ACOUSTICS BROWN BAG SEMINAR

Nonlinear Acoustics and Radiated Noise

by Alex Garcia

There are a million stories in that big place they call The University. Some of them are about people making a living from the peculiar way the density of water changes when it is compressed. This is one of those stories.

It's about a handful of men who measured the directivity pattern of a low frequency transducer using the sound scattered from a high amplitude, high frequency sound beam, called the pump. Not only that but they placed the pump so close to the transducer that most of the sound-sound interaction region was in the nearfield of the transducer! It is also the story of one man who tried to explain their results.

This talk is rated **PG-13** (a few brief scenes of mathematical gore). Non-acousticians are urged to attend as the speaker is not an acoustician and will otherwise feel intimidated.

WEDNESDAY, JANUARY 16
NOON-1:00
ETC 4.120

Students and Faculty Welcome

ACOUSTICS BROWN BAG SEMINAR

Hydrodynamic Instabilities and Chaos in Flow between Rotating Cylinders

by Dr. Randall Tagg
Research Fellow
Department of Physics

Fluid flow between coaxial rotating cylinders presents a problem rich in ways to test our understanding of the dynamics of systems governed by nonlinear equations. A review will be given, from an experimentalist's point of view, of the instabilities which occur in this flow geometry and of the quantitative methods used for comparison to the theory of hydrodynamic stability and to numerical simulation. The use of experimental data in recently developed techniques for quantifying chaotic motion will also be discussed.

WEDNESDAY, JANUARY 30, 1985
NOON-1:00 p.m.
ETC 4.120

Students and Faculty Welcome

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS BROWN BAG SEMINAR

General Theory of Acoustic Horns

by James McClean

In 1951, Dr. A. F. Stevenson published a landmark paper in which he put forth a general theory of electromagnetic wave propagation in horns. He also published a companion paper in which he briefly outlined how this theory might be applied to acoustic horns. However, this paper was not nearly as widely read.

This seminar consists of a presentation of Stevenson's theory as it applies to the acoustic horn. This theory predicts a system of coupled modes which can be exactly described by an infinite set of linear differential equations. Approximations to the exact theory and the consequent errors will be discussed. Finally, it will be shown that if coupling is neglected and only the lowest order mode is considered the exact theory simplifies to the well known Webster equation.

WEDNESDAY, FEBRUARY 6
NOON-1:00
ETC 4.120

Students and Faculty Welcome

ACOUSTICS BROWN BAG SEMINAR

An Experimental Investigation of Acoustic Propagation in Saturated Sand with Variable Fluid Properties

by Dan Costley

The Biot-Stoll theory describes the propagation of acoustic waves in a saturated, unconsolidated porous medium. The expressions for the attenuation and phase velocity derived from this theory depend explicitly on the viscosity, density, and bulk modulus of the pore fluid. An experiment has been designed to determine the dependence of attenuation and phase velocity on these properties of the pore fluid. The phase velocity and attenuation of compressional waves were measured using a mixture of water and glycerine as the interstitial fluid. A review of the experimental procedure and the results will be presented, together with comparisons with the Biot-Stoll theory.

WEDNESDAY, FEBRUARY 20
NOON-1:00
ETC 4.120

Students and Faculty Welcome

ACOUSTICS BROWN BAG SEMINAR

Diffusion Waves in a Particulate Suspension -
A Model for Blood Sedimentation

by A. Bedford
ASE-EM Department and
Applied Research Laboratories
The University of Texas at Austin

Although the classical diffusion equation is parabolic, in certain mixture models for the motion of particles in a fluid the equations of motion are hyperbolic and predict a phenomenon that can be called a "diffusion wave." A description of such a model will be given. It will be shown that including diffusive effects (such as Brownian motion) in the model causes the equations to be hyperbolic and also leads to the prediction that the state of steady sedimentation is stable under small disturbances. Numerical solutions obtained from the model will be compared with cell concentration profiles measured during sedimentation of human whole blood. Recent results on acceleration waves in particulate suspensions will also be described.

WEDNESDAY, FEBRUARY 27
NOON-1:00
ETC 4.120

Students and Faculty Welcome

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS BROWN BAG SEMINAR

Using Ultrasonic SH-Waves to Estimate the Quality of Adhesive Bonds in Plate Structures

by C. H. Yew

A method using SH-waves to estimate the quality of an adhesive layer in a bonded plate is discussed in this talk. A mathematical analysis of SH-wave motions in a bonded plate consistent with the experimental arrangement was carried out in full. We have found that the cut-off frequency of the second mode waves in the plate is dependent upon the thickness and the mechanical properties of the adhesive layer, and the waves in the plate resonate at this frequency. This wave resonating phenomenon was used in the experimental determination of the property of the adhesive layer.

An experimental verification of the method was carried out using adhesives of several different properties. We have demonstrated that the resonant frequency of the second mode wave in the plate is dependent upon the moduli and thickness ratio between the adhesive layer and plate as predicted by the analysis.

WEDNESDAY, MARCH 6
NOON-1:00
ETC 4.120

Students and Faculty Welcome

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS BROWN BAG SEMINAR

Higher Order Finite Amplitude Modes in a Rectangular Waveguide

by Mark F. Hamilton

Finite amplitude propagation of higher order modes in a rectangular waveguide is analyzed by decomposing the modes into plane waves. Two types of nonlinear interactions may then be considered. The self interaction of an individual plane wave generates harmonics that propagate in the same direction. Such interactions are unaffected by dispersion because each harmonic propagates at the same speed, although in a different mode. The second type includes noncollinear interactions between plane waves. In this case geometric dispersion prevents efficient transfer of energy between the interacting components.

A single transverse mode excited at a frequency not far from cutoff is composed of two plane waves propagating in very different directions. The noncollinear interactions are then so highly dispersive that as a first approximation they may be ignored. The remaining, nondispersive interactions were modeled using a modified Burgers equation that accounts for tube wall absorption of each mode. Theoretical results for this case agree well with experiment. Second order dispersive interactions characterized by spectral components that oscillate in space were also measured and shown to agree very well with theoretical predictions.

WEDNESDAY, MARCH 20
NOON-1:00
ETC 4.120

Students and Faculty Welcome

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS BROWN BAG SEMINAR

Dry Runs for Presentations at the
109th Meeting of the Acoustical Society of America

Transient Response of an Electret Microphone

by Whang Cho

A PVDF Touch Sensor for Robotics

by Mark Chang

An Electret Touch Sensor

by Don Voron

Measurements of Harmonics Generated by Finite Amplitude
Sound Radiated by a Circular Piston in Water

by Thomas L. Riley

WEDNESDAY, APRIL 3
NOON-1:00
ETC 4.120

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS BROWN BAG SEMINAR

Acoustic Intensity by Intuition

by J. E. White

Visiting Professor of Geophysics
Colorado School of Mines

For a plane sinusoidal acoustic wave, we know that average intensity is directed perpendicular to the wave front and uniform in magnitude. For two identical plane waves at right angles, intensity must be directed at 45° and be increased by $\sqrt{2}$. Wrong! For a standing wave, we realize that average intensity is zero. For two standing waves at right angles, the average intensity must surely be zero. Wrong again! Measurements in a 4-ft by 8-ft enclosure confirmed the circulating flow of energy which can exist. In an elastic solid, average intensity is perpendicular to the wave front for both compressional and shear plane waves. When a plane shear wave and a plane compressional wave at the same frequency travel in the same direction, one would expect the direction of average energy flow to be perpendicular to the wave fronts. Actually, the direction of average intensity as a function of distance oscillates about the perpendicular. It is clear that intuition based on linear theory may lead one astray when applied to a nonlinear phenomenon like intensity.

WEDNESDAY, APRIL 24
NOON-1:00
ETC 4.120

THE UNIVERSITY OF TEXAS

AT AUSTIN

Department of Mechanical Engineering

ACOUSTICS SEMINAR

Thursday, September 12, 1985

3:30 p.m. ETC 4.120

by

Rick Bailey

The University of Texas at Austin
Applied Research Laboratories
and
Department of Electrical Engineering

ROUGH SURFACE ACOUSTICAL SCATTERING

This study represents an inverse problem approach to rough surface acoustical scattering, the objective being to infer certain statistical characteristics of a randomly rough surface directly from the coherently scattered pressure field. Eckart's physical-acoustical scattering model is applied to derive relationships for the probability density function and correlation function of surface heights which can be inferred directly from the scattered pressure field. Signal processing techniques are used to obtain estimates of the probability density function and correlation functions from experimental data. The experimental measurements are made of the steady state complex scattered pressure field from a single frequency small beam width source incident upon a pressure release model rough surface. Comparisons are made between the characteristics inferred from the scattered pressure and the actual surface characteristics.

ACOUSTICS SEMINAR

Tuesday, September 17, 1985

3:30 p.m. ETC 4.120

by

Wayne M. Wright

Department of Physics
Kalamazoo College
Kalamazoo, Michigan

THERMOACOUSTICS IN AIR: SOUND GENERATED BY THERMAL MEANS IN A GAS-FILLED CYLINDRICAL RESONATOR

Thermally generated sound may be significantly enhanced by producing it in an enclosure which has a normal mode at the frequency of interest. A small gas-filled cylindrical container and a line thermal source are used to study the frequency response and efficiency of coupling energy into the acoustic field for axisymmetric modes. An alternating current in a thin, straight wire parallel with the container axis serves as the source of the acoustic waves. A similar system of current technological interest is the resonant optoacoustic spectrometer, for which a modulated lasar beam serves as the thermal line source.

ACOUSTICS SEMINAR

Thursday, September 26, 1985

3:30 p.m. ETC 4.120

by

Ronald L. Panton

Department of Mechanical Engineering
The University of Texas at Austin

INTERACTION OF A ROW OF HELMHOLTZ RESONATORS WITH TURBULENT BOUNDARY LAYER

The turbulent flow in a boundary layer can excite acoustic oscillations in a Helmholtz resonator imbedded in the wall. Under certain conditions of timing between the flow and the resonator an extra strong excitation occurs. This seminar will review what is known about this situation and speculate on the back interaction of the acoustic motion upon the turbulent fluid motions. It may be possible to use this mechanism to control the boundary layer in a beneficial way.

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS SEMINAR

Thursday, October 3, 1985

3:30 p.m. ETC 4.120

by

David A. Nelson

Tracoustics Acoustic Systems
Austin, Texas

STATISTICAL ENERGY ANALYSIS (SEA):

THEORY VS. THE REAL WORLD

The speaker has recently descended from the fog-shrouded mountain citadels of theoretical acoustics to the arid plain of nuts and bolts, brute force "acoustical engineering." The tension between these two extremes is exemplified in the speaker's attempts to provide a method, based on SEA, for predicting the transmission loss of as-yet unbuilt sound isolating panels. In this talk, basic explanation of SEA is followed by a rather sobering comparison of the prediction obtained with real world measurements. Several types of panel materials and structures (single wall, double wall, double wall with absorption, etc.) are considered.

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS SEMINAR

Thursday, October 10, 1985

3:30 p.m. ETC 4.120

by

David Lindberg

Physics Department
The University of Texas at Austin

ROUTES TO CHAOS IN CHEMICAL SYSTEMS

Chemical systems display a wide range of behaviors, including periodic and chaotic oscillations. The Belousov-Zhabotinsky reaction, the most studied chemical reaction giving chaos, will be used to present several routes to chaos. Routes to chaos presented will include the period doubling cascade, the universal sequence, the periodic-chaotic sequence, and motion on a torus.

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS SEMINAR

Thursday, October 17, 1985

3:30 p.m. ETC 4.120

by

Dennis Wilson

Mechanical Engineering Department
The University of Texas at Austin

THE FORMATION AND PROPAGATION OF

INTENSE PRESSURE PULSES IN WATER

This research is concerned with a theoretical investigation of intense pressure pulses in water. These pulses are due to the bow and recompression shocks created by a projectile which is fired from an electromagnetic rail gun. The velocities are on the order of 10 km/s and the associated overpressures are 10,000 atmospheres.

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS SEMINAR

Thursday, October 24, 1985

3:30 p.m. ETC 4.120

by

Mark F. Hamilton and **James A. TenCate**

Department of Mechanical Engineering
The University of Texas at Austin

Noncollinear Finite Amplitude Acoustic Interactions in a Waveguide

The noncollinear interaction in a rectangular duct of finite amplitude sound waves propagating in higher order modes is investigated both theoretically and experimentally. The theory predicts spatial oscillations in the nonlinearly generated sound field due to dispersion, and a coefficient of nonlinearity that depends on the angle at which the interacting waves intersect. Experimental results are reported for the interaction of waves in the (0,0) and (1,0) modes in an airfilled rectangular duct. Alternative formulations of the wave equation will be used to demonstrate the importance of imposing the proper boundary condition at the source.

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

HAMILTON

ACOUSTICS SEMINAR

Thursday, October 31, 1985

3:30 p.m. ETC 4.120

James McLean

Department of Electrical Engineering
The University of Texas at Austin

N-PORT NETWORK THEORY APPLIED TO COMPOSITE HORN/DRIVER SYSTEMS

In recent years, the thrust in acoustic horn loudspeaker design has shifted from impedance matching and power transfer to radiation pattern control. Although the two criteria are not completely incompatible with one another, horn designs which satisfy both are complex and have yet to be perfected. The major difficulty in designing such horns is the lack of a method by which composite acoustic waveguides may be analyzed. Fortunately, the two-port theory underlying microwave waveguide system design is fairly well developed. This theory allows approximate analysis of waveguide discontinuities and tapers in composite microwave waveguide systems. In recent years, this theory has been extended to an N-port analysis using coupled transmission lines which allows accurate analysis of systems in which mode conversion occurs and multiple propagating modes exist. We are in the process of borrowing this theory almost intact from an obscure book published in West Germany so that hopefully everyone will think we thought of it ourselves.

Although, the N-port theory has yet to be implemented, the two-port theory has yielded some interesting predictions which are in disagreement with those published in several well-known books. We plan to present experimental data which will hopefully justify our predictions.

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS SEMINAR

Thursday, November 14, 1985

3:30 p.m. ETC 4.120

by

Corinne Darvennes
Department of Mechanical Engineering
The University of Texas at Austin

SPEED OF SOUND IN HIGH PRESSURE GASES

Many noise control problems remain unsolved because the values of the speed of sound in real gases are lacking. In the low pressure limit, the perfect gas approximation can be used. At higher pressures, a good estimate is provided by a 2-parameter model derived from Dieterici's or Vander Waal's equations of state.

THE UNIVERSITY OF TEXAS
AT AUSTIN
Department of Mechanical Engineering

ACOUSTICS SEMINAR

Thursday, December 5, 1985

3:30 p.m. ETC 4.120

by

C. T. Tindle

Applied Research Laboratories
on leave from
University of Auckland
Auckland, New Zealand

NORMAL MODE PROPAGATION IN A WEDGE

Exact theoretical descriptions of acoustic propagation in shallow water are restricted to horizontally stratified situations. There are no exact descriptions for propagation over a sloping bottom.

Experimental measurements have been made in an indoor tank. Individual, low order normal modes can be excited by a line source.

Results show that propagation takes place as "wedge modes" which are similar to normal modes for constant water depth but their wavefronts are curved to suit the geometry of the wedge. The wavefronts are arcs of circles centered on a wedge apex.

Background theory and experimental results will be described.