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ECHOES

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A Noise-Immune Stethoscope for Use in Noisy Environments

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There are many medical emergencies where patient examination with a stethoscope (auscultation) is of critical importance for the patient's survival. In military settings, medical evacuation from the battlefield by helicopter (during the "critical hour") often involves casualties with acute injuries to heart and lung function. Auscultation is an important tool for assessing the integrity of heart muscle, valves, and major arteries while blood pressure may be determined in conjunction with a pneumatic cuff. Auscultation of the lungs can be essential when confirming the placement of endotracheal tubes or when diagnosing conditions such as a collapsed lung, asthma, or pulmonary edema. Fixed-wing medical transport flights are often of longer duration, and auscultation of body sounds becomes valuable in managing chronic conditions. The environment itself may lead to further medical complications; expansion of intestinal gases at high altitudes can be monitored by auscultation of bowel sounds. Rotary-wing and fixed-wing aircraft tend to be very noisy. Without doubt there would be great benefit to accurate, easy auscultation in the noisy medical transport environment.

Fig. 1. Dual-mode prototype stethoscope design.

There are also non-military situations where auscultation in noisy environments can be an issue. Train wrecks or multiple-car highway accidents are examples where victims are often transported to hospitals in helicopters. Noisy public events like football games or pop concerts are scenes where it could be difficult for a physician to provide the right diagnosis and emergency treatment to a heart attack victim.

Conventional acoustic stethoscopes are sensitive to noise from the immediate environment because it can invade the stethoscope in at least three different ways. It can enter through the earpieces, since these always have a finite amount of sealing power. It can enter through the acoustic tubing, since sound is always conducted through the tubing walls to some extent. The most sensitive entry point is the acoustic sensor, where environmental noise enters either directly through the housing or indirectly as a surface wave propagating along the skin of the patient. As a result, the maximum noise level in the environment that still allows successful auscultation is between 80 and 85 dB sound pressure level (SPL), dependent on details of stethoscope design and physician's skill.

Modern electronic stethoscopes have raised the maximum tolerable environmental sound level to about 90-95 dB SPL. This is because ear pieces are replaced by insert loudspeakers that provide a better seal with the ear canal, and tubing is replaced by electrical cables that do not pick up acoustic noise. Transducers in the stethoscope head can be designed to optimize mechanical to electrical transduction of body sounds while minimizing transduction of airborne sound from the environment.

Modern electronic stethoscopes are, unfortunately, still inadequate for effective auscultation in brutal noise environments as described above. Noise levels in heavy-duty helicopters like the Black Hawk can go as high as 120 dB SPL. Noise levels at indoor sporting events and pop concerts can easily reach 100 dB SPL. To conquer these high noise levels, a totally different technology was added to the stethoscope design. In ultrasound imaging, a high-frequency (megahertz range) sound signal is generated, transmitted from the stethoscope head into the patient's body, and reflections from moving body tissue are picked up by a receiver also located in the stethoscope's head. Since these reflections have a slightly different frequency than the transmitted signal caused by the Doppler effect, a difference-frequency can easily be computed and made into an audible sound. The advantage of this technique is that environmental noise, no matter how intense, does not interfere with the heart or lung sound, since the latter is carried by a 2.3 MHz carrier signal and a helicopter, ambulance, or stadium crowd do not produce any interfering sound at this high frequency.

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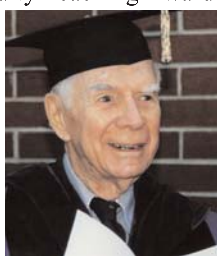
We hear that . . .

• **James G Miller**, Albert Gordon Hill Professor of Physics at Washington University (St. Louis), received the 2006 Achievement Award from the IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society for his "outstanding contributions to ultrasonic tissue characterization and echocardiography." Jim is a Fellow of ASA, of IEEE, of the American Institute of Ultrasound, in Medicine and the American Institute of Medical and Biological Engineering. In 2004 he received the ASA Silver Medal in Biomedical Ultrasound/Bioresponse to Vibration. At Washington University he has also received the Faculty Teaching Award and the Emerson Teaching Award.

• **John J. Ohala**, Professor Emeritus of Linguistics at the University of California, Berkeley, received the 2006 International Speech Communication Association (ISCA) Medal for Scientific Achievement. John is a Fellow of the ASA and served as president of the International Phonetic Association. His work was also recognized by an honorary degree from the University of Copenhagen.



• **Sean A. Genis**, a physics major at the United States Naval Academy, has been named a Rhodes scholar. Genis is a student of Murray Korman, Chair of the ASA Technical Committee on Physical Acoustics.

• **H. Frederick Dylla** has been selected as Executive Director of the American Institute of Physics (AIP). He will replace Marc Brodsky, who will retire March 31 after more than 13 years at AIP's helm. Dylla, who has been at the Thomas Jefferson National Laboratory at Newport News, Virginia since 1990, has a special interest in science education and helped to found the K-12 science education programs at Jefferson Lab.

• Silver medalist **Bill Yost** tells an amusing incident about carrying his new medal through airport security on his way back from Honolulu. "It was in my carry on, and after several looks at my bag and after I told them that the medal was probably what they were seeing, they took the blue case with medal out of my bag and put it through the x-ray machine. Three of them huddled for a minute or so looking at the x-ray, and then they told me I could go. "You haven't opened the case; don't you want to see what is inside?' I said. In a very firm manner I was told that I could not open the blue box until I was well clear of the security area. Not sure what they had on their minds, but it was all I could do to suppress my laughter."

• **Florida State University** is offering rewards of $50 for return of acoustic tags which they have attached to fish (groupers, snappers, and amberjack) for tracking purposes.

ECHOES

Newsletter of the Acoustical Society of America

Provided as a benefit of membership to ASA members

The Acoustical Society of America was organized in 1929 to increase and diffuse the knowledge of acoustics and to promote its practical applications.

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From the Editor:

As our readers know, we have been experimenting with different ways to deliver our *ECHOES* newsletter to ASA members in the most timely and economical way. Prior to 2006. it was printed and mailed to members and also posted online. The first three issues of 2006 were posted online and then reprinted in the ASA magazine *Acoustics Today*. This seemed to be a workable solution, although it meant a longer than desirable production schedule for a newsletter such as *ECHOES*: some news items were barely "news" by the time they reached their readers. Meanwhile *Acoustics Today* prospered to the point where it was not convenient to reprint all of *ECHOES*. Only two items from the Fall issue ("Scanning the Journals" and "Acoustics in the News") were reprinted in the October issue of *Acoustics Today*. Thus the Executive Council decided that *ECHOES* should again be printed and mailed to members, starting with this issue.

So once again, we are distributing a print copy of *ECHOES* to members as well as posting it online. As one Council member expressed it "ASA is big enough to have both a newsletter and a magazine." An informal poll at the Honolulu meeting revealed a preference for a print newsletter; few people found it convenient to read *ECHOES* online. We encourage your comments, both by email and by letters to the editor for publication.

As usual, we encourage letters to the editor on other subjects as well. Open meetings of the technical committees are a good place to share opinions with your colleagues on a variety of subjects, but Letters to the Editor in *ECHOES* are a good place to share opinions with other ASA members as well. We only ask that they be kept reasonably brief and to the point.

Other areas in *ECHOES* to which we especially encourage contributions are "We hear that…" (special honors and news about members) and "Good books I have read" (brief book reports, not meant to compete with the more complete reviews in *JASA*). Of course we always welcome contributed short articles on timely acoustics subjects. It is your newsletter!

Noise-Immune Stethoscope

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There are significant differences between the sounds produced by a conventional and by an ultrasound-based stethoscope. That is because they are based on totally different physical principles, and represent different physiological processes. Where a conventional stethoscope yields a "lub-dub" sound for normal heart beat, the same heart beat heard through an ultrasound stethoscope will yield a "ta-dá-da" pattern. Because of these differences, the new noise-immune stethoscope was designed on a hybrid two-in-one principle, where a conventional operation mode can be selected for quiet or moderately noisy environments, and ultrasound operation is selected in extreme noise conditions.

The new stethoscope is shown in Fig. 1. The top part of the device is the battery compartment, containing two 1.5V AA-cells. The device can be held between the index and middle fingers, with the thumb being free to operate a 4-button control panel. The finger space has been designed to fit an average hand covered with a standard UH-60 aviation glove.

The bottom part contains the stethoscope sensors and the signal-processing electronics. For electromechanical operation, a stack of conventional piezoelectric disk elements is driven by a movable piston at the bottom (the "head") of the device, designed as a mechanical transformer between chest tissue of the patient and the piezoelectric stack. The purpose of this transformer is to maximize the mechanical energy transfer from the human body to the sensor stack, while minimizing energy transfer from airborne sound to the sensor stack. An O-ring, placed on the bottom surface of the stethoscope and surrounding the sensor, keeps out surface waves that can be excited on the patient's skin by high-level environment noise or vehicle vibration.

For ultrasound operation, two semicircle-shaped disks, made of piezoelectric material, are embedded in the sensor head, where one functions as a transmitter and the other as a receiver of high-frequency sound waves. For this mode of operation, a contact gel placed between the stethoscope head and the patient's skin must be used to minimize ultrasound reflections at the sensor-skin boundary.

A thumb-operated 4-button control panel allows the device to be turned on, the signal volume to be set, and the operating mode to be selected. This allows a physician to switch between modes during auscultation of a patient, as long as noise levels are not so high as to obscure conventional-mode auscultation. Switching could be important, since each mode of auscultation provides its own specific kind of information. The stethoscope has a single signal output jack that can feed a set of Communications Earplugs ® or other types of sealed insert earphones or headsets.

Heartbeat auscultation was performed by a trained physician on a single healthy male subject of average body size. The auscultation environment was a reverberant chamber, equipped with high-power sound equipment capable of producing UH-60 type noise of various intensity levels, and yielding an approximately diffuse sound field. The maximum intensity level that could be produced by the sound system was 120 dB SPL.

Digital recordings of heartbeat signals were made at 16-bit resolution and 8-kHz sampling rates, at background noise levels from 70 to 110 dB SPL in 5-dB steps. A selection of results, obtained at background noise levels of 70 and 100 dB SPL are shown in Fig. 2. Graphs represent 5-second samples of stethoscope output on an arbitrary linear amplitude scale. Figure 2a, taken from the Littmann, shows a clearly discernable and audible heartbeat at 70 dB noise and a totally obscured and inaudible heartbeat at 100 dB. Figure 2b, however, shows almost identical heartbeat signals for the 70 dB and 100 dB background noise conditions, with both signals being clean and clearly audible. Even in a background noise level of 120 dB SPL, the maximum that could be produced by the equipment, the ultrasound stethoscope's output remained essentially noise-free.

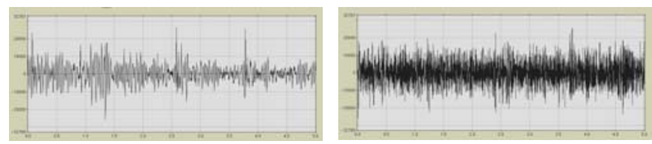


Fig. 2a. Heartbeat signats at 70 dB (left), 100 dB (right) background noise levels, measured with a 3M Littmann Cardiology III stethoscope.

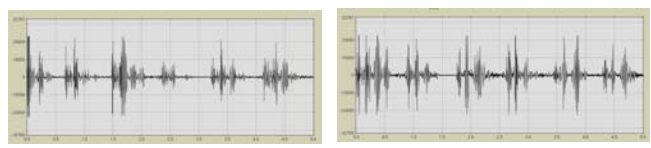


Fig. 2b. Same as Fig. 2a, measured with the dual-mode stethoscope in the ultrasound mode.

Conventional passive acoustic stethoscopes are ineffective in noisy environments that exceed levels of 80-85 dB SPL. Even if noise-attenuating earmuffs are worn, with the stethoscope tubing being fed through the earmuff walls, the background noise would still invade the system through the stethoscope's sensor head.

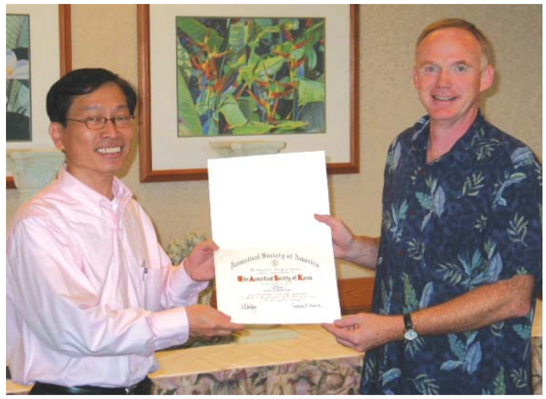
Ultrasound technology offers an auscultation mode that is essentially free of acoustic noise invasion from the environment. Auscultation in very noisy environments using this technology is limited only by the amount of hearing protection worn by the physician and by the maximum amount of sound that can be tolerated by the human ear. There always is, of course, some system noise associated with physical movement in the placement or orientation of the stethoscope head. This explains why measured signal-to-noise ratios in the output signal are not infinite but typically limited to about +20 dB.

Finally, the use of ultrasound in auscultation offers other advantages besides providing an essentially noise-free signal. The signal also contains information that cannot be obtained with conventional acoustical or electro-mechanical stethoscopes. Ultrasound acoustic images contain artifacts of tissue movement that could be of interest to cardiologists or other specialists, if it can be shown that specific sound features are correlated with specific physiological anomalies. Such exploration is left for future research.

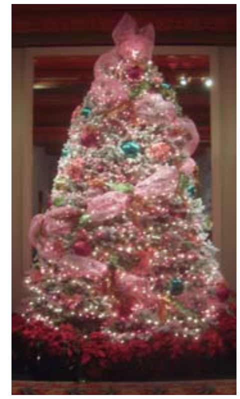
This article is based on paper 5pBB2 at the joint ASA/ASJ meeting in Honolulu December 2, 2006. Opinions, interpretations, and conclusions contained in this article are those of the authors and are not necessarily endorsed by the U.S. Army and/or the Department of Defense.

Echoes from Honolulu

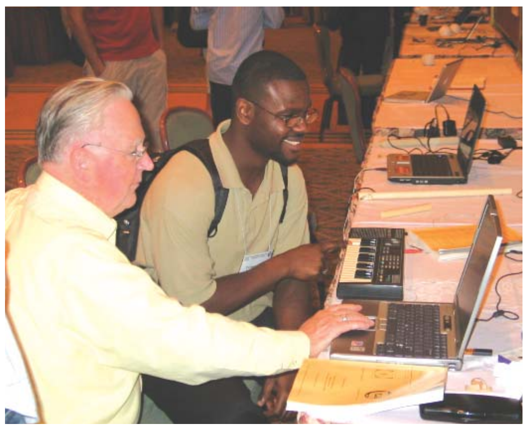
Session 2pMU included a koto concert by Tamaki Ando



Anthony Atchley (r) congratulates Suk Wang Yoon on the 25th anniversary of the Acoustical Society of Korea



Charles Schmid, Tom Rossing, Anthony Atchley at the banquet



Session 2aED Demonstrations and Tools in Acoustics Education (photo by Charles Schmid)

New Fellows with ASA officers (left to right) Philippe Blanc-Benon, Anthony Atchley, Michael Vorländer, Anthony W. Gummer, Marehalli G. Prasad, David A. Conant, Jody E. Kreiman, Charles W. Holland, Sergio Beristain,Kevin D. LePage, Hiroshi Riquimaroux, Whitlow W.L. Au

Echoes from Honolulu

Floyd Dunn was honored at sessions 3aBB/3pBB (photo by William O'Brien)

Manfred Schroeder was honored at sessions 2aPP/2pPP (photo by Juergen Schroeter)

From the Student Council

Andrew Ganse

Aloha! As expected, the Honolulu meeting was a popular one, with high attendance at the student functions. At every ASA meeting, two evenings of the week are filled with student social activities, meant to introduce students to each other and to encourage them to become more involved in their field and the ASA. Meanwhile, against a backdrop of tropical-tinged holiday tunes, beachwear, and leis, the student council was busy in Honolulu preparing more resources for the students of ASA:

The student website, the ASA Student Zone, is in the process of expanding again, and now has the address www.asastudentzone.org. (Note the old address still works if you have that one already bookmarked.) A new student website feature is in the works—an online student acoustics forum—with categories for each ASA section (architectural acoustics, acoustic oceanography, etc.) to host interactive Q&A and discussion by and for students.

The next Student Council Mentoring Award will be presented at the New Orleans meeting in fall 2007. The council welcomes all students in the ASA to nominate a mentor who has demonstrated exceptional ability in guiding the academic or professional growth of students and junior colleagues. The nominee does not need to be a professor, but must be a member of the ASA. Please see the "Mentor Award" section of the student website for more information and nomination forms, and email your student council representatives with questions. The deadline for submission is 23 April 2007.

Lastly, the council is soliciting for new fellowship/grant information and announcements for the student website and forum. If you are a professor or researcher who has a fellowship, grant, or post-doc position at your university dealing with acoustics that you would like to advertise to students in the ASA, the student council representative in your section would love to hear about it so that a short announcement can be placed on the student website.

All the best in the New Year and we'll look for you at the next meeting in Salt Lake City!

Andrew Ganse is a a seismology graduate student at the University of Washington and the student representative for Underwater Acoustics. aganse@apl.washington.edu

Best Student Paper Awards (Honolulu)

Animal Bioacoustics
First: T. Aran Mooney, University of Hawaii
Second: Adam Smith, Bowling Green State University

Acoustical Oceanography
First: Paul Roberts, Scripps Institution of Oceanography
Second: Tedanori Fujino, Fisheries Research Agency, Japan

Musical Acoustics
First: Andrey Ricardo da Silva, McGill University
Second: Eric Dieckman, Truman State University

Waikiki sunset

Scanning the Journals

Thomas D. Rossing

• **Low frequency sound** can travel almost unimpeded from water into air according to a paper in the 20 October issue of *Physical Review Letters*. These theoretical results are in stark contrast to the conventional view that the underwater world is largely silent to observers above water and could have important implications for marine biology, climatology and geophysics. The simple ray theory of acoustics predicts that any sound produced underwater will be reflected at the surface rather than transmitted into the air. However, the simple ray theory breaks down when the wavelength of the sound is comparable to (or longer than) the depth of the source. Water-to-air transmission at low frequencies involves evanescent sound waves in addition to the more familiar plane waves. The intensity of evanescent waves decreases exponentially with distance from the source and for a shallow source at a depth of a fraction of a wavelength they are transmitted to the air.

• "The troubled **song of the sand dunes**" is the title of an article in the November issue of *Physics World* that tells the story of strong disagreement between two French researchers over the mechanism responsible for the eerie song of "singing" sand dunes. In 2001 a group of researchers, including Stéphane Douady and graduate students Bruno Andreotti and Pascal Hersen were studying sand dunes in Morocco when they accidentally set off avalanches that were accompanied by loud booms. Douady came up with an explanation for the effect based on the "stick-slip" motion of sand grains moving down the slope as a single block. Andreotti thrashed out a more detailed explanation for how the motion of sand grains might produce sound. Douady reasoned that since sound is only produced when layers of sand above a certain thickness slide over one another, this means that the sound must arise from a resonance within the shear layer itself. Andreotti turned this logic around, arguing that the collisions between grains excite waves outside the shear layer on the dune surface that synchronize the collisions via a mechanism called wave-particle locking.

Some three or four years after their first trip, it was time for the researchers to submit for publication the considerable amount of knowledge they had amassed about the song of the dunes. At first they agreed to write a paper with the names of all the investigators on it, but opinions diverged. In 2004 Andreotti published a paper in *Physical Review Letters*, and in 2006 Douady, et al. published a paper in the same journal. Meanwhile another group of investigators at Caltech have made extensive measurements on sand dunes and found that they have a layered structure that causes a dune to act as a waveguide. They point out that neither Douady's nor Andreotti's analayses explain why some dunes do not sing. "Sand-dune science may not dominate the research-funding agenda, but unraveling the mystery of the singing dunes offers a valuable insight into how science is done," comments the author of the article in *Physicsi World*.

• Some **songbirds adapt their song** to survive in city noise, according to a paper in the December 5 issue of *Current Biology*. The pitch of the small songbird, the great tit (*Parus major*) was found to be higher in the city than in nearby forested areas, allowing them to be heard by potential mates over the lower frequency noise of traffic. Their songs were also observed to be shorter and faster, which may also be in response to the turbulent air found in cities.

• **Mechanoluminescence** (light emission by mechanical action in a solid) can be induced by pummeling crystals with ultrasound, according to a communication in the 9 November issue of *Nature*. Mechanoluminescence, also known as tribo-luminescence or fractoluminescence, has been known for many years; Francis Bacon noted in 1605 that lumps of sugar emitted light when scraped. However acoustic cavitation produces intense luminescence and emission lines that are not generated by other mechanisms such as grinding, cleaving, rubbing scratching, biting or thermal shock. When a slurry of resorcinol in helium- or argon-sparged hexadecane is sonicated, intense discharge lines of He and Ar gas are created, together with a weaker crystal luminescence.

• The November issue of *Acoustical Science and Technology* is a special issue devoted to **the amazing world of sounds with demonstrations**. Each article provides supplementary media files which can be viewed and heard at www.asj.gr.jp/2006/data/ast2706.html. Among the invited reviews are articles on phonemic restoration, demonstrations of the gap transfer illusion, perception of noise-vocoded speech sounds, combination tones, interaction auditory and visual information in conveyance of players' intentions, individualization of head-related transfer functions, perceptually isomorphic decomposition of speech sounds, single box surround sound, and demonstrations for education in acoustics in Japan. A CD-ROM with all the articles and media files will be attached to the April issue of the *Journal of the Acoustical Society of Japan*.

• An array of underwater microphones run by the UK military near the Scottish isle of Rona will be used to listen for **sound waves emitted when neutrons travel through water**, according to an article in the August issue of *Physics World*. Optical detectors are not sensitive to neutrons with energies above 1016 eV. Cerenkov radiation cannot travel more than about 100 m in water. Acoustic signals, on the other hand, can penetrate up to several km.

• "A simple **laser microphone** for classroom demonstration" is the title of a article in the December issue of *The Physics Teacher*. The inexpensive demonstration uses a pane of glass, a laser, a silicon solar cell, and an audio amplifier. This arrangement, used by law enforcement and intelligence agencies, resembles the "photophone" of Alexander Graham Bell, as pointed out in the Spring 2006 issue of *ECHOES*. Vibration of the glass causes the window to bend, changing the light intensity at the solar cell.

• Broadband **surface phonon wave packets** on a phononic crystal are tracked with an ultrafast optical technique accord-

Scanning the Journals

ing to a letter in the 12 September issue of *Physical Review Letters*. The eigenmode distribution and the acoustic band structure are obtained from Fourier transforms of the data up to 1 GHz. Stop bands for both Rayleigh waves and leaky-longitudinal waves are found at the zone boundaries.

• The August issue of *Acoustics Australia* includes 4 review papers on **active noise control**. The first one is entitled "Active Noise Control: A Review in the Context of the 'Cube of Difficulty.'" The cube illustrates how the three physical quantities: frequency bandwidth, spatial extent and signal coherence, contribute to the difficulty of achieving control performance.

• "**Language control in the bilingual brain**" is the title of a paper in the 9 June issue of *Science*. How does the bilingual brain distinguish and control which language is in use? Apparently neuronal responses within the left caudate are sensitive to changes in the language or the meaning of words. From studies of German-English and Japanese-English bilinguals, the investigators suggest that the left caudate plays a universal role in monitoring and controlling the language in use.

• Many night-flying insects evolved **ultrasound sensitive ears** in response to acoustic predation by echolocating bats. The noctuid moths are most sensitive to frequencies at 20-40 kHz, the lower range of bat ultrasound, but according to a paper in the 19 December issue of *Current Biology* they can mechanically shift this frequency upward to the higher frequencies used by hunting bats. A mathematical model is constructed for predicting a linear relationship between the ear's mechanical stiffness and sound intensity.

• The Revised **ISO 362 Standard for Vehicle Exterior Noise Measurement** is discussed in an article in the October issue of *Sound & Vibration*. The proposed standard provides a performance-based measurement for motorcycles, light duty vehicles, and heavy duty vehicles consistent with typical urban operation.

• Using a phase vocoder, low-frequency components can be used to simulate a **virtual bass loudspeaker** according to a paper in the November issue of the *Journal of the Audio Engineering Society*. Subjective tests showed that this approach, which uses three overtones, produced better timbral quality than the traditional approach of nonlinear processing of low frequencies to generate bass sensation.

• A direct determination of the dynamic behavior of confined **acoustic phonons in nanocavities** is reported in the 15 September issue of *Physical Review Letters*. Using picosecond acoustics, evidence is given for resonant transmission peaks in three successive stop bands in quantitative agreement with acoustic simulations. Picosecond transit times are measured in the stop band, shorter than in any of the constituting materials, a tunneling effect well known in photonic crystals as well as macroscopic phononic systems. The researchers think that a new field of nanophonics has been inaugurated and that the acoustical properties of semiconductor nanodevices will play important roles.

Acoustics in the News

• Seismologists can give residents of earthquake zones a few seconds of warning of a coming quake by analyzing the first waves the quake produces, but until now they have been unable to predict the magnitude. Now, according to a news note in the 15 December issue of *Science*, Italian researchers say the same p-waves can predict the magnitude as well. Some experts are skeptical, but find the data convincing enough to be looked at seriously. The first earthquake signals to arrive at a seismic station are the primary or p-waves, which are compression waves like sound in air. P-waves travel fast, about 8 km/s but they do not carry the destructive force of the secondary or s-waves, shear waves that travel at 3.5 km/s and cause the ground to oscillate. Depending upon distance from the epicenter, they arrive several seconds later. The Italian researchers analyzed records from 207 earthquakes that occurred between 1976 and 1999 in the Mediterranean area. The team compared the peak amplitude of the first 2 seconds of the p-waves to the amplitudes of the s-wave and found that both quantities correlate closely enough with a quake's magnitude to be useful in the early earthquake warning (EEW) system.

• When ice builds up on aircraft wings while flying through cloud, rain or drizzle it is more difficult for the pilot to control the aircraft. Drag increases and lift decreases, and in some cases the airplane crashes. Large aircraft direct hot engine air onto their wings to keep them free of ice, but smaller craft must depend on electric wing heaters. According to an item in the 18 November issue of *New Scientist*, engineers have demonstrated that piezoelectric actuators at the leading edge of the wing may do the job more efficiently. Small patches of piezoelectric crystal only 3 mm thick can shake off ice while using only 10 to 15 watts of alternating current per square meter.

• An important fish census in Canada is concerned with the impact of river dams on the survival of Pacific salmon. According to a story in the 11 December *Toronto Star*, salmon are equipped with acoustical transmitters whose signals are picked up by a network of more than 250 seabed receivers on the continental shelf, stretching along fish migration highways 2,000 kilometers from California to Alaska. Researchers found no significant difference in arrival rates between salmon forced to navigate eight dams on the Columbia River to reach the ocean compared to Fraser River salmon that faced one dam at most.

• "String Theory: Approaches to Instrument Design" is the title of a story in the 28 November issue of *The New York Times* about experimental violins and guitars made of graphite fibers in epoxy and even balsa wood. Layered graphite fibers and carved balsa are very stiff but far less dense than the traditional spruce used for violin and guitar top plates. Lighter plates appear to have a faster response.

• An oil pipeline leak last August caused BP to shut down its Prudhoe Bay operations and focused attention on oil pipeline inspection, according to a story in the October issue of *IEEE Spectrum* online. Domestic oil production capacity was cut by nearly 8% and traders bid up the price of oil futures. BP uses ultrasonics, radiographic, magnetic flux, guided wave, and electromagnetic methods to see inside pipes in Alaska, but they were not regularly used on the particular transit line that ruptured in August.

• Since at least the time of Marco Polo desert travelers have heard the deep hums of sand dunes, we are reminded in the 25 July issue of *The New York Times*. The dunes at Sand Mountain in Nevada sing a note of low C, two octaves below middle C. In the desert of Mar de Dunas in Chile, the dunes sing slightly higher, an F, while the sands of Ghord Lahmar in Morocco are higher yet, a G sharp. The deep hums, up to 115 dB, can last several minutes. (See related story in “Scanning the Journals”)

• Nine months after serious allegations were leveled against high-profile “bubble fusion” research at Purdue University, the institution is being criticized for its apparent failure to respond, according to a news item in the 7 December issue of *Nature*. The head of the nuclear engineering school where the work was carried out resigned his position, expressing disappointment over the slow pace and secrecy of the university’s response. Since March 2002, Rusi Taleyarkhan, a professor at Purdue, has published three papers claiming to have achieved nuclear fusion by using sound waves to collapse bubbles in deuterated liquids.

• Humpback whales possess a vastly more elaborate vocabulary than was previously known, according to an item in the 27 November edition of *Fox News.com*. Monitoring humpback whale sounds and activity as the whales migrated along the east coast of Australia, investigators found 35 different kinds of sounds, which they characterized as “thwops, wops, grumbles, snorts, cries” and what are likely underwater blows. These sounds appeared to have a variety of social uses, including possibly to help mothers and calves stay in contact. At times, they used sounds specific to male songs for social interactions, mainly when single males joined females.

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