The Search for Nonlinearity in High-Amplitude Noise from Military Jets

Friday, January 18, 2008 4:00 p.m. in ETC 4.120

Professor Anthony A. Atchley
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The Navy is confronted with complaints about noise from flight operations in the vicinity of military air bases. The proposed relocation of F/A-18 squadrons from Florida to Virginia in 1997 set off a hailstorm of citizen complaints, public relations campaigns and lawsuits. A key problem is accurate assessment of the impact of the noise. Linear propagation theory has been used to predict aviation noise in communities. However, measurements made during static engine run-up tests of the F/A-18 indicate that the sound pressure level 20 m away from a high performance military jet can approach 150 dB (re 20 uPa). Levels this high warn that nonlinear propagation effects may important. In fact, our nonlinear acoustic propagation calculations based on Burgers' equation showed that nonlinear effects produce important changes in the noise spectrum at community distances. Nevertheless, when we began investigating high-amplitude jet noise in 2002, the idea that nonlinearity plays a role was hard to sell to the aeroacoustics community. Today, through the efforts of several research groups, this idea is reasonably well established and the debate has shifted to how nonlinearity changes the impact and perception of the noise. This presentation reviews the search for nonlinearity in high-amplitude jet noise: why earlier field and laboratory measurements of jet noise missed evidence of nonlinearity, the search for simple metrics that unambiguously indicate the presence and relative importance of nonlinear acoustic effects in jet noise propagation, the impact of nonlinearity on perception, and unanswered questions.

Challenges in Automotive Audio and Infotainment

Friday, January 25, 2008 4:00 p.m. in ETC 4.120

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Branded-audio suppliers are regularly challenged by automotive manufacturers to minimize cost. By creating and using intellectual property to overcome problems inherent with commodity audio systems, branded-audio suppliers are able to acquire new business and maintain profitability. The experience of the speaker as a systems engineer for the Bose Automotive Division is reviewed. Challenges of spatial imaging, component packaging, and user experience are discussed, and intellectual-property solutions proposed by multiple companies are presented.

Case Studies in Architectures for Noise Identification through Low Cost Microphone Arrays

Friday, February 1, 2008 4:00 p.m. in ETC 4.120

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Microphone phased arrays have been used for many years. For the most part, phased arrays have been used as a research tool to gain insight into noise sources and into the physical mechanisms causing the noise. Aeroacoustic testing capability in both anechoic and hard-walled facilities has grown tremendously over the last several years, with successful collection of noise source location and directivity data in a variety of experiments.

With the use of high-speed computers and microphone phased arrays, it is now possible to acquire acoustic data in closed-wall wind tunnels, and this has allowed noise measurements to be made early in the product design cycle. This, in turn, has enhanced the ability to incorporate low-noise designs into new products. Recent studies have compared and validated the use of newer and lower cost microphones in arrays. They are already being deployed in a range of applications such as aeroacoustics measurements in wind tunnels, fly-by tests of aircraft, pass-by tests on trains, consumer goods, and a variety of products.

This presentation will be an overview of how flexible modular instrumentation based on PXI (PCI eXtensions for Instrumentation), employing the latest software technology, is being used in making high precision noise measurements. Examples include systems used by NASA and Boeing to test aircraft noise-reducing technologies and the new Aeroacoustics Research Complex. In these applications, higher sampling rates, higher channel counts, increased dynamic range, and distributed architectures were needed in smaller packages.

Techniques for Measuring the Acoustical Properties of Musical Instruments

Friday, February 15, 2008 4:00 p.m. in ETC 4.120

Alex Mayer
The University of Music and Performing Arts
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http://www.bias.at/welcome_eng.htm

An important area within the diverse field of musical acoustics is the objective evaluation of musical instruments using basic principles of physical acoustics. For example, broadband measurement of the acoustic input impedance can provide valuable information on more subjective instrument parameters such as intonation, sound quality and playability for brass, string and wind instruments.

This seminar will focus on the Brass Instrument Analysis System (BIAS), a tool developed for musical instrument manufacturers at the Institute for Musical Acoustics in Vienna, Austria to measure broadband input admittance of brass instruments. In order to improve the quality of BIAS with respect to reproducibility, accuracy and measurement range, the properties of the BIAS measurement head must be

investigated and documented. Some preliminary results and challenges facing this investigation are discussed.

Development of Acoustical Specification for Hard Disk Drive Clicking Noise

Friday, February 22, 2008 4:00 p.m. in ETC 4.120

Quoc Nguyen
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Dell, Inc. Austin Design Center
Round Rock, Texas
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Recently Dell has seen a rise in noise complaints tied to HDDs, where the customer feedback indicates objection to a "clicking" sound. Dell therefore wished to develop a specification to capture customer objection to this sound. In this presentation, the Dell acoustical engineering team will demonstrate the process to develop and validate a new DD noise sound quality specification.

Micromachined Optical Diffraction-Based Sound and Vibration Sensors

Monday, March 3, 2008 10:00 a.m.

Dr. Neal A. Hall
Micro-Audio, LLC
Atlanta, Georgia

This presentation will summarize recent developments with micromachined microphones employing diffraction-based optical displacement detection. The approach has the advantage of providing high-displacement detection resolution of the microphone diaphragm, independent of device size and capacitance, creating an unconstrained mechanical and acoustical design space for the mechanical structure itself. Micromachined microphone structures with 1.5-mm-diameter polysilicon diaphragms and monolithically-integrated diffraction grating electrodes are presented in this work. Their architectures deviate substantially from traditional condenser MEMS microphones. These structures have been designed for a 20 kHz broadband frequency response and low levels of Brownian (i.e., thermal mechanical) noise. The rigorous experimental characterization of these structures to be presented indicates a diaphragm displacement detection resolution of 20 fm/sqrt(Hz) and a thermal-mechanical induced diaphragm displacement noise density of 60 fm/sqrt(Hz), corresponding to an A-weighted sound pressure level detection limit of 24 dB(A) for these structures. Modeling and characterization results lead to the projection of 15 dB(A) noise levels from subsequent prototyping efforts, thus approaching the threshold of hearing. For reference, such performance figures are characteristic of only the highest quality traditionally manufactured microphones available today, and which are roughly 100 times larger in size. The potential commercial impact of the technology will be highlighted with reference to design-win opportunities in the areas of hearing aids, acoustic instrumentation, and some medical device applications. Time permitting, possible future directions and applications in medical ultrasound imaging and scanning probe microscopy will be discussed.

Human Bioresponse to Whole-Body Vibration Underwater

Friday, March 21, 2008 4:00 p.m.

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

Whole-body vibration of humans has been studied extensively since the 1950s, and now a new application for this work is found in an underwater environment. In this seminar, the response of a swimmer or diver to a low frequency sound field is considered. Although the primary concern associated with the underwater sound field is lung injury due to the acoustic pressure, the sound field also has a particle velocity component. Interest has also been expressed in human bioresponse to the particle velocity, which is the main focus of this seminar. With a frequency range of 40 – 80 Hz, chosen to encompass measured lung resonances, the acoustic wavelength is long enough – tens of meters – that the body of a diver can be approximated as a lumped-element system. A diver who is neutrally buoyant will oscillate with the particle velocity of the sound wave and thus experience whole-body vibration.

The seminar focuses on two methods of understanding the effects of this whole-body vibration. The first involves extrapolation from vibration experiments and health standards for vibration exposure in air to the vibration due to the underwater sound field. While information on whole-body vibration below 40 Hz is abundant, it is scarce at the stated frequencies of interest. The second method uses lumped-element mechanical models of the human body to simulate the biomechanical response to the sound field. A model created by Henning von Gierke in 1971 is examined in detail and used to predict the effects of the sound field on the lung and surrounding organs. Preliminary conclusions from the model show that human bioresponse to the acoustic pressure of the sound field dominates the response due to particle velocity.

Recording Classical Music as an Exercise in Realistically Capturing an Acoustic Event

Friday, April 4, 2008 4:00 p.m.

John Hadden
CD Producer and Engineer
London, England
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The ultimate goal of a classical music engineer is to record a musical performance as realistically as possible, capturing the very subtle details of sound colors, onset transients and dynamics as well as the reverberation, reflections and diffraction of the sounds within an acoustic space. This seminar will focus on elements which contribute to that goal including equipment choice, microphone techniques, choice of venue, positioning of artists and microphones within the venue, and how these various elements can come together to achieve an artistic or aesthetic goal. Some consideration will be given to aspects of digital recording including sampling rates, bit-length, sample rate conversion and pcm versus dsd.

John Hadden has had more than 20 years experience as a freelance classical recording producer and engineer. His recordings appear on many labels, most notably Sony, Teldec, deutsche harmonia mundi, EMI/Virgin Classics and harmonia mundi usa. His recordings have won many international awards, amongst them the Gramophone Award (England), Edison Award (Netherlands), Cannes Classical Award (France), Echo Klassic prize of the German Phono Academy and Premio Internazionale del Disco Vivaldi Antica (Italy). After earning degrees in physics and computer science he undertook graduate studies in music at Washington University. Dissertation research on the history and playing techniques of early valveless horns took him from the U.S. to London, where he began performing professionally on baroque and classical horns. Gradually his interests shifted from performing to recording, an activity which uniquely draws on his technical and musical knowledge.

Three-Dimensional Geoacoustic Inversion of the New Jersey Shelf

Friday, April 11, 2008 4:00 p.m.

Megan S. Ballard
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The Pennsylvania State University
http://www.arl.psu.edu

Perturbative inversion, based on a linearized relationship between sound speed in the sediment and modal eigenvalues, is applied to data from the Shallow Water Experiment 2006. Data were collected by towing a low-frequency sound source out and back along radials, spanning a 90 degree angular sector, from a common receiver location. Range-dependent estimates of horizontal wavenumbers are obtained along each of the radials using high-resolution signal processing techniques capable of detecting and localizing changes in sub-bottom properties, and that are particularly sensitive to changes in layer structure. Wave number estimates at each range are used in a linearized inversion algorithm to estimate local sediment properties. Locations of the R-reflector and other layering information are used as a priori information in the inversion algorithm. The additional information both constrains the solution of an otherwise ill-posed problem and emphasizes the layered structure of the sediment. These methods have been shown to yield accurate estimates of the sound speed profile deep into the sediment using very few perturbations to the forward model. By combining the local inversion results, a three-dimensional map of sediment sound speed structure is obtained for a 25 km square region of the seafloor.

A Model of the Interaction of Bubbles and Solid Particles under Acoustic Excitation

Friday, April 25, 2008 3:00 p.m.

Todd A. Hay
Applied Research Laboratories
The University of Texas at Austin
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Ph.D. Dissertation Defense

Dynamical equations of motion are presented for the interaction of clustered spherical bubbles and solid particles suspended in liquid. Both the bubbles and particles are free to pulsate and translate, and bubble coalescence is taken into account according to a set of conservation relations. The initial motivation for this research was the need for better understanding of the interaction of bubble clusters which routinely surround kidney stones during shock wave lithotripsy, an extracorporeal kidney stone disease treatment. The bubbles and particles may be of arbitrary size, the particles elastic or rigid, and external acoustic

sources are included to an order consistent with the accuracy of the model. Radiation damping due to finite liquid compressibility is also considered, allowing more accurate modeling of situations involving high-amplitude or high-frequency acoustic excitations, e.g., shock wave lithotripsy or high-intensity focused ultrasound.

Analytic time averages of the model equations predict a number of interesting effects due to the presence of the particle. For example, they show that bubbles will be attracted to particles of higher density than the surrounding liquid but repelled from particles of lower density than the liquid. Plots and movie animations obtained from numerical solution of the model equations are presented to demonstrate the effects of key parameters such as particle density and size, liquid compressibility, and particle elasticity on the dynamics of the system. Results will be shown for the free response as well as the response to sinusoidal and shock wave acoustic excitations.

The Size and Shape of Intracochlear Pressure

Thursday, May 15, 2008 3:30 p.m. in ACES 6.304

Professor Elizabeth S. Olson
Department of Biomedical Engineering
and
Department of Otolaryngology/Head and Neck Surgery
Columbia University
http://www.entcolumbia.org

Upon sound stimulation, the eardrum and ossicles are set in vibration. The stapes vibration pressurizes the cochlear fluids. Due to the cochlea's geometry and its approximately symmetric division by a flexible cochlear partition (which includes the sensory tissue), the intracochlear pressure can be decomposed into two dominant pressure modes. One of these, the compression mode, fills the cochlea nearly uniformly. The other, traveling-wave mode, is anti-symmetric across the partition. The traveling-wave mode creates the cross-partition pressure difference that leads to sensory hair-cell motion and excitation (and damage, with loud sounds). As far as we know, the compression mode serves no physiological function and is simply a by-product of the piston-like drive of the stapes upon the cochlea. Small intracochlear pressure sensors developed a decade ago have been useful in parsing the two intracochlear pressure modes and for probing the traveling-wave mode where it is largest, close to the cochlear partition. The traveling-wave mode shows many of the same interesting features as cochlear partition motion, in particular frequency tuning and nonlinearity that arises from active hair-cell-based mechanical nonlinearity. In this talk these fundamental characteristics of intracochlear pressure will be reviewed.

Plasmonic and Metamaterial Cloaking: A Route for Acoustic Cloaks?

Wednesday, June 11, 2008 10:00 a.m. in ARL Auditorium

Dr. Andrea Alu
Department of Electrical and Systems Engineering
University of Pennsylvania
http://www.seas.upenn.edu/~andreaal/index.html

The quest for miniaturizing and optimizing the performance of electromagnetic devices for numerous applications (wireless and optical communications, imaging, …) has fostered in recent years a strong interest in artificial materials, metamaterials and plasmonics, whose exciting and anomalous electromagnetic properties may overcome certain limitations of current technology. One of the most striking properties of these materials is the possibility of drastically reducing the visibility of (electromagnetic scattering from) an object. In this sense, in the last couple of years several venues have been suggested to employ metamaterials for electromagnetic cloaking, one of which, based on the use of plasmonic covers, may have arguable advantages over other competing cloaking techniques. In particular, its inherent simplicity in the cloak design and its robustness to variations in the design parameters and frequency of operation make this technique particularly appealing for several applications.

The extension of these concepts to acoustic waves does not seem to be, at least in principle, particularly challenging from the theoretical point of view. However, technological and material limitations need to be seriously taken into account before any attempt to translate and transplant the electromagnetic cloaking concepts to acoustics.

In this talk, I will provide a general overview of the plasmonic cloaking technique to envision thin efficient electromagnetic cloaks and I will explore the possible venues to introduce similar concepts into acoustics. I will compare these concepts with other recently proposed solutions for acoustic cloaks, analyzing and discussing the feasibility and potentials of these different possibilities from a practical point of view. Several potential applications and physical insights of these cloaks, both in electromagnetics and acoustics, will be envisioned.

Human-Based Percussion Detection and Self-Similarity in Electroacoustic Music

Thursday, June 12, 2008 10:00 a.m.

John Anderson Mills III
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Ph.D. Dissertation Defense

Electroacoustic music is music that uses electronic technology for the compositional manipulation of sound, and analyzing this music requires special measures. A preliminary tool set to analyze percussivity and percussive self-similarity in electroacoustic music has been designed that incorporates models of the human auditory periphery. A collection of human percussion judgments was undertaken to acquire clearly specified sound-event dimensions that humans use as percussive cues. Participants were asked to make judgments about the percussivity of synthesized snare-drum sounds. The grouped results

indicate that rise time is the strongest cue for percussivity of the dimensions tested. Gross spectral filtering also has an effect on the judgment of percussivity, but the effect is weaker than rise time and has less effect when the stronger cue of rise time is modified simultaneously.

A percussivity-profile algorithm (PPA) was designed to identify instants in pieces of music that humans would also identify as percussive. The PPA was implemented using a time-domain, channel-based approach and psychoacoustic models. The input parameters were optimized to maximize performance at matching participants' choices in the percussion judgment collection. The PPA was used to analyze pieces of electroacoustic music, which introduced new challenges. A similarity matrix was combined with the PPA in order to find self-similarity in the percussive sounds of electroacoustic music. This percussive similarity matrix was then used to identify structural characteristics of pieces of electroacoustic music.

Models for Acoustically Driven Bubbles in Channels

Friday, August 8, 2008 3:00 p.m.

Jianying Cui Atkisson
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http://www.me.utexas.edu

Ph.D. Dissertation Defense

A model is developed for the dynamics of an acoustically driven bubble in a channel. The bubble is assumed to be smaller than the transverse dimension of the channel and spherical in shape. The channels considered are infinite in length and formed by either parallel planes or tubes with triangular, rectangular, or hexagonal cross sections. For surfaces that are rigid or pressure release, the boundary conditions on the channel walls in each of these geometries can be satisfied using the method of images. Effects due to confinement by the channel walls are thus determined by an analysis of coupled bubble interactions in line and plane arrays. An existing model for the coupled dynamics of spherical bubbles provides the basis for the model. Liquid compressibility is an essential feature of the model, both in terms of radiation damping and the finite propagation speed of acoustic waves radiated by the bubble. Solutions for the frequency response are obtained analytically by perturbation for low drive amplitudes and weak nonlinearity, and by numerical solution for high drive amplitudes and strong nonlinearity. The response of a bubble between rigid parallel planes is found to be mass controlled, whereas for a rigid tube it is found to be damping controlled. The dynamics of a bubble located near the center of a tube are found to depend on the area but not the specific geometry of the cross section. All of the solutions can be extended to tubes with arbitrary wall impedance if the radiation impedance on the bubble is known, for example calculated by normal mode expansion.

Laboratory Measurements of the Speed of Sound in Water-Saturated Granular Sediments

Friday, September 5, 2008 4:00 p.m. in ETC 4.120

Theodore F. Argo IV
Department of Mechanical Engineering
and
Applied Research Laboratories
The University of Texas at Austin
http://www.me.utexas.edu

A better understanding of sound propagation in water-saturated granular sediments is required for improved shallow-water sonar performance and mine detection. For example, no existing first-principles model has accurately described both sound speed and attenuation across the range of frequencies of interest in ocean acoustics and across a range of sediment types. This is partly due to the difficulty of obtaining measurements with sufficient control of measurement uncertainty to reveal the true nature of sound propagation in these materials. To address this deficiency, a suite of laboratory measurements is underway. A resonant column is under development for the frequency range 0.4 to 4 kHz and a time-of-flight technique is being employed in the 10 to 700 kHz range. Preliminary resonant-column sound speed measurements with sorted banking sand will be presented, along with a discussion of the challenges in apparatus design and sample preparation. Time-of-flight measurements on an ensemble of monodisperse 250 um glass spheres that utilized a method for controlling the porosity of the sample will also be discussed. With this method, porosity values of 0.37 to 0.43 were achieved. Measurements with both techniques will be compared to existing model predictions and other similar measurements.

Theory and Estimation of Acoustic Intensity and Energy Density

Friday, September 12, 2008 4:00 p.m. in ETC 4.120

Derek C. Thomas
Department of Physics and Astronomy
Brigham Young University
http://www.physics.byu.edu/Research/acoustics

In order to facilitate the acquisition and accurate interpretation of intensity and energy density data in high-amplitude pressure fields, the expressions for intensity and energy density are examined to ascertain the impact of nonlinear processes on the standard expressions. Measurement techniques for estimating acoustic particle velocity are presented. The finite-difference method is developed in an alternate manner and presented along with bias and confidence estimates. Additionally, new methods for estimating the local particle velocity are presented. These methods appear to eliminate the errors and bias associated with the finite-difference technique for certain cases.

Review of Drill String Acoustic Telemetry System

Wednesday, September 17, 2008 4:00 p.m. in ETC 4.120

Dr. Fernando Garcia-Osuna
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Sugar Land, Texas
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and

Khalid H. Miah
Department of Electrical and Computer Engineering
The University of Texas at Austin
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Acoustic wireless telemetry systems for logging and measurements while drilling (LWD/MWD) applications, the drill string being the communication channel, has long been researched in the oil and gas industry. The goal of using acoustic carrier waves along the drill string is to increase the wireless data rate in drilling operations compared to current mud-pulse and electromagnetic telemetry systems. However, the drilling noise and acoustic attenuation along the drill string are the major bottlenecks in the realization of a reliable and fast two-way communication link between the bottom-hole assembly (BHA) and the surface. Laboratory experiments and theory show that different acoustic modes are sensitive to different frequencies. In addition, change in cross-sectional area, geometry in the drill collars and contact with the formation produce a band-pass filter effect that attenuates the signal in a desired bandwidth. Therefore careful consideration must be taken in selecting the carrier frequency and bandwidth for a modulation scheme. In this talk we revisit drill string acoustic wireless telemetry system for LWD/MWD applications, its limitations, and laboratory experiments to record drilling noise. This presentation will be an overview of how flexible modular instrumentation based on PXI (PCI eXtensions for Instrumentation), employing the latest software technology, is being used in making high precision noise measurements. Examples include systems used by NASA and Boeing to test aircraft noise-reducing technologies and the new Aeroacoustics Research Complex. In these applications, higher sampling rates, higher channel counts, increased dynamic range, and distributed architectures were needed in smaller packages.

Analog Feedback Control of an Active Sound Transmission Control Module

Friday, September 26, 2008 4:00 p.m. in ETC 4.120

Jason D. Sagers
Department of Mechanical Engineering
Brigham Young University
http://www.physics.byu.edu/Research/acoustics

An analytical and experimental proof-of-concept is presented for a new feedback-controlled sound transmission control module for use in an active segmented partition (ASP) array. The objective of such a module is to provide high transmission loss down to low audible frequencies while minimizing the overall mass of the module. The design of the new module overcomes two limitations that exist in current ASP

modules: the inability to control broadband random noise and the lack of bidirectional control through the module. Analogous circuit models were developed and used to predict the performance of the new ASP module under feedback control. The proof-of-concept design consists of two loudspeaker drivers mounted back-to-back in a duct, with two decoupled analog feedback controllers connected to reduce the vibration of the loudspeaker cones. An experimental proof-of-concept module was constructed using two 10 cm diameter loudspeaker drivers, two accelerometers, and other off-the-shelf materials. Transmission loss of broadband random noise in excess of 50 dB was achieved between 100 Hz and 2 kHz. The experimental transmission loss results validated the numerical model and showcased the transmission loss performance of the new module design.

Influence of Cooling Requirements and Chassis Design on Noise of Fan-Cooled Devices

Friday, October 10, 2008 4:00 p.m. in ETC 4.120

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A common early step in the design of a fan-cooled device is the selection of a cooling fan. The selection is usually made on the basis of the “quietest” fan that provides sufficient flow, based on manufacturer’s catalog data. It turns out that the noise emission of the device is only partially determined by the “noisiness” of a candidate cooling fan: thermal requirements and chassis design factors are also major determining factors. The process of reducing cooling fan noise is greatly aided by breaking the problem down into its constituent parts. The convective heat transfer and chassis back pressure equations can be combined with fan noise empirical relationships to make the influence of each of the factors clearer. Selection of an appropriate cooling fan arrangement is simplified by superimposing an “isoacoustic” curve (i.e., the locus of operating conditions which share a given sound power level) on the fan performance curve to give an early a priori estimate of noise emission.

Molecular Specific Photoacoustic Imaging with Gold Nanoparticles

Friday, October 17, 2008 4:00 p.m. in ETC 4.120

Srivalleesha Mallidi
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Cancer has become one of the leading causes of death. The early detection of cancer is absolutely necessary to decrease the mortality rate and also to obtain effective therapeutic outcomes. Advances in materials science have enabled the use of nanoparticles for added contrast in various imaging techniques. More recently there has been much interest in the use of gold nanoparticles as optical contrast agents because of their strong absorption and scattering properties at visible and near-infrared wavelengths. Highly proliferative cancer cells over express molecular markers such as epidermal growth factor receptor (EGFR). When specifically targeted gold nanoparticles bind to EGFR they tend to cluster, leading to an optical redshift of their plasmon resonance and an increase in absorption in the red region.

These changes in optical properties provide the opportunity for a photoacoustic imaging technique (the contrast mechanism is based on the optical absorption properties of the tissue constituents) to differentiate cancer cells from surrounding benign cells. To evaluate this technique, studies were performed on tissue phantoms and ex-vivo tumor models and the results indicate that highly sensitive and selective detection of cancer cells can be achieved utilizing the plasmon resonance coupling effect of EGFR targeted gold nanoparticles and photoacoustic imaging.

Sensing Resonant Targets through Iterative, Single-Channel Time Reversal

Friday, October 24, 2008 4:00 p.m. in ETC 4.120

Zachary J. Waters
Department of Mechanical Engineering
Boston University
http://www.bu.edu/me

The presence of noise and coherent returns from clutter often confound efforts to detect and identify targets buried in the ocean. Returns from a buried resonant target are enhanced by using iterative time reversal with a single channel transducer, yielding convergence to a narrowband waveform characteristic of the dominant mode in the scattering response of the target. The procedure consists of exciting the target with a broadband pulse, sampling the return using a finite time window, reversing the signal in time, and using this reversed signal as the source waveform for the next interrogation. Scaled laboratory experiments (0.5 to 2 MHz) are performed employing spherical targets suspended in the free field and buried in a sediment phantom. In conjunction with numerical simulations, these experiments provide an inexpensive and highly controlled means with which to examine the efficacy of the technique. Methods developed in the laboratory are then applied in medium scale (20 to 200 kHz) pond experiments for the detection of a steel shell buried in sandy sediment.

High Resolution, Long Range Imaging Sonar

Friday, October 31, 2008 4:00 p.m. in ETC 4.120

Dr. Keith H. Lent
Advanced Technology Laboratory
Applied Research Laboratories
The University of Texas at Austin
http://www.arlut.utexas.edu/atl/index.html

Some initial results of the Long Range Imaging Sonar project at ARL will be presented in this seminar. The primary motivation for this project is to solve the diver identification problem at ranges useful for harbor security applications (i.e., hundreds of yards). Solving this problem means the sonar must provide the ability to unambiguously discriminate between the following targets: divers, fish, fish schools, marine mammals and drifting flotsam (floating debris). The final proposed solution to this problem is a 300 foot long sonar array with frequency range from 40 kHz to 100 kHz. The concept demonstration sonar is “only” a 100 foot long array. This array provides an image resolution of 0.5 inches by 3 inches at 100 yards. It may be the world’s largest imaging sonar. Active, passive and Doppler processing of sonar data from targets at Lake Travis will be shown.

Experimental Studies of Microbubble Dynamics in Ultrasound Using Ultra-High-Speed Imaging and Optical Trapping

Friday, November 21, 2008 4:00 p.m. in ETC 4.120

Dr. Valeria Garbin
University of Twente
The Netherlands
pof.tnw.utwente.nl

Contrast agent microbubbles are widely used in the field of ultrasound medical imaging to enhance contrast of ultrasound images and quantify organ perfusion, among many other applications. A full understanding of the behavior of these micron-scale bubbles under acoustical excitation is crucial for improving diagnostic imaging protocols and designing new targeted molecular imaging strategies. The Brandaris 128 ultra-high-speed camera, a custom apparatus developed locally which operates at up to 25 million frames per second, enables the study of microbubble dynamics at nanosecond timescales. Use of this camera in conjunction with optical tweezers, which can precisely control the position of the bubbles without affecting their dynamic response, permits study of bubble dynamics in clinically relevant situations. Examples include interaction of bubbles with confining surfaces, bubble-bubble interactions, and the effect on bubble translation of the interplay between viscous and acoustic forces. During this seminar bubble dynamics experiments conducted with the Brandaris camera and optical tweezers will be discussed and compared to theoretical models.