Session 4aSP

Signal Processing in Acoustics, Engineering Acoustics, Architectural Acoustics and Education in Acoustics: Acoustics in Multimedia—Systems Issues I

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Invited Papers

8:00

4aSP1. *The Journal of the Acoustical Society of America* and other technical journals of the future—a new multimedia format? Daniel R. Raichel (Dept. of Mech. Eng., Steinman Hall, The City College of The City Univ. of New York, New York, NY 10031)

The *Journal of the Acoustical Society of America (JASA)* is now available in two formats—the traditional printed issue and the CD-ROM. However, CD-ROMs are in the early process of being displaced by the newer, more powerful DVDs which feature a capacity of approximately 2.8 GB per disk side rather than the 650 MB standard for each CD-ROM. CD-ROMs, however, will not immediately be rendered obsolete by the use of a current DVD player since the latter is backward compatible for CD-ROM playback. However, even in the CD-ROM format, a technical journal can take on new aspects of multimedia, which were hitherto unavailable or impracticable in printed media. The greatly enhanced capacity of the DVD disk provides even greater opportunities for extended expositions. Animation scenes, photographs, extended databases which would not have otherwise been included in a printed article, dynamic plots, sound effects, virtual reality scenes which permit one to ''visit'' laboratory sites or ''witness'' the topical phenomena, and even computer programs and entire reproductions of cited references can be incorporated in an article slated for publication on the new multimedia disks or on future storage devices.

8:25

4aSP2. Mediacoustics, a software package on CD for teaching acoustics using multimedia techniques. Michael Wahlrab (01dB, Inc., P.O. Box 796, Skaneateles, NY 13152)

Mediacoustics uses multimedia techniques on CD for teaching acoustics. It is divided into four study areas: basic physics, noise and man, room acoustics, and noise control. Sound clips, text, pictures, photos, and video animation illustrate each module. The index and chapters may be edited. Individual text passages may be annotated and an included acoustical dictionary provides definitions of common terms and formulas. Any contemporary multimedia computer equipped with a sound card and amplified loudspeaker can be used to access Mediacoustics and its hundreds of video clips.

8:50

4aSP3. Animations created in *Mathematica* for acoustics education. Victor W. Sparrow (Grad. Prog. in Acoust., Penn State Univ., University Park, PA 16802) and Daniel A. Russell (Kettering Univ., Flint, MI 48504)

One of the unifying assumptions in acoustics and vibrations is that waves and structures move and vibrate. In teaching these topics it makes sense to show students exactly HOW things move. For the last several years the authors have been using the symbolic manipulation program *Mathematica* [Wolfram Research, Inc., Champaign, IL] to produce brief animations for teaching acoustics. World Wide Web sites have been created for easy access to the animations by all students. The present paper will explain how the animations are created and will demonstrate several including one and two degrees of freedom oscillators, a piston in a tube, reflected waves, doppler effect, elastic waves, circular membranes, and circular plates. The current animations are relatively simple constructions to keep the file sizes to a minimum. However, improved animations containing substantially enhanced graphics will be possible with Internet 2.

Contributed Papers

9:15

4aSP4. A software teacher for acoustical measurements. Ila Tokola, Matti Karjalainen, and Martti Rahkila (Helsinki Univ. of Technol., Lab. of Acoust. and Audio Signal Processing, P.O. Box 3000, FIN-02015, Helsinki, Finland)

The huge development in computer technology has made it tempting to use computers in acoustics education. QuickSig, an object-oriented Common Lisp based signal processing environment has been used for acoustical measurements. It provides an excellent means to present graphics and handle signals, and it is easy to program for educational purposes as well. A Simple Loudspeaker Measurement Program is a Computer Based Education (CBE) application for self-studying of acoustical measurements. The application deals with free-field measurements of loudspeakers and related theory. The measurements are actually made with the program and genuine results are achieved each time. The software teacher interactively helps the student to obtain results that make sense and monitors the progress with multiple-choice questions. The results can also be

saved for post-processing. The main difference between this application and on-line help systems in measurement packages is that the teacher emphasizes learning of acoustical measurements, not the measurement software itself! On the other hand, with this application, the students do real measurements, including the loudspeaker and microphone setup in an anechoic chamber, unlike most self-study CBE applications. Furthermore, the application can be used also by engineers, technicians, etc. for assisted measurements.

9:35

4aSP5. Design and development of PC-IMAT. John W. Schuler (Naval Personnel Res. and Development Ctr., Armstrong Lab., Brooks AFB, TX 78235) and Murray S. Korman (U.S. Naval Acad., Annapolis, MD 21402)

NPRDC has been tasked to provide empirical evidence of effective instructional strategies for the acquisition of conceptual knowledge under the project name PC-IMAT (Personalized Curriculum for Interactive Multisensor Analysis Training). The domain to be investigated and demonstrated includes those concepts required for the successful planning and execution of antisubmarine warfare (ASW), specifically, the conceptual knowledge underlying the prediction of sound transmission paths and detection ranges. Navy-standard models which are used in fleet SONAR prediction systems are available to support the learners' conceptual understanding of the elements of the oceanographic environment which affect acoustic propagation. To date, these models are employed in a microcomputer based, stand-alone delivery architecture in both a linear interactive courseware (ICW) format and in modules suitable for independent exploratory learning. Midshipmen taking SP411 (Underwater Acoustics and Sonar) are currently using PC-IMAT to help investigate what are the effective instructional strategies which convey understanding of a complex multivariate domain (like ray trace or propagation loss models). Research on ''scientific visualization'' (to enhance comprehension and retention) and student feedback will also be used to help develop and evaluate other training materials including beamforming, reverberation, target motion analysis, and scattering. [Work supported by ONR.]

9:55

4aSP6. Construction of a HATS and its HRTF measurement for 3-D sound. Kyeong Ok Kang, Dong-Gyu Kang, Min-Soo Hahn (Elec. and Telecom. Res. Inst., P.O. Box 106, Yusong Post Office, Taejon, 305-600, Korea, kokang@audio.etri.re.kr), Mun-Jae Jho (Korea Res. Inst. of Standards and Sci., Taejon, Korea), and Dae-Kwon Jeong (Korea Aviation Univ., Koyang, Korea)

Based on the anthropometric data on the head and torso dimensions in Korean male adults, a head and torso simulator (HATS) was constructed. Data, which have no counterparts in the Korean standards, were used with ANSI S3.36-1985. Measuring microphones can be positioned at the eardrum or at the ear canal entrance according to measuring purposes. Head related transfer functions (HRTFs) for the HATS, i.e., binaural impulse responses, were measured at 710 points on a spherical surface of radius 1.55 m using a burst maximum length sequence (MLS) signal of 65 535 samples in an anechoic chamber. The measurement system consists of one part to generate the MLS signal and to drive a Boss 101A loudspeaker and another part to record the output signal of a microphone in the HATS and consequently to measure the impulse response. Also measured were the impulse responses of the driving loudspeaker and some headphones for 3-D sound reproduction in order to get the exact HRTF of the HATS-alone. The impulse-version HRTFs at the sampling frequency of 44.1 kHz, which have filter lengths of 512 points with minimum phase characteristics and can be used for 3-D sound, were finally obtained through a post-processing procedure.

10:15

4aSP7. Measuring and modeling the effect of source distance in head-related transfer functions. Jyri Huopaniemi and Klaus A. J. Riederer (Helsinki Univ. of Technol., Lab. of Acoust. and Audio Signal Processing, P.O. Box 3000, FIN-02015, Helsinki, Finland)

Efficient modeling of human spatial hearing by digital filter approximations of head-related transfer functions (HRTFs) is the key technology in 3-D sound processing. It is well known that the HRTF bears the major static localization cues, the interaural time difference (ITD), and the interaural level difference (ILD) that are functions of frequency and the incident angle of arrival. The effect of source distance has, however, often been neglected in HRTF models. In this paper, a method for efficient distance-dependent HRTF modeling is presented, which is based on both theoretical and empirical data. HRTF measurements on eight human subjects and one dummy head were carried out at two source distances, 2 and 0.65 m. It has been argued in the literature that the distance changes mainly affect the ILD, whereas the ITD remains approximately constant. Based on this finding, which was also supported by the measurements performed in this study, a filter structure that models the ILD change as a function of distance was derived. The results of this study are applicable to many near-field listening applications.