11:35

4aAA12. Impulse response measurement system and its recent applications. Kazuhiro Takashima, Hiroshi Nakagawa, Natsu Tanaka, and Daiki Sekito (1-21-10, Midori, Sumida-Ku, Tokyo 130-0021, Japan)

Our impulse response measurement system has been developed for ten years. During this decade, the environment related to this measurement has changed significantly. In this article, the features and notes on the measurement system using the sound card, and our brand new system, which is expanded for multichannel inputs, will be presented. Finally, a new technique, which combines multichannel impulse response measurement and signal processing with microphone array, will be presented. The microphone array was designed for noise analysis for automobile interiors. The array consists of 31 microphones on the surface of an acoustically hard sphere. Moreover, 12 cameras are arranged on the surface of the sphere to take photos. Some applications and future development will be presented.

FRIDAY MORNING, 1 DECEMBER 2006 KOHALA/KONA ROOM, 8:00 TO 11:45 A.M.

Session 4aAB

Animal Bioacoustics: Marine Mammal Acoustics I

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Contributed Papers

8:00

4aAB1. Development of evoked-potential audiometry in odontocetes. Alexander Supin (Inst. of Ecology and Evolution, 33 Leninsky prospect, 119071 Moscow, Russia)

Evoked-potential methods are widely used for investigation of hearing in whales, dolphins, and porpoises. For this purpose, mostly the auditory brainstem response (ABR) or rhythmic trains of ABRs, the envelope-following response (EFR), are used. Although very productive, these methods require further elaboration. (*i*) Traditionally the EFR is provoked by sinusoidally amplitude-modulated tones (SAM). SAM stimuli have narrow frequency band, which makes them little effective to produce the EFR, because response amplitude depends on the stimulus bandwidth. A solution of the problem is the use of trains of short tone pips instead of SAM tones. Such stimuli produce several times higher EFR than SAM tones. This makes the threshold determination much more confident and precise. The effect is achievable at stimulus bandwidths, which still do not influence negatively the precision of attribution of the threshold to a certain frequency. (*ii*) To extract low-amplitude evoked potentials from noise, the average technique is traditionally used. This operation returns a mean value of averaged traces. Effectively diminishing stationary noise, this method poorly eliminates big artifacts, which may spoil the record even it if appeared once or twice during acquisition. With this respect, computation of the median instead of mean is much more effective.

8:15

4aAB2. Towards a predictive model of noise-induced temporary threshold shift for an amphibious marine mammal, the California sea lion (*Zalophus californianus*). David Kastak, Marla M. Holt, Jason Mulsow, Colleen J. Reichmuth Kastak, Ronald J. Schusterman (UCSC Long Marine Lab., 100 Shaffer Rd., Santa Cruz, CA 95060), and Brandon L. Southall (Natl. Marine Fisheries Service, Silver Spring, MD 20910)

A California sea lion that had previously been tested under water was assessed for noise-induced temporary threshold shift (TTS) in air. One hundred ninety-two controlled exposures of octave-band noise centered at 2.5 kHz were conducted over a 3-year period. The noise was varied in level (to 133 dB SPL *re*: 20 μPa) and duration (to 50 min) to generate a variety of equal sound exposure levels (SELs). Behavioral psychophysics was used to measure hearing sensitivity at 2.5 kHz before, immediately following, and 24 h following noise exposure. The levels of threshold shifts obtained ranged up to 30 dB. In cases where TTS exceeded 20 dB, thresholds were obtained at regular intervals until recovery occurred. The average slope of the long-term recovery function was 10 dB per log-(minute). Results show that the threshold shifts correlated with SEL; however, the equal-energy trading rule did not apply in all circumstances, with exposure duration contributing more than exposure level. Repeated testing showed no evidence of a permanent threshold shift at 2.5 kHz or octave higher. The amphibious sea lions appear to be equally susceptible to noise in air and under water, provided that the exposure levels are referenced to the subjects thresholds in both media.

8:30

4aAB3. Electrophysiological investigation of temporal resolution in three pinniped species: Adaptive implications. Jason Mulsow and Colleen Reichmuth Kastak (Univ. of California Santa Cruz, Long Marine Lab., 100 Shaffer Rd., Santa Cruz, CA 95060)

Electrophysiological studies of auditory temporal processing in marine mammals have traditionally focused on the role of highly refined temporal resolution in dolphin echolocation. Studies in manatees, however, have found their temporal resolution to be better than expected, leading to speculation that such capabilities are an adaptation for underwater sound localization. This study measured the ability of auditory brainstem responses to follow rhythmic click stimuli in California sea lions (*Zalophus californianus*), harbor seals (*Phoca vitulina*), and northern elephant seals (*Mirounga angustirostris*). Trains of 640-s clicks were presented in air at repetition rates of 125–1500 per second and averaged rate-following responses were recorded. Rate-following responses were detected in both the harbor seal and the sea lion at rates up to 1000 clicks per second, indicating that pinnipeds, like manatees, possess temporal resolution greater than humans but inferior to dolphins. While this finding might support an underwater sound localization hypothesis, comparable results were obtained in preliminary testing of a dog (*Canis familiaris*), suggesting that increased temporal resolution in pinnipeds may not be the result of the evolutionary pressure of an aquatic environment, but rather a result of increased high-frequency hearing essential to mammalian sound localization. [Work supported by NOPP, ONR, and NMFS.]