Session 1pEDa

Education in Acoustics: Acoustics Demonstrations I

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Contributed Papers

1:00

1pEDa1. Introducing phonetics students to spectral components of vowel-like sounds. Geoffrey Stewart Morrison (Dept. Linguist., Univ. of Alberta, Edmonton, AB T6G 2E7, Canada, gsm2@ualberta.ca)

Undergraduate students in phonetics classes typically have difficulty understanding the concept behind Fourier analysis: that vowels can be decomposed into a series of spectral components. The concept can be introduced to students beginning with its inverse: that vowel-like sounds can be constructed from a series of sine waves. The demonstration consists of a PRAAT script which students are given to work with as a homework assignment before vowels are covered in class (PRAAT is free cross-platform software). The students are asked to input three frequencies, the script plots the time-domain representation of each sine wave and the sum of the three sine waves, and the frequency-domain representation of the sum of the three sine waves. It also plays the three sine waves and the sum of the three sine waves. Instructions include suggestions of frequencies for the students to try, and ask which vowels the results sound most like. Instructions also ask students to experiment with different frequencies to try to make sounds similar to other vowels. The students gain hands-on experience with vowel-like synthesis in order to give them an intuitive sense of the spectral components of vowel-like sounds before the theoretical concepts are introduced in the classroom.

1:15

1pEDa2. A speech-perception training tool to improve phonetic transcription. Noelle R. Padgitt, Benjamin Munson, and Edward J. Carney (Dept. Speech Lang. Hear. Sci., Univ. of Minnesota, 115 Shevlin Hall, 164 Pillsbury Dr. SE, Minneapolis, MN 55455, Padg0010@umn.edu)

University instruction in phonetics requires students to associate a set of quasialphabetic symbols and diacritics with speech sounds. In the case of narrow phonetic transcription, students are required to associate symbols with sounds that do not function contrastively in the language. This learning task is challenging, given that students must discriminate among different variants of sounds that are not used to convey differences in lexical meaning. Consequently, many students fail to learn phonetic transcription to a level of proficiency needed for practical application (B. Munson and K. N. Brinkman, Am. J. Speech Lang. Path. [2004]). In an effort to improve students' phonetic transcription skills, a computerized training program was developed to trains students' discrimination and identification of selected phonetic contrasts. The design of the training tool was based on similar tools that have been used to train phonetic contrasts in second-language learners of English (e.g., A. Bradlow *et al.*, J. Acoust. Soc. Am. **102**, 3115 [1997]). It consists of multiple stages (bombardment, discrimination, identification) containing phonetic contrasts that students have identified as particularly difficult to perceive. This presentation will provide a demonstration of the training tool, and will present preliminary data on the efficacy of this tool in improving students' phonetic transcription abilities.

1:30

1pEDa3. Visualizing vowel-production mechanism using simple educational tools. Takayuki Arai (Dept. of Elec. and Electron. Eng., Sophia Univ., 7-1 Kioi-cho, Chiyoda-ku, Tokyo, 102-8554 Japan, arai@sophia.ac.jp)

To develop intuitive and effective methods for educating Acoustics to students of different ages and from varied backgrounds, Arai [J. Phonetic Soc. Jpn. **5**, 31–38, (2001)] replicated Chiba and Kajiyama's physical models of the human vocal tract as educational tools and verified that the physical models and sound sources, such as an artificial larynx, yield a simple but powerful demonstration of vowel production in the classroom. We have also started exhibiting our models at the Science Museum "Ru-Ku-Ru" in Shizuoka City, Japan. We further extended our model to a lung model as well as several head-shaped models with visible vocal tract to demonstrate the total vowel-production mechanism from phonation to articulation. The lung model imitates the human respiratory system with a diaphragm. In the head-shaped model, the midsaggital cross section is visible from the outside. To adjust the degree of nasopharyngeal coupling, the velum may be rotated. Another head-shaped model with the manipulable tongue position was also developed. Two test results were compared before and after using these physical models, and the educational effectiveness of the models was confirmed. The homepage of the vocal-tract models is available at http://www.splab.ee.sophia.ac.jp/Vocal_Tract_Model/index-e.htm. [Work supported by KAKENHI (17500603).]

1:45

1pEDa4. Demonstrations of simple and complex auditory psychophysics for multiple platforms and environments. Seth S. Horowitz, Andrea M. Simmons (Dept. of Psych., Brown Univ., Box 1853, Providence, RI 02912, shorowitz@neuropop.com), and China Blue (Brooklyn, NY 11211)

Sound is arguably the most widely perceived and pervasive form of energy in our world, and among the least understood, in part due to the complexity of its underlying principles. A series of interactive displays has been developed which demonstrates that the nature of sound involves the propagation of energy through space, and illustrates the definition of psychoacoustics, which is how listeners map the physical aspects of sound and vibration onto their brains. These displays use auditory illusions and commonly experienced music and sound in novel presentations (using interactive computer algorithms) to show that what you hear is not always what you get. The areas covered in these demonstrations range from simple and complex auditory localization, which illustrate why humans are bad at echolocation but excellent at determining the contents of auditory space, to auditory illusions that manipulate fine phase information and make the listener think their head is changing size. Another demonstration shows how auditory and visual localization coincide and sound can be used to change visual tracking. These demonstrations are designed to run on a wide variety of student accessible platforms including web pages, stand-alone presentations, or even hardware-based systems for museum displays.