10:15

4aSA4. Acoustic Kramers–Kronig relations in the ultrasonic frequency band. Joel Mobley (NCPA, Univ. of Mississippi, 1 Coliseum Dr., University, MS 38677)

Physical manifestations of the principle of causality, Kramers–Kronig (KK) relations, have proven to be adaptable to a wide array of tasks which include measuring fundamental material parameters, establishing the consistency of laboratory data, and building causally consistent physical models. This talk is concerned with the use of finite bandwidth KK relations between and among the components and derivatives of the complex wavenumber in the low megahertz ultrasound band. Special focus is given to their applicability to data from suspensions of resonant scatterers and media exhibiting attenuation with a power-law dependence on frequency. One recent development is the validation of a KK relation for the direct prediction of the group velocity from the attenuation coefficient, which has demonstrated great utility for suspensions with resonant type dispersion. The roles of KK analysis in other recent issues are also discussed, including the apparent negative dispersion in cancellous bone.

10:45

4aSA5. Is an impedance operator necessary causal, and is this an issue of complexity? John J. McCoy (School of Eng., The Catholic Univ. of America, Washington, DC 20064)

An impedance operator describes the mapping of a velocity field across a part of a boundary surface, to the traction field across the same part. Understood to represent the solution of a "direct" problem, i.e., the velocity field describes the problem forcing and the traction field part of the solution, the impedance operator is necessary causal. On the other hand, understood to represent the general solution of an "inverse" problem, i.e., the velocity field is part of the observed solution with the traction field representing the problem forcing, the operator need not be causal. Continuing, a uniqueness theorem that applies to the direct problem assures that the impedance operator thusly defined is unique. The lack of a corresponding theorem for the inverse problem suggests that the impedance operator thusly defined need not be unique. This further suggests requiring causality selects from *multiple* impedance operators, representing multiple solutions to the inverse problem, the one that is unique. This raises two questions. Is the causality that makes the operator unique a requirement of the governing physics? What impact does this have on the concept of impedance as a tool for addressing complexity in dynamical systems?

THURSDAY MORNING, 13 NOVEMBER 2008 LEGENDS 7, 9:00 A.M. TO 12:00 NOON

Session 4aSC

Speech Communication: Production (Poster Session)

Ewa Jacewicz, Chair
Ohio State Univ., Speech and Hearing Sci., 1070 Carmack Rd., Columbus, OH 43210

Contributed Papers

All posters will be on display from 9:00 a.m. to 12:00 noon. To allow contributors an opportunity to see other posters, contributors of odd-numbered papers will be at their posters from 9:00 a.m. to 10:30 a.m. and contributors of even-numbers papers will be at their posters from 10:30 a.m. to 12:00 noon.

4aSC1. Development of temporal characteristics in the speech of hearing impaired preschoolers. Mark VanDam, Nicholas A. Smith, Dana Ide Helvie, and Mary Pat Moeller (Boys Town Natl. Res. Hospital, 555 N 30 St, Omaha, NE 68131, vandamm@boystown.org)

This longitudinal study examined the development of temporal speech properties in hearing impaired and normal hearing children at 4 and 5 years of age. Children repeated a list of target words following the experimenter's model. Measures of duration for onset, nucleus, coda, and syllable were collected for children with normal hearing and children identified early (mean = 3 months) versus late (mean = 30 months) as hearing impaired. Main effects of age and group were observed for nucleus, coda, and syllable but not onset duration. Early-identified children were more similar to normal-hearing children than late-identified peers, despite early-identified children having much less hearing (mean diff. = 40 dB HL). Age and group differences were examined using (1) relationships among acoustic duration measures, (2) phone-by-position accuracy, and (3) spoken word intelligibility to assess the influence of hearing experience on development. Although there was a wide individual variation, results suggest benefits of early identification: early identified hearing impaired children performed more like normal hearing children. Results favor a "delayed-acquisition" over "different-mechanism" model for the development of temporal speech properties in children with hearing loss. [Work supported by NIH-NIDCD T32 DC00013-26; R01 DC006681; and P30 DC04662.]

4aSC2. Children's articulatory constraints inferred from acoustic output: How some speech-sound errors arise. Richard S. McGowan (CReSS LLC, 1 Seaborn Pl., Lexington, MA 02420) and Susan Nittrouer (The Ohio State Univ., Columbus, OH)

Our investigations of children's speech acoustics indicate that normally developing children exhibit speech behavior that is not simply scaled adult behavior. Specific anatomical differences between children's and adults' vocal tracts cause these effects: For example, the size of the tongue in relation to the size of mouth decreases with age. The effects of these age-related anatomical differences have been identified for preschool children as young as 1 year of age in phonetic segments, such as /ɹ/, /s/, and /ʃ/. These anatomic differences may lead children to produce subphonemic distinctions, as between /r/ and /w/ in English. Children's anatomical features can also affect sounds generally not considered to be difficult for normally developing children to produce, such as syllable-initial stops. We have noted children 12–18 months old producing intended /g/ that is often transcribed as /d/ by adult listeners. However, fronted velar /g/, which could be the result of a large