Experimental Detection of a Slow Acoustic Wave in Sediment at Shallow Grazing Angles

Wednesday, January 30, 1991 4:00 p.m.

Frank A. Boyle and Nicholas P. Chotiros
Applied Research Laboratories
The University of Texas at Austin

Following recent experimental results at sea that suggest the existence of a previously undetected type of acoustic wave in sandy sediments, an experiment was designed to detect and measure the speed of acoustic waves in an isolated environment. The experiment was conducted in a laboratory tank containing lm of unwashed river sediment under a 3m water column. Observations were made of the travel time and attenuation of a pulse from an acoustic source located above the water-sediment interlace to a set of probes below the interface. It was observed that, at normal incidence the pulse travelled at about 1750 m/s, while at shallow grazing angles, the pulse travelled through the sediment at close to 1200 m/s. An interesting possible explanation exists in the Biot model, which predicts a slow acoustic wave in porous materials.

Measurement of Sediment Transport Using Acoustics

Friday, February 8, 1991 4:00 p.m.

Peter D. Thorne
Birkenhead, Merseyside, U.K.

The measurement of sediment transport is a critical parameter in marine studies. It has traditionally been difficult to accurately quantify, and recently acoustics has been applied to solve this problem. To monitor the bedload transport of marine gravels, caused by turbulent tidal currents, investigations have utilized sediment generated noise, SGN, arising from the interparticle collisions of mobile material. The present work describes the origins of the sound source and the application to sediment studies in the marine environment.

Experimental Results with a High Efficiency Siren for High Intensity Acoustic Applications

Friday, February 15, 1991 4:00 p.m.

Bart Lipkens
Graduate Student
Mechanical Engineering Department
The University of Texas at Austin

The application of high intensity acoustics to several energy-related processes has recently experienced much renewed interest. Acoustic levels of 150 to 160 dB appear to be required at frequencies in the 1000-3000 Hz range. In a traveling wave field a 160 dB sound pressure level requires an intensity level of 1 $Watt/cm^2$ for atmospheric conditions. The large cross-sectional area ducts needed in such applications require the efficient generation of acoustic power since often many kilowatts of acoustic power are required. Overall efficiencies have to be much higher (10 to 50%) than was the experience in the past in order to make these processes economically viable. Experimental results show that rotational sirens can successfully be operated at high efficiencies.

Seismo Acoustics at the Saclant Undersea Research Laboratory, La Spezia, Italy

Friday, February 22, 1991 4:00 p.m.

Dr. Tom Muir
Applied Research Laboratory
The University of Texas at Austin
Assigned to SACLANTCEN, 1986-89

In order to support ocean acoustic modeling and sonar performance prediction, it is necessary to acquire geoacoustic data on the sediment structures. The direct measurement of shear wave velocity and attenuation within the sedimentary volume is a difficult and time consuming process. More rapid, remote measurements involving inversion techniques are evolving, but their evaluation requires “ground truth” data obtained by direct measurements. A comparison of various “in situ” methods used at SACLANTCEN is presented to illustrate the development of testbed sites where ground truth data is obtained. Comments on living and working in Italy are made with a color slide show. The continuation of this work at The University of Texas (ARL and Dept. of Civil Engineering) is previewed.

Focused Acoustic Pulses and Renal Stone Fragmentation

Friday, March 8, 1991 4:00 p.m.

Dr. C. L. Morfey
Institute of Sound and Vibration Research,
Southampton, United Kingdom

Acoustical aspects of extracorporeal shock-wave lithotripsy (ESWL) will be outlined, with emphasis on simple time-domain models. ESWL is a clinical procedure now in routine use: it involves short-duration acoustic pulses (time scale of order 1 to 5 μs), which are focused onto a target (typically a kidney stone) within the body. Peak pressures within the target area are of order 50 MPa (500 bar). In order to achieve safer and more effective treatment, better acoustical understanding is required of: (1) the focusing process, and (2) the stone fragmentation mechanism.

Edge Effects in Reverberation Room Sound Absorption Measurements

Friday, March 22, 1991 4:00 p.m.

David Nelson
Acoustic Systems Acoustical Research Facility
Austin, Texas

The “edge effect” is a natural consequence of sound absorption measurements in reverberation chambers, which comes about because the reverberant sound field is diffused everywhere except directly over the specimen. The effect causes inflated sound absorption coefficient readings which are often in excess of 1.00, as if the plan area of the test specimen had mysteriously increased. As a mystery the diffraction effect is at best an annoyance. If the effect were reliably quantified, however, the effective area increase could be used to optimize (on the basis of cost of performance) the amount of sound absorption used in a particular treatment. In this study, we have quantified diffraction effects using a simple empirical model based on the results of two ASTM C423 sound absorption tests performed on different size specimens of the same material. The result is a reliable determination of both a “radius of influence” and an estimate of the random incidence sound absorption independent of the diffraction effect.

Dispersion Relations for Acoustics Revisited

Friday, March 29, 1991 4:00 p.m.

Dr. Thomas Griffy
Department of Physics
The University of Texas at Austin

At a previous acoustics seminar (October 29, 1990) the application of dispersion relations to acoustic propagation was discussed. Some of the results presented at that time and some of the papers on which the presentation was based, were wrong. We will try again.

Active Control of the Forced Response of a Finite Beam

Friday, April 5, 1991 4:00 p.m.

John T. Post
Department of Electrical and Computer Engineering,
The University of Texas at Austin

and

Richard J. Silcox
Structural Acoustics Branch, Mail Stop 463,
Acoustics Division, NASA/Langley Research Center,
Hampton, VA 23665

With the trend towards lighter weight for aerospace structures, the need to control the vibrations of operational aerospace vehicles such as aircraft, space stations, radio telescopes and solar panels grows more important. Vibrations in these structures may result in reduced performance, noisy interiors or even structural failure. A novel approach to vibration reduction, made possible by advances in the digital computer, is active control. This technology utilizes additional force inputs to reduce the undesired disturbances. Clearly, it is of great interest to understand the maximum reduction possible, and the limiting mechanisms, before attempting more specific, practical implementations that include limitations of the control system itself. This talk explores the theoretical limit on reducing transverse vibrations in a simply-supported, finite beam. Both steady state and random excitations will be considered.

Shockwave Stability in Compressible Fluids

Friday, April 12, 1991 4:00 p.m.

Dr. Ethan T. Vishniac
Department of Astronomy
The University of Texas at Austin

The impulsive release of energy into a fluid gives rise to a spreading discontinuity (shock) whose behavior is usually observed to be quite regular. However, it can be shown that if the post-shock density is sufficiently large, then the shock wave will give rise to a broad, turbulent flow. In this talk I will explain the linear stability theory for shock waves under a variety of circumstances. I will also discuss the application of this work to laboratory experiments and astronomical observations.

Overshoot Effect in Auditory Masking

Friday, April 19, 1991 4:00 p.m.

Dr. Dennis McFadden
Department of Psychology
The University of Texas at Austin

There is a phenomenon in auditory masking that has traditionally been viewed as a manifestation of an adaption-like effect in the auditory system. If a brief tonal signal is presented within a couple of milliseconds of the onset of a broadband masking noise, it can be 10-20 dB less detectable than if its onset is delayed by about 150 ms from the onset of the masking noise. This effect, known as overshoot, has an apparent parallel in the firing patterns of primary auditory neurons. Thus, that neural pattern has long been taken as the explanation for overshoot. Craig Champlin and I have shown that the overshoot effect can be greatly reduced or eliminated by exposure to intense sound or by moderate doses of aspirin, and this reduction comes in a paradoxical manner. Detectability in the short-delay overshoot condition improves following exposure or aspirin, even though these agents make hearing worse in the quiet. The implications of these paradoxical findings for the traditional explanation for overshoot will be discussed, and overshoot will be demonstrated.

Propagation of Sound Over a Curved Surface of Finite Impedance

Wednesday, April 24, 1991 4:00 p.m.

Dr. James A. Kearns
Applied Research Laboratories
The University of Texas at Austin

As part of a program to understand key aspects of long range propagation of sound over irregular topography, an investigation was made of the diffraction effects which occur near the top of hills and ridges. This investigation evolved into a study of the diffraction of a high frequency plane wave due to its grazing of a two-dimensional curved surface of finite impedance. Laboratory scale models were constructed and measurements were made of the field on, above, and behind either of two curved surfaces possessing distinctly different impedances. The pressure waveforms associated with a transient acoustic pulse were simultaneously measured at a reference point and at a field point. The ratio of the discrete Fourier transforms provided an estimate of the insertion loss at the field point. The results of the measurements were compared with the predictions of a Matched Asymptotic Expansions theory. The predictions relied upon the experimental evaluation of the impedance of each surface at grazing angles of incidence. The comparison between the measurements and predictions clearly indicated that the theory gives an excellent description of the field anywhere near a curved surface.

Nonlinear Acoustic Wave Propagation in a Pekeris Waveguide

Thursday, September 19, 1991 1:00 p.m.

Carl Bruch
Department of Physics
The University of Texas

Although acoustical media are often stratified, either continuously (e.g., via sound speed gradients) or with discrete but penetrable layers, finite amplitude effects in stratified media have been all but ignored. By channeling the sound, however, stratification can maintain high acoustic intensities over long propagation distances.

The small signal propagation of sound in shallow water is frequently analyzed on the basis of the Pekeris waveguide model. A Pekeris waveguide consists of a layer of water that is bounded above by a vacuum and below by a fluid half-space. The sound speed in the fluid half-space is greater than that in the water, which provides a necessary condition for total internal reflection, and thus guided wave propagation, within the layer.

Perturbation methods are used to investigate finite amplitude propagation of sound in a Pekeris waveguide. At first order, the classical linear mode shapes and dispersion relations are recovered. At second order, a quasilinear solution is derived for second harmonic generation in the layer. At third order, a nonlinear Schrödinger equation that governs the propagation of narrow-band pulses can be obtained [Zabolotskaya and Shvartsburg, Sov. Phys. Acoust. 33, 221 (1987)]. Finally, a recently constructed waveguide to be used for testing the theoretical predictions will be discussed.

Physical Acoustics and Relaxation

Friday, September 20, 1991 12:00 p.m.

Dr. Timothy S. Margulies
U.S. Nuclear Regulatory Commission
Washington, D.C.

The theoretical prediction of acoustic wave propagation in fluids is important for understanding medical diagnostic techniques, ocean and other geophysical transmission characteristics; as well as, for measuring physio-chemical properties of fluids, and for estimating equations of state. The purpose of this talk is to review extensions of the classical viscothermal problem of wave propagation in a single component Newtonian fluid to more general multi-component, and multi-phase materials where significant relaxation phenomena occur. The intent is to clarify the acoustic roles, thermodynamic bases, and theoretical development of several different types of relaxation phenomena for example stress, internal energy such as chemical, and particle-fluid interaction. Calculations and applied research activities related to sound absorption and dispersion in a variety of acoustical materials will be systematically discussed along with comparisons to available experimental measurements.

Research at the General Physics Institute in Moscow

Monday, September 30, 1991 3:00 p.m.

Professor E. A. Zabolotskaya
General Physics Institute
USSR Academy of Sciences
Moscow

This seminar will provide an overview of the history, structure, and research areas of the General Physics Institute of the USSR Academy of Sciences. The Institute is composed of 10 Departments (e.g., Wave Phenomena, Microelectronics, Solid State Physics, Plasma Physics, Optics), with the primary emphasis of its research in the field of laser physics (interaction with matter, generation of sound, fiber optics, etc.). Specific attention will be devoted to investigations in the field of acoustics.

A Broadband, Constant Beamwidth, Near Field Receiving Array or “No Hands” Cellular Phone

Monday, October 7, 1991 3:00 p.m.

Noel A. Adorno and E. L. Hixson
Department of Electrical and Computer Engineering
The University of Texas at Austin

A focused microphone array in the headliner of a car could provide a “no hands” cellular system microphone. The usually installed stereo could provide the receiver. The focal volume should remain constant with frequency for fidelity and good S/N ratio.

Farfield beamwidth control over an octave band using array processing has been successful. However, here we are in the near field and we need a decade (300-3000 Hz).

By combing the filtered outputs of three linear steered arrays and making some compromises, reasonably good focal area control was achieved. It was shown that another array perpendicular to the first can control the focal volume.

Digital signal processing was used to provide the time delays for focusing and the required filter functions.

Acoustical Characterization of Seafloor Sediments: Geoacoustic Description of Bubbly Sediment Samples

Monday, October 14, 1991 3:00 p.m.

Aubrey L. Anderson
Department of Oceanography
Texas A&M University

Remote sensing characterization of seafloor sediments with acoustic systems is a long standing goal of acoustical oceanographers. Recent results of measurements with side scan sonars and chirp sonars are encouraging. A major complication in the interpretation of such measurements is introduced when bubbles of free gas are present in the sea floor layers. Testing of theories for the acoustic response of bubbly sediments has been limited by available techniques for extracting information from bubbly sediment samples. Ongoing research in techniques for such description, including computed X-ray tomography (CT scanning) are described.

Sonic Boom Propagation Through an Inhomogeneous Windy Atmosphere

Friday, October 25, 1991 3:00 p.m.

Leick D. Robinson
Applied Research Laboratories
The University of Texas at Austin

One of the primary obstacles to NASA's proposed High Speed Civil Transport is the sonic boom produced by the aircraft. Features of the sonic boom that are of primary importance are the amplitude and rise time of the waveform received on the ground. A model capable of accurately predicting these values at the ground is required.

A computer model, called ZEPHYRUS, has been constructed which models sonic boom propagation. through a "real" atmosphere. The theoretical basis for this model is discussed. A number of physically interesting numerical results are presented, including the absence of stable shock formation.

Measurements of Nonlinear Effects in the Sound Field Radiated from a Circular Piston in Water

Monday, October 28, 1991 3:00 p.m.

James A. Ten Cate
Department of Mechanical Engineering
Applied Research Laboratories
The University of Texas at Austin

This talk is a "dry run" for a paper which will be given at the Acoustical Society of America Meeting in Houston, Texas, November 4-8 1991.

Experimental Study of the Effect of Turbulence on Rise Time and Waveform of Spark-Produced N Waves

Monday, October 28, 1991 3:30 p.m.

Bart Lipkens
Applied Research Laboratories
The University of Texas at Austin

This talk is a “dry run” for a paper which will be given at the Acoustical Society of America Meeting in Houston, Texas, November 4-8 1991.

Investigation of Sea Surface Roughness Using Scanning Laser Beams

Monday, November 11, 1991 3:00 p.m.

Dr. Konstantin A. Naugol’nykh
Andreev Acoustical Institute
USSR Academy of Sciences
Moscow

No abstract available.

A General Method for Determining Arbitrary Acoustical Impedances

Monday, November 18, 1991 3:00 p.m.

John Post
Electrical & Computer Engineering Department
The University of Texas at Austin

To study the throat impedance of a JBL constant directivity horn, a new acoustic impedance measurement system has been developed. This system will be presented along with supporting data from the horn measurements. Additional applications will also be discussed.

On the Use of Acoustic Cues to Aid Pilot Orientation

Monday, December 2, 1991 3:00 p.m.

D. C. Teas
KRUG Life Sciences, Inc.
and
Kent K. Gillingham
Armstrong Laboratory, Brooks AFB, TX

Spatial disorientation accounts for a substantial percentage of aircraft accidents and nearly all such accidents are fatal. Pilots also report experiencing disorientation during flight without losing control of their aircraft. When disorientation is recognized pilots can make their instruments read correctly and maintain proper flight control. When spatial disorientation is unrecognized a pre-condition for an aircraft accident exists. We have studied the possibilities for using acoustic signals to deliver information to pilots about the state of their aircraft. Our objective is to indicate aircraft orientation continuously rather than to provide warning signals. We will discuss the basis for our choice of continuously-variable, information-bearing acoustic signals to provide orientation combining and will describe some results from test flights.