THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS SEMINAR

Jointly Sponsored By
Mechanical Engineering, Electrical and Computer Engineering,
Engineering Mechanics, and Applied Research Laboratories

Friday, January 20, 1995

4:00 p.m. ETC 4.120

by

Dr. Evan K. Westwood

Applied Research Labs, University of Texas at Austin

Normal Mode Modeling of Acoustic Propagation in a Multi-Layered Acousto-Elastic Ocean Environment

A normal mode model has been developed for underwater acoustic propagation in an ocean having a multi-layered elastic bottom. Following a brief tutorial on normal mode theory and the effects of shear waves, a description of the algorithm for finding mode eigenvalues will be given. The algorithm is based on an intuitive normal mode criterion, which states that modal eigenvalues correspond to plane wave angles for which constructive interference occurs between upgoing and downgoing plane waves. Complex eigenvalues are required when energy is lost from the waveguide due to any of the following mechanisms: attenuation in the media, partial reflection/partial transmission at the waveguide boundaries, or shear wave conversion at the waveguide boundaries. In the process of explaining the theory and algorithm, an attempt will be made to remove some of the mystery regarding leaky modes, branch line integrals, lateral waves, and Scholte modes. Finally, a method for performing broadband mode calculations will be described, and several examples of impulse response calculations will be shown.

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Friday, January 27, 1995

4:00 p.m. ETC 4.120

by

Geoffrey S. Royal

Applied Research Labs, University of Texas at Austin

Shallow-Water Time Series Simulation Using Normal-Mode Theory in Range-Dependent Environments

A broadband coupled-mode model analysis of acoustic propagation in a shallow-water wedge-shaped environment is presented. Simulated time series from a coupled mode model calculation are compared to measured time series taken during a tank experiment conducted by Tindle [**JASA 81**, 275-294, (1986)]. After a brief review of the results and analysis of the original tank experiment, the coupled mode formalism is discussed. Our method, a coupled mode approach, is based on a "stair-step" approach introduced by Evans [**JASA 74**, 188-195, (1983)]. Next, the simulated time series from the normal mode calculation are compared to the measured time series. It is shown that the main effect of the mode coupling is to produce a depth dependent time shift of the waveforms, which is in excellent agreement with the time shifts extracted from a wedge mode interpretation of the measured data. Finally, conclusions and suggestions for further research are presented.

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Friday, February 10, 1995

4:00 p.m. ETC 4.120

by

Dr. J. D. Gavenda

Department of Physics, University of Texas at Austin

A Continuous-Wave Method for Measuring Magnetoacoustic Effects

Ultrasonic waves are strongly absorbed by the conduction of electrons in pure metals at low temperatures. An applied magnetic field can induce resonant absorption of the ultrasound with accompanying changes in the sound velocity. A brief review of these phenomena, known as "magnetoacoustic effects," will be presented, including some recent work with surface acoustic waves. A new continuous-wave method for making high-resolution ultrasonic measurements, developed to overcome some of the dynamic range limitations of the traditional pulse-echo technique, will be described. It uses a network analyzer which Fourier-transforms the data from the frequency domain to the time domain to provide time discrimination between electrical feed-through signals and the acoustic signal.

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Friday, Feb. 24, 1995

4:00 p.m. ETC 4.120

by

Dr. Linda Thibodeau and Dr. Craig Champlin

Program in Communication Sciences and Disorders

Acoustics in Communication Sciences and Disorders

We will provide an overview of the various applications in acoustics that are being undertaken in the Program in Communication Sciences and Disorders. The general areas that will be covered include academic coursework and both basic and clinical research activities. The specific areas that will be discussed include amplification systems, speech perception, otoacoustic emissions, psychoacoustics, and auditory evoked potentials.

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ACOUSTICS SEMINAR

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Thursday, March 9, 1995

9:00 a.m. ETC 4.120

by

Robin O. Cleveland*

Applied Research Labs and Dept. of Mechanical Engineering,
University of Texas at Austin

Propagation of sonic booms through a real, stratified atmosphere

The Unites States is considering the development of a new supersonic passenger aircraft. Of some concern is the annoyance of the sonic boom generated by the aircraft to observers on the ground. We investigate the effect of stratification of the ambient properties of the atmosphere on the ground signatures. In the absence of losses, analysis shows that geometrical spreading and stratification of the medium slow down the nonlinear distortion of finite-amplitude waves. In certain cases the distortion reaches an absolute limit, a phenomenon called waveform freezing. We demonstrate that nonlinear effects in sonic booms are indeed reduced but that waveform freezing does not occur. A new computer code, THOR, is presented to solve the problem of propagation through a dissipative atmosphere. The novel feature of the code is that all its calculations, including absorption and dispersion, are done in the time domain. Results from the code compare very well with analytical solutions. THOR participated in a NASA exercise to compare sonic boom computer programs. THOR gave results that agreed well with other participants and ran faster. THOR is used to examine the effect of the stratification of absorption on sonic boom rise time. Earlier sonic boom research has assumed that sonic boom shocks are in steady state when they reach the ground. We show this not to be the case.

*Final Ph D oral examination

ACOUSTICS SEMINAR

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Friday, March 24, 1995 4:00 p.m., ETC 4.120

by

Dr. Joe Thornhill

Applied Research Labs, University of Texas at Austin

A Brief Introduction to Wavelet Transforms

Wavelet transforms are a relatively new member of a family of mathematical techniques referred to as time-frequency and time-scale techniques. Wavelets have found application in many fields including down hole oil well drilling, vibration, speech, video, electrocardiology and fingerprinting. They are used for data compression/synthesis as well as data analysis.

Fourier transforms map a function of a single independent variable, usually time, into a function of a single independent frequency variable using infinite extent sinusoids as the basis for the signal decomposition. This technique works well for stationary signals but not very well for transient signals. The wavelet transform maps the time function into a domain with two independent variables, time and frequency. This preserves the information about the timing of the transient events in the signal and since many signals contain transients, wavelets are finding wide application.

The basic concepts of wavelet analysis will be presented and compared to Fourier analysis. The two-scale dilation equation, multiresolutional analysis, iterated filters, and wavelet transforms not having a fixed set of basis functions will be discussed. Implementation techniques for the discrete wavelet transform will be presented and interpreted in terms of FIR filter banks. Wavelet transform results will be presented for image and speech compression/synthesis, high speed drill vibrations, bearing vibrations, and surface electromyograms.

ACOUSTICS SEMINAR

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Friday, April 7, 1995

4:00 p.m. ETC 4.150
(Note Room Change)

by

Steve Ho

Mechanical Engineering Department
University of Texas at Austin

Noise Barriers with Random Edge Profiles

In normal design the top edge of a noise barrier is straight. As a result, noise diffracted from the barrier edge seems to come from a string of highly correlated point sources, that is, a straight line source. The coherence of the diffracted sound therefore limits the effectiveness of the barrier. One way to spoil the coherence of the diffracted sound, and thus increase the insertion loss, is to vary the barrier height by making the top edge irregular instead of straight. The radiations from the point sources at the edge then are not well correlated. We have conducted preliminary experiments using physical models with random edge profiles. The spacing between height transitions and the height variation maxima are scaled to the wavelength at which the sound source (a spark) has a peak in its spectrum. Results to date show significant improvement (3-8 dB) for a barrier with random edge profile compared to one of the same average height with a straight edge.

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Wednesday, April 12, 1995

3:00 p.m. ETC 4.150
(Note Time and Room Changes)

by

Dr. Rodney Whitaker

Los Alamos National Laboratory

Long Range Atmospheric Acoustics

Los Alamos National Laboratory has had a program in long range, low frequency atmospheric acoustics, for the last several years. This work began as part of the Laboratory's research in arms control and verification under the sponsorship of the Department of Energy. Originally the research was directed toward the propagation of acoustic signals from underground nuclear tests (UGT), while recent work has focused on the detection of atmospheric explosions, as part of the Laboratory program of research in test detection. Three low frequency acoustic arrays have been operating on a 24-hour basis for routine data collection, in the frequency range 0.1-10 Hz. This region is usually called "infrasound" by most researchers. Data has been collected on UGTs, earthquakes, large chemical explosions, microbaroms, and other natural and man made sources. These data are collected at long range from their sources; from a few hundred to a few thousand kilometers. The work has included field operations for data collection, signal processing of array data, source physics and wave propagation modeling, and data interpretation and analysis. The overall program will be reviewed and examples of long range detection of various infrasound sources will be presented.

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Friday, April 21, 1995

4:00 p.m. ETC 4.150

by

Dr. Jack Sheehan

Applied Research Labs,
The University of Texas at Austin

Analysis of Gear Vibration and Noise in Automobiles

Automotive customers tend to identify quiet with quality. Vehicles which eliminate engine, transmission, final drive, tire, road, and wind noise from the passenger compartment command a premium in the market place compared to otherwise similar competitors. It is widely held that silencing as is much art as science. However, the most uniformly successful approach in automotive practice is brute force application of mass and mechanical isolation. Without denigrating the necessity of art, this paper asserts an alternative perspective on the difficulty of producing vehicles which are genuinely quiet: the silencing problem is qualitatively and quantitatively different than the problems in design, both nominal and detailed. In particular, this paper makes these points:

(1) The production of sound by final drive gear trains is an extremely inefficient process; therefore, the vibration components which dominate sound generation are negligible quantities in typical gear design trade-offs. Hence the usual silencing adjustments to the in-service gear assembly simply shift but do not remove the offending source.

(2) Hypoid gear trains produce phase-coherent sinusoidal vibrations with modulated sidebands; unfortunately, human hearing is acutely sensitive to sound with exactly those characteristics. Thus, modifications which reduce signature energy in a specific vibrational component may have no useful effect on perceived acoustic annoyance.

(3) Classical signal processing is best suited for steady-state, deterministic signatures confounded by independent, Gaussian random interference; however, final drive measurements produce transient, stochastically modulated hypoid gear signatures confounded by highly correlated, non-Gaussian interference. To obtain useful results, then, instrumentation must be added to measure the transient signatures and sources of interference.

(4) Emerging higher-order spectral analysis methods seem particularly well suited for the non-stationary, highly correlated, and non-Gaussian final drive signatures; however, in order to obtain definitive results, very large and complex measurement ensembles are required. Therefore, experimental design and data handling architecture for long, replicated ensembles is crucial.

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Friday, April 28, 1995

4:00 p.m. ETC 4.150
(Note Room Change)

by

Dr. Mukul Sharma

Department of Petroleum Engineering
University of Texas at Austin

Nonlinear Elastic Behavior of Granular Porous Media

For most rocks, the elastic moduli obtained from ultrasonic measurements, well logs and static stress cycling measurements indicate that $E_{ultrasonic} > E_{log} \gg E_{static}$. Stress-strain diagrams demonstrate that the sampled rocks exhibit large hysteresis and attenuation. As strain amplitude is increased, the attenuation increases while both compressional and shear velocities decrease. These variations in elastic moduli can be explained by accounting for the effects of frequency and strain amplitude.

The origin of the nonlinear elastic response of rocks is traced back to grain contact mechanics and the surface chemical interactions between the grains and the pore fluids. A squirt flow model is proposed to explain the frequency dependence (viscoelastic behavior). A new energy loss mechanism is proposed based on grain contact adhesion hysteresis to explain the hysteretic stress-strain behavior observed experimentally. The grain contact adhesion hysteresis model predicts energy dissipation that is frequency independent. It also predicts that attenuation increases with strain amplitude and decreases with overburden stress. These trends are consistent with experimental observations.

ACOUSTICS SEMINAR

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Friday, May 5, 1995

4:00 p.m. ETC 4.120

by

James Bulgrin

Brooke Army Medical Center, Fort Sam Houston, TX
and
Hughes Aircraft Corp., Fullerton, CA

Comparison of Binomial, ZAM and Minimum Cross-Entropy Time-Frequency Distributions of Intracardiac Heart Sounds

During the past thirty years there have been few advances in the development of automated heart sound analysis. The slow advancement is in part due to the inability of conventional spectral analysis techniques to adequately describe the nonstationary, multicomponent characteristics of phonocardiograms. This study is an examination of the time-varying nature of high-fidelity intracardiac phonocardiograms (ICPs) using several recently-developed "Cohen-class" time-frequency distributions (TFDs). ICPs were obtained at rest, exercise and during physiologic maneuvers in 6 patients using catheter-mounted piezoelectric transducers. ICPs were bandpass filtered (50-500 Hz) and digitized at 4 KHz. The TFDs employed in this study included: the binomial transform, Zhao-Atas-Marks (ZAM) and minimum cross-entropy (MCE) distributions. Results were compared with the time-frequency distributions from the short-time Fourier transform. All Cohen class distributions provided improved temporal and spectral resolution. These findings suggest that recently develped TFDs may prove useful in the design of automated auscultation systems.

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FLUID DYNAMICS & ACOUSTICS JOINT SEMINAR

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Tuesday, June 13, 1995 4:00 p.m., ETC 7.146

by

Bruce J. P. Mortimer

School of Electrical Engineering Cape Technikon, Cape Town, South Africa

OBLIQUE REFLECTION OF SHOCK WAVES IN A SLOW SOUND SPEED FLUOROCARBON LIQUID

Fluorocarbon liquids have very low sound speed. In addition, because the equation of state of these fluids is highly nonlinear, the nonlinearity parameter B/A is exceptionally high. They therefore exhibit nonlinear effects at relatively low pressure amplitudes. An experimental and numerical investigation of regular shock reflection from a rigid wedge is reported. The liquid is FC-43, for which the sound speed is 655 m/s, or 44% of the value for water. Schlieren photographs were used to measure the angles of incidence and reflection, α and β, respectively. Only for very weak shocks is $\beta = \alpha$. Results are reported for wedge angles from 25° to 79° and incident shock pressures in the range 10-28 Bar. Theory and experiment are in excellent agreement.

Bruce Mortimer will give another seminar, **An Electromagnetic Liquid Shock Wave Generator for the Production of a Pulsed Water Jet**, at Applied Research Laboratories, 10:00 a.m. on Wednesday, June 14, 1995.

ACOUSTICS SEMINAR

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Friday, September 1, 1995

4:00 p.m. ETC 4.150
(Normally the seminar will be held in room 4.120)

by

Members of the Acoustics Faculty

Departments of Mechanical Engineering and Electrical Engineering

Faculty Introductions and Overviews of Current Projects

The purpose of this seminar is to introduce members of the acoustics faculty and their research associates to anyone who is either new at UT or simply curious. Overviews of current projects will be provided by members of the acoustics faculty.

ACOUSTICS SEMINAR

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Friday, September 8, 1995

4:00 p.m. ETC 4.120

by

B. J. Landsberger

Department of Mechanical Engineering

Ultrasonic Beam Distortion and Rotation at Fluid-Solid Interfaces

Similar to a beam of light, underwater ultrasonic beams can be very directive. Also similar to light, an ultrasonic beam will undergo diffraction as it propagates and refraction as it encounters an interface of two media. For an acoustic wave, when the second medium is an elastic solid two transmitted waves can be generated, a longitudinal and a shear wave. At certain special angles, the reflected and transmitted beams can undergo both distortion and rotation, resulting in an apparent displacement from the position expected by ray acoustics. The presentation will show that by sending pulses at and through a submerged aluminum block, we have been able to observe several interesting cases of beam displacement in the reflected and transmitted fields. The way these phenomena were successfully modeled using the angular spectrum method of beam decomposition will also be shown. Ongoing work concentrating on finite amplitude effects for ultrasonic beams propagating through a fluid-solid-fluid layered medium will be discussed.

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Friday, September 15, 1995

4:00 p.m. ETC 4.120

by

Dr. Melvin J. Hinich

Mike Hogg Professor of Local Government

Detection Using Biocorrelations

Consider the problem of detecting an unknown waveform in additive noise. The waveform may be unknown due to changes in a known waveform used in active radar or sonar, or it may be a waveform used in an intercepted signal. The standard approach for detecting an unknown waveform is energy detection. In energy detection a threshold is set for the average energy in the signal in a frame which is about the length of the waveform. Detection is claimed when the average energy exceeds the threshold. Some prior knowledge is needed to select the frame size, which is the averaging period.

It is possible to obtain a higher detection probability with a fixed false alarm probability by using functions of the sample correlation and bicorrelation of the signal in the frame. The bicorrelation is the average $x(t)x(t+r)x(t+s)$ for t in the frame and for a number of lags r and s in the region $0 < s < r$. This statistic is sometimes called the "triple correlation." The test statistic is the sum of squared bicorrelations for all r and s less that a value L which is less than the square root of the number of samples in the frame.

The large sample statistical properties of this test statistic are derived and compared with simulation results using tested using artificial noise. No assumption is needed for the joint density of the noise other than the moments are bounded. The method gives good results when the noise has an exponential density.

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Friday, September 22, 1995

4:00 p.m. ETC 4.120

by

Dr. David P. Knobles

The Applied Research Laboratories
The University of Texas at Austin

Computational Ocean Acoustics for Range Dependent Shallow Water Waveguides Using a Normal Mode Approach

Modeling acoustic propagation in shallow water and/or littoral ocean environments is a difficult problem in present day computational ocean acoustics. Unlike deep water propagation, the propagation of sound in shallow water waveguides is usually characterized by numerous interactions with the seafloor and subbottom structure. Information on the parameters which describe the geoacoustic structure of the bottom is usually limited, and often the goal in the analysis of shallow water data is the determination of a geoacoustic profile for the bottom. Another difficulty in modeling shallow water is that significant range variations in the waveguide are likely to be present. Also, the use of approximation methods such as ray optics and the parabolic approach, which have previously proved useful for deep water applications, are not always applicable to shallow water problems. The discussion in this talk focuses on research conducted at the Applied Research Laboratories and whose purpose is to investigate the physics of shallow water propagation. Of specific interest is range dependent propagation and the broadband simulation of the time dependent Green's function or impulse response. The theoretical approach to the calculations are based on a normal mode approach to the construction of the waveguide Green's function. For the range dependent case both adiabatic and coupled mode methods are considered. New computational methods which have their origins in nuclear theory are presented. Detailed comparisons of broadband time series measured in shallow water waveguides with simulated time series using broadband adiabatic and coupled mode computations are presented. It is concluded that a coupled mode approach to computational ocean acoustics in shallow water waveguides is quickly becoming a feasible theoretical approach.

ACOUSTICS SEMINAR

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Friday, October 6, 1995

4:00 p.m. ETC 4.120

by

Steve Ho

Mechanical Engineering Department
The University of Texas at Austin

Noise Reduction by an Irregular-Edged Barrier

A preliminary model experiment showed that a random-edged barrier provided a higher insertion loss than a straight-edged barrier of the same average height. Based on this promising result, we have conducted a 3-level full factorial model experiment on a random-edged barrier. The top of the barrier is a strip of aluminum of fixed average height but made randomly triangular by straight line cuts. A random number generator was used to scale the height variations (y) to a prescribed maximum/minimum at fixed intervals (x) along the barrier. Nine different random edges provided a range of 9–37 mm in x and 5–18 mm in y. An electric spark and a 1/8 inch B&K condenser microphone were used, respectively, as the sound source and receiver. The frequency range of the measurements is 5–21 kHz, and the Fresnel number range is 2–20. The insertion loss for a random-edged barrier was found to be up to 3–8 dB better than that for a straight edge. For a few cases, however, the straight-edged barrier was better. Using statistical analysis, an empirical relationship was found for the random-edged barrier which defines the insertion loss as a function of the Fresnel number, the random height variation and the horizontal interval.

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Friday, October 13, 1995

4:00 p.m. ETC 4.120

by

Kenneth Gallia

Physics Department
The University of Texas at Austin

Acoustical Tracking of Supersonic Projectiles

A method for acoustically tracking airborne supersonic projectiles is discussed. An array of transducers is used to detect the shock wave generated by the passage of a supersonic projectile. The time of arrival of the shock wave at each sensor is recorded. For properly arrayed sensors, the arrival times form a unique fingerprint of the projectile's trajectory. Using a model of the projectile's attached shock wave, we can determine the projectile's trajectory, instantaneous velocity, and time of arrival at a virtual plane. Other variables which can be measured include the local small signal sound speed and wind velocity. Simultaneous tracking of multiple projectiles in an array may also be possible.

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Friday, October 20, 1995

4:00 p.m. ETC 4.150

by

Tom Kite

Electrical Engineering Department
The University of Texas at Austin

**The Evolution of Cinema Sound:
From Silent Movies to Dolby Stereo Digital**

The last fifteen years have seen an enormous improvement in the quality of sound recorded on film, with Dolby Stereo becoming the standard distribution format. Magnetic audio, with four and even six tracks, was the system of choice until the introduction of Dolby Stereo in 1976, which enabled four channels of audio to be encoded cheaply on two optical tracks. A proprietary decoder installed at the projection site restored the original four channels.

Improvements in compression technology and the availability of cheap, powerful digital signal processors have led to three new digital sound formats: SDDS, DTS, and Dolby Stereo Digital. All use perceptual coding to reduce the bit rate while encoding multiple audio channels. The Dolby system is unique in placing the digital data between the sprocket holes of the film, rather than on a CD-ROM synchronized with the movie.

There will be a demonstration of a Dolby Stereo encoder by two undergraduate students who are building a digital encoding and decoding system for their senior project.

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Friday, October 27, 1995

4:00 p.m. ETC 4.150

by

Steven Younghouse

Mechanical Engineering Department
The University of Texas at Austin

A Basic Introduction to Modern Recording Techniques

Although recorded music has become an integral part of our culture, most people do not know about the methods and equipment used to make a professional recording. The layman might say that some sort of "studio magic" is used to produce the album in a room full of complicated equipment. Of course, in truth there is no magic. A good recording is the result of careful work on the parts of the producer, studio engineers, and musicians, along with the help of the proper equipment.

It is the aim of this seminar to provide some sense of what takes place in the modern recording studio. The speaker will start with a description of the chain of processes involved in making an album, and will then discuss the difficulties encountered at each step. The history and future of music recording will also be briefly discussed.

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Thursday, November 2, 1995

3:00 p.m.   ETC 4.120

by

Dr. Won-Kyu Moon

Mechanical Engineering Department

Modeling of Piezoelectric Transducers for Design

The thermal variable is successfully included into a model for the piezoelectric thickness vibrator by use of the bond graph approach. In the process of developing this model, a proper thermodynamic material property model of piezoelectric ceramics is developed from the data in the publications, and the effects of the thermo-electro-mechanical coupling are evaluated. Then, the partial differential equations for the piezoelectric body, including thermal effects, are derived. From those partial differential equations, the thermodynamic thickness vibrator is newly defined. After a bond graph model for the one-dimensional thermal conduction is developed for the thickness vibrator including thermal effects, the final complete model is correctly developed. Finally, the results of the developed model are compared with the results from experiments.

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Friday, November 3, 1995

4:00 p.m. ETC 4.120
(note room change)

by

Won-Suk Ohm

Mechanical Engineering Department

Numerical Simulation of Noise Reduction by an Irregularly-Edged Barrier

The performance of an irregularly-edged barrier is investigated numerically. The main motivation of this work is Steve Ho's model experiment on an irregularly-edged barrier (reported in a recent acoustics seminar). The simplest case of a plane N wave normally incident to a thin rigid barrier is considered. The numerical code implements a Green's function solution to obtain the pressure time waveform and insertion loss at the receiver. The comparison between a straight-edged barrier and an irregularly-edged barrier is done in terms of their insertion loss. Future work will include the modification of the code to accommodate the incidence of a spherical N wave. A quantitative verification of Kurze and Anderson's formula will also be performed.

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Friday, November 10, 1995

4:00 p.m. ETC 4.120

by

Penelope Menounou
Mechanical Engineering Department

Edge wave on axis behind a disk or aperture having a random edge

The Helmholtz-Kirchhoff intergral is used to predict the edge wave on axis behind a disk (or an aperture) that has a ragged edge. The ragged edge is modeled as being made up of N arcs of equal angle but differing radii r_i. The on-axis edge wave is thus a sum of N scattered signals. A formula has been derived for the edge wave rms pressure, in terms of N and the incident wave's rms pressure and autocorrelation function. The formula has been evaluated for incident waves that are sinusoidal, random (noise), and transient. The calculations agree reasonably well with M.Bailey's underwater measurements made with a spark source and various apertures and disks.

and

Michael Bailey
Mechanical Engineering Department and
Applied Research Laboratories

**Intensified cavitation produced with
pressure release and rigid ellipsoidal reflectors**

An underwater bubble grows in response to a strong negative acoustic pulse and then collapses because of inertial forces. An auxiliary positive pulse, delayed to arrive after collapse begins, is shown numerically and experimentally to intensify the collapse. The negative-then-positive pulse sequence is produced by two ellipsoidal reflectors, each with an electrical spark at its near focus f_1 and aimed so that they share a common second focus f_2. The negative pulse is produced by a polyurethane (pressure release) ellipsoid, the positive by a brass (rigid) ellipsoid. A timing circuit triggers the sparks to select the delay between the pulses. Ways of measuring cavitation will be discussed.

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Friday, November 17, 1995

4:00 p.m. ETC 4.120

by

William A. Englblom

Aerospace Engineering and
Engineering Mechanics Department

The Acoustics of High Speed Flow Over a Blunt Body with a Forward-Facing Cavity

There is substantial interest in increasing the flight speed of kinetic energy anti-armor penetrators. Unfortunately, in the range of interest (Mach 6 to 12), it is expected that the aerodynamic heating of nose regions of these tungsten rod penetrators causes ablation. There has been speculation that introducing an axial cavity in the nose region may reduce stagnation point heating.

The main objectives of this research are 1) to describe and model the acoustics involved, and 2) to determine how surface heating rates are affected by the presence of the cavity. The investigation is performed numerically (using a commercial CFD code) and experimentally (using a Mach 5 blowdown tunnel and a quiet Mach 4 Ludweig tube).

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Monday, December 4, 1995

3:00 p.m. ETC 4.120

by

Monica Obermier

Electrical Engineering Department
The University of Texas at Austin

Energy Density Measurement in a Reverberation Room

Accurate acoustical measurements in a reverberant enclosure are very important for applications which range from determining the sound power output of noisy machinery to measurement of the sound transmission loss of partitions. The sound power can be determined by measurement of the sound pressure and the particle velocity. A data acquisition system that measures total energy density in a reverberation room has been developed. The system digitizes the signals received from a microphone array transducer and determines the sound power from the acoustic pressure and particle velocity. The theoretical considerations necessary to measure acoustical energy density in a reverberation room will be presented. The techniques for energy measurement and calibration will be discussed, and preliminary results will be presented.

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Friday, December 8, 1995

4:00 p.m. ETC 4.120

by

Philippe Blanc-Benon

Centre Acoustique, Ecole Centrale de Lyon
Lyon, France

Acoustic Wave Propagation through Turbulent Fields: Experiments and Numerical Simulations

One of the most interesting features of sound is that its propagation characteristics are greatly influenced by the medium through which it travels. Through the processes of convection, refraction and scattering, acoustic waves may be bent, attenuated, or amplified. Even if the turbulent fluctuations of the medium are weak, the cumulative effects over long distnaces may be great, and the acoustic waves may be incoherent. In this presentation we will illustrate these effects using laboratory experiments or numerical simulations.

In the experiments we focus on the intensity fluctuation measurements. We present data for the scintillation index, the probability distribution of the intensity and the transverse correlation function. The measurements cover the whole regime from weak to strong scattering and are compared with the theoretical predictions of the literature.

In the numerical simulations we describe a technique to introduce the turbulence in the modeling of acoustic wave porpagation taking into acount both mean gradient effects and impedance boundaries. Illustrations will be given for atmospheric propagation. We will address the question of the multi-saclar and vectorial random inhomgeneities.