

elements. It has been previously shown that flow distribution and pressure drop calculation can be done using the same two-port elements but using a different set of transfer matrices. A similar approach was previously proposed to calculate the temperature drop using the same two-port elements but using a new set of transfer matrices. This technique has the advantage to solve all physics by defining only one network. An improved version of this formulation is presented in this paper. Several cases were tested and the thermal and acoustic results were compared to finite element simulations and measurements. The two port results matched well with the other techniques.

9:30

**5aEA5. Modeling acoustic propagation in a compartment fire.** Mustafa Z. Abbasi, Preston S. Wilson, and Ofodike A. Ezekoye (Appl. Res Lab. and Dept. of Mech. Eng., The Univ. of Texas at Austin, 204 E Dean Keeton st., Austin, TX 78751, mustafa\_abbasi@utexas.edu)

Firefighters unable to move and in need of rescue use an audible alarm to signal for help. Rescue teams can then follow this sound to the firefighter. This alarm is governed by NFPA 1982 : Standard on Personal Alert Safety System (PASS). Introduced in 1983, the PASS has saved many firefighter lives. However, a number of incidents have occurred where the PASS is less effective. There have been incidents where the PASS was heard sporadically on the fireground, or where localization of the alarm was difficult, leading to injury and loss of life. We hypothesized that the temperature field created by the fire is distorting the sound, making it difficult to recognize and localize. At ICA 2013, the authors presented experimental results showing changes in the room acoustic transfer function as the fire evolved. This paper will present efforts at modeling these effects. Using a combination of computational fluid dynamics and wave models, a comprehensive model will be presented capable of modeling sound propagation in the firefighting environment. The goal of this work is to develop a PASS signal more robust against distortion by the fire, and better able to serve the firefighting community. [Work supported by DHS/FEMA.]

9:45

**5aEA6. A wearable real-time vocal biofeedback device.** Mark VanDam (Speech & Hearing Sci., Washington State Univ., PO Box 1495, Spokane, WA 99202, mark.vandam@wsu.edu), Bradley C. Clemetson, Marshall Hurson, Tyler Pacheco (School of Eng. and Appl. Sci., Gonzaga Univ., Spokane, WA), Shirley Jakubowski, Walter Jakubowski (Parkinson's Resource Ctr. of Spokane, Spokane, WA), and Doreen Nicholas (Commun. Disord., Eastern Washington Univ., Spokane, WA)

A body-worn, real-time speech and voice biofeedback device is described. Data from an acoustic microphone and piezoelectric sensor worn comfortably in a neckband are streamed to a digital signal processor and a small, mobile computer, altogether able to fit into a pocket for extended use. User laryngeal and spectral characteristics are determined from the combination of sensor inputs. Selected vocal characteristics (e.g., vocal intensity, shimmer, jitter, spectral output, and fundamental frequency) are analyzed in real-time to provide immediate user feedback via tactile or visual response to indicate speech production pathologies including reduced loudness, pitch instability, or other features. With minimal training, this feedback can be immediately acted upon by the wearer to adjust speech and voice production characteristics accordingly. In addition, all data from input sensors are collected and stored in the computer's memory for offline analyses of speech and voice production characteristics. Extended-use, large-sample data collection addresses issues in the extant literature including ecological validity, reactivity (e.g., the Hawthorne effect), small sample sizes, and unaccounted for individual differences. This work offers a realistic description of voice use and assesses a wide range of functional and organic clinical conditions that are known to affect speech production (e.g., Parkinson's disease).

10:00–10:15 Break

10:15

**5aEA7. Measurements of sound absorption of living grass.** Chelsea E. Good, Aldo J. Glean, Joseph F. Vignola, John A. Judge, Teresa J. Ryan, Nicole B. Bull (Mech. Eng., The Catholic Univ. of America, 620 Michigan Ave. NE, Washington, DC 20064, 26good@cardinalmail.cua.edu), and Diego Turo (BioEng., George Mason Univ., Fairfax, VA)

This work presents measurements of acoustic absorption coefficients of sod samples with grass blades of different length. These measurements were made with a vertical acoustic impedance tube over a 200–1600 Hz frequency band. The acoustic measurements will be compared to values calculated using an equivalent fluid model. Sod is a coarse aggregate material such that the observed absorption will have components resulting from the different constituent elements. A layer of granular material with known acoustic properties is placed at the bottom of each sample to account for the acoustic absorption of soil. This work considers the sod as a two-component system: foliage and substrate (soil and roots together). The absorption effects due to each component were isolated by making measurements before and after shearing the mature foliage near the soil surface. We show the effects of foliage length on acoustic absorption. Measurements of sound absorption of living grass

10:30

**5aEA8. Acoustic characteristics of a dielectric elastomer absorber.** Zhenbo Lu, Yongdong Cui (Temasek Labs., National Univ. of Singapore, T-Lab Bldg., 5A, Eng. Dr. 1, #09-02, Singapore 117411, Singapore, tssluz@nus.edu.sg), Jian Zhu, Zijie Zhao (Dept. of Mech. Eng., National Univ. of Singapore, Singapore, Singapore), and Marco Debiasi (Temasek Labs., National Univ. of Singapore, Singapore, Singapore)

The present paper is devoted to study the acoustic characteristics of a dielectric elastomer (DE) absorber, which has a wide variety of potential applications as a novel actuator technology. DE, a lightweight and high elastic energy density smart material, can produce a large deformation under high DC/AC voltages. These excellent characteristics can be used to improve the present typical noise control systems. The performance of using this new soft-controlled-material is experimentally investigated. It is found that the voltage on the DE could tune the resonance frequencies of DE absorber thus it could absorb broadband noise. The results also provide insight into the appropriateness of the absorber for possible use as an active noise control system for replacing the traditional acoustic treatment.

10:45

**5aEA9. Underwater acoustic measurements of an ultrasonic barrier for guidance of American Shad in front of hydroelectric installations.** Francois Lafleur (EMMH, Hydro-PQ Res. Inst., 1800 boul. Lionel-Boulet, Varrennes, QC J3X1S1, Canada, lafleur.francois@ireq.ca)

This article presents the results of ultrasonic underwater acoustic measurements in a project guide shads during their downstream migration. Biological issues will be explained to allow the context, but the focus will be on the acoustic problems. In the spring, thousands of shad ascend the St. Lawrence River to spawn downstream of the Central Carillon. After spawning, adults return to sea heading toward the dam Rivière-des-Prairies. The configurations of the installed barriers at the Rivière-des-Prairies dam and at the ile Bizard site will be presented. A design of a signal amplifier was performed to optimize the barrier. A series of simulations and acoustic measurements have been conducted for the evaluation of the emission level of the barrier. The measurement strategy must take into account aspects such as high frequency signal (125 kHz) and geolocation measurement to allow achieving a mapping program of the barrier. The paper will describe: The issue biological; The deployment sites; The mechanism of hearing ultrasonic shad; Configuration of the barrier; The measurement system and the analysis of the results; Typical results obtained for mapping acoustic; Future directions in terms of signal measurements of the acoustic barrier.