Acoustics Seminar Abstracts 1986
University of Texas at Austin

Ray Theory Construction of Synthetic Seismograms for Ocean Bottom Reflected Acoustic Fields

Wednesday, January 29, 1986 4:00 p.m.

David Knobles
Applied Research Laboratories
The University of Texas at Austin

The mathematical aspects of applying classical ray theory to describe acoustic interaction with the seafloor are developed. An integral solution of the time independent wave equation for a point source is first developed. Stationary phase approximations are made on the bottom interacting contributions. In this way we obtain ray paths both reflecting off the surface of the sediment and penetrating into the sediment.

Signal Subspace Techniques for Dense Acoustic Array Processing

Wednesday, February 5, 1986 4:00 p.m.

T.L.Henderson
Applied Research Laboratories
The University of Texas at Austin

A narrowband approach to signal subspace processing of acoustical signals has been developed over the past several years. Recently, a broadband approach has been developed, requiring the use of dense arrays of hydrophones. Applications will be discussed, for example, acoustic remote profiling of the ocean bottom. Some unsolved problems will also be described.

Present Thoughts on Room Acoustics

Wednesday, February 12, 1986 4:00 p.m.

David McCandless, Jr.
The Joiner-Rose Group, Inc.

Looking back over almost 30 years of consulting in Architectural acoustics conjures up some insights to share and some questions to ask. Is acoustics an art or a science? How much does the jargon of acoustics confuse discussions of it? How do you establish the most appropriate acoustical design criteria? Why are the old concert halls still so good? Is open office planning here to stay? Has the quadratic residue diffuser a practical application? Using anecdotes about past projects and clients, and their influence on new work, we discuss these questions in a “retrospective look at where we’re going.”

Application of Ray Theory to Downward Propagation of Low Frequency Noise

Wednesday, February 19, 1986 4:00 p.m.

James A. Hawkins, Jr.
Applied Research Laboratories
The University of Texas at Austin

With the advent of large megawatt sized wind turbines has come an interest in the low frequency noise from the turbines . NASA has reported measurements of downwind propagation for very low frequency noise from a large wind turbine generator . The source height was 40 m , and ground measurements were taken out to 10,000 m . The noise was found to spread spherically near the source (out to 450 m) but cylindrically thereafter. We present ray theory calculations of the propagation loss for this experiment. Our computer program is adapted to the atmosphere from MEDUSA , a ray theory program developed for underwater sound. We assume a realistic ground impedance to calculate reflections at the ground and a logarithmic wind velocity profile to account for sound speed variation. Results for 8 Hz show that channeling caused by downwind refraction is responsible for the cylindrical spreading observed downrange of the source. Near the source, spherical spreading occurs because channeling has not yet been established. The results are in quantitative agreement with NASA's data.

Problems of Noise Control

Wednesday, February 26, 1986 4:00 p.m.

Jack Evans
Joiner-Rose Group, Inc.

There are two general classes of noise: loud and louder. Most engineers, architects, and faculty managers will encounter noise at some time in their careers. It is important to realize that most noise can be controlled by paying close attention to basic building and land planning techniques and taking other precautions. Noise control is not a magical art but a relatively new field of engineering and architecture. The speaker, a registered professional engineer in Texas and a noise and vibration control specialist, will discuss several aspects of noise and vibration control in the “real world”. Questions are invited.

The Effect of Shear Waves on the Reflectivity of the Seafloor

Wednesday, March 5, 1986 4:00 p.m.

Paul J . Vidmar
Applied Research Laboratories
The University of Texas at Austin

Typical marine sediments are rigid enough to sustain the propagation of shear waves. Reviewed in this seminar is the influence of shear wave coupling on the plane wave reflection coefficient of the seafloor. The following mechanisms are discussed:

§ Coupling of energy into shear waves at the surface of the sediment and the substrate beneath the sediment.

§ The effect of sediment shear waves on interface (Stoneley) waves.

§ Gradient driven coupling between shear and compressional waves.

Bispectral Analysis of Ocean Acoustic Noise Processes

Wednesday, March 12, 1986 4:00 p.m.

Gary R. Wilson
Applied Research Laboratories
The University of Texas at Austin

Although spectral analysis of time series is a useful tool in many areas, it has generally been limited to the power spectrum. The less commonly employed higher-order spectra (polyspectra) contain information about the time series that cannot be obtained from the power spectrum. The bispectrum, the next higher-order spectrum above the power spectrum, may be used to determine whether a time series is nonlinear or non-Gaussian. Recently, the application of bispectral analysis to ocean acoustic noise processes has demonstrated that in some cases ocean acoustic noise is nonlinear. In this seminar, the theory of polyspectra will be reviewed, and the results of a bispectral analysis of ocean acoustic noise will be discussed.

Beamforming Without Plane Waves

Wednesday, March 19, 1986 4:00 p.m.

Robert A. Koch
Applied Research Laboratories
The University of Texas at Austin

Practical applications of imaging (beamforming) techniques for inhomogeneous media require an assessment of the constraints imposed by the propagation environment. In this seminar the general features of such constraints will be illustrated with results for an ocean acoustic waveguide. A matched filter algorithm and a normal mode representation of propagation in the waveguide were used to construct an imaging processor (beamformer). The performance of the processor was simulated using acoustic receiver inputs predicted by a propagation model which was also based on normal modes. Constraints on receiver geometry, e.g., element spacing, and possible effects of environmental variability will be discussed.

Mechanisms of Hearing – Update 1986

Wednesday, April 2, 1986 4:00 p.m.

Craig Wier
Speech Communications
The University of Texas at Austin

Improved micro-manipulation techniques are revealing important new information about transduction mechanisms in hair cells. Following a brief review of the fundamentals of auditory-system anatomy, physiology and biophysics, the results of recent work on hair-cell behavior will be described.

Nonlinear Effects in Focused Sound Beams

Wednesday, April 9, 1986 4:00 p.m.

Timothy S. Hart
Department of Electrical Engineering
The University of Texas at Austin

The nonlinear behavior of focused sound beams is not completely understood. Past research has failed to examine situations in which the effects of both nonlinearity and diffraction are strong. Our technique involves the numerical solution of a parabolic nonlinear wave equation that accounts for nonlinearity, diffraction and absorption simultaneously. The algorithm has been modified for application to a focused finite amplitude sound beam.

Preliminary results of the technique -namely, predictions for the fundamental and second harmonic components of a moderately nonlinear and strongly diffractive beam- show very good agreement with prior theoretical and experimental research.

Review of Room and Duct Acoustics

Wednesday, April 16, 1986 4:00 p.m.

Christopher L. Morfey
The Institute of Sound and Vibration
Southampton, England

This tutorial lecture will look at the way modes are used to describe the linear acoustic response of ducts and rooms to sources of sound. Beginning with the unforced situation, first the propagation of duct modes (with respect to the axial coordinate) is discussed and illustrated with examples; second the same procedure is followed for room modes, with t as the propagation coordinate.

Sources of sound are then introduced via jump conditions in the propagation direction. In this way the apparently disparate problems of room and duct excitation are given a unified conceptual basis. Some awkward points in the classical (Morse and Bolt) treatment of room response are thereby avoided.

A Technique to Calculate Parametric Beam Patterns

Wednesday, April 23, 1986 4:00 p.m.

John Sample
Applied Research Laboratories
The University of Texas at Austin

Since it is relatively easy to integrate gaussian functions, it is tempting in certain cases to model complex sound sources as a superposition of gaussian functions. One such case is in the calculation of the parametric radiation associated with a noise source with a high-frequency pump mounted on it.

During the past summer Drs. Hamilton, Naze Tjøtta, and Tjøtta solved this case analytically for the paraxial region of a gaussian source with a gaussian pump. Their solution may be used to find the parametric radiation for more complicated sound sources (e.g., a piston) by modeling the source as a superposition of gaussian functions. The parametric radiation associated with each is calculated separately and superposed.

In this seminar four gaussian superposition models for a piston are compared by examining their near and farfield beam patterns. Preliminary results of the parametric radiation beam pattern are also given.

Acoustics in Mechanical Systems

Wednesday, October 8, 1986 4:00 p.m.

Dr. Mark Hamilton
The Department Mechanical Engineering
The University of Texas of Austin

A discussion of the role of acoustics in mechanical systems. Among the novel applications of acoustics are levitation, heat engines, particulate control, and microscopy. Special attention will be devoted to current research at UT in nonlinear acoustics.

Sound Generation by Magnetohydrodynamic and Joule Heating Mechanisms in a Fluid

Friday, October 17, 1986 12:00 p.m.

Stephen Schreppler
Applied Research Laboratories
The University of Texas at Austin

When an electrical current passes through a resistive fluid in the presence of a magnetic field, two mechanisms for sound generation are present. The interaction of the electrical current with the magnetic field results in the Lorentz force which acts on the fluid. If the current is time dependent, the Lorentz force (the magnetohydrodynamic sound mechanism) creates an acoustic disturbance. Joule heating is also associated with the passage of electrical current through the fluid. The heating, which results from the dissipation of electrical power, causes a perturbation of the fluid density and is thus another mechanism for sound generation. The unique properties of these mechanisms and results of experiments performed at the Applied Research Laboratories will be discussed.

Aerodynamic Generation of Sound The Movie

Friday, October 24, 1986 12:00 p.m.

Aerodynamic Generation of Sound, The Movie (44 minutes)
directed and produced by Sir James Lighthill and J.E. Ffowcs Williams for the US Committee for Fluid Mechanics Films

The study of sound produced by a variety of sources usually requires the use of well-calibrated microphones, accelerometers, and anechoic chambers. However, simulations of sound generation sometimes give a clearer understanding of the phenomenon. Since the ripple speed in a glass-bottomed tank filled with 5 mm of water is independent of frequency, the ripples in a tank simulate wave motion in air. In this film Lighthill and Ffowcs Williams use a ripple tank to demonstrate the characteristics of monopole, dipole, and quadrupole acoustic sources and their interactions.

Frequency Dependent Ray Theory

Friday, October 31, 1986 12:00 p.m.

Terry L. Foreman
Applied Research Laboratories
The University of Texas at Austin

Geometrical ray theory has proven to be a versatile and popular method for obtaining approximate solutions to the Helmholtz equation

$$\nabla^2\Psi + k^2\Psi = 0$$

in such diverse fields as optics and underwater acoustics. But ray theory suffers from several deficiencies, perhaps the most serious of which are the neglect of diffraction and the prediction of singularities at caustics. A modified ray theory is proposed in which the approximation giving rise to the deficiencies is avoided, with the result that the ray path trajectories become frequency dependent. Preliminary investigations based on numerical calculations of frequency dependent ray path trajectories have revealed ray paths which lack the multipathing characteristic of classical ray theory and otherwise differ strikingly from their classical counterparts, raising questions about the nature of the classical ray theory approximation.

Shock Waves in Astrophysics

Friday, November 21, 1986 12:00 p.m.

Ethan Vishniac
Astronomy Department
The University of Texas at Austin

The interstellar medium is constantly subjected to explosive accelerations from a variety of events ranging from stellar winds to supernovae. The kinetic energy imparted to the gas acts to counteract the gravitational force and modulates the rate of star formation. In this talk I will discuss how this large scale motion is changed into small scale random motions through shock instabilities and the implications for the dynamics of the interstellar medium.

The Spatial Structure of the Acoustic Signal Field near the Deep Ocean Bottom Due to a Near-Surface CW Source

Friday, December 5, 1986 12:00 p.m.

David Grant
Applied Research Laboratories
The University of Texas at Austin

The spatial structure of the acoustic signal field near the ocean bottom was investigated experimentally. A source near the ocean surface projected a CW tone as it moved along a radial path from a range of 40 km to within 2 km of a near-bottom vertical array of receiving hydrophones in a 2643 m deep ocean. The signal level at each hydrophone and the signal phase difference between consecutive pairs of hydrophones were measured as a function of source-receiver range. A technique for modeling the signal field spatial structure was developed that demonstrated those physical mechanisms that influence the signal field. It was found that, for short ranges, signal phase difference was dominated by a few eigenrays and that coherent interference among these rays was an important factor in describing certain aspects of the signal field. An application to receiving array beamforming was made in which it was shown that inhomogeneities in the spatial structure of the signal field led to degradation of array signal gain when standard delay-and- sum beamforming was done.