subjects are asked to attend to one source at a specific location whilst being distracted with sources from different directions. The work presented here reports on experiments in which bottom-up spatial auditory attention, or saliency, has been tested. The tests were run using a fully immersive 3D audio-visual reproduction system, where interactions between auditory and visual modalities have been included. We tested how temporal structure and absolute location of sound sources around the listener influence saliency and attention.

MONDAY AFTERNOON, 26 JUNE 2017 ROOM 201, 1:15 P.M. TO 6:00 P.M.

2pSAa

Structural Acoustics and Vibration, Physical Acoustics, and Engineering Acoustics: Acoustic Metamaterials II

Christina J. Naify, Chair
Acoustics, Naval Research Lab, 4555 Overlook Ave. SW, Washington, DC 20375

Chair's Introduction—1:15

Invited Papers

1:20

2pSAa1. Highly directional source radiation using isotropic transformation acoustics. Andrew Norris and Xiaoshi Su (Mech. and Aerosp. Eng., Rutgers Univ., 98 Brett Rd., Piscataway, NJ 08854, norris@rutgers.edu)

Recent developments in transformation acoustics (TA) have taken advantage of the isotropic nature of conformal mappings to form gradient index lens devices, such as a two-dimensional monopole-to-quadropole lens. While this TA precisely maintains the wave equation solution within the lens the radiated field is still multi-directional and not fully efficient due to impedance mismatch and non-planar

radiation. A three-fold strategy is outlined here to achieve highly directional and impedance matched devices. First, most of the rays leaving the original circular region are mapped to a single face of a polygon. Second, the center of the radiating face is impedance matched by simply scaling the size up or down. Finally, the polygon is replaced by a two-sided crescent moon mapping which optimizes the radiation across the face of higher curvature, allowing near-field focusing and quasi-planar far-field radiation. These ideas are illustrated by example simulations. Practical design methods, including water matrix and solid matrix devices, will be discussed. [Work supported through ONR MURI.]

1:40

2pSAa2. Perfect and broadband acoustic absorption in deep sub-wavelength structures for the reflection and transmission problems. Vicente Romero-García, Noé Jiménez, Vincent Pagneux, and Jean-Philippe Groby (LAUM, UMR CNRS 6613, France, Av. Messiaen, Le Mans 72085, France, virogar1@gmail.com)

The mechanisms to achieve perfect acoustic absorption by sub-wavelength structures in both reflection and transmission problems are reported. While the mechanism consists in critically coupling a single resonance independently of its nature in the reflection problem, the mechanism becomes more complicated in the transmission problem. To tackle these issues, we use asymmetric interacting resonators, whose interaction leads to the perfect absorption condition. The analyzed system consists in a panel with a periodic distribution of thin slits, the upper wall of which being loaded by Helmholtz Resonators. The propagation in the slit is highly dispersive due to the presence of the resonators, producing slow sound conditions and down-shifting the slit resonance to low frequencies. By controlling the geometry of the resonators, the visco-thermal losses are tuned to compensate the leakage of the system and fulfill the perfect absorption condition. In the case of the reflection problem, a single resonator is enough to obtain the perfect absorption. However, in the case of transmission, using an array of identical Helmholtz resonators only quasi-perfect absorption can be obtained. A possible solution is the use of double interacting resonators, one acting as reflecting wall for the previous one. This procedure can be iteratively repeated and one can design perfect and broadband acoustic absorbers based on the rainbow trapping mechanism.

Contributed Papers

2:00

2pSAa3. Redirection and splitting of sound waves by a periodic chain of thin perforated cylindrical shells. Andrii Bozhko (Univ. of North Texas, 316 Fry St. Apt. 156, Denton, TX 76201, andriibozhko@my.unt.edu), Jose Sanchez-Dehesa (Universidad Politecnica de Valencia, Valencia, Valencia, Spain), and Arkadii Krokhin (Univ. of North Texas, Denton, TX)

A line of perforated cylindrical shells in air is practically transparent for sound since each individual unit is a weak scatterer. However, strong scattering occurs due to the coupling to the acoustic eigenmodes of the chain. Here we develop an analytical theory of sound transmission and scattering at a linear chain of perforated shells and predict strong anomalous effect for oblique incidence. The chain eigenmodes are weakly decaying, with symmetric profile and anomalous dispersion, or with antisymmetric profile and normal dispersion, and their excitation leads to deep minima in the transmission and 90°-redirection of the external sound. At normal incidence, only the symmetric eigenmode can be excited, otherwise both modes are excited at close frequencies. Moreover, the wave which resonates with the normal-dispersion mode is redirected along the "right" direction, whereas the wave resonating with the anomalous-dispersion mode is redirected in the "wrong" direction. Thus, a periodic chain of perforated shells may serve not only as a 90°-redirecting antenna but also as a splitter of sound waves with close frequencies. For example, an acoustic signal containing two frequencies around 3 kHz can be split into monochromatic components propagating in opposite directions along the chain, if the beat frequency is ≈500 Hz.

2:20

2pSAa4. Nonuniform distribution of point defects in ferroelectric phononic crystal. Chandrima Chatterjee (Phys. and Astronomy, The Univ. of MS, Oxford, MS) and Igor Ostrovskii (Phys. and Astronomy, The Univ. of MS, Lewis Hall, Rm. 108, University, MS 38677, iostrov@phy.olemiss.edu)

The photoluminescence (PL) from point defects in ferroelectric phononic crystal (FPC) is investigated at room temperature. The FPC consists of periodically poled domains 0.45-mm-long each along the x-axis in the 0.5-mm-thick z-cut $LiNbO_3$ wafer. The spectra of PL are excited by 310 nm ultraviolet light and registered in the range of 350 to 900 nm. The PL spectra reveal different point defects including F-center, Ba, Ar, Ne, Cr, K, Fe^+, Xe, and others. The electrically active defects such as F-center and Fe^+ are expected to be sensitive on a local electric polarization. In a FPC, the ferroelectric neighboring domains are inversely poled and have an opposite electric polarization. The change from polarization "up" to polarization "down" happens across so called interdomain wall. The point defect concentrations along the neighboring domains are researched by PL-scanning, consisting of taking PL-spectra from narrow zones across the domain structure along the x-axis. This scanning reveal a nonuniform distribution of defects along the FPC. The striking result is that some of the defects such as F-center and Fe^+ have respectively narrow extrema in PL-intensity right in the interdomain wall location. Engineering application of these findings may be new non-destructive characterization method for ferroelectric phononic crystals.

2:40

2pSAa5. An improved helical-structured acoustic metamaterial design for broadband applications. Jie Zhu (Hong Kong Polytechnic Univ., Kowloon 00000, Hong Kong, jiezhu@polyu.edu.hk)

Helical structured acoustic metamaterial has been proposed to provide non-dispersive sound wave slowdown, which is an interesting topic that not only matters about fundamental explorations of slow wave physics, but also will benefit a lot of applications. Although the effect of delay acoustic signal the sound wave phase modulation is obvious, the helical structured acoustic metamaterial only provides satisfying transmission performance over narrow frequency range. In this presentation, I will introduce an improved design developed based on the original helical structured acoustic metamaterial. Such improved design can slow down acoustic wave propagation through refractive index tuning and wave-front revolution, over a much wide spectra.

3:00

2pSAa6. A discussion of macroscopic properties for acoustic metamaterials: Models and measurements. Caleb F. Sieck, Andrea Alu (Dept. of Elec. & Comput. Eng. and Appl. Res. Labs., The Univ. of Texas at Austin, 1616 Guadalupe St., Austin, TX 78712, cfsieck@utexas.edu), and Michael R. Haberman (Dept. of Mech. Eng. and Appl. Res. Labs., The Univ. of Texas at Austin, Austin, TX)

Macroscopic material properties are useful to describe long wavelength dynamics of inhomogeneous media. Analytically, these properties are often determined by weighted field averages, which define the effective fields of a representative unit cell. The relations between these effective fields provide macroscopic properties. In addition to traditional properties (wavenumber, impedance, density, and compressibility), recent research has shown that inhomogeneous media require coupling parameters between effective volume-strain and momentum fields, known as Willis coupling or bianisotropy. However in the absence of embedded sources, metamaterial properties are