The 7th Meeting of the MidSouth Chapter of the Acoustical Society of America

Rhodes College
Memphis, TN 38112

October 8-9, 2010

Meeting Proceedings

Meeting Schedule:

Friday, October 8

12:00-1:00PM	:	Registration
1:00-2:45PM	:	Opening Session
2:45-3:00PM	:	Break
3:00-4:30PM	:	Afternoon Session
6:00-7:30PM	:	Dinner & Socializing Downtown

Saturday, October 9

7:30-8:30AM	:	Coffee & Donuts
8:00-9:45AM	:	Morning Session
9:45-10:15AM	:	Poster Session & Break
10:15-12:30PM	:	Closing Session
12:45-1:45PM	:	Exec. Committee Meeting

Meeting Location: The meeting will be held in Lecture Room B of the Frazier Jelke Science Center located on the Rhodes College campus. Posters will be displayed in the hallway outside the room. Check the Chapter website for a campus map, photos of the building and lecture room, as well as meeting t-shirts designed by the Rhodes College Physics Club.

Special thanks to Brent Hoffmeister, Eva Owens and Stephanie Milazzo at Rhodes College for organizing and hosting the meeting.

Announcements: The next meeting of the MidSouth Chapter of the Acoustical Society of America will be in the spring of 2011 in Oxford, MS.

Check the chapter website:

`http://www.acosoc.org/RegChapters/MidSouth/`

for more details about the upcoming meeting in the months ahead.

Oral Abstracts

FRIDAY AFTERNOON, 8 OCTOBER 2010

1:00-2:00 PM

Diagnostic Medical Ultrasound How US Helps Patient Care. Harris Cohen (Lebonheur Children's/UT, 5639 Ashley Sq S, Memphis, TN 38120, hcohenmb@optonline.net)

Diagnostic Ultrasound (US) has been a practical diagnostic tool for over 30 years. This lecture will show some of the evolution of US imaging with improvements in transducer hardware and US machine software. Such changes include the development of real time imaging, the development of Doppler analysis, the development of transvaginal imaging and the development of high frequency linear array transducers. These improvements have led to revolutionary and evolutionary diagnosis of the fetus, children and adults in all medical disciplines. We will show examples of diagnostic US's help in diagnosing the fetus in its entirety, the pregnant uterus and its placenta, the neonate's brain and spinal cord, the child, teenager and adult's abdomen including various causes of pain and vomiting, the female pelvis including malignant and nonmalignant diseases of the gynecologic tract and their simulators. We will review the use of emergency US to save (via the surgeon/urologist/gynecologist) testes from torsion and ovaries from torsion as well as to rapidly diagnose gallstones and appendicitis and simulators of their diseases or symptoms. Its use in the rapid diagnosis of deep venous clots in the lower extremities has saved many a patient from the negative consequence of pulmonary emboli. Hopefully by the talk's end the attendee will have a feel for the usefulness of Diagnostic US (helped by medical acoustic research over the years) as it helps medical care through rapid diagnosis of disease entities from head to toe.

2:00-2:15 PM

Effect of attenuation on ultrasonic backscatter measurements of cancellous bone. Stephanie Milazzo and Brent Hoffmeister (Rhodes College, 2000 North Parkway, milsm1@rhodes.edu)

Ultrasound is a well established method of measuring bone density. Some investigators have proposed that ultrasonic backscatter techniques may be useful for this purpose. Backscattered power has been found to decrease with bone density. We hypothesize that attenuation effects may cause this negative correlation between backscatter and density. To test this hypothesis we performed backscatter and attenuation measurements on 12 specimens of human and bovine cancellous (spongy) bone ranging in density from 0.142-0.507 g/cc. A negative linear correlation was found between apparent integrated backscatter (AIB) and density. A strong positive linear correlation was found between broadband ultrasound attenuation (BUA) and density. These results suggest that increases in attenuation due to increased specimen density cause a decrease in the measured backscattered power.

2:15-2:30 PM

Low frequency noise complaints in residential applications. Dave Woolworth (Oxford Acoustics, 356 CR 102, Oxford, MS 38655, dave@oxfordacoustics.com)

Noise ordinances normally, if quantified, deal with A-weightings which are compromised at low frequencies. Low frequency noise from mechanical equipment and modern sound systems are not considered in these ordinances but are valid complaints and have specific physiological effects on living beings. Ordinances and low frequency complaints will be assessed and two noise complaints from the Memphis area will be discussed in terms of validity and legal aspects.

2:30-2:45 PM

Contralateral cues influence detection of tones in noise. Shaum Bhagat (The University of Memphis, School of Audiology and Speech-Language Pathology, 807 Jefferson Avenue, Memphis, Tennessee 38105, sbhagat@memphis.edu)

Listener performance in detecting tones in noise can be aided or hindered by the provision of cue tones that precede the listening task. Previous research has emphasized examining the effects of cuing when the cue tone and test tone are presented to the same ear. In this work, listeners were provided with cue tones presented to the ear contralateral to the test tone. The cue tones were the same as or were either an octave above or an octave below the test tones. Masked thresholds were measured with a two-interval, two-alternative forced-choice procedure that tracked the 71% correct performance level. The masker was a broadband noise. Masked thresholds obtained with cue tones that were the same as the test tones were elevated compared to masked thresholds obtained without cue tones. However, when the cue tone was an octave below the test tone, masked thresholds were lower with the cue tone compared to without the cue tone. Listener performance in detecting tones in noise was hindered when contralateral cue tones and test tones were the same, consistent with previous results examining the effects of ipsilateral cue tones. However, a release from masking was observed when the contralateral cue tone was below the test tone. Possible explanations for these results, including involvement of the olivocochlear bundle, will be discussed.

2:45-3:00 PM
Break

3:00-3:15 PM

Laser-Lever NonContact Vibration Detection For Extreme Environments. Swapna Male*, Qin Zhang, and Josh Gladden (University of Mississippi, 1 Coliseum Dr., NCPA Room 1077, University, MS 38655, smale@olemiss.edu)

In traditional direct contact Resonant Ultrasound spectroscopy (RUS) measurement, a sample is placed between two piezoelectric transducers. One transducer excites the sample throughout a frequency range and the other measures the sample response. With careful transducer design, such a system can be used up to 550 degree centigrade. The transducers can be removed from direct contact with the sample and mounted on buffer rods for even higher temperatures. The weight of the buffer rods upshifts the measured spectrum by applying load to the sample and degrades the signal to noise ratio and therefore shifts the measured resonance frequencies. These experimental difficulties introduced by the buffer rod system motivate the development of a non-contact vibration detection system. The Optical Lever Method (OLM) is used to provide the non-contact measurement of the vibration response of the specimen. A laser beam with a wavelength of 650nm from a laser diode is directed at the surface of the sample and reflected off to a quadrant photo detector, which converts light into current. When the sample is not driven, the beam spot falls on the center of the photo diode quadrant and produces zero differential current. The vibration of the surface causes the beam to change position on the photodiode array and therefore changing the differential voltage output through an electric circuit design to monitor orthogonal components of displacement. A prototype of the RUS/OLM system has been employed for the measurement of aluminum sample with dimensions of 38.1mm$\times$18.9mm$\times$6.3mm at room temperature and validated by comparing the resonant spectrum with that of obtained from traditional direct contact piezo-based detection RUS system. In the future this instrument will be designed to work at elevated temperatures up to 1900 degree centigrade and pressures up to 2500 psi. The proposed project will be useful for characterizing new aerospace and energy related materials that exhibit superior performance at high temperatures and pressures.

3:15-3:30 PM

Development of Rugged, Lightweight and Flexible Acoustic Sensors. R.A. Adebisi* and Josh Gladden (University of Mississippi, National Center for Physical Acoustics, University, MS 38677, raadebis@olemiss.edu)

One of the major challenges of rescue workers is to determine the existence of human beings in collapsed structures following a natural disaster such as earthquake. A rugged, lightweight and flexible acoustic sensor that can operate in the range of human noise will be very helpful in such scenario. Polyvinylidene fluoride (PVDF) based acoustics sensor is a good candidate for such applications. It is a polymeric material that can be made to have piezoelectric property. It has been shown that PVDF bonds well with carbon nanotubes (CNT). The combination of the strength of CNT and the toughness of PVDF (which is an inherent property of polymeric materials) has the potential to produce such a sensor. We have developed a procedure for making a uniform thin film (20 microns thick) from raw PVDF. Its toughness has been measured and to increase the strength we have incorporated CNT into the solution of the film using high power sonicator to disperse the CNT in the solution. Mechanical properties of the resulting composite films are being tested and the result will be discussed.

3:30-3:45 PM

Elastic properties of SnAgCu solder alloy using ultrasonic pulse-echo technique. Sumudu Tennakoon* and Josh Gladden (University of Mississippi, National Center for Physical Acoustics, University, MS 38677, sptennak@olemiss.edu)

Lead (Pb) free solder plays an important role in various electronic assembly applications due to recent concerns of environmental and health issues related with lead based solder alloys. However, failures of solder joints made by lead free solder at their usage environments have been reported in the literature. This motivates a study of their elastic properties under different ageing conditions. For this work, ultrasonic pulse-echo technique was introduced as a non-destructive material characterization method to determine elastic moduli of SnAgCu solder alloy. Shear wave speed (Cs) and longitudinal wave speed (Cl) were examined in the temperature range of 0 C 100 C for non-aged SnAgCu solder alloy samples. Shear modulus (G) and longitudinal modulus (M) were determined using above mentioned wave speeds (Cs & Cl) and mass density (ρ) of the material. Temperature dependence of Youngs modulus (E), Bulk modulus (K) and Poissons ratio (ν) were interpreted using trends of Shear and longitudinal moduli (G & M). Investigation of elastic moduli using samples aged for duration of 500 h and 1000 h at three different temperatures (75 C, 100 C, and 150 C) is in progress.

3:45-4:00 PM

Fluid-Structure Interactions: Wing Surface Vibration. Wesley Henderson* (Louisiana Tech University, 1046 Sanders Ln, Ruston, LA 71270, wesley.henderson11@gmail.com), Nathan Murray and Bernard Jansen (National Center for Physical Acoustics, The University of Mississippi, 1 Coliseum Drive, University, MS 38677)

Preliminary measurements are taken to address the lack of empirical data for wing flutter. Measurements are taken on a model airplane-style wing in a low-speed wind tunnel. Vibrations are measured using laser Doppler vibrometers. Results indicate that for a near-constant tunnel flow velocity prominent tones depend on angle of attack and position along the length of the wing.

4:00-4:30 PM

Sun Studio. Matt Ross-Spang (Sun Studio, Memphis TN 38103, mrs@sunstudio.com)

The history of Sun Studio will be presented with emphasis on famous artists who have recorded there including Elvis Presley, Johnny Cash and Jerry Lee Lewis. The science of music recording has changed since

the founding of Sun Studio and so this evolution will be chronicled and discussed. Lastly, the issues before the modern acoustic engineer and their solution will be discussed.

SATURDAY MORNING, 9 OCTOBER 2010

8:00-8:30 AM

Earthquakes in Arkansas. Scott Ausbrooks (Arkansas Geological Survey, 3815 West Roosevelt Road, Little Rock, AR 72204, scott.ausbrooks@arkansas.gov)

An overview of Earthquakes in Arkansas with emphasis on how the geology of the region (Mississippi Embayment and Reelfoot Rift) is related to seismicity will be discussed. Historic earthquakes in the New Madrid seismic zone will be reviewed with connections made to current hazards and probabilities of repeated large events. Finally, a survey of recent earthquakes in North-Central Arkansas will be discussed.

8:30-9:00 AM

EarthScope, USArray, and Infrasonics. Charles Langston (Center for Earthquake Research and Information, The University of Memphis, 3876 Central Ave., Suite 1, Memphis TN 38152, clangstn@memphis.edu)

EarthScope is a multiyear scientific initiative in the Earth Sciences community funded by the National Science Foundation. It consists of three major facilities for exploring the structure and evolution of the North American Continent in addition to providing educational and research opportunities for the public and academia. The San Andreas Fault Observatory at Depth (SAFOD) is a 3km deep drill hole that penetrates the San Andreas fault in central California to probe the physical properties of earthquake generating crust. The Plate Boundary Observatory (PBO) is composed of over a thousand permanent GPS stations, borehole seismometers, borehole strainmeters, tiltmeters, and laser strainmeters to monitor tectonic deformation along the west coast and Alaska. USArray consists of 400 broadband seismic stations, called the Transportable Array, which will sequentially cover, from west to east, the land area of the conterminous United States and Alaska at an average station spacing of 70km. A portable, "flexible" array of instruments will be available for special experiments. In addition, there are magnetotelluric instruments to survey hundreds of sites throughout the country to infer the deep resistivity structure of the continent. A recent development in Transportable Array instrumentation is the inclusion of broadband infrasound sensors to complement seismic observations of natural and man made phenomena and to investigate the seismo-acoustic boundary layer. The Transportable Array is currently as close as western Arkansas and will move into the mid-south early next year opening up a variety of local research areas in continental earth structure, earthquake source observations, and atmospheric infrasonics.

9:00-9:15 AM

Testing Rotational Seismometers with Array Computed Rotations. Lauren Kendall* and Charles Langston, W.H.K. Lee, C.J. Lin and C.C. Liu (Center for Earthquake Research and Information, The University of Memphis, 3876 Central Ave., Suite 1, Memphis TN 38152, lmkndall@memphis.edu)

On 4 March, 2008, two explosions were set off in northeastern Taiwan associated with a TAIGER (TAiwan Integrated GEodynamics Research) long-range refraction experiment. The first one (N3P) used 3000 kg of explosives and the second (N3) used 750 kg. Thirteen strong motion seismic stations were installed close to the explosions including an 11 station gradiometric array with a sensor spacing of 5 m from each other and an average distance of 500 m from the sources. Each station contained an accelerometer and 5 also contained eentec R-1 rotational sensors. The objective of this experiment was to test the response of these experimental rotational sensors against calculated rotations about the local x, y, and z axes using wavefield gradients computed with the array data. Computed array rotations have little variation across the array but the point rotation measurements obtained from individual rotation sensors show large deviations with each other and with the array rotations. These comparisons suggest that either point rotation measurements are actually highly variable in space because of very local site conditions and instrument installation practices or that a method be developed to accurately determine the rotation instrument response before installing these instruments in the field.

9:15-9:45 AM

What We Think We Know and What We Know We Don't Know About Ring Laser Acoustic / Seismic Detectors. Bob Dunn (Hendrix College, Department of Physics, 1600 Washington Ave. Conway, AR 72032, dunn@hendrix.edu)

This presentation will briefly review the history of using large ring laser interferometers as acoustic and seismic detectors. It will then focus on the results from a series of collaborative experiments performed by researchers from The University of Central Arkansas and Hendrix College. The results to be presented were obtained from large ring lasers deployed in and around Conway, AR. One goal of these studies is to try to better understand the coupling mechanisms between acoustic/seismic waves and the ring laser interferometer.

9:45-10:15 AM
Poster Session & Break

10:15-10:45 AM

Seismic Instrumentation of the I-40 Mississippi River Bridge in Memphis, Tennessee. Shahram Pezeshk (Department of Civil Engineering, The University of Memphis, Memphis, TN 38152, spezeshk@memphis.edu)

Memphis and Shelby County, Tennessee, are located geographically close to the southwestern segment of the New Madrid seismic zone (NMSZ), which is regarded by seismologists, engineers, and public officials as the most hazardous seismic zone in the Eastern United States. Thus, Memphis and Shelby County are potentially exposed to significant seismic hazards. A large earthquake occurring anywhere within the NMSZ could cause widespread loss of life with damage to buildings, bridges, and lifelines due to ground shaking and ground failure induced by the earthquake. The purpose of this paper is to describe the development and installation of a seismic instrumentation system that has been deployed on and in the vicinity of the I-40 Hernando DeSoto Mississippi River Bridge in Memphis, Tennessee. This bridge has been retrofitted to withstand a magnitude (mb) 7 event at 65 km distance from the site with a depth of 20 km. The goal of the retro-fit was to have this bridge fully operational following the maximum probable earthquake (2500 year return period). As part of the I-40 bridge retrofit, Friction Pendulum^{TM} Isolation Bearings will be used to insure the integrity of the main spans of the bridge. Currently, in the United States and elsewhere in the world, there is very little data available on the response of long-span bridges during seismic events. Since such data are scarce, our ability to understand the behavior of such structures and to verify dynamic analyses performed on such structures during design/analyses/retrofit phases is limited. Data collected from instrumentation of the I-40 Bridge in Memphis will be an invaluable asset in evaluating the structure.

10:45-11:00 AM

On the sensitivity of infrasound to the upper atmosphere. J.D. Assink* and Roger Waxler (National Center for Physical Acoustics, The University of Mississippi, 1 Coliseum Drive, University, MS 38677, jdassink@olemiss.edu) and D. Drob (Naval Research Laboratory, Washington, DC, USA)

In comparison to the lower atmosphere where comprehensive global atmospheric specifications are commonplace, methods to measure the properties of the atmosphere above the stratopause is an active area of scientific research. In this paper, we revisit the use of infrasound

as a remote sensing technique for the upper atmosphere. Signals from the Tungurahua volcano in Ecuador are used to investigate the behavior of the upper atmosphere. Depending on the atmospheric conditions, stratospheric, mesospheric and thermospheric arrivals are observed during intervals of explosive volcanic activity. It is found that the travel times of the thermospheric arrivals exhibit a coherent variability with periods equal to those of the tidal harmonics. As such, these observations suggest a readily accessible means of passive atmospheric remote sensing that can be utilized in conjunction with others techniques, as well as a-priori information, to routinely measure and specify the state of the upper atmosphere.

11:00-11:15 AM

Investigation of the time dependent relationship between the vertical wind velocity and pressure fluctuations over flat open ground. John Paul Abbott*, Richard Raspet, Jeremy Webster, and Jiao Yu (The National Center for Physical Acoustics, The University of Mississippi, University, MS 38677, jrabbott@olemiss.edu)

The time dependent relationship between the vertical wind velocity and the pressure sensed on the ground as measured in an open field was investigated using time dependent correlations and other comparisons. The purpose of the investigation was to determine how the vertical component of the mean turbulence-shear wind flow is related to the infrasonic wind noise present in ground level microphones and pressure sensors. Investigations were also conducted to determine where this causal relationship is the strongest in the flow field. Correlation coefficients were very low, typically between 0.08-0.15, for broadband frequencies up to 5.0 Hz; with the highest values typically found along a forty-five to fifty-five degree angle path, up- and downstream, relative to the microphone. These low correlation values were found to be due to the incoherence of the spatial correlation length for the vertical flow velocity and the relative size of the source region. Further investigations showed improved correlation values between the measured pressure and flow field when the anemometers were moved closer together and both the respective finite time difference due to the wind and the numerical derivative of the measured wind velocities were used to calculate the flow field.

11:15-11:45 AM

Numerical Simulation of Acoustic Propagation in the Ocean. Michael Vera (University of Southern Mississippi, 118 College Dr. #5046, Hattiesburg, MS 39406, michael.vera@usm.edu)

Acoustics is the dominant means of transmitting a signal in the ocean, particularly for ranges beyond a few hundred meters. Sound can remain detectable at long ranges due, in part, to refraction toward a minimum sound speed in the ocean interior. This refractive effect results from the depth dependence of the oceans physical properties. The propagation of sound in the marine environment can be modeled using rays or a wave equation. Acoustic tomography, the mapping of ocean properties based on the structure of a received sound signal, is one application. Depending on the configuration of the source and receiver and on the propagation environment, successful simulation of sound propagation may also require a treatment of acoustic interaction with the seafloor. A computation which incorporates the details of the conversion of acoustic energy into elastic shear modes in the solid seafloor can be unstable or computationally prohibitive, especially for long ranges and complicated environments. The use of equivalent fluids (which lack support for elastic shear) is intended to provide a numerically straightforward way of accurately estimating the reflection of acoustic energy back into the water column. This concept has been applied to geoacoustic inversion, the determination of the parameters of the seafloor solid using reflected acoustic signals, with data from the Basin Acoustic Seamount Scattering Experiment.

11:45 AM - 12:30 PM

The Physics of the Laser Interferometer Gravitational-wave Observatory. Marco Cavaglia (Department of Physics & Astronomy, The University of Mississippi, Oxford, MS 38677, cavaglia@olemiss.edu)

The physics of the Laser Interferometer Gravitational-wave Observatory Gravitational waves are distortions of the space-time geometry that propagate with the speed of light, just like waves on the surface of a pond. They can be observed through the stretching and compression of the objects they traverse. Gravitational wave are produced by some of the most energetic and dramatic phenomena in the cosmos, including black holes, neutron stars and supernovae. Their discovery should help to address a number of fundamental questions in physics, from the evolution of stars and galaxies to the origin of dark energy and the nature of space-time itself. The Laser Interferometer Gravitational-wave Observatory (LIGO) is attempting to detect gravitational waves by using a laser interferometer to measure with high precision the time it takes light to travel between suspended mirrors. The LIGO interferometers are the world's largest precision optical instruments and among the most sensitive scientific instruments on the planet. Thus they are affected by a variety of disturbances of non-astrophysical origin such as microseisms, wind, acoustic noise, and electromagnetic interference. These sources of noise may limit LIGO's sensitivity and affect the discovery of gravitational waves. In this talk we present an overview of the physics (and the challenges) of the LIGO experiment.

Poster Abstracts

A Trigger for a Helmholtz Resonator. John Lahmann*, Stephen R. Addison, and William V. Slaton (Department of Physics, The University of Central Arkansas, Conway AR 72035, lahmannjohn@yahoo.com)

With the use of a Helmholtz Resonator, our objective is to investigate wave coupling mechanisms at low frequencies. The resonator will work as an impulsive sound source which will be used to calibrate low frequency detectors. Acting as the resonator is a 2.5-ft stainless steel pipe 4-in diameter closed at both ends. Using a different assortment of flanges, we have securely closed off one end of the pipe and to close off the other end we use different thicknesses of sheet aluminum which acts as a diaphragm held on by one of the flanges. To create the pulse, we pull a vacuum in the pipe to the desired pressure and trigger the resonator by puncturing the diaphragm causing it to rupture. Work to date has concentrated on the development of a triggering mechanism. The various methods of triggering the resonator will be discussed.

Effect of Window Choice on the Analysis of Ultrasonic Backscatter Measurements of Bone. Anne Wilson* and Brent Hoffmeister (Rhodes College, 2000 North Parkway, wilar1@rhodes.edu)

Effect of window choice on the analysis of ultrasonic backscatter measurements of bone Osteoporosis is a degenerative bone disease that causes normally porous bone tissue, called cancellous bone, to become even more porous and weak. We have proposed that ultrasonic backscatter measurements may be sensitive to these changes in bone porosity. Backscatter measurements were performed by propagating broadband ultrasonic pulses (1-10 MHz) into regions of cancellous bone and receiving the returned backscattered signal. In software, a window was used to select a portion of the backscattered signal for analysis. The goal of this study was to determine how the location, duration and type of window affected the results of the analysis. Backscatter signals from 22 specimens of human cancellous bone were analyzed by changing either the windows location, duration, or type (rectangular vs. Hanning) from the original chosen settings. Three different ultrasonic parameters were extracted from the data, and linear regression analysis was used to determine how strongly these parameters correlated with the density of the bone specimens. We found no statistically significant changes in the linear correlation coefficients with different window choices. We conclude that backscatter measurements of cancellous bone are not strongly affected by the choice of window used for analysis.

The Effect of a Helmholtz Resonator's Neck Geometry on the Aero-Acoustic Excitation of Resonance. Asami Nishikawa* and William V. Slaton (Department of Physics, The University of Central Arkansas, Conway AR 72035, asami.nishikawa@gmail.com)

The aero-acoustic excitation of a Helmholtz resonator with different neck geometries has been examined with an improved measurement technique. A Helmholtz resonator consists of a volume connected to a duct and has a well defined resonance frequency which depends on the length of the duct, the volume of the resonator and the cross-sectional area of the duct. In the system used during this experiment, two Helmholtz resonators have been positioned at opposite sides of a junction in a wind tunnel. The air speed in the wind tunnel can be varied over the range 0 to 28 m/s. The air flowing over the junction openings to the Helmholtz resonators can excite the acoustic resonance of the system. This is similar to blowing over an empty bottle's opening and creating a tone. The excitation of the resonator as a function of flow speed in the wind tunnel has been recorded. The effect of the resonator's geometry has been seen in the measured acoustic amplitude and frequency in the resonator and will be presented.