Using Otoacoustic Emissions as a Window into Hormonal Events during Prenatal Development

Friday, January 30, 2004 4:00 p.m.

Professor Dennis McFadden
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The normal cochlea contains a series of elements known as the cochlear amplifiers. As a harmless byproduct, these amplifiers produce sounds called Otoacoustic Emissions (OAEs). OAEs exhibit sex differences that are present in newborns as well as in adults. OAEs also exhibit differences in certain special populations of humans such as opposite-sex twins, homosexuals, and children with attention-deficit/hyperactivity disorder (ADHD). Taken together, the data suggest that OAEs can serve as a marker for the degree of androgen exposure a fetus receives during prenatal development. Those data and their implications will be reviewed, and then OAE data from two species of primates will be presented—rhesus monkeys and spotted hyenas. Spotted hyenas are an especially interesting species in this context because the females are highly masculinized in body, brain, and behavior beginning at birth, suggesting that their OAEs should be quite weak. Also, for both species, we obtained data from animals that were treated with androgenic or antiandrogenic agents during prenatal development—an excellent experimental test of our suggestion that high levels of androgens during prenatal development masculinize OAEs. Come to the talk and you will see if our predictions about those animals were confirmed.

History of Physical and Engineering Acoustics at Texas

Friday, February 6, 2004 4:00 p.m.

Professor David T. Blackstock
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Acoustics appeared as an academic field of interest at the University of Texas as early as the 1930s. Acoustical interests were pursued by C. Paul Boner in the Physics Department and Lloyd A. Jeffress in the Psychology Department. They were good friends. When World War II came, Boner and most of the other Physics faculty were called off to war work, Boner as Associate Director of the Harvard Underwater Sound Laboratory (HUSL). Meanwhile, back at the campus, someone had to teach freshman physics, and Jeffress did it. On returning to the University in 1945, Boner organized the Defense Research Laboratory (DRL), which was housed in buildings where the present Law School now stands. A radar and aeronautics laboratory at first, DRL became involved in underwater acoustics in the early 1950s, and by the late 1950s that was its dominant work. During this period acoustics on the campus (except for hearing) was still limited to the Physics Department. However, that interest waned and acoustics gradually began to make its way into Engineering, beginning about 1960 with Elmer L. Hixson in the Electrical Engineering Department. In the middle 1960s Mechanical Engineering began to be involved. DRL, which played a role in prompting ME to become interested, changed its name to Applied Research Laboratories and moved to its current site at Balcones Research Center (now the Pickle Research Campus). Today acoustics at the University is a flourishing interdisciplinary field involving students, faculty, and research staff in many academic departments—ME, ECE, ASE & EM, Physics, Psychology, Linguistics, Communication Sciences and Disorders, and Music—and ARL.

Geoacoustic Inverse Problems for Sound Transmission in Shallow Seas

Friday, February 13, 2004 4:00 p.m.

Dr. David P. Knobles
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Sound transmission in shallow seas is significantly influenced by the geophysical structure of the seabed, both at the surface and beneath the seafloor. The reasons include the proximity of the seafloor to the water-air interface of the waveguide, and the commonly downward refractive character of the speed of sound as a function of depth within the water column. While modern numerical methods can accurately solve the wave equation boundary value problem, the details of the geophysical properties of the seabed are often unknown, and thus lead to inaccurate predictions. Analysis and the ability to successfully predict the properties of sound propagation in such waveguides often require the use of inversion methods to estimate the properties of the seabed from acoustic measurements made in the water column. The inference of the seabed structure employs a simulated annealing approach to estimate seabed parameters such as sound speeds, densities, and attenuations, and their uncertainties. Simulated annealing uses the analogy of the thermodynamics of the formation of crystalline structures from heating certain types of material followed by a long cooling period. Discussed are several examples of such analyses from experiments in the Gulf of Mexico and the East China Sea. A variety of data are considered and include multi-frequency tonals with large source-receiver offsets, time series data generated by impulsive sources and recorded on multiphone arrays, and received noise generated by moving surface ships.

Novel Strategies for Beam Formation: Line-by-Line Acquisition Zone Acquisition

Friday, February 27, 2004 4:00 p.m.

Tom Jedrzejewicz
Medical Ultrasound Consultant
Formerly with Siemens Medical Solutions
http://www.medical.siemens.com

The traditional line-by-line strategy to acquire ultrasound echo is described and compared to zone-based technique for real-time B-mode imaging. The zone technique utilizes a broad transmit beam from which many receive beams are formed, such that a full field of view image can be formed using only 5-15 transducer excitations. On receive, the RF data is pre-processed and accumulated in a channel domain baseband I/Q memory, and then transferred to a DSP-based imaging system, which performs dynamic

receive focusing, detection, log compression, spatial filtering, and scan conversion. This technique and architecture extracts more information from each transmit firing, transforming the image formation rate problem from one of acoustic propagation time limitations, to processing speed limitations and thus, leverages Moore Law. The basic technique and architecture will be discussed, as well as providing several example images from different applications.

Contrast Ultrasound Imaging and Local Drug Delivery

Monday, March 8, 2004 3:00 p.m.

Professor Katherine Ferrara
Department of Biomedical Engineering
University of California, Davis
http://www.bme.ucdavis.edu

Ultrasound contrast agents are small microbubbles with a thin shell and a resonance frequency in the range of clinical ultrasound instruments (1-5 MHz). We have developed a model for their oscillation in response to ultrasound pulses and have calibrated the model using a very high speed camera (capable of acquiring 100 million frames per second). The contrast agents may be used to estimate microvascular perfusion; the resulting imaging techniques are shown to have value in cancer imaging. We have also developed a method by which ultrasound and ultrasonically-active drug-carrying vehicles deliver bioactive substances with high spatial selectivity. A delivery vehicle consisting of a small gas bubble surrounded by a thick oil shell and enclosed by an outermost lipid layer has been engineered for local delivery of small molecules or hydrophobic drugs. A sequence of ultrasound pulses can deflect these vehicles to a vessel wall and then disrupt them, painting their contents across the vascular endothelium.

Case Studies Involving Acoustical Standards, Products, and Test Facilities

Friday, March 26, 2004 3:00 p.m.

Jeff G. Schmitt, P.E.
JGS Consulting and ViAcoustics
http://www.viacoustics.com

When the going gets tough, the tough look to the government and public sector for most of their projects, and that’s what JGS Consulting did this year. This seminar will be an overview of several recent projects. These include the new acoustical test facility at Georgia Tech, efforts by NIOSH (National Institute for Occupational Safety and Health) to measure and lower the sound levels produced by mining equipment, and development of an ISO 17025 quality system at the NASA Glenn Structural Dynamics Laboratory. The talk will also survey products developed together with Nelson Acoustical Engineering for measurement of product noise emission. As with previous presentations by the speaker, this will be a smorgasbord of tidbits on how to make a living waving around microphones and interpreting the results.

Noise Emission and Spaceflight Hardware

Friday, April 16, 2004 4:00 p.m.

David A. Nelson, INCE Bd. Cert., P.E., Principal
Nelson Acoustical Engineering, Inc.
http://nelsonacoustical.com

Scientific missions of long duration on the International Space Station (ISS) have led to an increased vigilance regarding noise levels within laboratory modules. Reduced noise levels have the potential to increase crew productivity on-station by improving speech communication and reducing fatigue. NASA has therefore imposed what appears to be a fairly relaxed noise level criterion similar to that for earthbound laboratories. However, when applied to individual experimental packages the criterion leads to some significant noise control challenges that all but demand noise control at the source. The seminar will be an overview of the author’s experiences with low-noise design and testing of spaceflight hardware, including the rationale for the criterion, “noise budgeting”, design constraints imposed by the flight environment, and specific challenges for testing spaceflight hardware.

Exploring Medical and Industrial Applications of Time Reversal Acoustics

Friday, April 23, 2004 4:00 p.m.

Dr. Armen Sarvazyan
Artann Laboratories, Inc.
Lambertville, NJ

The concept of Time Reversal Acoustics (TRA) developed by Mathias Fink provides elegant possibilities for both temporal and spatial concentration of acoustic energy in inhomogeneous composite media. Furthermore, numerous reflections from boundaries, which distort focusing in conventional focused ultrasound systems and are viewed as a significant technical hurdle, lead to improvement of the focusing ability of the TRA system. TRA takes advantage of this usually undesirable process. Even the simplest TRA system based on a single transducer may potentially provide efficient spatial and temporal concentration of the emitted ultrasonic signal in complex multilayered media. We are currently exploring applications of TRA in such diverse areas as medical diagnostics, ultrasound assisted drug delivery, therapy and surgery, in-situ nondestructive evaluation of aircraft and spacecraft systems, and remote detection of landmines. Medical applications of TRA include nonlinear imaging and shear wave elasticity imaging (SWEI). The project on TRA SWEI is being developed in collaboration with Mathias Fink’s Laboratory for Waves and Acoustics at the University of Paris. Our projects on land mine detection and on spacecraft NDE are being developed in cooperation with Los Alamos National Laboratory.

The Interesting Effects of Added Complexity: The Acoustics of Elastic Waveguides and Liquid-Filled Impedance Tubes

Friday, September 10, 2004 4:00 p.m.

Professor Preston S. Wilson
Department of Mechanical Engineering
The University of Texas at Austin
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The impedance tube has been used to study the acoustic properties of materials in air for years and is a mature technology. The acoustic absorption of ceiling tiles and automobile mufflers are typical examples, and a number of commercial impedance tubes are available. The need to investigate the acoustic properties of materials and structures in a liquid environment is less prevalent, but can be very important in certain areas, such as underwater acoustics and the design of dynamic hydraulic circuits. A practical liquid-filled impedance tube (LFIT) is difficult to achieve and no commercial devices are available. The reason: In the air-filled case, the walls appear rigid to an airborne acoustic wave. In the liquid-filled case, one must account for the motion of the tube wall. This was achieved by modeling the LFIT as an elastic waveguide, which has a number of interesting properties. These will be discussed along with the design of a high-precision LFIT, which primarily suppresses these properties. Resulting LFIT measurements of the acoustic properties of a bubbly liquid and a water-saturated marine sediment will be presented and compared to existing theory. It turns out, the complexity of these materials also results in interesting acoustic behavior.

Church Opal – 1975, Recovery and Analysis of Archival Data

Friday, September 24, 2004 4:00 p.m.

Jack Shooter
Applied Research Laboratories
The University of Texas at Austin
http://www.arlut.utexas.edu

In October 2002 the Office of Naval Research (ONR) sponsored a Convocation that reviewed the ocean acoustic studies done from 1967 to 1992 under the U.S. Navy's Long Range Acoustic Propagation Project (LRAPP). Beginning in 1972 LRAPP fielded self-contained assemblies of vertically distributed hydrophones as part of environmental acoustic exercises in a variety of oceanic regions. Analog signals were recorded in a submerged buoy on multi-channel magnetic tape. Presentation of results from a 1975 measurements exercise in the Northeast Pacific stimulated interest in recovering and digitizing the 10-day dataset from 13 hydrophones. ONR sponsored a pilot project to demonstrate the feasibility of recovering the data and setting up digital files while preserving absolute accuracy. The original magnetic tape was sticky. It had to be heat treated and cleaned before playback. A spectrum from the original analysis for near-field passage of a ship was used to validate data recovery in the range of 10500 Hz. A final objective is to produce calibrated time series so that the digital dataset can be made available for general use.
[Work supported by ONR.]

The Application of Current Audio Analysis Techniques to Electro-acoustic Music for the Purpose of Visualization

Friday, October 1, 2004 4:00 p.m.

Anderson Mills
Department of Electrical and Computer Engineering
The University of Texas at Austin
http://www.ece.utexas.edu

Electro-acoustic music has been ignored by music theorists for years. One theory suggests that this deficiency is due to the lack of an objective visual representation of this type of music. This research is focused upon the audio analysis involved in the creation of a “pseudo-score” for electro-acoustic music.

Computer analysis of music is a complicated task. The “holy grail” of automatic computer music analysis has most often been the translation a continuous pressure variation into traditional Western musical notation. Since electro-acoustic music is rarely able to be transcribed into this type of notation, the automatic analysis of electro-acoustic music confounds many previous algorithms. An approach without source segregation is suggested in order to extract acoustic and musical information from recordings of electro-acoustics music. This type of approach has already proven successful in extraction of musical tempo [Scheirer E., M.I.T. Ph.D. Thesis, 2000].

A cochlear model is used as a front-end processor in order to capture some of the auditory phenomena experienced by humans trying to translate a continuous pressure variation into useful acoustic information. Although this model apparently encodes some redundant information, cross- and auto-correlation techniques allow easier extraction of some acoustic information. This presentation will detail the current state of this research.

Seabed Characterization on the New Jersey Middle and Outer Shelf: Correlability and Spatial Variability of Geological and Geoacoustic Properties

Friday, October 8, 2004 4:00 p.m.

John Goff
Institute for Geophysics, Jackson School of Geosciences
The University of Texas at Austin
http://www.ig.utexas.edu
http://www.geosci.utexas.edu

Nearly 100 collocated grab samples and in situ 65 kHz acoustic measurements were collected on the New Jersey middle and outer shelf within an area that had previously been mapped with multibeam backscatter and bathymetry data, and more recently with 1-15 kHz chirp seismic reflection profiling. Eighteen short cores were also collected, and probed for resistivity-based porosity measurements. The combined data set provides a basis for empirically exploring the relationship among the remotely sensed data, such as backscatter and reflection coefficients, and directly measured seabed properties such as grain size distribution, velocity, attenuation and porosity. The spatial variability of these properties through semi-variogram analysis is investigated to facilitate acoustic modeling of natural environmental variability. I will also present a preliminary analysis of sediment variability over much larger regions, employing the USGS's developmental usSEABED database which includes many thousands of measurements of mean grain size within US EEZ waters. These data, although possessing higher uncertainties, are comprehensive enough to examine relationships between sediment variability and environmental relationships such as water depth, geologic history, dipward vs. strikeward directionality, etc.

Simulation of Shallow-water Reverberation and Geoacoustic Characterization

Friday, October 15, 2004 4:00 p.m.

Tom Yudichak
Applied Research Laboratories
The University of Texas at Austin
http://www.arlut.utexas.edu

An important reverberation mechanism in underwater environments is the scattering of sound from random inhomogeneities, such as fluctuations in sound speed and density, throughout sediment layers. The scattering strength of the sediment in such cases depends in part on the statistics of the fluctuation fields. This dependence is studied by simulating shallow-water reverberation using randomly generated fluctuation fields and solving the waveguide scattering problem in the Born, or single-scattering, approximation. Scattering strengths at various frequencies are then computed from the simulated time series. The results are compared to scattering strengths computed from experimental data in an attempt to characterize the fluctuation statistics of the sediment. The sensitivity of the results to the mean geoacoustic description is also examined.

Effects of Room Acoustics on Stereo and Surround Sound System

Friday, October 22, 2004 4:00 p.m.

Ruchi Goel
Department of Electrical and Computer Engineering
The University of Texas at Austin
http://www.ece.utexas.edu

A home theater system recreates the surround sound heard in cinemas and concerts in the listening room of any house. It is an extension of stereo system to create a three-dimensional sound field. The aim of this study is to determine the effects of Room Acoustics on stereo and surround sound. It also involves the study of the characteristics of a home theater system along with their optimized placement in any room. A quantitative evaluation of the room acoustics effect is made by observing the signals from the microphone in the ears of an anthropomorphic manikin (KEMAR) as compared to qualitative evaluation by listeners. Both the stereo and surround sound characteristics are tabulated and analyzed. The measurements of frequency response and cross-correlations are done in the three rooms (anechoic, reverberant and listening room) in this study. Then, the plots between the speaker and manikin are compared to evaluate the effect of different rooms on the measurements. The study shows that only in the reverberation room, the unadulterated program material gets to the listener. The cross correlation is the

best measure of this condition. Correlation is also useful in speaker placement so that program material arrives at the listener 'in phase'. Transfer functions are useful in showing room modes in non ideal listening rooms.

Acoustics and Noise Control of Bass Concert Hall

Friday, November 12, 2004 4:00 p.m.

Ken Dickensheets
Dickensheets Design Associates
http://www.dickensheets.com

Ken Dickensheets will lead an acoustics and noise control tour of Bass Concert Hall at the University of Texas Performing Arts Center. We will all meet on the front steps of Bass Concert hall, which is located at the NW corner of 23rd Street and Robert Dedman Drive, just across 23rd Street from the stadium.

Tour of Acoustic Systems

Friday, December 3, 2004 4:00 p.m.

William McKenna
Acoustic Systems
http://www.ets-lindgren.com/page/?i=Acoustics

Acoustic Systems, located in Austin, Texas, has been designing, manufacturing, and installing acoustical products since 1971. While Acoustic Systems does offer standard products, our focus is on custom designs, manufactured per customer specifications. Acoustic Systems is staffed by highly qualified sales professionals who work in tandem with a team of talented designers to provide responsive customer support throughout the design, manufacture and installation phases of every project. The company operates a state-of-the-art manufacturing facility and a NVLAP (National Voluntary Laboratory Accreditation Program) certified laboratory for the measurement of acoustic transmission loss, absorption and noise reduction. The test facility is used for ongoing analysis and improvements to Acoustic Systems' products as well as independent testing for companies throughout the United States.