**3:00**

**3aUWd8. Biot-Stoll with squirt flow and shear (BICSQS) model: high-frequency correction**. Nicholas P. Chotiros (Applied Research Laboratories, University of Texas, PO Box 8029, Austin, TX 78713-8029, USA, chotiros@arlut.utexas.edu)

The modeling of the grain to grain shear stiffness within the larger Biot-Stoll plus contact squirt flow and shear (BICSQS) model [N. P. Chotiros and M. J. Isakson, J. Acoust. Soc. Am. 116(4), 2011-2022, 2004] assumes Poiseuille flow, which must become invalid at high-frequencies. Specifically, the viscous shear drag term will be unphysically large. A correction is introduced based on Biot's solution for oscillatory flow between two parallel plane boundaries [M. A. Biot, J. Acoust. Soc. Am. 28, 179-191, 1956]. Although the original solution was derived for oscillatory fluid flow relative to stationary parallel plane boundaries, it can be readily adapted for oscillatory motion of the boundaries in opposite directions relative to the fluid, as in shear drag at the grain to grain contact. This correction extends the frequency range of the BICSQS model. Theoretical results, with and without the correction, will be compared. Work supported by the Office of Naval Research, Ocean Acoustics.

### *Contributed Paper*

**3:20**

**3aUWd9. Use of dual methods to infer methane bubble populations in gassy sediment: Inversion of propagation data**. Gary B. Robb (National Oceanography Centre, University of Southampton Waterfront Campus, European Way, SO14 3ZH Southampton, UK, gbor199@noc.soton.ac.uk), Timothy G. Leighton (Institute of Sound and Vibration, Univ. of Southampton, University Road, Highfield, SO17 1BJ Southampton, UK, T.G.Leighton@soton.ac.uk), Agni Mantouka (Institute of Sound and Vibration, Univ. of Southampton, University Road, Highfield, SO17 1BJ Southampton, UK, am2@isvr.soton.ac.uk), Angus I. Best (National Oceanography Centre, University of Southampton Waterfront Campus, European Way, SO14 3ZH Southampton, UK, aib@noc.soton.ac.uk), Justin K. Dix (National Oceanography Centre, University of Southampton Waterfront Campus, European Way, SO14 3ZH Southampton, UK, jkd@noc.soton.ac.uk), Victor F. Humphrey (Institute ofSound and Vibration, Univ. of Southampton, University Road, Highfield, SO17 1BJ Southampton, UK, vh@isvr.soton.ac.uk), Zygmunt Klusek (Institute of Oceanography, Polish Academy of Science, P.O. Box 148 Sopot, Poland, klusek@iopan.gda.pl), Paul R. White (Institute of Sound and Vibration, Univ. of Southampton, University Road, Highfield, SO17 1BJ Southampton, UK, prw@isvr.soton.ac.uk)

The inversion of the acoustic properties of gassy sediments presents the optimum manner of determining the in situ distribution of sediment-based methane bubbles. An in situ device that measures both compressional wave attenuations and combination-frequency components in gassy sediment lying within 2 m of the seabed has been developed at the University of Southampton. This device was deployed at an inter-tidal site along the South coast of England. Compressional wave attenuations were measured from 10 to 100 kHz though the analysis of propagation signals transmitted from a variety of sources to a buried co-linear hydrophone array, with propagation distances spanning 0.5 to 2 m. Measured attenuations were inverted to infer in situ bubble size distributions using both established and new acoustic models for gassy sediment. The analysis and results of the combination-frequency component are described in a companion paper.

## WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 242B, 2:00 TO 3:40 P.M.

# Session 3pAA

## Architectural Acoustics: Architectural Acoustics Potpourri I

David T. Bradley, Cochair
*124 Raymond Avenue, Poughkeepsie, NY, 12604*

Andrea Farnetani, Cochair
*University of Ferrara, Via Saragat 1, 44100 Ferrara, Italy*

### *Contributed Papers*

**2:00**

**3pAA1. Shape optimization of polygonal rooms for a correct modal distribution at low frequencies based on psychoacoustic criterion**. Sergio Floody (Universidad Tecnologica de Chile INACAP, Brown Norte 290, Nunoa, 7790569 Santiago, Chile, sfloody@utc.cl), Rodolfo Venegas (University of Salford, Acoustics Research Centre, Newton Building, M5 4WT Salford, UK, R.G.VenegasCastillo@pgr.salford.ac.uk)

Resonances in small rooms may lead to inadequate frequency responses. In rooms, where the exigencies on the listening conditions are important, these resonances may cause non wanted coloration effects, which implies a non desirable sound quality. By choosing the right shape and dimensions it is possible to reduce the audible effects of these resonances. The presented methodology aims to determine the shape and size of small and medium polygonal-shaped rooms based on the finite element method for modeling the physical acoustic behavior of the room; a neural network for loudness estimation and genetic algorithm for estimating the optimal dimensions. A comparison with previous techniques used to choose the dimension of rectangular room is also presented.

**2:20**

**3pAA2. The reflected sound field by curved surfaces**. Martijn Vercammen (Peutz, De Grippen 1124, 6605 TA Wijchen, Netherlands, m.vercammen@mook.peutz.nl)

Many spaces have curved walls or ceilings. With improved building technology and new fashions in architecture (blobs) there is an increasing number of problems due to the acoustic reflections by these surfaces. Sound reflected by concave surfaces will concentrate in a narrow area. In practical applications of room acoustics these curved surfaces will be calculated with mirror imaging or ray tracing programs, in which the structure is modeled by flat segments. Alternative is a geometrical approach. Both methods do

not correspond to reality. The only valid calculation method is the calculation from a wave extrapolation method. It is shown that a theoretical correct solution of the sound field by curved surfaces is possible. A fairly simple expression for the sound pressure in the focal point is found and a more complicated description of the reflected sound field by small curved surfaces is presented. With these results the sound field in field applications can be calculated.

**2:40**

**3pAA3. Calculation of temporal evolution of sound pressure levels in rooms, based on diffuse reflection**. René Gamba (Gamba Acoustique, 2 rue de la découverte, BP 163, 31676 Labege Cedex, France, rene.gamba@acoustique-gamba.fr), Guillaume Cazard (Gamba Acoustique, 2 rue de la découverte, BP 163, 31676 Labege Cedex, France, guillaume.cazard@acoustique-gamba.fr), Claude Senat (Gamba Acoustique, 2 rue de la découverte, BP 163, 31676 Labege Cedex, France, claude .senat@acoustique-gamba.fr)

This paper describes a model which enables the temporal evolution of sound pressure levels in rooms to be calculated. It is built on the assumption that sound waves are totally scattered when reflected by the walls. This model prescribes the sampling of all the surfaces of the room and defines a process of time discretization, process which enables the temporal evolution of energetic exchanges between each sample to be known. Ultimately, the model allows the sound pressure level to be calculated in every point of the room for each time sample $\Delta t$ (echograms). Thanks to the echograms, some useful criterias for room acoustic studies can be evaluated : reverberation time, EDT, D50, C80,... Measurements and calculations have been carried out for different kinds of rooms. We will describe them in the second part of this paper.

**3:00**

**3pAA4. Sound absorption with fibre-free sintered aluminium in combination with thermally activated concrete slabs**. Wouter Rottiers (Sonogamma, P.O.Box 49, Heverlee Ambassade, 3001 Leuven, Belgium, info@sonogamma.com)

Due to increasing ecological awareness and growing requirements of human well-being in working environments, contemporary interior design requires sustainable solutions. Consequently, cooling ceilings are an efficient alternative to conventional air conditioning systems with high energy demands. In order to maintain its thermal efficiency however, the ceiling surface must remain uncovered as much as possible. Conventional perforated or grooved acoustical materials allow for sound absorption only in combination with mineral wool or foam, thus presenting a thermal isolating barrier: they obviously decrease the performance of a thermal ceiling. Porous panels made of pure sintered aluminium offer a conductivity up to 96 kcl / mhC with a thermal radiation of 18.4 W / $m^2$K, combined with a broadband sound absorption up to $\alpha w = 0.7$ without the use of any additional thermally isolating material. The panels meet the environmental, hygienic and fire safety requirements: they are fibre-free, non-combustible (Euroclass A1), rust-, moisture- and chlorine-proof and can be recycled. The unvisible porosity does not give away the outstanding acoustical qualities. Available in several designs and any colour, the sheets are optically identical to a plain, matt aluminium panel. Several possible configurations are discussed.

**3:20**

**3pAA5. Sound reduction of open noise screens**. Jan Hardlooper (Cauberg-Huygen Consulting Engineers, Postbus 9222, 3007 AE Rotterdam, Netherlands, j.hardlooper@chri.nl)

Open noise screens consist of vertical absorbing screens with a depth of 1 meter, placed perpendicular to a building with a mutual distance of 1 meter. The screens are placed at a distance of approximately 1,5 meter. Open noise screens combine a sound reduction of 16 dB with a very open character for ventilation and daylight admittance. Measurements are carried out on a scale model (1:40) in a laboratory and in situ on a real size mock-up, built in a 40-ft container. The results of the mock-up are comparable to the laboratory results. Frequency analysis shows the acoustical principles of the screens and the influence of several parameters. A calculation model is developed tot predict the results for other configurations. The principle of open noise screens is successfully applied for 200 new dwellings in Amsterdam. Suggestions are given for applying open noise screens near highways and railroads, instead of traditional closed screens.

## Session 3pAB

# Animal Bioacoustics, Psychological and Physiological Acoustics, and ECUA: Auditory Brainstem Response and Behavior Correlation I

Elizabeth Brittan-Powell, Cochair
*Dept of Psychology, University of Maryland, College Park, MD 20742, USA*

Alexander Y. Supin, Cochair
*Institute of Ecology and Evolution, 33 Leninsky Prospect, Moscow, 119071, Russian Federation*

### *Invited Papers*

**2:00**

**3pAB1. Auditory brainstem responses in birds: How well do they compare to behavioral techniques for assessing hearing?** Elizabeth Brittan-Powell (Dept of Psychology, University of Maryland, College Park, MD 20742, USA, bbrittanpowell@psyc.umd.edu), Bernard Lohr (Department of Biological Sciences, Northern Kentucky University, SC 204D, Nunn Drive, Highland Heights, AK 41099, USA, lohrb1@nku.edu), Isabelle Noirot (Dpt of Science/Oceanography, University of Liege, Bat B6c, 4000 Sart-Tilman, B-4000 Liege, Belgium, isa_noirot@hotmail.com), Robert Dooling (Dept of Psychology, University of Maryland, College Park, MD 20742, USA, dooling@psyc.umd.edu)

Behavioral methods are the gold standard for assessing hearing sensitivity in birds. In many cases, however, behavioral techniques are simply impractical. The non-invasive auditory brainstem response (ABR) represents perhaps the next best approach, and researchers are increasingly turning to the ABR to obtain estimates of hearing sensitivity, auditory system function and development. Our lab has evaluated hearing sensitivity in over 11 species of birds using the ABR, and for six of these species, we have also obtained auditory thresholds by behavioral conditioning methods. These data, along with other results from the literature on bird hearing, now allow general conclusions about the use of ABR as a tool for measuring auditory sensitivity in birds. Waveform morphology is highly conserved across orders of birds. Regardless of how threshold is defined, the ABR audiogram reliably reflects the frequency range of hearing and the shape of the behavioral audiogram. However, ABR thresholds are higher than behavioral thresholds by 20-30 dB but with some variation across species. Aside from audiograms based on simple detection thresholds for tone bursts, ABR methods in birds have also been useful in assessing auditory development, hearing impairment, recovery of function with hair cell regeneration, masked thresholds and aspects of spectral and temporal processing.

**2:20**

**3pAB2. The Auditory Brainstem Response (ABR) Across Mammalian Species**. Robert Burkard (University at Buffalo, Department of Rehabilitation Science, 511 Kimball Tower, Buffalo, NY 14214, USA, rfb@buffalo.edu)

The auditory brainstem response (ABR) has been reported in a variety of mammalian species. I have published ABR studies in mammalian species including humans, gerbils, cats, rats, bats, and mice. In many cases, the non-human work was designed to extend observations made in humans. I will discuss data that addresses the variability in the slope of the ABR latency/intensity function across animal species. I will compare ABRs in humans and in gerbils to stimulus manipulations such as click level, click rate, noiseburst risetime and level of masking noise. I will discuss the effects of high stimulus rates across age in the kitten/cat, and compare this to reports in humans from the literature. I will end by discussing my views of the advantages as well as the challenges of using animal models when interested in human normative or pathologic processes.

### *Contributed Paper*

**2:40**

**3pAB3. Arbitrary evoked potentials: using AEPs to measure hearing in fishes**. David Mann (University of South Florida, College of Marine Science, 140 7th Ave. S., St. Petersburg, FL 33701, USA, dmann@marine.usf.edu), Randy Hill (University of South Florida, College of Marine Science, 140 7th Ave. S., St. Petersburg, FL 33701, USA, randyjhill@yahoo.com)

Auditory evoked potential (AEP) techniques have become commonly used to measure hearing of a wide variety of animals. However, there is no standard way of defining a threshold from auditory evoked potential data. There are two arbitrary factors affecting the precision of AEP data: the number of sweeps averaged together to detect the AEP, and the method of calculating a threshold from the AEP data. While these arbitrary factors do not invalidate comparative studies where these variables are standardized, different laboratories use different techniques. We describe sources of variation in estimating thresholds using evoked potential techniques using the goldfish as an example. There was little variation in AEP thresholds due to variation in electrode placement or in the method of arbitrarily assigning an AEP threshold. The largest variation was due to differences in the number of sweeps averaged. Under controlled conditions using the same goldfish in the same test tank with the same number of sweeps averaged, AEP's better predicted behavioral thresholds at high frequencies than low frequencies. Since averaging reduces uncorrelated background noise (neural and electrical), it should theoretically be possible to obtain AEP measurements below behavioral thresholds with enough sweeps averaged together.

### *Invited Papers*

**3:00**

**3pAB4. False killer whale hearing adjustment during echolocation measured with evoked potentials**. Paul E. Nachtigall (University of Hawaii, Hawaii Institute of Marine Biology, P.O. Box 1106, Kailua, HI 96734, USA, nachtiga@hawaii.edu), Alexander Y. Supin (Institute of Ecology and Evolution, 33 Leninsky Prospect, 119071 Moscow, Russian Federation, alex_supin@mail.ru)

While much has been previously learned about the echolocation performance and characteristics of the outgoing signals of echolocating dolphins and small whales, we have measured hearing using evoked potentials during echolocation. We have found that: (1) the whale may hear her loud outgoing clicks and much quieter returning echoes at comparable levels, (2) the whale has protective mechanisms and hears her outgoing signals at a level about 40 dB lower than similar signals presented directly in front of her, (3) when echo return levels are lowered either by making the targets smaller or by placing the targets farther away - without changing the levels of her outgoing signals, the hearing of those echoes remains at almost the same level, (4) if targets are made much smaller and harder to echolocate, the animal will increase what she hears of her outgoing signal - as if to heighten overall hearing sensitivity to keep the echo level hearable, and (5) the animal has an active 'automatic gain control' mechanism in her hearing based on both forward masking that balances outgoing pulse intensity and time between pulse and echo and active hearing control. Overall, hearing during echolocation appears to be an actively changing process.

**3:20**

**3pAB5. Temporal resolution in the hearing system and auditory evoked potentials**. Kristian Beedholm (Institute of Biology, University of Southern Denmark, Campusvej 55, 5230 Odense M, Denmark, beedholm@mail.dk), Lee A. Miller (Institute of Biology, University of Southern Denmark, Campusvej 55, 5230 Odense M, Denmark, lee@biology.sdu.dk)

A popular type of investigation with auditory evoked potentials (AEP) consists of mapping the dependency of the envelope following response to the AM frequency. This results in what is called the modulation rate transfer function (MRTF). The physiological interpretation of the MRTF is not straight forward, but is often used as a measure of the ability of the auditory system to encode temporal changes. It is, however, shown here that the MRTF must depend on the waveform of the click-evoked AEP (ceAEP), which does not relate directly to temporal resolution. The theoretical relationship between the spectrum of the ceAEP and MRTF is such that the MRTF should be identical to the ceAEP if a 1/f weighting is applied to the ceAEP. Deviations from this relationship indeed reflect temporal resolution capabilities. We measured this in a harbour porpoise. Our devised stimulus was a sequence of 0.5 ms Hann weighted 130 kHz tone pips presented at an increasing rate (chirped) over a time span of 32 ms. The results reveal that the system's responsiveness declines roughly exponentially as a function of click rate with a rate constant of about -0.7 kHz and appears more rate limited than implied by traditional MRTF.

WEDNESDAY AFTERNOON, 2 JULY 2008 AMPHI MAILLOT, 1:40 TO 3:40 P.M.



## Session 3pMUa

## Musical Acoustics: Bowed and Keyboard Stringed Instruments I

Knut Guettler, Cochair
*Norwegian Academy of Music, P.O.Box 5190 Majorstuen, Oslo, 0302, Norway*

Claudia Fritz, Cochair
*University of Cambridge, Music Faculty, West Rd, Cambridge, CB3 9DP, UK*

### *Contributed Papers*

**1:40**

**3pMUa1. On the dynamics of the clavichord**. Christophe D'Alessandro (LIMSI-CNRS, B.P. 133, 91403 Orsay, France, cda@limsi.fr)

The clavichord is generally considered as the most sensitive and subtle among keyboard instruments. The player/instrument interaction is very direct: the mechanism is reduced to as simple lever, allowing for a direct contact between the finger and string through the key. Key velocity, two string-tangent contact signals, radiated acoustic signal have been synchronously measured for about 10 dynamic nuances and all the notes of four instruments (a 51 notes unfretted instrument, after a German XVIIIth century model, a 51 notes fretted instrument after Hubert (1754), a 45 notes fretted instrument, after a German XVIIth century model, a 37 notes fretted instrument after a medieval model). The instruments can be portrayed in terms of dynamic range, tonal/spectral colour and sound decay time. As for the dynamics, there is some evidence for a linear relationship between sound pressure level and the velocity of the tangent; and an almost constant spectral richness independently of loudness (in contrast with e.g. the piano). A simple model of the tangent/string interaction is proposed. This model reproduces well the behaviour of experimental data, and it may explain why sound quality of the clavichord depends much on the player's ability.

**2:00**

**3pMUa2. Couchet Harpsichord soundboard vibroacoustics behaviour: An application of the Impact Nearfield Acoustical Holography (IPNAH)**. Sylvie Le Moyne (UPMC Univ Paris 06, CNRS UMR 7190 Institut Jean Le Rond D'Alembert, 2 Place de la Gare de Ceinture, 78210 Saint Cyr l'Ecole, France, slemoyne@ccr.jussieu.fr), Sandie Le Conte (Musée de la Musique,

221 avenue Jean Jaures, 75019 Paris, France, sleconte@cite-musique.fr), François Ollivier (UPMC Univ Paris 06, CNRS UMR 7190 Institut Jean Le Rond D'Alembert, 2 Place de la Gare de Ceinture, 78210 Saint Cyr l'Ecole, France, frol@ccr.jussieu.fr)

The Music Museum in Paris recently acquired a harpsichord made by Ioannes Couchet in 1652 in Anvers. As a masterpiece this instrument is considered as a ″National Treasure″ and therefore protected. A challenging problematic has risen when its restoration was decided since the aim was to play this instrument again in concert. In the objectives of increasing our understanding of the harpsichord ageing, improve a numerical model currently in process and develop a diagnostic method for conservation, an experimental modal analysis of the soundboard was performed by processing its sound field. A non intrusive method, the Impact Planar Nearfield Acoustic Holography, was used. This technique, developed by the authors, implements the well known inverse method NAH on the basis of the acoustic impulse response field and is well adapted to modal analysis. NAH is performed here in unusual conditions compared to literature, as they are far from the ideal: unbaffled source, low sound pressure level, unusually large measurement distance, preponderance of evanescent waves. An additional challenge was to muffle strings, as they should not be removed nor slackened. However, a very satisfying modal decomposition for [30-1500Hz] bandwidth is obtained. Results are confronted with literature and an energetic analysis is proposed.

**2:20**

**3pMUa3. What have they done to the Strads?** John McLennan (University of New South Wales, Music Acoustics, School of Physics, NSW 2052 Sydney, Australia, jmcl1597@bigpond.net.au), Joe Wolfe (University of New South Wales, Music Acoustics, School of Physics, NSW 2052 Sydney, Australia, J.Wolfe@unsw.edu.au)

Almost every baroque violin, including those of Stradivarius etc, was extensively modified during the conversion to the romantic or modern configuration. What were the acoustic and playing changes? To answer this question, independently of the confounding factors of wood and manufacture, a baroque violin was made and subjected to acoustic and playing tests, before and after (i) replacement of the neck and fingerboard with longer, heavier more inclined parts, (ii) replacing gut with modern nylon-cored strings. Other changes were also made, including bridge style and position, bass bar and soundpost sizes and bow used. Loudness (Saunders plot) was not greatly changed, except for the E string with a long string length. Some acoustic features survived the changes, and professional baroque and modern style players reported that the instrument preserved some of its ″personality″. Comparisons were made with modern gut strings used by professional baroque players. As well as the acoustic differences, player assessments of bright/dull, full/thin, open/closed, ease of response, evenness, dynamic range are reported. Averaged over all ratings, the players ranked the romantic set up slightly better than the baroque (78% vs 71%).

**2:40**

**3pMUa4. Perceptual studies of violin vibrato**. Claudia Fritz (University of Cambridge, Music Faculty, West Rd, CB3 9DP Cambridge, UK, cf291@cam.ac.uk), Jim Woodhouse (University of Cambridge, Dept of Engineering, Trumpington St, CB2 1PZ Cambridge, UK, jw12@cam.ac.uk), Brian Moore (University of Cambridge, Department of Experimental Psychology, Downing Street, CB2 3EB Cambridge, UK, bcjm@cam.ac.uk), Ian Cross (University of Cambridge, Music Faculty, West Rd, CB3 9DP Cambridge, UK, ic108@cam.ac.uk)

Although it seems obvious to violinists that vibrato has a large influence on the perception of violin tone quality, published studies of violin vibrato have mainly concerned its influence on the sound from a scientific point of view, i.e. the characterisation of its time-frequency properties. Work will be described to explore the link between the perception of vibrato notes, the extent of frequency modulation and the level of damping of the resonance modes of the violin. Damping influences the ″peakiness″ of the frequency response function. The test methodology is based on liveliness ratings and triadic comparisons, where subjects have to select the most similar and the most different pair in each triad (presentation of three sounds). The sounds of the corpus are synthesised using sawtooth waves with frequency modulation, whose amplitude is varied, filtered through a set of admittances corresponding to a reference violin and two modified violins, one with the damping of all modes increased, the other one with the damping decreased.

**3:00**

**3pMUa5. Performance comparison of violins through experimental force analyses**. Enrico Ravina (University of Genoa - Centre of Research on Choral and Instrumental Music (MUSICOS), Via Opera Pia 15 A, 16145 Genova, Italy, enrico.ravina@unige.it), Paolo Silvestri (Univ. of Genoa - DIMEC, Via Opera Pia 15 A, 16145 Genova, Italy, p.silvestri@unige.it), Federico Lowenberger (Master Violinmaker, Via Marussig 13, 16100 Genova, Italy, info@baroqueviolins.com)

The paper describes the most recent experiments developed on violins with different mounting (baroque, classical, modern) and specifically oriented to the dynamic forces analysis in significant points of the instruments. The vibrational behaviour of the soundboards are strongly influenced by the dynamic forces transmitted from the bridge: they are related also to the tension of the strings. An original testbench conceived to forces measurement has been set up: tensions on strings, forces detected under the bridge and deformations on the fingerboard and on the tailpiece are, in particular, monitored by means not intrusive thin-film tactile pressure measurement devices, micro load cells and micro strain gauges. Mapping of forces and strains are acquired in real time playing the instrument; the paper reports comparisons between differently mounted violins, playing notes under different techniques: continuous (″tenuta″) , ghost (″strappata″), ″detachet″. Experiments are developed using different kind of strings (bowels, metallic,...). The results are used as input for experimental dynamic analyses and tests of the soundboard: in addition, they can be correlated to the acoustic response of the instrument.

**3:20**

**3pMUa6. Shaping and understanding sound: Violin makers, musicians and scientists from Renaissance to Romantism**. Anne Houssay (Cité de la musique, 221, avenue Jean Jaurès, 75019 Paris, France, ahoussay@cite-musique.fr)

The training of instrument-makers in Renaissance Italy is linked to a rediscovery of theoretical works on physics and sound as well as to some new tools and skills. Then, the development of physics in the seventeenth and eighteenth century lead the establishment of acoustic as a modern science, with the distinction of partials from harmonics. The ″western world″ has given explanations on vibrations, modes and then elasticity theories, some of which have been included into general knowledge. By times, links between scientists and makers have developed and have participated to the development of musical instruments. Traditional violin makers are craftspeople, and they construct instruments by choosing step by step between many possibilities from the drawing of the model and the choice of materials, to the cutting out of the shapes to create air volumes and vibrating facings. Their parameters are the dimensions, shapes, weight, elasticity, quality and duration of sounds and notes. The test for judging the results is the playing of the instrument by a very competent musician. We will explore, with a point of view of the historian of techniques how the meeting of different cultures and knowledge have transformed the instruments from the Renaissance to the begining of the 19th century.

## Session 3pMUb

# Musical Acoustics: Wind Instruments I

Seiji Adachi, Cochair
*Fraunhofer Institute for Building Physics, Nobelstrasse 12, Stuttgart, 70569, Germany*

Simon Félix, Cochair
*Laboratoire d'Acoustique de l'Université du Maine, Avenue Olivier Messiaen, Le Mans, 72085, France*

### *Contributed Papers*

**1:40**

**3pMUb1. Individual reed characteristics due to changed damping using coupled flow-structure and time-dependent geometry changing Finite-Element calculation**. Rolf Bader (University of Hamburg, Institute of Musicology, Neue Rabenstr. 13, 20354 Hamburg, Germany, R_Bader@t-online.de)

The vibration of a reed of a saxophone is calculated using a 2D model of the mouth cavity, the mouth piece and the reed. The time-dependent Finite-Element calculation takes the flow-structure interaction into account and changes the geometry of the flow according to the reed vibration in time. The model is used to study the flow behaviour, pressure distribution, reed vibration and reaction to disturbances of the system. A constant pressure is assumed at the mouth cavity to simulate the pressure of the player's lungs. During the time-dependent process, an impulse is modeled at the end of the mouth piece travelling back from the end of the tube. The damping of the reed was changed to study the reed behaviour. Hard damped reeds show a simple and stable impulse behaviour causing a clear pressure impulse. When the damping is decreased, the impulse coming back from the end of the tube causes the reed not only to open and close but also to show additional vibrations caused by the interplay of the reed's eigenfrequencies and the pressure acting on the reed. These are more or less independent of the travelling impulse and so are a sound characteristic of the reed itself independent of the played note and used articulation.

**2:00**

**3pMUb2. Aspects of vibrato and micromodulation in double reed instrument sounds**. Michael Oehler (Institute for applied Musicology and Psychology, Saarstrasse 1A, 50677 Koeln, Germany, michael.oehler@iamp.info), Christoph Reuter (University of Cologne - Musicological Institute, Beethovenstrasse 4, 50674 Koeln, Germany, info@chr-reuter.de)

The perceived naturalness of real and synthesized oboe and bassoon vibrato sounds has been investigated in several perception experiments. The stimuli were generated by means of a currently developed synthesis and analysis framework for wind instrument sounds (first presented at 152nd ASA meeting), based on the pulse forming theory. The framework allows the control of amplitude and frequency parameters at different sound production levels. The stimuli were rated by 60 subjects from ″natural″ to ″unnatural″. A conducted ANOVA showed ($p<.01$) that the different types of modulation significantly affect the perceived naturalness of vibrato sounds: The synthesized stimuli with combined pulse width and cycle duration modulation (source modulation) are perceived as natural as the real sounds. The subsequently modulated synthesized stimuli (AM and/or FM near the end of the signal path) are perceived significantly less natural ($p<.01$). The results support the hypothesis, that source-affected timbre modulation is an important factor for the perceived naturalness of oboe and bassoon vibrato sounds. The use of the developed framework for wind instrument sounds is an alternative method to analyze (micro-)modulation effects. Further investigations may be useful for exploring new sound synthesis algorithms as well as for other experiments in the field of timbre research.

**2:20**

**3pMUb3. The influence of the mean flow on the transmission properties of wind instruments**. Andrey R. Da Silva (Schulich School of Music, McGill University, 555 Sherbrooke Street West, Montreal, QC H3A 1E3, Canada, andrey.dasilva@mail.mcgill.ca), Gary Scavone (Schulich School of Music, McGill University, 555 Sherbrooke Street West, Montreal, QC H3A 1E3, Canada, gary@music.mcgill.ca)

The influence of mean flow on the transmission properties of wind instruments has traditionally been neglected due to the range of Strouhal numbers in which this family of instruments normally operate. However, this topic has gained considerable interest among the musical acoustic community during the last decade due to the appearance of new outcomes in research on duct acoustics. Nevertheless, very few contributions have investigated the effect of the mean flow on the transmission properties by taking into account the physical characteristics and dynamic peculiarities of wind instruments. The goal of this work is to present a numerical investigation of the influence of the mean flow on the end correction and on the magnitude of the reflection coefficient for different geometries and Strouhal numbers normally found in wind instruments. The results suggest that, excepting for a few cases, the mean flow can indeed be neglected and the aforementioned transmission properties can be described by the quiescent flow theory.

**2:40**

**3pMUb4. Effect of bending portions of the air column on the acoustical properties of a wind instrument**. Simon Félix (Laboratoire d'Acoustique de l'Université du Maine, Avenue Olivier Messiaen, 72085 Le Mans, France, simon.felix@univ-lemans.fr), Cornelis J. Nederveen (Acacialaan 20, 2641 AC Pijnacker, Netherlands, cjnederv@xs4all.nl), Jean-Pierre Dalmont (Laboratoire d'Acoustique de l'Université du Maine, Avenue Olivier Messiaen, 72085 Le Mans, France, Jean-Pierre.Dalmont@univ-lemans.fr), Joël Gilbert (Laboratoire d'Acoustique de l'Université du Maine, Avenue Olivier Messiaen, 72085 Le Mans, France, joel.gilbert@univ-lemans.fr)

The need to keep long wind musical instruments compact imposes the bending of portions of the air column. Although manufacturers and players mention its effects as being significant, the curvature is generally not included in physical models and only a few studies, in only simplified cases, attempted to evaluate its influence. The aim of our study is to quantify the influence of the curvature by modelling the wave propagation in an air column with a multimodal formalism. In a duct with a circular cross-section and a finite curvature, two infinite sets of coupled first-order differential equations are constructed for the components of the pressure and axial velocity, projected on the local transverse modes. From these an impedance matrix is defined, which can be easily calculated, particularly when considering a duct with a piecewise constant curvature. Influence of the curvature on the input impedance, effective length, or playing frequencies is then quantified, displaying notably a dependence to frequency such that, compared to an equivalent straight tube, the shift in resonance frequencies in a tube with bent sections is not always positive, as generally stated. Results are independently corroborated by numerical - finite differences - computations.

**3:00**

**3pMUb5. Numerical investigations of the bassoons aeroacoustic**. Andreas Richter (Technische Universität Dresden, Institute for Aerospace Engineering, 01062 Dresden, Germany, andreas.richter4@tu-dresden.de), Roger Grundmann (Technische Universität Dresden, Institute for Aerospace Engineering, 01062 Dresden, Germany, roger.grundmann@tu-dresden.de)

Solving the compressible, unsteady Navier-Stokes equations allows us to track single traveling waves in conjunction with a nonuniform superposed mean flow. Significant physical phenomena like wave steepening, viscothermal losses and acoustic streaming can be investigated. This may be helpful to understand the acoustical characteristics of different geometries, especially in musical woodwind instruments. Since acoustic perturbations are usually small compared to the driving pressure, the solution demands high-order accuracy and appropriate boundary conditions. We present a collection of our numerical results based on two- and threedimensional simulations of the aeroacoustic behavior inside the bassoon. This includes both simulations of the whole instrument under real playing conditions and also numerical studies of subsections of the instrument like tone holes. Here especially viscothermal effects are analyzed. Nonlinear effects like acoustic streaming which is primarily present in the crook of the instrument are also investigated and discussed. Flow field measurements based on Particle Image Velocimetry and pressure measurements inside and outside the instrument are performed to validate the earned results and show a good agreement between measurements and numerical results.

**3:20**

**3pMUb6. Analysis of the timbre of Slovak folk reed aerophones using source-filter model**. Milan Rusko (Institute of Informatics of the Slovak Academy of Sciences, Dubravska cesta 9, 845 07 Bratislava, Slovakia, milan.rusko@savba.sk)

Bagpipes are the only group of traditional folk reed instruments that have survived in Slovak folk culture until now. Unlike Scottish highland pipe, gaita, cornemuse etc., all the types of Slovak bagpipes use single reeds in both chanters and drones. Moreover the horns of the drones are partly closed with a plate having only a small opening for air output and sound radiation. This forms a Helmholz-like resonator - acoustic filter having a strong influence on the acoustic and aesthetic properties of the sound. The ideal of the sound timbre of these pipes is ″less open″ (compare to open and closed vowels in speech) and, in spite of its relatively high loudness, ″less agressive″ in comparison to pipes with open horns. This paper presents our approach to study the ideal of sound timbre of the Slovak bagpipe using a source-filter all-pole model. To identify resonance frequencies/formants, we applied inverse filtering technique using discrete linear prediction. Some properties of the source (reed) were studied using parameters like amplitude qutient and open quotient. The possible relations between timbre of speech sounds (vowels) and the timbre of the sound of musical instruments are discussed.

## WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 252A, 1:40 TO 3:40 P.M.

## Session 3pNSa

## Noise, ASA Committee on Standards, and EURONOISE: Sleep Disturbances and Other Health Effects

Lily M. Wang, Cochair
*University of Nebraska - Lincoln, 1110 S. 67th St., Omaha, NE 68182-0681, USA*

Barbara Griefahn, Cochair
*Institute for Occupational Physiology, Ardeystr. 67, Dortmund, 44139, Germany*

Jacques Lambert, Cochair
*Laboratoire Transport et Environnement, INRETS, 25, Avenue François Mitterrand, F-69675 BRON cedex, France*

***Invited Paper***

**1:40**

**3pNSa1. Associations between road traffic noise level, road traffic noise annoyance and high blood pressure in the HYENA study**. Wolfgang Babisch (Federal Environmental Agency, Corrensplatz 1, 14195 Berlin, Germany, wolfgang.babisch @uba.de), Danny Houthuijs (The National Institute For Public Health and Environmental Protection, PO Box 1, 3720 B A Bilthoven, Netherlands, danny.houthuijs@rivm.nl), Goran Pershagen (Institute of Environmental Medicine, Karolinska Institutet, Box 210, 17177 Stockholm, Sweden, goran.pershagen@ki.se), Klea Katsouyanni (Department of Hygiene and Epidemiology, Medical School, University of Athens, 75 Mikras Asias Str, 11527 Athens, Greece, kkatsouy@med.uoa.gr), Manolis Velonakis (Laboratory of Prevention, Nurses School, University of Athens, 123 Papadiamadopoulou St, 11527 Athens, Greece, evelonak@nurs.uoa.gr), Ennio Cadum (Piedmont Regional Environmental Protection Agency, Via Sabaudia 164, 10095 Grugliasco (TO), Italy, e.cadum @arpa.piemonte.it), Lars Jarup (Imperial College London, Norfolk Place, W2 1PG London, UK, l.jarup@imperial.ac.uk)

The HYENA study is a multi-centred study regarding the effects of aircraft noise and road traffic noise on blood pressure (BP) which was funded by the European Community. Study subjects were 4,861 males and females aged between 45 and 70 years, who had lived for at least 5 years in the vicinity of any of six major European airports. Aircraft noise contours and road traffic noise levels were modelled using the Integrated Noise Model (INM) and national calculation methods. The noise levels were linked to each participant's home address (most exposed façade) using graphical information systems (GIS). Noise annoyance was assessed using the 11-point ICBEN scale. High blood pressure was determined by measurements of systolic and diastolic blood pressure, anti-hypertensive medication and self-reported doctor diagnosed hypertension. The focus here is on the effects of road traffic noise. The road traffic noise level

(LAFm, 24 hours) and noise annoyance due to road traffic noise were both significantly associated with high blood pressure. The association between road traffic noise and high blood pressure was stronger for the road noise level than for the road noise annoyance (90th percentile vs. 10th percentile of the exposure distributions).

## *Contributed Paper*

**2:00**

**3pNSa2. Computing Number of People Awakened by Aircraft Operations Noise**. Nicholas P. Miller (Harris Miller Miller & Hanson Inc., 77 South Bedford Street, Burlington, MA 01803, USA, nmiller@hmmh.com)

The acoustics literature documents a number of field studies in which aircraft noise was measured in people's bedrooms while their awakening was simultaneously monitored. Nearly all the field studies produced a dose-response relationship between noise and an awakening response. These dose-response relationships generally show good agreement with each other. Virtually without exception, however, these dose-response relationships pertain to (1) the indoor noise dose produced by a single aircraft flyover and (2) the chances that the noise dose will awaken an average person. These dose-response relationships are too limited for application to a full night of operations and to a realistic population of varying individual sensitivities to noise-induced awakenings. The dose-response relationships do not account for multiple aircraft exposures during the night or for person-to-person variation in how deeply different people sleep. This presentation first briefly reviews a method previously reported for applying the study data to a full night of operations, accounting for time of night and for individual sensitivity to awakening. It then compares percent of population awakened for realistic situations, and shows the effects of including or excluding time of night or individual sensitivities to awakening.

## *Invited Paper*

**2:20**

**3pNSa3. Determination of noise sensitivity within an internet survey using a reduced version of the Noise Sensitivity Questionnaire**. Barbara Griefahn (Institute for Occupational Physiology, Ardeystr. 67, 44139 Dortmund, Germany, griefahn@ifado.de)

The Noise Sensitivity Questionnaire (NoiSeQ), that determines noise sensitivity as a moderator of annoyance globally and separately for different everyday activities is with 35 items too long for extended social surveys. This study aimed at the development of a shorter version. Using 429 questionnaires (266 women, 163 men, 16-74 yrs) three factor analyses were performed leading to the NoiSeQ-R that consists of the three subscales 'Sleep', 'Habitation', and 'Work' with 4 items each. The scores are normally distributed, internal consistency is $\alpha = 0.87$ and test-retest reliability varies between rtt = 0.66 and 0.74 depending on the time gaps that varied between 1 to 37 months. To test the validity the NoiSeQ-R was applied to a field study where 190 residents (102 males, 88 females, 17-80 years, median: 51 years) in the vicinity of a large airport rated their chronic annoyance (for the previous 12 months) and their actual annoyance hourly during four consecutive days. As expected, noise sensitivity did not correlate with the individual noise load but significantly with annoyance and with age. Thus the NoiSeQ-R, which is available in ten languages, is regarded as a reliable and valid instrument which can be easily applied in even extended surveys.

## *Contributed Paper*

**2:40**

**3pNSa4. A case study on the validation of models that predict the impact of aircraft noise on sleep**. Sarah McGuire (Ray W. Herrick Lab., School of Mechanical Engineering, Purdue Univ., 140 S. Martin Jischke Drive, West Lafayette, IN 47907-2031, USA, mcguires@purdue.edu), Patricia Davies (Ray W. Herrick Lab., School of Mechanical Engineering, Purdue Univ., 140 S. Martin Jischke Drive, West Lafayette, IN 47907-2031, USA, daviesp@ecn.purdue.edu)

The impact of aircraft noise on sleep disturbance is not accurately assessed by cumulative noise metrics that are often used to predict community impact, such as $L_{dn}$, because sleep disturbance is highly dependent on the noise level of individual events. Most existing sleep disturbance models are dose-response relationships that relate the noise level of individual events, as measured by *SEL(A)* or $L_{A_{max}}$ to the percent awakened, and independence of responses to individual events is assumed. There are a few models that also incorporate additional parameters such as time of night and noise sensitivity, and some that predict the impact of noise on sleep structure. In order to determine whether a model should be used as a general aircraft noise sleep disturbance prediction tool, its performance in a variety of situations must be evaluated. Data was collected from a number of sleep disturbance studies and comparisons were made between responses and model predictions of awakenings and sleep stages. The sufficiency of the collected data for estimating the parameters of more complex models of sleep disturbance is also discussed.

## *Invited Paper*

**3:00**

**3pNSa5. Effects of a hearing aid noise management feature on user perception and performance under noise**. Lauren M. Ronsse (University of Nebraska - Lincoln, 1110 S. 67th St., Omaha, NE 68182-0681, USA, lronsse@mail.unomaha.edu), Lily M. Wang (University of Nebraska - Lincoln, 1110 S. 67th St., Omaha, NE 68182-0681, USA, LWang4@UNL.edu)

This paper presents the effects of a hearing aid noise management feature on user perception and performance under noise. Hearing-impaired subjects were exposed twice to seven different noise signals which simulate common mechanical system noise, once with the noise management feature enabled and once disabled. The seven noise signals vary in terms of level and spectral quality, but are all within the range of background noise conditions found in commercial offices. Performance is gauged on three types of tests (math, verbal and typing), while subjective perception is measured via a subjective questionnaire. The results of this investigation will show if the hearing aid noise management feature reduces detrimental effects caused by background noise. Additionally, the data from hearing-

impaired subjects are compared to those from normal-hearing persons to assess if significant differences are present between the two groups. If so, they may lead to the development of different standards for noise criteria levels in spaces designed for the hearing-impaired. [Work supported by a Univ. of Nebraska Layman Award and an ASHRAE Graduate Student Grant-in-Aid]

### *Contributed Paper*

**3:20**

**3pNSa6. Noise and health in the Greater Rotterdam Area**. Henk Wolfert (DCMR EPA, P.O. Box 843, sGravelandseweg 565, 3100AV Schiedam, Netherlands, henk.wolfert@dcmr.nl)

In the Greater Rotterdam Area a second study to Noise and Health has been carried out in 2007 and 2008. In 2003 a first study was carried out and that study reported that around 12 percent of the people living in the Greater Rotterdam Area were highly annoyed by noise mainly caused by traffic. The number of people sleep was disturbed and suffered high blood pressure were reported and amounted to 6 percent for sleep disturbance and 3 percent were suffering hypertension. The 2003 study took place within the regularly framework of the Rotterdam Regional Council of Governments Environmental Monitoring program, a program that reports yearly the environmental performance indicators in the Greater Rotterdam Area. Beside this yearly report a theme report is published. Last year's theme reports were published about Air Quality and Energy. In 2007 the board of this program decided that in 2008 the theme should be Noise and Health. The 2008 study is not only an update of the 2003 study but is more detailed and more comprehensive as well, and based on recent insights in health effects, caused by long lasting noise too.

## WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 251, 2:00 TO 3:40 P.M.

## Session 3pNSb

## Noise, ASA Committee on Standards, and EURONOISE: Prominent Discrete Tones I

Robert Hellweg, Cochair
*13 Pine Tree Road, Wellesley, MA 02482, USA*

Lothar Schmidt, Cochair
*Currenta GmbH & Co. OHG, Building F1, Dormagen, 41538, Germany*

### *Invited Papers*

**2:00**

**3pNSb1. Comparison of various procedures for the assessment of prominent discrete tones using a large number of sound samples**. Lothar Schmidt (Currenta GmbH & Co. OHG, Building F1, 41538 Dormagen, Germany, lothar.schmidt@currenta.de), Dirk Sagemuehl (Kattenbachstr. 77a, 51467 Bergisch-Gladbach, Germany, DSagemuehl@aol.com)

The procedures from the standards ISO 1996-2 and DIN 45681 as well as the two procedures (TNR and PR) from ISO 7779 are compared. In the first section, characteristic features of the procedures (e.g. signal analysis parameters, degree of automation and characteristics of the prominent discrete tone analysis) are compared. In the second section, the procedures are applied to approximately 70 sound samples. Besides natural sounds (e.g. from machines), synthetic sounds (e.g. peak in a trough) are also used. The results are compared against assessments of the sounds by human subjects. The results of the comparisons are discussed, with special attention paid to cases where significant deviations occur. The third section looks at the results of the comparisons under the aspect of requirements for a standard (e.g. robustness, precision). Overall it was determined that none of the procedures investigated provides optimal results for all sound samples.

**2:20**

**3pNSb2. Prominent tones in noise - Proficiency testing among 30 laboratories of the ISO 1996-2 Annex C method and its predecessors**. Torben Holm Pedersen (Delta Acoustics & SenseLab, Venlighedsvej 4, 2970 Hørsholm, Denmark, thp@delta.dk)

Since 1979 the Danish Environmental Protection Agency's Reference laboratory for noise measurements have arranged proficiency testing for the around 30 approved Danish laboratories that are measuring environmental noise. Many of these ″comparison measurements″ have included objective analysis of the prominence of audible tones according to the Joint Nordic Methods which are the predecessors and very similar to the method described in ISO 1996 part 2 Annex C. This paper gives examples on (computerized) analyses of the samples from these proficiency tests and states the uncertainties that can be expected when a number of laboratories with different experience and different types of equipment analyze the same samples. The samples will be available for future reference and can be downloaded from DELTA's homepage.

**2:40**

**3pNSb3. Updates on Prominent Discrete Tone Procedures in ISO 7779, ECMA 74, and ANSI S1.13**. Robert Hellweg (13 Pine Tree Road, Wellesley, MA 02482, USA, Hellweg@HellwegAcoustics.com)

There are two alternative procedures for determining if a tone is prominent, i.e. a ″prominent discrete tone″ in ISO 7779, ECMA 74 and ANSI S1.13: the Tone to Noise Ratio (TNR) method and the Prominence Ratio (PR) method. Both of these procedures have been used by the computer industry for more than a decade. Recent revisions to these procedures have refined the calculation of the critical bandwidth and modified the both procedures for low level tones. This paper describes these changes and the rationale behind them. Examples are presented that demonstrate the features of each procedure. The paper presents an overview on the applicability and limitations of each procedure.

**3:00**

**3pNSb4. Issues in the evaluation of the tonality of nonstationary sounds containing time- varying harmonic complexes**. Patricia Davies (Ray W. Herrick Lab., School of Mechanical Engineering, Purdue Univ., 140 S. Martin Jischke Drive, West Lafayette, IN 47907-2031, USA, daviesp@ecn.purdue.edu), Shashikant R. More (Ray W. Herrick Lab., School of Mechanical Engineering, Purdue Univ., 140 S. Martin Jischke Drive, West Lafayette, IN 47907-2031, USA, shashi@purdue.edu)

Nonstationary sounds that contain broadband noise and tone complexes whose fundamental frequency varies with time are encountered frequently. Aircraft flyovers and machines shifting operating speeds are examples. The tonalness of such sounds is a factor in how annoying they are. Most metrics used to quantify the tonalness of sounds have been developed for stationary sounds and are based on an analysis of spectra. Contributions from individual sinusoids are estimated and either summed or the maximum is taken. When sounds vary, spectral estimation can be problematic due to the conflicting needs to reduce the variance of the estimate, maintain high frequency resolution, and generate spectra at a rate where the varying tonal behavior can be tracked sufficiently. Harmonic complexes are often perceived holistically, having one dominant pitch, thus treating sinusoidal components independently and summing may not be appropriate. Tests conducted to analyze the tonalness of harmonic complexes in noise are described, and an analysis of aircraft flyovers is used to illustrate the issues that need to be addressed when estimating the tonalness of complex time-varying sounds.

**3:20**

**3pNSb5. Implementation of ISO 1996-2 (2007) pure tone assessment in a sound level meter**. Charles Greene (Brüel & Kjær, Skodsborgvej 307, 2850 Nærum, Denmark, cgreene@bksv.com), Douglas Manvell (Brüel & Kjær, Skodsborgvej 307, 2850 Nærum, Denmark, dmanvell@bksv.com), Matthias Scholz (Brüel & Kjær, Skodsborgvej 307, 2850 Nærum, Denmark, mscholz@bksv.com), Anne Lin Enggaard (Nordsjællands Akustik, Skræntevej 13, Holløselund, 3210 Vejby, Denmark, ale@nordsjaellandsakustik.dk)

Noise can be said to be tonal if it contains a distinguishable, discrete, continuous note. This may include a whine, hiss, screech, hum, etc., and any such subjective finding is open to discussion when reported. This is important when it is considered that the likelihood of a noise-provoking complaint depends on its relative level to background, and whether or not it has certain audible characteristics. Fortunately, ISO 1996-2 (2007) provides objective FFT (engineering) and 1/3-octave band (survey) assessment procedures to be used to verify the presence of audible tones if their presence is in dispute. Brüel & Kjær has implemented the methodology of ISO 1996-2 in relation to assessing the audibility of prominent discrete tones in environmental noise into its innovative 2250 and 2270 hand-held analysers. This paper describes the implementation in hand-held instrumentation.

## Session 3pNSc

# Noise and EURONOISE: Car Acoustics I

Luc Mongeau, Cochair
*McGill University, 817 Sherbrooke St. West, Montreal, QC H3A 2K6, Canada*

Virginie Maillard, Cochair
*RENAULT, Groupe Acoustique, Technocentre, 1 avenue du Golf, 78288 Guyancourt Cedex, France*

### *Contributed Paper*

**2:20**

**3pNSc1. Effects of notches on span wise correlation of surface pressure fluctuations downstream of a wall-mounted spoiler**. Paloma Mejia (Purdue University, 140 S. Intramural Dr., West Lafayette, 47906, USA, umaphuyu@gmail.com), Jong Beom Park (McGill University, 817 Sherbrooke St. West, Montreal, QC H3A 2K6, Canada, jong.b.park @mail.mcgill.ca), Luc Mongeau (McGill University, 817 Sherbrooke St. West, Montreal, QC H3A 2K6, Canada, luc.mongeau@mcgill.ca)

Leading edge spoilers are widely-used for suppressing flow-induced cavity resonance such as buffeting due to open sunroofs in moving cars. Spoilers deflect the grazing flow over the opening into a region of greater flow velocity, thereby increasing the critical velocity. Notched spoilers have been observed to enhance resonance suppression while moving the flow reattachment region upstream, resulting in a decreased drag. The mechanisms involved in the effectiveness of the notched spoiler were investigated experimentally and numerically. Static and dynamic pressures on the surface behind a wall mounted notched spoiler were measured, and the spatial correlations of the measured pressures were compared to those for a spoiler without notches. The span wise pressure correlation was decreased by the presence of the notches, suggesting a breakdown of the span wise leading vortices predominantly responsible for the cavity excitation. Numerical flow simulations were performed using the lattice Boltzmann method (LBM) with turbulence modeling. Surface pressure results were compared with experimental data to better highlight surface pressure trends.

### *Invited Papers*

**2:40**

**3pNSc2. Simulation of vehicle interior wind noise at low frequencies: a case study**. Robert Powell (Ford Motor Company, EVB, MD X-19, Rm 1EB08, 20800 Oakwood Blvd, Dearborn, MI 48121, USA, rpowell7@ford.com), Bijan Khatib-Shahidi (Ford Motor Company, EVB, MD X-19, Rm 1EB08, 20800 Oakwood Blvd, Dearborn, MI 48121, USA, bshahidi@ford.com)

Quietness of passenger vehicle interiors has become a critical-to-quality metric in designing modern passenger vehicles. At the same time, the necessity of bringing fresh designs to market quickly has greatly compressed the development time available to achieve the desired refinement of interior noise and vibration. This has forced manufacturers to place increasing responsibility on analytical simulations in developing countermeasures for noise problems. One aspect of car acoustics that has not received very much attention from the simulation community is the wind noise created by external air flow at speed. Significant contributions to interior loudness can come from underbody air flow, while improvements in simulation efficiency of Computational Fluid Dynamics (CFD) flow models and Finite Element Analysis (FEA) vehicle vibration and acoustic models now make it feasible to analytically simulate interior noise caused by wind excitation. This lecture describes a case study where existing vehicle models were adapted to first build a wind load case from CFD, and then to apply it in estimating and reducing interior noise in FEA. Topics to be covered include: spatial discretization of continuous panel pressures, application of random loads to deterministic vehicle FEA models and diagnostic imagery for visualizing noise and vibration responses.

**3:00**

**3pNSc3. On the use of linear aero-acoustic models**. Mats Abom (KTH-The Marcus Wallenberg Laboratory, Teknikringen 8, 100 44 Stockholm, Sweden, matsabom@kth.se)

The classical theory of aero-acoustics is based on Lighthills acoustic analogy which essentially leads to a wave equation with a source term defined by the flow field. This source term is assumed unaffected by the acoustic field and the resulting model can be seen as a linear model which, e.g., for duct acoustic problems can be formulated as an acoustic multi-port. Such linear aero-acoustic models can be applied to most aero-acoustic problems occurring in engineering practice with the exception of whistling, i.e., situations where the source term is affected by the acoustic field. At KTH this methodology has been applied to a number of applications over the years ranging from cooling and ventilation fans to flow generated noise from ducted orifices (valves) and air terminal devices. In this paper the experience from these works is summarized and the experimental techniques developed at KTH to characterize linear aero-acoustic sources are described. Recent efforts to extract linear aero-acoustic models from numerical calculations are also addressed.

### *Contributed Paper*

**3:20**

**3pNSc4. Modeling and characterization of rattle noise encountered in an automotive environment**. Ludovic Desvard (Renault, Technocentre, 1 avenue du Golf, 78288 Guyancourt, France, ludovic.desvard@renault.com), Nacer Hamzaoui (LVA, INSA de Lyon, Bat. Saint-Exupéry, 25 bis avenue Jean Capelle, 69621 Villeurbanne, France, nacer.hamzaoui@insa-lyon.fr), Jean-Marc Duffal (Renault, Technocentre, 1 avenue du Golf, 78288 Guyancourt, France, jean-marc.duffal@renault.com)

In an automotive cockpit, rattle noises deal with all noise due to normal impacts which radiate as annoying noises for customers. The state of the art shows studies focused on one automotive subsystem, describing the specific associated physic. The method proposed, in this study, is to generate automotive rattle noises using simple geometries. The interest of this approach is to know all the parameters of the system (impact location, material, geometries, excitation...) and to precisely describe the physical phenomena related to the apparition of rattle noises. Firstly an experimental bench was proposed to generate rattle noises using simple geometries. These rattle noises are similar to those encountered in an automotive environment. This experimental approach allows to measure the vibrational behaviour and the radiated sound of the system under a random impact excitation. Then an analytical model, which describes the experimental approach, is developed to predict the radiated sound, knowing the displacement of the impactor. Numerical and experimental results are compared. Finally, thanks to the experimental approach, a database of rattle noises is created and used to find metrics to quantify the annoyance.

## WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 351, 1:40 TO 3:40 P.M.

# Session 3pPAa

## Physical Acoustics: Quantum Acoustics I

Michel De Billy, Cochair
*Institut Jean le Rond d'Alembert / UMR 7190, 2, place de la Gare de Ceinture, Saint Cyr l'Ecole, 78210, France*

Walter Lauriks, Cochair
*Lab ATF, Katholicke Universiteit Leuven, Celestijnenlaan 2000, Leuven, B-3001, Belgium*

### *Contributed Papers*

**1:40**

**3pPAa1. Phonon dispersion in graphene**. Leonid A. Falkovsky (Landau Institute for Theoretical Physics, Kosygina 2, 119334 Moscow, Russian Federation, falk@itp.ac.ru)

Taking into account constraints imposed by the lattice symmetry, we calculate analytically [1] the phonon dispersion for graphene with interactions between first and second neighbors. We find that the out-of-plane (bending) modes are not coupled with in-plane modes and described only with two force constants, one of which is determined by the corresponding Raman frequency and another by the smallest elastic constant C44. In contrast to calculations by Saito et al, we find the linear dispersion of the bending (out-of-plane) mode around the Γ point with a small but finite sound velocity =1.57 km/s. The sound velocity of this mode is very sensitive to small variations of the force constants. The sound velocities of in-plane modes are = 20.3 km/s and =13.1 km/s. Because of the lack of information for graphene, we compare the present theory with experiments on graphite. The low phonon frequencies in the critical points turn out less than their values in graphite, since the atoms in graphene are more free to move in the out-of-plane direction in comparison with graphite. Accuracy of the comparison can be estimated using the value of the observed splitting of the ZA and ZO' modes in graphite which is around 130 1/cm. [1] L.A. Falkovsky, cond-mat/0702409.

**2:00**

**3pPAa2. Mechanical (acoustic-like) wave propagation along a vortex array in the superconducting heterostructure**. Bogdan T. Maruszewski (Poznan University of Technology, Institute of Applied Mechanics, ul. Piotrowo 3, 60-965 Poznan, Poland, bogdan.maruszewski@put.poznan.pl), Andrzej Drzewiecki (Poznan University of Technology, Institute of Applied Mechanics, ul. Piotrowo 3, 60-965 Poznan, Poland, andrzej.drzewiecki@put.poznan.pl),Roman Starosta(Poznan University of Technology, Institute of Applied Mechanics, ul. Piotrowo 3, 60-965 Poznan, Poland, roman.starosta@put.poznan.pl)

Magnetic flux can penetrate the type - II superconductor in the form of Abrikosov vortices (also called flux lines, flux tubes or fluxons) each carrying a quantum of magnetic flux. These tiny vortices of supercurrent tend to arrange themselves in a triangular or quadratic flux-line lattice. Since the vortices are formed by the applied magnetic field, around of each of them the supercurrent flows. Moreover, there also exist some Lorentz force interactions among them. Those interactions form an origin of an additional mechanical (stress) field occurring in the type-II superconductor. The paper deals with an analysis of elastic (acoustic-like) wave propagation solely along vortices in a heterostructure consisted of the superconducting layer put on the superconducting substrate. Dispersion and the amplitude distribution of those waves in the vortex field existing in that structure has been presented.

**2:20**

**3pPAa3. Amplitude distribution of magnetoelastic waves propagating in a vortex field in a superconducting layer**. Bogdan T. Maruszewski (Poznan University of Technology, Institute of Applied Mechanics, ul. Piotrowo 3, 60-965 Poznan, Poland, bogdan.maruszewski@put.poznan.pl), Andrzej Drzewiecki (Poznan University of Technology, Institute of Applied Mechanics, ul. Piotrowo 3, 60-965 Poznan, Poland, andrzej.drzewiecki@put.poznan.pl), Roman Starosta (Poznan University of Technology, Institute of Applied Mechanics, ul. Piotrowo 3, 60-965 Poznan, Poland, roman.starosta@put.poznan.pl)

Magnetic field enters the type - II superconducting body along a discrete arrangement of magnetic vortex lines. In the dynamic case when the magnetic field vary in time, around each such a line a supercurrent flows. So, the vortices interact one to another with the help of the Lorentz force forming this way a new mechanical field of elastic properties. Moreover, those lines arrange themselves in a triangular or quadratic lattice. Such a set is observed

if the intensity of the applied to the material magnetic field is close to its lower limiting value. The paper aims at investigating amplitude distributions of magnetoelastic waves propagating solely in the vortex field of the superconducting layer. Our attention have been focused on the applied magnetic field intensity influence on those amplitudes for various wave frequencies.

**2:40**

**3pPAa4. Acoustical dissipation due to phonon-phonon interaction, thermoelastic loss and dislocation damping in MnO and CoO**. Rishi Pal Singh (Banaras Hindu University, 221005 Varanasi, India, rishisingh80@rediffmail.com), Manish Pratap Singh (Banaras Hindu University, 221005 Varanasi, India, mps_bhu@yahoo.co.in), Rajendra Kumar Singh (Department of Physics, Banaras Hindu University, 221005 Varanasi, India, rksingh_17@rediffmail.com)

The temperature dependent acoustical dissipation due to phonon-phonon (p-p) interaction, thermo-elastic mechanism and dislocation damping due to screw and edge dislocations have been evaluated in MnO and CoO in fcc (NaCl-B1 type) phase, in a wide temperature range $50 \leqslant T \leqslant 500$K for longitudinal and shear modes of propagation along three crystallographic directions viz. <100>, <110> and <111>. Electrostatic and Born repulsive potentials were used to obtain second order and third order elastic constants (SOEC and TOEC), taking interactions up to next nearest neighbours.The SOEC and TOEC obtained at diffrent temperatures have been used to obtain gruneisen parameters and non-linearity or anisotropic parameters which in turn were used to evaluate ($\alpha$/f2) for longitudinal and shear waves. Specific heat (as function of Debye temperature), hardness parameter, lattice parameter have been used as input data. It has been found that ($\alpha$/f2) increases with temperature and the acoustical dissipation is mainly influenced by p-p interaction.The possible implications of results have been discussed.

**3:00**

**3pPAa5. Numerical and experimental results on sonic band gaps in 1-D phononic crystals with a symmetric stub**. Michel De Billy (Institut Jean le Rond d'Alembert / UMR 7190, 2, place de la Gare de Ceinture, 78210 Saint Cyr l'Ecole, France, mdebilly@univ-paris-diderot.fr), Anne-Christine Hladky-Hennion (IEMN, UMR CNRS 8520, avenue Poincaré, BP 60069, 59652 Villeneuve d'Ascq, France, Anne-Christine.Hladky@isen.fr), Jérôme Vasseur (IEMN, UMR CNRS 8520, avenue Poincaré, BP 60069, 59652 Villeneuve d'Ascq, France, jerome.vasseur@univ-lille1.fr), Bahram Djafari-Rouhani (IEMN, UMR CNRS 8520, avenue Poincaré, BP 60069, 59652 Villeneuve d'Ascq, France, Bahram.Djafari-Rouhani@univ-lille1.fr)

The wave propagation in periodic systems has received a great deal of attention during the last years. By analogy with the studies driven on photonic crystals, many works were conducted on phononic crystals. In this paper the propagation of elastic waves through a one dimensional chain of beads with grafted stubs is experimentally as well as numerically investigated. The results obtained by both approaches are well correlated and show that the stub introduces a dip in the spectral response of the chain. The numerical analysis shows that this dip is due to the excitation of a stub mode that cancels the transmission from one extremity of the chain to the other. The position and the shape of the dip in the response are related to the geometry and nature of the stub. The results show that it is possible to adjust the position of the dip and open potential applications of these structures for filtering or demultiplexing. Finally first results on periodically grafted stubs in the chain are presented.

**3:20**

**3pPAa6. Evidence for vortex transport by surface acoustic waves in a high-Tc superconductor**. Carsten Hucho (Paul-Drude-Institut, Hausvogteiplatz 5-7, 10117 Berlin, Germany, hucho@pdi-berlin.de), Munise Rakel (Paul-Drude-Institut, Hausvogteiplatz 5-7, 10117 Berlin, Germany, rakel@pdi-berlin.de), Arno Wirsig (Paul-Drude-Institut, Hausvogteiplatz 5-7, 10117 Berlin, Germany, wirsig@pdi-berlin.de), Fabian Jachmann (Paul-Drude-Institut, Hausvogteiplatz 5-7, 10117 Berlin, Germany, jachmann@pdi-berlin.de)

The interaction of surface acoustic waves (SAW) with the magnetic vortex system in YBa2Cu3O7 is investigated. A 100nm YBCO film is deposited on a piezoelectric substrate and structured for electrical 4-point measurements. Interdigital transducers are fabricated on the same substrate. When applying an external magnetic field perpendicular to the film surface a SAW-induced dc-voltage perpendicular to the acoustic sound-path is observed. This is interpreted as consequence of directed dragging of vortices by the SAW induced dynamic pinning structure [1]. The piezoacoustic wave acts as a conveyor for mobile flux quanta. Additional ac-dc-conversion as result of the nonlinear current-voltage characteristics close to the superconducting transition temperature can be resolved and separated. In order to observe the sound-induced vortex motion directly, the flux distribution is analyzed magnetooptically. Magnetooptic imaging allows for time resolved analysis of flux distribution. Quantitative analysis of changes in the magnetization distribution when acoustic driving fields are applied is carried out. The influence of piezoacoustic waves on the pinning properties and sound-induced depinning is discussed. [1] F. Jachmann and C. Hucho, Sol. State Comm., 142 (4) (2007), 212

## Session 3pPAb

# Physical Acoustics: General Topics in Nonlinear Acoustics I

Thomas Matula, Cochair
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Murray S. Korman, Cochair
*Physics Dept., United States Naval Academy, Chauvenet Hall Room 295, 572 C Holloway Road, Annapolis, MD 21402, USA*

### *Contributed Papers*

**2:00**

**3pPAb1. Atomization and deviation of cylindrical water jets in a transverse acoustic field**. Jean-Baptiste Carpentier (Coria UMR 6614, avenue de l'Université, 76800 Saint-Etienne-du-Rouvray, France, jean-baptiste.carpentier@univ-rouen.fr), Françoise Baillot (Coria UMR 6614, avenue de l'Université, 76800 Saint-Etienne-du-Rouvray, France, baillot@coria.fr), Jean-Bernard Blaisot (Coria UMR 6614, avenue de l'Université, 76800 Saint-Etienne-du-Rouvray, France, blaisot@coria.fr), Christophe Dumouchel (Coria UMR 6614, avenue de l'Université, 76800 Saint-Etienne-du-Rouvray, France, dumouchel@coria.fr)

This work deals with a particular breakup mode experienced by cylindrical liquid jets when submitted to an intense transverse acoustic wave. Experiments on low speed water jets ($< 1$ m/s) of diameters 3 mm and 6 mm show that sound waves with a frequency ranging from 500 Hz to 1800 Hz can produce bulges along the jet. When the sound level is high enough, these bulges can trigger an effective atomization mechanism where the jet flattens as a liquid sheet before disintegrating. Sound field can also induce steady deviation of the jet. Both phenomena are theoretically studied. A first model, which treats bulges as outward marks of one particular mode of vibration of the liquid column, is proposed. This model leads to a criterion for the onset of atomization that satisfactorily agrees with experimental observations of the present work. A second analysis identifies deviations as radiation pressure effects. It predicts the direction of experimental deviations with success.

**2:20**

**3pPAb2. Numerical and experimental observations of azimutal shock waves**. Régis Marchiano (Institut Jean Le Rond d'Alembert, Université Pierre et Marie Curie, Boites 161 et 162, 4 place Jussieu, 75252 Paris Cedex 05, France, marchi@lmm.jussieu.fr), Jean-Louis Thomas (Centre National de la Recherche Scientifique, Institut des NanoSciences de Paris, Université Pierre et Marie Curie, 4 place Jussieu, 75252 Paris Cedex 05, France, thomasjl@ccr.jussieu.fr), Thomas Brunet (CNRS and Paris VI University, INSP - 140 rue de Lourmel, 75015 Paris, France, thomas.brunet@insp.jussieu.fr), François Coulouvrat (Institut Jean Le Rond d'Alembert, Université Pierre et Marie Curie, Boites 161 et 162, 4 place Jussieu, 75252 Paris Cedex 05, France, coulouvr@ccr.jussieu.fr)

Acoustical Vortices (AV) are acoustical beams with a phase singularity of screw type. They possess a phase with an helical structure which is winding around the axis of propagation. These twists of phase engender special properties such as the existence of an associated angular momentum and imply a coupling between the axial and transverse components of the beam. Propagation of AV of finite amplitude follows the classic rule of nonlinear acoustics. Beyond a shock formation distance, AV develop shocks, but the structure of the latters is noticeable. It will be shown by numerical simulations and experimental measurements, that the nonlinear propagation of AV gives birth to 3D shock waves: a classical shock in the direction of propagation plus an azimutal one in the transverse plane. The numerical simulation, based on an original algorithm solving the 3D Khokhlov-Zabolotskaya equation, is used to investigate the dynamic of the formation of the azimutal shock. Experimental observations made with ultrasonics in water confirm the existence of particular shock waves. Finally, a brief discussion of the potential applications will be proposed.

**2:40**

**3pPAb3. Water flow generation owing to interaction between pulsing bubble and rigid wall**. Alexey P. Drozhzhin (Lavrentyev Institute of Hydrodynamics SB RAS, Lavrentyev ave., 15, 630090 Novosibirsk, Russian Federation, ruslan@hydro.nsc.ru), Vyacheslav S. Teslenko (Lavrentyev Institute of Hydrodynamics SB RAS, Lavrentyev ave., 15, 630090 Novosibirsk, Russian Federation, vteslenko@academ.org)

Generating a directed water flow in periodic forming a non-symmetrical acoustic field was experimentally investigated in the work. Periodic acoustic wave field was formed with the help of a vapor-gas bubble pulsing in the hole of a thin diaphragm near a rigid wall. Alternate formation of two water flows moving in opposite directions was found. During the bubble growth stage the flow at velocity V1 was formed in the opposite direction of the plate, and during the bubble collapse stage the flow at velocity V2 was formed towards the plate. By changing the parameter $k=R/r$ where R was a distance from the hole center to the rigid wall, and r was a hole radius, the possibility to control average values V1 and V2 was shown. It was found that at $k=R/r=5.8$ $V1=V2$, at $k>5.8$ $V1>V2$, and at $k<5.8$ V1 was less than V2. It was shown that due to variation of the distance between a pulsing bubble and a rigid wall it was possible to control velocity V and direction of the total flow of water through the hole. The maximum value of velocity V reached 40 cm/s in the experiment.

**3:00**

**3pPAb4. Nonlinear ultrasound fields simulation of harmonics from exponential and bessel beams sources**. Hicham Jakjoud (Lab. Electrical Systems and Telecommunications, Faculté des Sciences et Techniques Gueliz B.P. 549, 40000 Marrakech, Morocco, hicham.jakjoud@gmail.com), Ahmed Chitnalah (Lab. Electrical Systems and Telecommunications, Faculté des Sciences et Techniques Gueliz B.P. 549, 40000 Marrakech, Morocco, chitnalah@fstg-marrakech.ac.ma), Noureddine Aouzale (Lab. Electrical Systems and Telecommunications, Faculté des Sciences et Techniques Gueliz B.P. 549, 40000 Marrakech, Morocco, aouzale.nour@gmail.com), Djilali Kourtiche (Lab. d'Instrumentation, Electronique de Nancy, UHP Nancy I, BP 239, 54506 Vandœuvre, 54506 Nancy, France, djilali.kourtiche@lien.uhp-nancy.fr)

It's well known that the harmonic imaging quality can be improved by using sources that radiate narrower and attenuated sidelobe beams. Hence we try to enhance the harmonics' cartography by studying different source's power distributions. We developed a numerical code, using the spectral method, in order to resolve the parabolic wave equation. The numerical results are compared to those given by other researchers in order to validate our algorithm. Two source's power distributions (exponential and Bessel beams) are studied and compared to the uniform case. The use of exponential source leads to harmonics diagrams without sidelobes neither nearfield oscillations. But the beam width is increasing with propagation. The Bessel

source presents a limited diffraction beam. The beam width is almost constant throughout the nearfield and the transition zone. The sidelobes have a weak level in the fundamental curves and they don't appear in the second harmonic ones.

**3:20**

**3pPAb5. Experimental confirmation of the theory of acoustic radiation pressure applying on transparent interfaces**. Bruno Issenmann (Bordeaux University - CPMOH, 351 cours de la Liberation, 33405 Talence Cedex, France, b.issenmann@cpmoh.u-bordeaux1.fr), Alice Nicolas (Laboratoire de Physique Matiere Condensee - Univ. Nice, Parc Valrose - 28, avenue Valrose, 06108 Nice Cedex 02, France, Alice .NICOLAS@unice.fr), Regis Wunenburger (Bordeaux University - CPMOH, 351 cours de la Liberation, 33405 Talence Cedex, France, r.wunenburger@cpmoh.u-bordeaux1.fr), Sébastien Manneville (Ecole Normale Supérieure de Lyon, 46 allée d'Italie, 69364 Lyon Cedex 07, France, sebastien.manneville@ens-lyon.fr), Jean-Pierre Delville (Bordeaux University - CPMOH, 351 cours de la Liberation, 33405 Talence Cedex, France, jp.delville@cpmoh.u-bordeaux1.fr)

Since Rayleigh and Brilloin, the acoustic radiation pressure has been the subject of several theoretical works, but of few quantitative tests. Whereas the radiation pressure acting on perfectly reflecting or perfectly absorbing solid targets is commonly used for the calibration of high intensity focused ultrasonic beams, it has never been quantitatively studied on acoustically transparent interfaces. Using an acoustically transparent liquid-liquid interface deformed by the radiation pressure of a focused, continuous wave beam, we have tested the theory of the acoustic radiation pressure acting on transparent interfaces for the first time. At large intensity, depending on the direction of propagation of the beam, we observe surprising interface shapes such as drop emitting jets and ″nipple-like″ deformations.

WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 241, 2:00 TO 3:40 P.M.

## Session 3pPPa

## Psychological and Physiological Acoustics: General Topics in Psychological and Physiological Acoustics II

Elizabeth Strickland, Cochair
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Armin Kohlrausch, Cochair
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Alain De Cheveigne, Cochair
*CNRS, Universite Paris 5, Ecole Normale Superieure, 29 rue d'Ulm, Paris, 75230, France*

### *Contributed Papers*

**2:00**

**3pPPa1. A pair of spectral notches which plays a role as a spectral cue in the vertical localization, and it's application to estimation of sound source elevation from binaural signals**. Kazuhiro Iida (Chiba Institute of Technology, 2-17-1 Tsudanuma, 275-0016 Narashino, Japan, kazuhiro.iida @it-chiba.ac.jp)

The author [Applied Acoustics, 68, 835-850 (2007)] proposed a parametric HRTF model for vertical sound localization. The parametric HRTF is recomposed only of the spectral peaks and notches extracted from the measured HRTF. The results of the median plane localization tests, which were carried out using the parametric HRTFs with various combinations of spectral peaks and notches, show that the pair of first and second notches (N1 and N2) above 5 kHz can be regarded as spectral cues. In this research, estimation of the elevation of sound source in the upper median plane by extracting N1 and N2 frequencies from binaural input signal was carried out. The kinds of sound sources were female voice, male voice, music, white noise, and pink noise. The results show that the estimation is accurate for almost of all the elevation and of all the kind of sound sources.

**2:20**

**3pPPa2. Trading of intensity and interaural correlation cues in the perception of loudness**. John F. Culling (Cardiff University, School of Psychology, Tower Building, Park Place, CF10 3AT Cardiff, UK, CullingJ@cardiff.ac.uk), Hannah G. Lewis (Cardiff University, School of Psychology, Tower Building, Park Place, CF10 3AT Cardiff, UK, lewishg @Cardiff.ac.uk)

When a signal is added to noise in the NoS$\pi$ binaural configuration, a reduction in interaural cross-correlation (IACC) occurs at the signal frequency. Increases in tone intensity produce decreases in IACC. Consistent with this relationship, direct manipulations of IACC can result in the perception of an added signal and progressive reduction in IACC produces progressive increases in the loudness of this signal [Culling et al. 2001 J. Acoust. Soc. Am. 110, 1020-1029]. In the present study, a narrow sub-band of noise (460-540 Hz) embedded within a broadband (0-3 kHz) diotic noise was manipulated in both intensity and IACC in a 3-interval, odd-one-out task. In the reference intervals, IACC was zero and the spectrum was flat. In the target interval, both the IACC and the intensity of the target band were incremented. These increases have opposing effects on loudness. Correct identification of the target interval followed a U-shape as a function of the size of intensity increment. The minimum of the function was at chance performance, indicating that the opposing cues were fully traded.

**2:40**

**3pPPa3. A comparison between interaural level difference and interaural correlation uncertainty on binaural signal detection thresholds**. Nicolas Le Goff (Technical University Eindhoven, Den Dolech 2, 5600 MB Eindhoven, Netherlands, n.legoff@tm.tue.nl), Armin Kohlrausch (Philips Research Europe, Digital Signal Processing (MS WO02), High Tech Campus 36, 5656 AE Eindhoven, Netherlands,

armin.kohlrausch@philips.com),Jeroen Breebaart(Philips Research Europe, Digital Signal Processing (MS WO02), High Tech Campus 36, 5656 AE Eindhoven, Netherlands, jeroen.breebaart@philips.com)

Experiments were performed to study the effect of the presence of interaural level differences (ILDs) on binaural detection abilities. The subjects had to detect an interaurally out-of-phase 500-Hz tone in the presence of a diotic noise masker that had a bandwidth of either 1 kHz, 100 Hz or 10 Hz. Experiments were conducted for both frozen and running-noise conditions and ILDs up to 30 dB were applied to both signal and masker. The results indicate an ILD dependency that varies with the bandwidth of the masker. Furthermore, with increasing ILDs, the difference in detection thresholds between frozen and running-noise conditions was larger for narrow-band noise conditions. Similar observations were made by previous investigations on the influence of reduced masker correlation. Both data sets are compared in order to find possible similarities in the mechanisms involved in the detection tasks.

**3:00**

**3pPPa4. The effect of a speech target's motion on its recognition in the presence of simultaneous competing sentences**. Wesley Grantham (Vanderbilt Bill Wilkerson Center, Department of Hearing and Speech Sciences, 1215 21st Avenue South, Room 8310, Nashville, TN 37232-8242, USA, d.wesley.grantham@vanderbilt.edu), Todd Ricketts (Vanderbilt Bill Wilkerson Center, Department of Hearing and Speech Sciences, 1215 21st Avenue South, Room 8310, Nashville, TN 37232-8242, USA, todd.a.ricketts@vanderbilt.edu), Daniel Ashmead (Vanderbilt Bill Wilkerson Center, Department of Hearing and Speech Sciences, 1215 21st Avenue South, Room 8310, Nashville, TN 37232-8242, USA, daniel.h.ashmead@vanderbilt.edu)

Prior knowledge of where to listen significantly improves speech recognition of target sentences presented in the presence of distracter sentences coming from different locations [G. Kidd et al., J. Acoust. Soc. Am. 118, 3804-3815 (2005)]. The present study extended the work of Kidd et al. by measuring the effect of a target's motion on its recognition when competing messages are present. In an anechoic chamber normal-hearing subjects were presented with three simultaneous sentences from the CRM corpus and were instructed to indicate key words from the target sentence (identified by a call-sign previously known to the subject). In the stationary condition the three sentences came from -60°, 0°, and +60° azimuth. In the moving condition, the target source moved during its on-time (e.g., from -60° to 0°) while the two distracter sentences were stationary (e.g., at ±60°). In both cases, subjects either knew in advance where the target would be (Certain Condition) or did not know (Uncertain Condition). It is hypothesized that motion of the target will result in a release from informational masking. That is, the detrimental effect of location uncertainty observed with the stationary targets will be reduced or eliminated when the target is moving.

**3:20**

**3pPPa5. Frequency selectivity in diotic and dichotic masking conditions for normal-hearing and hearing-impaired listeners**. Marc Nitschmann (Universität Oldenburg, Medizinische Physik, Carl-von-Ossietzky Str. 9-11, 26111 Oldenburg, Germany, marc.nitschmann@uni-oldenburg.de), Jesko Verhey (Universität Oldenburg, Medizinische Physik, Carl-von-Ossietzky Str. 9-11, 26111 Oldenburg, Germany, jesko.verhey@uni-oldenburg.de), Birger Kollmeier (Universität Oldenburg, Medizinische Physik, Carl-von-Ossietzky Str. 9-11, 26111 Oldenburg, Germany, birger.kollmeier@uni-oldenburg.de)

Previous studies argued that, for broadband maskers, the operational binaural critical bandwidth is similar to the monaural critical bandwidth. The aim of the present study was to test this hypothesis using the notched noise paradigm. Thresholds were measured for a diotic masker and a signal that was either in phase or had an interaural phase difference of 180 degrees. For comparison, thresholds were also measured for a broadband masker (without a notch) at various masker levels to account for possible level effects of the binaural masking level difference (BMLD). Normal-hearing and hard-of-hearing listeners with various degrees of sensorineural hearing impairment participated in the experiment. For all subjects, the thresholds decreased faster for the diotic than the dichotic signal as the notch width increased. The comparison with the data for the broadband masker indicated that this decrease of the BMLD is not due to the decrease of masker level within the auditory filter centered at the signal frequency. The thresholds can be predicted by an equalization-cancellation model assuming a slightly broader auditory filter in the dichotic masking condition. A possible realization of this different binaural auditory filter shape is adding to the on-frequency filter fractions of the adjacent filters.

## Session 3pPPb

# Psychological and Physiological Acoustics: General Topics in Psychological and Physiological Acoustics III

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Alain De Cheveigne, Cochair
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### *Contributed Papers*

**2:00**

**3pPPb1. Effects on cochlear frequency selectivity after hypobaric pressure exposure**. Jonas Brännström (Department of Audiology, Malmö University Hospital and Lund University, 205 05 Malmö, Sweden, jonas.brannstrom@skane.se), Jan Grenner (Department of Audiology, Lund University Hospital, 221 85 Lund, Sweden, jan.grenner@skane.se)

The effects of hypobaric pressure chamber exposure was measured in noise in ten patients with monaural fluctuating low-frequency hearing loss (FLFHL) such as Ménière's disease using psychophysical tuning curves (PTC), transiently evoked otoacoustic emissions (TEOAE), binaural pitch matches and speech recognition scores (SRS) in noise. In the literature, reversible hearing losses have been observed in about 50 % of the patients, but sometimes improved SRS can be observed in patients without hearing threshold improvement. This indicates possible effects of pressure treatment on cochlear frequency selectivity. The relative overpressure in the middle ear obtained after repeated exposures in hypobaric pressure chamber (total duration 18.5 to 28 minutes) was used to impose pressure gradients to the inner ear. The results indicated that the treatment effects were small, but slightly improved SRS in noise, TEOAEs emission strength and PTCs were observed after treatment. Pure tone hearing thresholds improved only for patients exposed to longer treatment durations. Subjective improvement at follow-up could not be predicted from the results. Although the effects were small, the data suggest that hypobaric pressure treatment may improve cochlear frequency selectivity in the affected ear in patients with monaural FLFHL.

**2:20**

**3pPPb2. IPods listening levels on London Underground**. Stephen Dance (London South Bank University, FESBE, Borough Road, SE1 0AA London, UK, dances@lsbu.ac.uk), Phil Wash (Bickerdike Allen Partners, 117-121 Salusbury Road, Queens Park, NW6 6RG London, UK, pwash @bickerdikeallen.com)

In the last 5 years the prevalence of the iPod/MP3 players has grown exponentially. The use of such in-earphones under urban conditions has been reported widely in the press at the anecdotal level. This study compared listening levels under quiet conditions and that representative of a London Underground train journey. Calibrated recordings of underground trains running in tunnels were played through loudspeakers in an anechoic chamber, whilst pop music or speech podcasts were played through the iBuds. Thirty-three participates listened to the iPod whilst a Binaural Head and Torso measured the noise levels through the in-earphones. The participants had time to adjust the volume setting on each occasion. A small audiometric study was undertaken for those participates with particularly high and low volume settings a week after the tests were completed. Results show very high volume settings were used when speech was played with the train noise.

**2:40**

**3pPPb3. Assessment of hearing damage when listening to music through a personal digital audio player**. Adriano Farina (Liceo Classico G.D. Romagnosi, Viale Maria Luigia 1, 43100 Parma, Italy, adriano @adrianofarina.it)

This study evaluates the sound pressure at the ears of users of personal digital audio players, equipped with in-ear earbuds. More than 50 devices were measured, provided by students aged 15/18. EN standard 50332 specifies the techniques for measuring the sound pressure level at the ears employing an head and torso simulator equipped with binaural microphones, when the gain control of the device is set to maximum. In this study, however, two measurmenets were performed on each device, one at maximum level, and another at the level at which the device had been left by the user after last listening. This way, on a statistical basis, it is possible to relate the effective exposure in daily usage with the maximum loudness of which the device is capable. Furthermore the study did also analyze the spectrum of the test signal: whilst the EN standard mandates for the IEC programme simulation noise, the analysis of thousands songs taken from the players under test revealed a slightly different spectrum, characterized by more boost at low frequencies and larger crest factor. The results of the study did show a relevant hearing risk for users of these personal digital audio players, which exceed noise exposure limits even when used for just one hour per day.

**3:00**

**3pPPb4. The Healthy Benefits of Isolating Earphones**. Jeremie Voix (Sonomax Hearing Healthcare Inc, 8375 Mayrand, Montreal, QC H4P 2E2, Canada, jvoix@sonomax.com), Cecile Le Cocq (Ecole de Technologie Superieure, 1100 Notre-Dame Ouest, Montreal, QC H4P 2E2, Canada, clecocq@mec.etsmtl.ca), Lee D. Hager (Sonomax Hearing Healthcare Inc, 8375 Mayrand, Montreal, QC H4P 2E2, Canada, lhager@sonomax.com)

With the ubiquitous presence of Personal Stereo Players (PSPs), namely iPods™ and the like, many hearing conservationists have raised concerns about the temporary and permanent hearing damages that could result from long exposure to loud music playback, especially among adolescents and teenagers. The crux of the problem can be identified as an overexposure of the auditory system. In order to reduce the dose received by the PSP listener, the playback level and/or the duration should be reduced. Assuming that the duration of the music playback experience is really up to the user, the remaining parameter is the music playback level. The purpose of this study is to first understand - from the available public and scientific literature - what factors are influencing the PSP playback level; and second, to investigate if the use of earphones featuring good attenuation of the ambient noise level would lead to a reduced playback level, hence a reduced dose and eventually less auditory damage. Other benefits on sound quality that are associated with isolating earphones will be presented in a third part. Finally the article will review other safety mechanisms that could be used in earphones and PSP to make them safe for the hearing.

**3:20**

**3pPPb5. Potentiation of noise-induced hearing loss by aviation fuel exposure in rats**. Laurence D. Fechter (Loma Linda VA Medical Center, Research Service (151), 11201 Benton Street, Loma Linda, CA 92357, USA, larry.fechter@va.gov), Caroline A. Gearhart (Loma Linda VA Medical Center, Research Service (151), 11201 Benton Street, Loma Linda, CA 92357, USA, caroline.gearhart@va.gov), Sherry Fulton (Loma Linda VA Medical Center, Research Service (151), 11201 Benton Street, Loma Linda, CA 92357, USA, sherry.fulton@va.gov), Yoon Hwan Kim (Dept Otolaryngology Cheongju St Mary's Hospital, 589-5 JuJung-Dong, SangDang-Gu, Cheong-Ju, 360-568 Chung-Buk, Republic of Korea, akeell@hanmail.net)

Clear standards have been established for workplace noise. These are designed to protect workers against noise-induced hearing loss. That occupational hearing loss still occurs despite such standards may reflect a variety of issues ranging from enforcement of standards, to adequacy of standards, and problems of noise assessment. An additional factor that influences susceptibility to noise-induced hearing loss is the presence of chemical contaminants in the workplace that render the auditory system especially vulnerable to noise. We report on the ability of aviation fuels to potentiate noise-induced hearing loss in laboratory rats. Subjects were exposed to JP-8 jet fuel, a synthetic fuel produced from coal using the Fischer-Tropsch method, or to clean air. Half of the subjects received a moderate noise exposure following fuel or air exposure. The noise exposure was designed to produce a temporary threshold shift. JP-8 + noise produced greater disruption of distortion product otoacoustic emissions as well as the auditory threshold than did noise alone. Supported by VA Rehabilitation Service grants and the American Petroleum Institute.

WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 240, 2:00 TO 3:40 P.M.

## Session 3pSCa

## Speech Communication: Phonetics

Joseph S. Perkell, Chair

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### *Contributed Papers*

**2:00**

**3pSCa1. Auditory and somatosensory goals for sibilants**. Joseph S. Perkell (Massachusetts Institute of Technology, Research Laboratory of Electronics, Room 36-511, 50 Vassar St., Cambridge, MA 02139-4307, USA, perkell@mit.edu), Melanie L. Matthies (Massachusetts Institute of Technology, Research Laboratory of Electronics, Room 36-511, 50 Vassar St., Cambridge, MA 02139-4307, USA, matthies@bu.edu), Satrajit S. Ghosh (Massachusetts Institute of Technology, Research Laboratory of Electronics, Room 36-511, 50 Vassar St., Cambridge, MA 02139-4307, USA, satra@speech.mit.edu), Edwin Maas (Massachusetts Institute of Technology, Research Laboratory of Electronics, Room 36-511, 50 Vassar St., Cambridge, MA 02139-4307, USA, maas@bu.edu), Alexandra Hanson (Massachusetts Institute of Technology, Research Laboratory of Electronics, Room 36-511, 50 Vassar St., Cambridge, MA 02139-4307, USA, alex.hanson@gmail.com), Frank H. Guenther (Boston University, 677 Beacon Street, Boston, MA 02215, USA, guenther@cns.bu.edu), Harlan Lane (Massachusetts Institute of Technology, Research Laboratory of Electronics, Room 36-511, 50 Vassar St., Cambridge, MA 02139-4307, USA, lane@speech.mit.edu), Lucie Ménard (Département de linguistique et de didactique des langues, Université du Québec à Montréal, Case postale 8888, succursale Centre-ville, Montréal, QC H3C 3P8, Canada, menard.lucie@uqam.ca), Mark Tiede (Massachusetts Institute of Technology, Research Laboratory of Electronics, Room 36-511, 50 Vassar St., Cambridge, MA 02139-4307, USA, tiede@speech.mit.edu)

In prior studies [JSLHR 47, 1259-69, 2004; JASA 116, 2338-44, 2004], we found that speakers' auditory acuity for synthetic sibilant (/s/, /sh/) and vowel stimuli was correlated with the degree of acoustic contrast they produced. This outcome is consistent with the view that the articulatory movements underlying phonemic contrasts have auditory goals. There was also a cross-speaker relation between sibilant contrast and use of contact between the tongue tip and lower alveolar ridge for /s/ (but not /sh), indicating that such contact is a somatosensory goal for /s/. In the current study, another, larger group of subjects also showed relations between measures of auditory acuity and acoustic contrast for sibilants and vowels. To determine whether the idea of a somatosensory goal for /s/ would also be supported by a relation between acuity and contrast, we made measurements of somatosensory discrimination. Small plastic (JVP) domes with grooves of different spacing were pressed against each subject's tongue tip and the subject was asked to identify one of four possible orientations of the grooves. A wide range of individual performance was observed with a bias-corrected sensitivity measure. Correlations with produced sibilant contrast and further analyses will be reported. [Research supported by NIDCD, NIH.]

**2:20**

**3pSCa2. Perceptual explanations of articulatory variability in the realisation of the nasal feature for the consonants**. Jacqueline Vaissière (Laboratory of Phonetics and Phonology, 19 rue des bernardins, 75005 Paris, France, jacqueline.vaissiere@univ-paris3.fr)

This paper illustrates how the perceptual constraints explain the observed articulatory and aerodynamic inter-speakers and inter-languages variability between initial nasal consonants (/n/), and unreleased final consonants (/N/). In the case of /n/, only a short, well-defined region around the consonant release needs to be nasalized for the consonant to be perceived as nasal. In the case of /N/, because of the lack of a nasal release, a longer span is needed for deciphering the presence of nasalisation; contextual nasalization of the preceding vowel can be avoided, but in that case, the nasal murmur has to be long to be perceived (since the first part of the murmur is perceptually masked by the vowel), and/or /N/ has to be released. Such observations argue for the division of the nasal consonant into three parts, onset, murmur and release: the realisation of the nasal feature is aligned around the /N/ onset, and around the /n/ offset. It also argues for a better integration of the perceptual requirements and masking phenomena in modelling the observed variability. Finally, it shows that a feature can be realized very differently depending on the position of the phoneme in the syllable.

**2:40**

**3pSCa3. Final consonant voicing and vowel height contrasts in whispered speech**. Yana D Gilichinskaya (City University of New York, Graduate Center, 365 Fifth Avenue, New York, NY 10016, USA, ygilichinskaya@gc.cuny.edu), Winifred Strange (CUNY Graduate Center,

365 5th Avenue, Program in Speech-Language-Hearing Sciences, New York, NY 10016, USA, strangepin@aol.com)

Whispered speech is a naturally distorted speech signal. Whereas it preserves some characteristics of fully phonated speech, some important acoustic cues are removed, diminished or altered. The prominence of acoustic cues in whispered speech may change due to the physical properties of the whispered speech signal, i.e., decreased intensity, the absence of periodic vibration of the vocal folds, damping of F1, shift of the formants and flattening of the amplitude envelope. Such changes affect the acoustic cues both for vowels (e.g. vowel height) and consonants (e.g. voicing contrasts). The objective of the present project was to explore the acoustic cues for post-stressed syllable-final consonant voicing contrasts and the vowels preceding them in continuous whispered speech of American English speakers and to compare the results with those in fully phonated speech. The stimuli were recorded in the carrier sentence ″I'll utter /habVC/ off the list″. The consonant pairs included voiced/voiceless bilabial stops /b-p/ and labiodental fricatives /f-v/, each combined with 11 AE vowels /i, I, ″epsilon″, e, æ, a, ″turned-v″, o, ″open-o″, u, ″horseshoe″/. Preliminary results showed that vowels had longer duration in whispered speech than in fully phonated speech. Spectral dispersion, temporal contrastivness of vowels; F1, and vowel duration cues will be reported in the presentation.

**3:00**

**3pSCa4. Production and perception of vietnamese short vowels**. Nguyen Viet Son (MICA center HUT - CNRS/UMI2954 INP Grenoble, C10 Hanoi university of Technology, No1 Dai Co Viet street - Hai Ba Trung, 0084 Hanoi, Viet Nam, viet-son.nguyen@mica.edu.vn), René Carré (Laboratoire Dynamique du Langage, UMR 5596, CNRS, Université Lyon 2, 14 Avenue Marcelin Berthelot, 69363 Lyon cedex 07, France, recarre@wanadoo.fr), Eric Castelli (MICA center HUT - CNRS/UMI2954 INP Grenoble, C10 Hanoi university of Technology, No1 Dai Co Viet street - Hai Ba Trung, 0084 Hanoi, Viet Nam, Eric.Castelli@mica.edu.vn)

It is well known that vowels can be produced in isolation, acoustically stable in such a way that they are represented as points in the F1-F2-F3 space. Vietnamese language presents 13 vowels, however, Vietnamese can only pronounce 9 vowels [i, u, e, o, $\omega$, a, $\sigma$, $\varepsilon$, $\gamma$] in isolated mode. A previous study showed that the 4 remaining vowels [$\alpha$, $\delta$, $\nu$, $\epsilon$] have the same acoustic characteristics (F1, F2, F3) as, respectively, the vowels [a, $\varepsilon$, $\sigma$, $\gamma$], but their dynamic characteristics (the rate of CV transitions) are clearly distinct. Measurements show us that vowels durations of [$\alpha$, $\nu$] are always shorter than the one of corresponding classical vowels [a, $\gamma$] and are not acoustically stable. For test perceptions (with 10 Vietnamese people), synthesized syllables [a-t] and [$\gamma$-t] with changing vowel duration are recognized as [$\alpha$-t, $\nu$-t] when then duration of initial vowel [a, $\gamma$] are 60% - 70% shorter. It means that the vowel duration is an important parameter that allows Vietnamese distinguishing the long vowels and short vowels in Vietnamese language. This paper further analyses the production of Vietnamese CV, including long vowels and short vowels in terms of duration, formant evolution and rate of C.V transitions.

**3:20**

**3pSCa5. Acoustic properties of the interdental approximant in Kagayanen**. Kenneth S. Olson (SIL International, 7500 W Camp Wisdom Rd, Dallas, TX 75236, USA, Ken_Olson@sil.org), Jeff Mielke (University of Ottawa, Arts Hall, 70 Laurier Ave East, Room 401, Ottawa, ON K1N 6N5, Canada, jmielke@uOttawa.ca)

This paper describes the acoustic properties of the interdental approximant, a rare speech sound reported to date only in a dozen languages in the Philippines. The measurements analyzed here are based on recordings of one female speaker of Kagayanen. The interdental approximant exhibits acoustic characteristics typical of semi-vowels: the formant pattern is similar to that of vowels, and the formant transitions with adjoining vowels have a long duration, usually 35 ms or more. The values of F2 and F3 are analogous to those of the Kagayanen [l], a prototypical voiced alveolar lateral; the only significant formant value difference between the two sounds involves F1: the interdental approximant has a mean of 508 Hz (n=9), whereas the mean for [l] is 368 Hz (n=9). On the other hand, while these two segments sound impressionistically similar, the interdental approximant differs acoustically from [l] in several other respects as well: there is no abrupt change in the formant pattern at the junctures with adjoining vowels, the higher formants (F6 and above) are not reduced in intensity, and F3 is not enhanced in intensity compared to semi-vowels.

WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 250B, 2:00 TO 3:40 P.M.

## Session 3pSCb

## Speech Communication: Prosody II

Marion Dohen, Chair

*Speech and Cognition Department, GIPSA-lab, 46 avenue Félix Viallet, Grenoble, 38031, France*

### *Contributed Papers*

**2:00**

**3pSCb1. Audiovisual perception of prosodic contrastive focus in whispered French**. Marion Dohen (Speech and Cognition Department, GIPSA-lab, 46 avenue Félix Viallet, 38031 Grenoble, France, marion.dohen@gipsa-lab.inpg.fr), Hélène Loevenbruck (Speech and Cognition Department, GIPSA-lab, 46 avenue Félix Viallet, 38031 Grenoble, France, Helene.Loevenbruck@gipsa-lab.inpg.fr)

This study investigates the potential contribution of visual information in the audiovisual perception of prosodic contrastive focus in French. Contrastive focus is used to attract the listener's attention to a specific part of the utterance. Mostly conceived of as auditory/acoustic, it also has visible correlates which have been shown to be perceived. This study aimed at analyzing the interaction between audition and vision for the perception of prosodic focus by using a whispered speech paradigm. It was based on audiovisual recordings from 4 speakers wearing no facial markers. It combined performance assessment to reaction time measurements and confirmed and extended preliminary results obtained on 2 speakers wearing facial markers (needed for a parallel articulatory analysis). The results showed that adding vision to audition for the perception of prosodic focus can not only improve perception performances but can also reduce perceptual cognitive load. A further analysis suggested that the two modalities are integrated for the perception of prosodic focus. Visual only perception was facilitated for whispered speech suggesting an enhancement of visual cues. Moreover, the absence of facial markers did not impair perception. Therefore facial markers do not seem to enhance the relative importance/salience of visual cues.

**2:20**

**3pSCb2. Effects of boundary tones on accent-related F0 peak alignment**. Yen-Liang Shue (Univ. of California Los Angeles, Dept. of Electrical Engineering, 405 Hilgard Ave., Los Angeles, CA 90095, USA,

yshue@ee.ucla.edu),Markus Iseli(Univ. of California Los Angeles, Dept. of Electrical Engineering, 405 Hilgard Ave., Los Angeles, CA 90095, USA, iseli@ee.ucla.edu), Stefanie Shattuck-Hufnagel (Massachusetts Institute of Technology, Research Laboratory of Electronics, Speech Communication Group, 77 Massachusetts Ave., Cambridge, MA 02139, USA, stef@speech.mit.edu), Nanette Veilleux (Simmons College, Dept. of Computer Science, 300 The Fenway, Boston, MA 02115, USA, nanette.veilleux@simmons.edu), Sun-Ah Jun (Univ. of California Los Angeles, Dept. of Linguistics, 405 Hilgard Ave., Los Angeles, CA 90095, USA, jun@humnet.ucla.edu), Abeer Alwan (University of California, 405 Hilgard Ave, Los Angeles, CA 90095, USA, alwan@ee.ucla.edu)

Speakers sometimes delay the F0 peak of a high accent beyond the accented syllable (Silverman and Pierrehumbert, Papers in Laboratory Phonology I, 1990; Xu, Phonetica, 2001). Previous studies of factors affecting peak alignment focused on the phrasal position of the accented word and the segments of the accented syllable (Jilka and Möbius, Interspeech 2007). Shue et al. (Interspeech 2007) hypothesized that if an accented word also contains boundary tones, that could influence the position and height of the F0 peak. A test corpus controlling for vowel type, syllable number and position of the focused word, based on the utterances ″Dagada gave Anne a dada (daily)″ and ″A dada gave Anne dagadas (daily)″, was produced using four prosodically different contours, involving high (H*) and low (L*) pitch accents on either ″dagada″ or ″dada″, in declarative and interrogative forms eliciting different boundary tones. Analysis of five repetitions spoken by four male and four female native American English speakers reveals that for most speakers, the presence of boundary tones on the target word shifts the accent-related F0 peak earlier when other factors are held constant. Preliminary results suggest effects of boundary tone on H* F0 peak height as well.

**2:40**

**3pSCb3. Double focus in general American English**. Fang Liu (The University of Chicago, Department of Linguistics, 1010 E. 59th Street, Chicago, IL 60637, USA, liufang@uchicago.edu)

This study investigates the acoustic realization of double focus in statements and declarative questions in English. Five speakers produced eight sets of utterances with alternating focus (medial, final, or double) and sentence type (statement or declarative question) conditions. F0 analyses indicate that the effect of double focus on the global pitch range and the local pitch target is somewhat moderate when compared to that of single focus: 1) Post-focus pitch range suppression shows a smaller magnitude in double- than in medial-focused statements, 2) Post-focus pitch range raising is less dramatic in double- than in medial-focused questions, and it ends before the stressed syllable of the second focus in double-focused questions, in order to realize a rising pitch target for the on-focus stressed syllable, and 3) pitch targets of on-focus stressed syllables are more fully realized (i.e., showing steeper slopes or higher registers) in single- than in double-focused sentences. Duration analyses indicate that the length of the double-focused item is in between those of the corresponding single- and non-focused item, with the single-focused stressed syllable having the longest duration. These findings demonstrate a delicate balance among the realization of lexical stress, focus, and sentence type in English.

**3:00**

**3pSCb4. Melodic prominences structures: exploring to what extent the speaker variability is spreading**. Geneviève Caelen-Haumont (MICA Center, C10, Hanoi Universirty of Technology, 1 Dai Co Viet Str., Hai Ba Trung, Hanoi, Hanoi, Viet Nam, genevieve.caelen@mica.edu.vn)

Melodic prominences in speech have a deserved reputation of conveying a great part of variability, as they are greatly based on subjective impulse and feelings. We think that these specific contours are nevertheless relevant, and that their structure, while obeying to internal laws of regulation, allow also a range of speaker variability. Generally no specific tool was used to describe these FO contours with precision. An automatic analysis tool MELISM was then developed by Caelen-Haumont and Auran (2004) allowing accurate descriptions of F0 salience (melisms). This paper aims at 1° describing the MELISM tool, the automatic segmentation, the annotation, the melodic labelling of the melism structure it provides in the prosody domain 2° presenting the main results over 4 speaker exploring to what extent the speaker variability spreads. The melism structures are explored and analysed such as the whole variability is reduced through three major components (onset, nucleus, coda) and their respective subparts, where only the nucleus is the compulsory part. Statistics running on these structures put to light a set of interesting laws about the internal regulation of melisms but in the other side, the part devoted to the speaker variability.

**3:20**

**3pSCb5. How prosody correlates with syntax: An observation on Sakizaya, an endangered Formosan language**. Sally Chen (Grad. Inst. of Linguistics, National Taiwan Univ., 1, Roosevelt Rd. Sec. 4, 106 Taipei, Taiwan, d93142002@ntu.edu.tw), Wen-Chi Shen (Grad. Inst. of Linguistics, National Taiwan Univ., 1, Roosevelt Rd. Sec. 4, 106 Taipei, Taiwan, r94142007@ntu.edu.tw), Li-May Sung (Grad. Inst. of Linguistics, National Taiwan Univ., 1, Roosevelt Rd. Sec. 4, 106 Taipei, Taiwan, limay@ntu.edu.tw), Janice Fon (Grad. Inst. of Linguistics, National Taiwan Univ., 1, Roosevelt Rd. Sec. 4, 106 Taipei, Taiwan, jfon@ntu.edu.tw)

This pioneering study investigates the relationship between prosody and syntax of Sakizaya, an endangered Formosan language in eastern Taiwan. Both elicitation data and spontaneous data were collected from five informants (aged 48 to 74), in order to provide a more thorough sketch on this VSO language with clear case marking and voice systems. Preliminary results showed that in descriptive sentences, prosodic units and syntactic units do correlate with each other, depending on which of the four voices is used. (The four voices in Sakizaya: agent-, patient-, instrumental, and locative voices) However, once specific functions are imposed onto a sentence, they will override this ″default″ setting, and adopt corresponding prosodic patterns for the ease of communication. For example, in this language, the default position to receive a nuclear accent should be the ultimate syllable of a sentence; however, we observed an accent shift onto the penultimate syllable for yes/no questions, exclamations, as well as continuously progressive sentences. In negation sentences, pitch peaks are distinctively higher in the accented syllable of the negator (which posited sentence-initially), instead of the ultimate syllable in sentence-final position. Lastly, case markers and voice markers were found as preferred positions for speech planning and repair.

## Session 3pSP

# Signal Processing in Acoustics, Acoustical Oceanography, and ECUA: Model-Based Signal Processing I

Sean Lehman, Cochair
*Lawrence Livermore Natl. Lab., Livermore, CA 94551, USA*

Christian Pichot, Cochair
*Antennas & Telecommunications Laboratory, University of Nice-Sophia Antipolis, France*

### *Invited Papers*

**2:00**

**3pSP1. Model-based algorithms for detecting damage in ultrasonic nondestructive evaluation measurements**. Grace A. Clark (Lawrence Livermore National Laboratory, 7000 East Ave., L-130, Livermore, CA 94550, USA, clark9@llnl.gov)

This work addresses the ″As-Built″ modeling problem in ultrasonic nondestructive evaluation (NDE), in which one is given measurements of a mechanical part before and after use. The condition of the ″as-built″ part (prior to use) is known, so that after the part has been used, it can be tested for damage. This enables a two-step model-based approach: (1) Given input-output measurements (A-Scans), estimate a dynamic prediction-error model of the ″as-built″ measurement(s) using system identification algorithms. The model is validated by testing the innovations (residuals) for statistical whiteness and then stored for future use. (2) Later, when testing the part for damage, the error between the measurement and the output of the stored model is tested against a short-term whiteness confidence interval test statistic. If the part passes the test, this implies that the model remains valid and the part is declared undamaged. If the part fails the test, this indicates a model mismatch, which means that the part's acoustic properties have changed, and the part is declared damaged. Performance of the algorithms is demonstrated using real measurements, receiver operating characteristic (ROC) curves and a confidence interval about the probability of correct classification.

**2:20**

**3pSP2. Signal-based ray tracing modeling in complex tectonics**. Paul Cristini (CNRS-UMR5212 Modélisation et Imagerie en Géosciences, UPPA BP115, 64013 Pau, France, paul.cristini@univ-pau.fr), Eric De Bazelaire (11, Route du Bourg, 64230 Beyrie-en-Béarn, France, edebaz@wanadoo.fr), Charles Revaux (50, Rue Lagardere, 64000 Pau, France, charles.revaux@wanadoo.fr)

The objective of this talk is to present a novel method which can perform the fast computation of the times of arrival of seismic waves which propagate between a source and an array of receivers in a stratified medium. This method combines signal processing concepts for the approximation of interfaces and wavefronts, and ray theory for the propagation of wavefronts. The main idea is to put in adequation the computations with the the precision and the resolution of the source signal in order to avoid unnecessary computational effort. This new approach leads to the redefinition and simplification of the model through which waves propagate. The modifications are governed by the spectral characteristics of the source signal. All rays are computed without any omission at a much lower cost in computing time than classical methods. In addition, we will show how to include surface waves such as head waves within the proposed method.

### *Contributed Papers*

**2:40**

**3pSP3. Imaging the earth's subsurface via regularized inversion**. Robert Clapp (Stanford University, 397 Panama Mall, Geophysics Department, Stanford, CA 94305, USA, bob@sep.stanford.edu)

Modern seismic exploration geophysics attempts to construct a model of the earth's subsurface using measurements taken at the earth's surface. The recorded measurements comprise datasets with billions to trillions of samples. Despite the size of the datasets, models are often poorly sampled because of the complexity of the earth's subsurface. Therefore, the resultant model is poorly determined for many components. The massive size of our problems introduce additional limitations. We are limited to adjoint-based inversion methods, we can never afford to iterate to true convergence, and most importantly we make approximations to the physics in our operators. These limitations introduce spurious events when inverting. Significantly improved results can be obtained by incorporating regularization that incorporates a priori knowledge of the physics and geology into the inversion process.

**3:00**

**3pSP4. Characterization of targets buried in disordered medium**. Kamal Belkebir (Faculté St Jérôme, 13397 cedex 20 Marseille, France, kamal.belkebir@fresnel.fr), Faheem Ashraf (Faculté St Jérôme, 13397 cedex 20 Marseille, France, faheem.ashraf@fresnel.fr), Marc Saillard (Faculté St Jérôme, 13397 cedex 20 Marseille, France, marc.saillard@lseet.univ-tln.fr), Patrick Chaumet (Faculté St Jérôme, 13397 cedex 20 Marseille, France, patrick.chaumet@fresnel.fr)

We consider in this paper the problem of the determination of the permittivity profile of an unknown buried object from measurements of the electromagnetic scattered field. The target under test is assumed to be buried in one of the two involved media while the sources and the receivers are located in the other medium (limited-aspect data configuration). This ill-posed and non-linear inverse scattering problem is reformulated as an optimization problem that is solved iteratively. This method consists in building up a sequence of the parameter of interest by minimizing, at each iteration step, a cost functional representing the discrepancy between the data and

those that would be obtained with the best available estimation of the parameter. In addition, when clutter is present, the decomposition of the time reversal operator method is used to improve the signal-to-clutter ratio, since it allows us to synthesize a wave that focuses on the scatterer. The data associated with this incident field are included in the iterative minimization procedure.

***Invited Paper***

**3:20**

**3pSP5. Underwater channel characterization using opportunity sources : a time-frequency-phase approach**. Cornel Ioana (GIPSA-lab, dep. DIS, 961, rue de la Houille Blanche, 38402 St Martin d'Hères, France, cornel.ioana@gipsa-lab.inpg.fr), Arnaud Jarrot (Schlumberger Riboud Product Center, 1 rue Becquerel, 92140 Clamart, France, ajarrot@clamart.oilfield.slb.com), Cédric Gervaise (E3I2 - EA3876, 2 rue François Verny, 29806 Brest Cedex, France, cedric.gervaise@ensieta.fr), Andre Quinquis (Scientific Research and Innovation Division, DET/GESMA BP 42, 29240 Brest, France, andre.quinquis@dga.defense.gouv.fr), Jérôme I. Mars (GIPSA-lab, dep. DIS, 961, rue de la Houille Blanche, 38402 St Martin d'Hères, France, jerome.mars@gipsa-lab.inpg.fr)

Analyzing natural signals constitutes the main tool for characterization of physical phenomena. Underwater channel is an example of a natural environment potentially characterized by signals generated by various sources : underwater mammals, human activity noise, etc. In order to efficiently exploit the information from these signals two major problems should be addressed. First, since the signals are unknown or disturbed by unpredictable factors, we are deal with a blind processing context. That is, the lack of a priori hypothesis has to be considered. Generally, the signal has a complex shape characterized by multi-component non-linear time-frequency structures. The proposed solution consists in focusing our processing on non-parametric time-frequency analysis considering also fundamental signal items such as time-frequency energy and local phase analysis. The second problem is related to the complex connection between physical parameters of a phenomenon and parameters of signals characterizing this phenomenon. The proposed approach consists of combining the physical model with the information provided by a parametric representation of the signal. This framework helps to the definition of the concept of underwater passive tomography which provides the characterization of the underwater channel of interest by taking advantage of environmental signals : mammals vocalizations, motion sources, etc.

WEDNESDAY AFTERNOON, 2 JULY 2008 AMPHI BORDEAUX, 2:00 TO 3:20 P.M.

## Session 3pUWa

## Underwater Acoustics and ECUA: Fluctuations and Statistics

Barry J. Uscinski, Cochair
*Cambridge University, Centre for Mathematical Sciences, Wilberforce Rd., Cambridge, CB3 0WA, UK*

Kevin D. Lepage, Cochair
*Naval Research Laboratory, 4555 Overlook Ave SW, Washington, DC 20375, USA*



***Contributed Papers***

**2:00**

**3pUWa1. Horizontal structure of acoustic intensity fluctuations in the ocean**. Barry J. Uscinski (Cambridge University, Centre for Mathematical Sciences, Wilberforce Rd., CB3 0WA Cambridge, UK, bju1@cam.ac.uk), Jim Nicholson (QinetiQ Ltd., Winfrith Technology Centre, Dorchester, Dorset, DT2 8XJ Dorchester, UK, jrnicholson@qinetiq.com)

In April 1989 an acoustic experiment was performed over the abyssal plain south of Msderia in which transmissions were made, for about an hour, at 482, 680 and 740Hz from a ship steaming at 5kts to a receiving array towed by another ship 65km away travelling on a parallel course at the same speed. The signals arrived by two paths, an upper path trapped in the surface duct and a lower path via the main sound channel. This paper describes the experiment and analyses the intensity fluctuations in the signal received by the lower path. We investigate the horizontal structure of intensity fluctuations in the ocean when these are mainly due to internal waves. This aspect of such acoustic intensity fluctuations has received little attention until now. The experimental results are compared with theoretical predictions based on the parabolic moment equations for propagation and scattering in randomly irregular media, and on the stnadard Garrett-Munk model for ocean internal waves. The experimental results and theoretical predictions agree quite well but some new questions arise about the correlation of intensity fluctuations as the acoustis transmission frequency is varied.

**2:20**

**3pUWa2. Evolution of the statistics of the unscattered component of low order acoustic modes as a function of range**. Tarun K. Chandrayadula (George Mason University, 4400, University Drive, Fairfax, VA 22030, USA, tchandra@gmu.edu), Kathleen E. Wage (George Mason University, 4400, University Drive, Fairfax, VA 22030, USA, kwage@gmu.edu)

Scattering due to internal waves in the ocean causes the acoustic modes to exchange energy as they propagate. At a specific range, the mode signal consists of two components: the unscattered component is the energy that has propagated only in the designated mode and the scattered component contains the contributions from other modes. The unscattered component dominates the signal at short ranges, but decays to zero at longer ranges. If the unscattered component can be isolated from the scattered energy, it could be used in tomographic inversions. Signal processing techniques are needed to detect the unscattered component. A statistical model for the unscattered component that would help design signal processing techniques is currently unavailable. This talk describes a new model for the unscattered component that was developed using coupled mode and parabolic equation simulations. The model characterizes the statistics of the unscattered component using parameters such as frequency and time coherence. The characteristics of the unscattered component are then compared with the scat-

tered component. The implications of these results for the design of detectors is briefly discussed. [Work supported by ONR Ocean Acoustics Graduate Traineeship Award]

**2:40**

**3pUWa3. Exact and approximate moments for dispersive pulse propagation**. Leon Cohen (City University of New York, Hunter-Phyiscs, 695 Park Ave., New York, NY 10021, USA, leon.cohen @hunter.cuny.edu), Patrick Loughlin (University of Pittsburgh, 348 Benedum Engineering Hall, Dept. of Electrical & Computer Engineering, Pittsburgh, PA 15261, USA, loughlin@engr.pitt.edu)

We derive exact moments for pulse propagation in a dispersive medium. These moments are not only inherently interesting but clarify the validity of a recently proposed approximation scheme for wave propagation. The approximation method for pulse propagation is based on the Wigner position-wave/number representation and is very accurate, easy to apply, and moreover is physically illuminating. In particular one obtains the evolved approximate Wigner distribution from the initial Wigner distribution by a simple linear translation in phase space. Propagation with damping is also taken into account. We will show that the reason for the high accuracy of the approximation is that the important low order moments are exactly given by the approximation and that these low order moments preserve very well the basic shape of the pulse. Moreover, now that we understand why the approximation method works well, the approximation can be systematically improved. We give a number of specific examples of exactly calculable moments to illustrate the method and we compare exact and approximate moments. The work of PL is supported by The Research of LC was supported by AFOSR and the work of PL is supported by ONR (N00014-06-1-0009)

**3:00**

**3pUWa4. Absolute intensities of acoustic shadow zone arrivals**. Lora Van Uffelen (MPL, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0238, USA, lvanuffe@ucsd .edu), Peter Worcester (MPL, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0238, USA, pworcester@ucsd.edu), Matthew Dzieciuch (MPL, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0238, USA, mad@ucsd.edu)

Qualitative observations from bottom-mounted US Navy SOSUS receiving stations in the North Pacific reveal anomalously deep acoustic arrivals at travel times directly corresponding with timefronts expected to have turned much higher in the water column. The vertical structure of these shadow zone arrivals was studied during SPICEX, a long-range propagation experiment conducted from June to November 2004 in the North Pacific, utilizing moored sources 500 and 1000 km distant from two vertical line array receivers, which together virtually spanned the full ocean depth. Comparison of the measured absolute intensities of shadow zone arrivals with Monte Carlo parabolic equation simulations suggest that the amount of internal wave scattering associated with the standard Garrett-Munk (GM) internal wave spectrum is not adequate to account for the extent of scattering into the acoustic shadow evident in the experimental data, suggesting either that the GM spectrum is not an appropriate representation of the internal wave field or that some other mechanism, such as oceanic spice, may be also be contributing to the scattering.

WEDNESDAY AFTERNOON, 2 JULY 2008 ROOM 341, 2:00 TO 3:40 P.M.

## Session 3pUWb

## Underwater Acoustics and ECUA: Array Processing

David L. Bradley, Cochair
*Pennsylvania State University, Post Office Box 30, State College, PA 16804-0030, USA*

Claire Debever, Cochair
*MPL, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0238, USA*

### *Contributed Papers*

**2:00**

**3pUWb1. Effect of array element location on coherent inter-array processing**. Claire Debever (MPL, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0238, USA, cdebever@ucsd.edu), William A. Kuperman (MPL, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093-0238, USA, wkuperman@ucsd.edu)

In the SWellEx-96 experiment, two 25-elements horizontal arrays, each of length 250 m, were moored 3.5 km apart [N.O. Booth et al, IEEE, JOE, 25, no 3, July 2000]. A broadband source (50 to 400 Hz tones) was towed from 1 km to 10 km away from the arrays. The data is processed using the simple conventional plane-wave beamformer for all the cases covering incoherent frequency and incoherent inter-array processing to coherent frequency and coherent inter-array processing as a function of source position relative to the arrays. The effect of noise and array element location mismatch on source localization and coherent processing gain is investigated. An attempt to improve array element localization is made using a self-focusing technique. [Work supported by ONR.]

**2:20**

**3pUWb2. Longitudinal Correlation Improvement with Model-based Technique**. Renhe Zhang (National Laboratory of Acoustics, Institute of Acoustics, Chinese Academy of Sciences, No 21, Beisihuanxilu, 100080 Beijing, China, zrh@mail.ioa.ac.cn), Fenghua Li (National Laboratory of Acoustics, Institute of Acoustics, Chinese Academy of Sciences, No 21, Beisihuanxilu, 100080 Beijing, China, lfh@mail.ioa.ac.cn)

Longitudinal correlation coefficient is one of the most important parameters for signal processing in ocean acoustics. Multi-path interference is an important effect on the decrease of the longitudinal correlation for low frequency sound propagation in shallow water. In this research, the Frequency-Phase-Shift Relationship (FPSR) between the Frequency Response Function (FRF) of sound propagation at two horizontally separated locations based on waveguide invariant is derived. The validity of the FPSR is demonstrated by both numerical simulations and data from two experiments. Experimental data also show that the decrease of the longitudinal correlation coefficient of low frequency signals from explosive source due to multi-path interference can be conquered significantly with the FPSR. [Work supported by the National Natural Science Foundation of China under Grand No 10734100].

**2:40**

**3pUWb3. Performance analysis of GARCH based DOA estimation in SONAR**. Hadi Amiri (Engineering Research Institute, Ministry of J-Agriculture, 13445-754 Tehran, Iran, h.amiri@ieee.org), Hamidreza Amindavar (Amirkabir University of Technology, Department of Electrical Engineering, 15914 Tehran, Iran, hamidami@aut.ac.ir), Mahmoud Kamarei (University of Tehran, Department of Electrical and Computer Engineering, 14395-515 Tehran, Iran, kamarei@ut.ac.ir)

In this paper we propose a new source localization method using additive noise modeling based on Generalized Autoregressive Conditional Heteroscedasticity (GARCH) time-series. In an actual application such as underwater acoustics, the measurement of additive noise in a natural environment shows that noise can sometimes be significantly non-Gaussian and nonstationary, and therefore, signal processing algorithms that are optimized for Gaussian noise, may degrade significantly in this environment. GARCH models are feasible for heavy tailed PDFs and time varying variances of stochastic process and also has flexible forms. We use a more realistic GARCH(1,1) based noise model in the Maximum Likelihood Approach for the estimation of Direction-Of-Arrivals (DOAs) of impinging sources. In the performance analysis of the method, we examine the suitability of the proposed method in a passive sonar using simulation methods with cramer-rao bound (CRB) and perturbaion appraoch such as gain, phase and sensors positions errors.

**3:00**

**3pUWb4. Direct wave suppression using wavelet transform for bistatic sonar**. Bo Lei (Institute of Acoustic Engineering, Northwestern Polytechnical University, 710072 Xi'an, China, lei.bo.thunder@gmail.com), Yuanliang Ma (Institute of Acoustic Engineering, Northwestern Polytechnical University, 710072 Xi'an, China, ylma@nwpu.edu.cn), Kunde Yang (Institute of Acoustic Engineering, Northwestern Polytechnical University, 710072 Xi'an, China, ykdzym@nwpu.edu.cn), Chao Sun (Institute of Acoustic Engineering, Northwestern Polytechnical University, 710072 Xi'an, China, csun@nwpu.edu.cn)

The bistatic sonar is often influenced by the direct wave, especially when the target approaches the baseline of the system. The direct wave is above 50dB higher than the scattering signal level. The paper analyzes the effect of the direct wave, and proposes a new method based on wavelet transform for direct wave suppression. The strong direct wave is well eliminated while maintaining the weak scattering signal almost unchanged. The basic idea is that the direct wave is firstly removed form the received signal after wavelet transform. Then the signal is reconstructed in time domain, finally the cross-correlation is achieved to shown the doppler frequency shift of the weak scattering signal. Computer simulation is given. The cross-correlations of the received signal for both before and after the direct wave suppression are compared. It shows that the influence of the direct wave is correctly removed, the time delay and Doppler frequency shift are shown in the figure and the target is detectable.

**3:20**

**3pUWb5. Adaptive beamforming applied to underwater acoustic measurements**. Denis Orlov (Institute of Applied Physics of the Russian Academy of Sciences, 46 Ulyanov Street, 603950 Nizhny Novgorod, Russian Federation, denis@hydro.appl.sci-nnov.ru), Iosif Fiks (Institute of Applied Physics of the Russian Academy of Sciences, 46 Ulyanov Street, 603950 Nizhny Novgorod, Russian Federation, fiks@hydro.appl.sci-nnov.ru), Galina Fiks (Institute of Applied Physics of the Russian Academy of Sciences, 46 Ulyanov Street, 603950 Nizhny Novgorod, Russian Federation, galya@hydro.appl.sci-nnov.ru), Pavel Korotin (Institute of Applied Physics of the Russian Academy of Sciences, 46 Ulyanov Street, 603950 Nizhny Novgorod, Russian Federation, monitor@hydro.appl.sci-nnov.ru), Victor Turchin (Institute of Applied Physics of the Russian Academy of Sciences, 46 Ulyanov Street, 603950 Nizhny Novgorod, Russian Federation, tvi@hydro.appl.sci-nnov.ru)

In many applications, such as measuring the underwater noise level of moving ships, underwater acoustic measurements face serious difficulties related to several factors, including low signal-to-noise ratio, effects of surface and bottom on signal, as well as complicated spatial structure of the sea interference. The increase of the measurement interference resistance, compared to the case of a single receiver (hydrophone), can be provided by the use of spatially distributed receiving systems (antenna arrays), which are able to suppress the interference due to their spatial selectivity. The present work is aimed at developing adaptive methods for underwater acoustic measurements with the use of vertical antenna arrays. The method must provide the maximum reduction of external interference keeping the given measurement accuracy, i.e., the result must coincide with the output of a single receiver in the absence of interference. From the point of view of synthesis of array systems, the originality of the presented approach is mainly in conjunction of measurement functionality of the antenna array and the maximum interference suppression. The results of numerical simulation and experimental testing under sea conditions show that the proposed adaptive methods provide high precision of measurements under strong and/or complex interference conditions.

## Session 3pUWc

# Underwater Acoustics and ECUA: Objects Scattering and Detection

Sven M. Ivansson, Cochair
*Swedish Defence Research Agency, FOI Kista, Stockholm, SE-16490, Sweden*

Ahmad Abawi, Cochair
*HLS Research, Inc., 3366 N. Torrey Pines Ct., Ste. 310, La Jolla, CA 92037, USA*

### *Contributed Papers*

**2:00**

**3pUWc1. Numerical design of Alberich anechoic coatings with superellipsoidal cavities of mixed sizes**. Sven M. Ivansson (Swedish Defence Research Agency, FOI Kista, SE-16490 Stockholm, Sweden, sveni@foi.se)

Thin rubber coatings with cavities in a doubly periodic lattice are able to reduce reflections of underwater sound by redistributing normally incident energy such that absorption in the surrounding rubber is enhanced. For spherical scatterers, the anechoic effect can be studied numerically by the layer multiple-scattering method. In comparison to more flexible but also more computer intensitive methods, such as FEM modeling, there are two important advantages. An improved physical understanding of the anechoic effect can be achieved by simplified semianalytical analysis, and the high computational speed allows modern global optimization techniques to be applied for coating design. In this paper, the flexibility of the layer multi-scattering method is improved by combination with an efficient algorithm for numerical computation of transition matrices for superellipsoidal scatterers. Extensions to mixtures of nonspherical scatterers of different types are also considered, in order to enhance the broad-band performance. Symmetry properties are used to reduce the size of the pertinent equation systems. Examples of numerical coating design for underwater acoustic applications are presented, using differential evolution algorithms for the optimization.

**2:20**

**3pUWc2. Scattering from rotationally-symmetric objects using only free space Green's functions**. Ahmad Abawi (HLS Research, Inc., 3366 N. Torrey Pines Ct., Ste. 310, La Jolla, CA 92037, USA, Abawi@HLSResearch.com), Michael B. Porter (HLS Research, Inc., 3366 N. Torrey Pines Ct., Ste. 310, La Jolla, CA 92037, USA, michael.porter@hlsresearch.com)

To compute scattering from an object, one has to solve the wave equation and impose the appropriate boundary conditions on the surface of the object. For objects for which the wave equation can be separated, like cylinders, spheres and spheroids, this problem can be solved analytically. For more general objects, methods like the finite element or boundary element techniques can be employed. The use of free space Green's functions offers another method for computation of scattering from a general-shaped object. This method, which is known as the method of field superposition or the virtual source technique, can be used to impose the appropriate boundary conditions on the surface of the object by using free space Green's function with complex amplitudes. These amplitudes are determined from a matrix equation that results when boundary conditions are imposed. In this paper we apply this technique to compute scattering from rotationally symmetric objects. These objects can be homogeneous solids or shells, filled with a homogeneous fluid. The versatility and robustness of the method is demonstrated by applying it to various objects in free space and in a waveguide.

**2:40**

**3pUWc3. Modeling of underwater sonar barriers**. Andrzej Elminowicz (R&D Marine Technology Centre, Ul. Dickmana 62, 81-109 Gdynia, Poland, andrzeje@ctm.gdynia.pl), Leonard Zajaczkowski (R&D Marine Technology Centre, Ul. Dickmana 62, 81-109 Gdynia, Poland, leonard@ctm.gdynia.pl)

Commonly used Diver Detection Sonar (DDS) are characterized by detection and tracking as well as intruder warning in limited range 300 m ÷ 600 m. A new approach to underwater protection is focused on multi-monostatic, bistatic and multistatic active sonar barriers (ASB). This paper describes key features of a multi-monostatic (MM), bistatic (BS) and multistatic (MS) operation in the littoral beginning from system configuration, its performance and constraints. A new type of acoustic devices in a form of a transmitting/receiving module and its application in active sonar barriers (ASB) has also been presented. Coverages and ranges of barriers for various technical parameters, environmental conditions and wave propagation as well as modules location (including transducers' depth, azimuth and inclination) have been studied. The application of active sonar barriers (ASB), especially in protection systems, has been presented as barriers protecting docks, harbour basins, ships at piers or harbour entries. The new type of a monostatic/bistatic acoustic barrier in technology demonstrator form, has been designed and constructed. In order to display detection and localization of the small underwater objects as well as their tracking and classification the performance tests of the barrier will be conducted. The results of the tests will be attached to the paper.

**3:00**

**3pUWc4. Wideband sonar system for autonomous surveys using REMUS**. Chris Capus (Ocean Systems Laboratory, School of Eng. & Phys. Sciences, Heriot-Watt University, EH14 4AS Edinburgh, UK, C.Capus@hw.ac.uk), Yan Pailhas (Ocean Systems Laboratory, School of Eng. & Phys. Sciences, Heriot-Watt University, EH14 4AS Edinburgh, UK, Y.Pailhas@hw.ac.uk), Keith E. Brown (Ocean Systems Laboratory, School of Eng. & Phys. Sciences, Heriot-Watt University, EH14 4AS Edinburgh, UK, K.E.Brown@hw.ac.uk)

Many new roles are being proposed for Autonomous Underwater Vehicles (AUVs) to carry out hazardous tasks in harsh or remote locations and to free up valuable resources required for manned missions. These roles include marine environmental survey, target detection and classification and tracking of underwater pipes and cables. Suitable sensing and processing packages must be provided and building on recent wideband sonar research, the Ocean Systems Laboratory (OSL) is putting together a wideband system for deployment on board a REMUS AUV. The prototype sensor package comprises paired projectors and receivers mounted in a side-looking arrangement to provide complementary information to the standard REMUS sidescan modules. The sensor bandwidths cover a range from 30-130kHz similar to those used by the bottlenose dolphin. Data is gathered autonomously with a dedicated AMD Geode based PC104+ PC controlling a 4-channel 800kHz simultaneous sampling data acquisition module. Acquisition is triggered to coincide with mission requirements from a separate mission control PC on board the vehicle.

**3:20**

**3pUWc5. A multistatic synthetic aperture sonar to detect a cylinder lying on a rough interface: experimental results**. Caroline Herve (Laboratory for Mechanics and Acoustics CNRS, 31 chemin Joseph Aiguier, 13009 Marseille, France, herve@lma.cnrs-mrs.fr), Jean-Pierre Sessarego (Laboratory for Mechanics and Acoustics CNRS, 31 chemin Joseph Aiguier, 13009 Marseille, France, sessarego@lma.cnrs-mrs.fr), Régine Guillermin (Laboratory for Mechanics and Acoustics CNRS, 31 chemin Joseph Aiguier, 13009 Marseille, France, guillermin@lma.cnrs-mrs.fr), Françoise Schmitt (Groupe d'Electromagnétisme Appliqué, Pôle Scientifique et Technologique de l'Université Paris X Nanterre Site de Ville d'Avray, 50, rue de Sèvres, 92410 Paris Ville-d'Avray, France, fschmitt@u-paris10.fr), Franck Daout (Groupe d'Electromagnétisme Appliqué, Pôle Scientifique et Technologique de l'Université Paris X Nanterre Site de Ville d'Avray, 50, rue de Sèvres, 92410 Paris Ville-d'Avray, France, fdaout@u-paris10.fr)

Monostatic Synthetic Aperture Sonar (SAS) are high resolution systems for target imaging which are now of common use in the underwater acoustics domain. The objective of this work was to analyse what kind of information should be obtained from a multistatic SAS system. This idea has been applied in radar but very few works exist in the underwater acoustics domain. The applications could be detection and identification of buried mines or mines lying on the seabed and divers detection for harbour protection. These applications deal with the problem of target detection and identification near a rough surface. To show what can be obtained with a multistatic SAS processing, we have performed an experiment with a circular cylinder of 1 cm diameter lying on a rough interface made of sand grains of 1 mm diameter. Measurements were performed in a tank with both a multistatic and a monostatic SAS systems. The signal used to insonified the target area was a short impulse with a 2 MHz central frequency which corresponds to a ka about 40. Images of the cylinder in presence of clutter have been reconstructed with the matched filtering algorithm from monostatic and multistatic acquisitions and have been compared.

## Awards Ceremony

Gilles A. Daigle
*President, Acoustical Society of America*

Luigi Maffei
*President, European Acoustics Association*

Jean Kergomard
*President, Société Française d'Acoustique*

### Acoustical Society of America

**Presentation of ASA Fellowship Certificates**

Michael A. Akeroyd
Susanna B. Blackwell
Dick B. Botteldooren
Dani M. Byrd
Brian R. Glasberg
Larry E. Humes
Vera A. Khokhlova
Christophe D. Micheyl
Anthony P. Nash
John C. Osler
Subramaniam D. Rajan
Richard M. Stern
Brad H. Story
Lily M. Wang

2007 Research Grant in Speech Science of the American Speech-Language-Hearing Foundation to Mary K. Fagan

Medwin Prize in Acoustical Oceanography to Mark V. Trevorrow

Distinguished Service Citation to Charles E. Schmid

R. Bruce Lindsay Award to Tyrone M. Porter

Helmholtz-Rayleigh Interdisciplinary Silver Medal to James V. Candy

Gold Medal to Patricia K. Kuhl

### European Acoustics Association

Award for Lifetime Achievements in Acoustics to Gunnar Rasmussen

Award for Contributions to the Promotion of Acoustics in Europe to the Federation of Acoustical Societies of Europe (FASE) 1971–1996

Award for Outstanding Recent Scientific Results Published in *Acta Acustica united with Acustica* to Catherine Guastavino, Brian F. G. Katz, Jean-Dominique Polack, Daniel J. Levitin, and Danièle Dubois

### Société Française d'Acoustique

The French Medal to Vitalyi Gusev

The Foreign Medal to Walter Lauriks

# Session 3eID

## Plenary Session



**Introduced by Dick Botteldooren, Ghent University, Belgium**

**5:40**

**3eID1. Binaural Hearing and Systems for SOund Reproduction**. Philip A. Nelson (ISVR, University of Southampton, Highfield, SO171BJ Southampton, UK, P.A.Nelson@aoton.ac.uk), M. Park (ISVR, University of Sothamton, Highfield, SO171BJ Southamption, UK, unknown@unknown.com), Takashi Takeuchi (OPSODIS Limited, c/o ISVR, University of Southamption, Highfield, SO17 1BJ Southampton, UK, ff1@isvr.soton.ac.uk)

Recent developments in models of binaural hearing can be usefully adapted and extedned to provide design tools for engineers engaged in the design of systems for sound reproduction. The particular focus of the work described is upon the development of models that give good statistical predictions of human sound localisation, based upon knowledge of the fluctuating acoustic pressures at the ears. Such models can be applied successfully to the prediction of stereophonic image localisation and reveal a number of important features of localisation relevant to audio system design. Developments will also be described in loudspeaker based systems for binaural reproduction that are finding their way into practical use. Binaural hearing models can be used to provide a preliminary evaluation of the performance of alternative designs. Finally, a brief review will be presented of multi-channel loudspeaker-based systems aimed at "full field" sound reproduction. Again, models of localisation provide some useful guidance for the designers of such systems.

**Introduced by William M. Hartmann, Michigan State University, USA**

**6:10**

**3eID2. Optoacoustics: Can ultrasound become the preferred modality for molecular imaging?** Matthew O'Donnell (University of Washington, 371 Loew Hall, Box 352180, Seattle, WA 98195-2180, USA, odonnel@engr.washington.edu)

Optoacoustics can be used to image the distribution of optical absorption in tissue, combining the specificity and sensitivity of optical imaging with the high resolution and penetration of ultrasound imaging. It represents one of the most promising techniques for molecular imaging because the optical absorption of bioconjugated nanoparticles can greatly exceed that of tissue over a range of wavelengths in which light can penetrate multiple centimeters into the body. We have explored several types of nanoparticles conjugated to a range of antibodies targeted to several important biological systems. Here we discuss two potential applications of bioconjugated gold nanorods, one for cancer cell targeting and the other to identify inflamed endothelial cells signaling the early stages of atherosclerosis. Optoacoustic images of cell cultures and animal models demonstrate the sensitivity and specificity of these nanosystems for molecular imaging. To translate these experimental findings into a clinically acceptable molecular imaging modality, we have also explored integrated optical systems able to deliver the optical pulse for optoacoustic excitation and detect the resultant ultrasonic waves using an all-optical transducer. The basic operating principles of this device, and the prospects for ultrasound-based molecular imaging using it, will be discussed.

## ACOUSTICAL SOCIETY OF AMERICA GENERAL ASSEMBLY

### Acoustical Oceanography Prize Lecture

James H. Miller, Chair
*Univ. of Rhode Island, Dept. of Ocean Engineering, Narragansett, RI 02882*

**Chair's Introduction–5:40**

**5:45**

**The use of moored inverted echosounders for monitoring near-surface processes**. Mark Trevorrow (Defence R&D Canada Atlantic, 9 Grove St., PO Box 1012, Dartmouth, NS B2Y 3Z7, Canada, mark.trevorrow@drdc-rddc.gc.ca)

The near-surface ocean is a difficult place to conduct measurements of physical and biological processes. High-frequency inverted echo-sounders (IES), moored a short distance below the surface, provide a simple means for sustained, high-resolution monitoring. In particular, long duration deployments are useful in capturing transient events, such as storms or solitary wave trains, and placing their occurrence within the context of longer term trends. Lessons learned from use of these moored IES systems can be applied to modern ocean observatories. A number of long duration deployments of a self-contained 200kHz IES were made in the late 1990's. Three specific examples will be discussed. Firstly, an investigation of calibrated volume scattering from near-surface bubbles in the NE Pacific Ocean showed the frequent occurrence of vertical, plume-like structures drawn downwards up to 25 m. Within the plumes, the backscatter cross-section exhibited an exponential decay with depth, with e-folding scale in the range 0.5 to 2.5 m. Secondly, imaging of near-surface internal solitary waves was performed from a mooring near the Oregon coast, supplementing measurements made with nearby temperature sensors. These measurements showed some suggestion of scattering by turbulence. Thirdly, through the use of both backscatter intensity and echo statistics, a moored IES demonstrated quantitative monitoring of migratory zooplankton and fish populations.



## Celebration of the 60th Anniversary of the French Acoustical Society

On June 25, 1948, the so-called "Groupement des Acousticiens de Langue Française" (GALF) was created, with its first President, Yves Rocard, and was transformed into the "Société Française d'Acoustique" (SFA) in 1986. SFA now has 830 members and is composed of 8 technical groups and 3 regional sections. It is one of the founding members of the European Acoustics Association (EAA).

The 60th anniversary will be focused on the presentation of the "White Book" of Acoustics in France, and the publishing of a DVD including the main part of the French journals in Acoustics since 1934.

### Agenda

Opening by the current President of SFA and a former President (René-Guy Busnel)

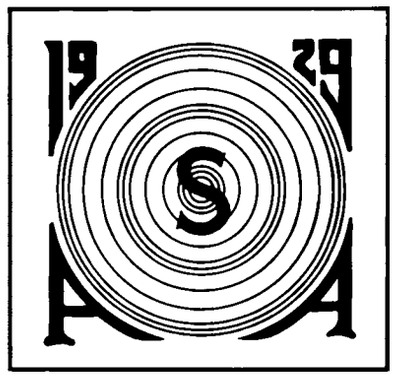
Acoustical French journals since 1934: Presentation of the DVD

The White Book of Acoustics in France in 2008

White Book: An example of the position of acoustics in an activity sector: The automotive industry

60 years of acoustics in France: An overview

# ACOUSTICAL SOCIETY OF AMERICA
# DISTINGUISHED SERVICE CITATION



## Charles E. Schmid

## 2008

The Distinguished Service Citation is awarded to a present or former member of the Society in recognition of outstanding service to the Society.

PREVIOUS RECIPIENTS

| | | | |
|---|---|---|---|
| Laurence Batchelder | 1972 | Frederick E. White | 1987 |
| Robert W. Young | 1973 | Daniel W. Martin | 1989 |
| Betty H. Goodfriend | 1973 | Murray Strasberg | 1990 |
| Gerald J. Franz | 1974 | William J. Cavanaugh | 1994 |
| Robert T. Beyer | 1978 | John C. Burgess | 1996 |
| Henning E. von Gierke | 1978 | Alice H. Suter | 1997 |
| R. Bruce Lindsay | 1981 | Elaine Moran | 1999 |
| William S. Cramer | 1984 | John V. Bouyoucos | 2000 |
| Stanley L. Ehrlich | 1986 | F. Avril Brenig | 2000 |
| Samuel F. Lybarger | 1986 | Thomas D. Rossing | 2006 |

## CITATION FOR CHARLES E. SCHMID

*. . . for contributions as Executive Director of the Acoustical Society of America*

**PARIS, FRANCE • 2 JULY 2008**

Charles Ernest Schmid grew up in East Williston, New York, about a 15-minute drive from the ASA's current headquarters in Melville. His father was an electrical engineer who ran the Shield Electric Company, which was founded by Charles's grandfather in 1909. They developed a process called thermo-welding for third rails for the Long Island Railroad and the New York City subway system. Charles's mother was a social worker who volunteered for the Red Cross. Long before the term "family values" became a cliché, Charles's parents were the genuine article, and they imparted those values to their children. His dad was a hard worker but tenderhearted and sometimes took in friends or relatives who were down on their luck. His mother was the practical one—very smart with a quick wit. Charles had one sibling, a younger sister Susan. There was much laughter in the Schmid household, and they had close and friendly relations with their neighbors and relatives. Summers were spent at their cottage on Fire Island, NY. There, Charles and Susan were free to roam—swimming, fishing, and clamming with their cousins and friends. It was an idyllic childhood for Charles, and that warmth and sense of optimism has carried over to his adult life.

At school Charles showed an early interest in mathematics, science, and history. Charles's great grandfather had emigrated from Ulm, Germany, "the city of artists and engineers," and that tradition apparently trickled down to Charles, who received a bachelor's degree in electrical engineering from Cornell University in 1963. Rowing was a big part of his undergraduate years. He still keeps in touch with fellow oarsmen, and can sometimes be found during lunch break taking a row in Eagle Harbor. Charles was also known on the Cornell campus for his 1929 Model-A Ford. It had a manifold heater and no defroster (you put your hand on the window to melt the ice) and a tendency to break down. It was truly an adventure to head off from Cornell in upstate New York to Long Island, especially during the winter.

After graduation from Cornell Charles moved to the seaside village of Stonington, Connecticut and went to work for Electric Boat designing sonar systems, where he participated in many submarine sea trials in the Atlantic and the Pacific. He also began working on his masters degree at the University of Connecticut and took courses in creative writing on the side. It was during this period that he met his wife Linda. Linda says that not only was he tall and nice looking, but by now he had ditched the old Model A and drove a red sports car!

Captivated by the natural beauty of the Pacific Northwest while on a sea trial there, Charles moved to Seattle in 1966 to work at Honeywell Marine Systems. He immediately joined the Seattle Mountaineers and learned glacier and rock climbing techniques, eventually leading seven climbs to the summit of Mt. Rainier, over 14,000 ft. This was one of the most productive times of Charles's life, working at Honeywell, helping to raise two children (Andrew and Jenny), and pursuing a PhD at the University of Washington. His dissertation was on computer recognition of musical instruments. When Charles finds any free time at an ASA meeting, he can often be found in a Musical Acoustics session.

Apparently the childhood memories of Fire Island remained with Charles because he and Linda found a place on Bainbridge Island, where they bought an old house that introduced Charles to the gentle arts of plumbing, wiring, and drywall hanging. On Bainbridge Island, Charles began community activities; he helped spearhead incorporation for Bainbridge Island and organized their new all-island government. (If you want to start a spirited conversation, just ask Charles what is happening in local politics on Bainbridge Island.)

In 1985, Charles took his interest in politics to Washington, DC as one of the first ASA Congressional Science and Engineering Fellows. The year in Washington, DC was a seminal one for Charles as he learned a new set of skills in his work to increase communications between scientists and Congress. A few years later, when the ASA announced an opening for its first Executive Director, Charles was an enthusiastic applicant. He assumed the position in 1990 and has held it ever since. Fortunately, Charles brought to the job of Executive Director qualities and skills he learned from his parents and

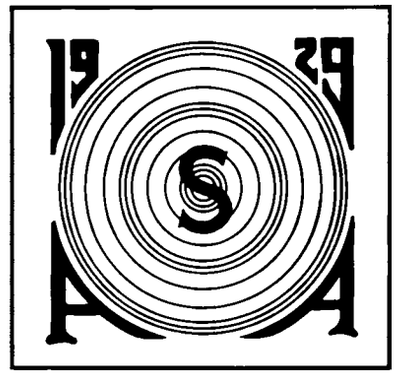
developed over a lifetime: love of family, leadership, imagination, problem solving, abundant energy, persistence and patience, a good memory and sense of history, and a tolerance for diverse viewpoints. The ASA Executive Director must ensure that the Society not only survives, but flourishes. Directing an organization that depends so much on an ever-changing cadre of volunteers requires diplomacy of a high order. Charles has thrived in this environment as few others could, and the Society has thrived as well.

Charles has made many contributions to our Society, and to acoustics. He has been a member of the Governing Board of the American Institute of Physics (AIP) since 1990, and was elected to its Executive Committee for five separate terms. Anyone who has attended a meeting of the AIP Board will quickly recognize the high regard with which he is held by his AIP peers. He is also a member of the International Commission for Acoustics and regularly attends meetings of other national and regional acoustical societies. Charles played an indispensable role in leading the Society to reach out beyond its geographical borders. In 1998, he helped organize a joint meeting of the ASA and the International Congress on Acoustics, followed by a meeting with the European Acoustics Association in Berlin in 1999, a joint meeting with the Mexican Institute of Acoustics and Federation of Iberoamerican Acoustics held in Cancun, Mexico in 2002, and in 1996 and 2006 the third and fourth joint meetings with the Acoustical Society of Japan in Hawaii. It is appropriate that Charles should be recognized for his service to acoustics worldwide at another international conference, Acoustics'08 in Paris.

LAWRENCE A. CRUM
WILLIAM M. HARTMANN
PATRICIA K. KUHL

# ACOUSTICAL SOCIETY OF AMERICA

# R. BRUCE LINDSAY AWARD



## Tyrone M. Porter

## 2008

The R. Bruce Lindsay Award (formerly the Biennial Award) is presented in the Spring to a member of the Society who is under 35 years of age on 1 January of the year of the Award and who, during a period of two or more years immediately preceding the award, has been active in the affairs of the Society and has contributed substantially, through published papers, to the advancement of theoretical or applied acoustics, or both. The award was presented biennially until 1986. It is now an annual award.

PREVIOUS RECIPIENTS

| | |
|---|---|
| Richard H. Bolt | 1942 |
| Leo L. Beranek | 1944 |
| Vincent Salmon | 1946 |
| Isadore Rudnick | 1948 |
| J. C. R. Licklider | 1950 |
| Osman K. Mawardi | 1952 |
| Uno Ingard | 1954 |
| Ernest Yeager | 1956 |
| Ira J. Hirsh | 1956 |
| Bruce P. Bogert | 1958 |
| Ira Dyer | 1960 |
| Alan Powell | 1962 |
| Tony F. W. Embleton | 1964 |
| David M. Green | 1966 |
| Emmanuel P. Papadakis | 1968 |
| Logan E. Hargrove | 1970 |
| Robert D. Finch | 1972 |
| Lawrence R. Rabiner | 1974 |
| Robert E. Apfel | 1976 |
| Henry E. Bass | 1978 |
| Peter H. Rogers | 1980 |
| Ralph N. Baer | 1982 |
| Peter N. Mikhalevsky | 1984 |
| William E. Cooper | 1986 |
| Ilene J. Busch-Vishniac | 1987 |
| Gilles A. Daigle | 1988 |
| Mark F. Hamilton | 1989 |
| Thomas J. Hofler | 1990 |
| Yves H. Berthelot | 1991 |
| Joseph M. Cuschieri | 1991 |
| Anthony A. Atchley | 1992 |
| Michael D. Collins | 1993 |
| Robert P. Carlyon | 1994 |
| Beverly A. Wright | 1995 |
| Victor W. Sparrow | 1996 |
| D. Keith Wilson | 1997 |
| Robert L. Clark | 1998 |
| Paul E. Barbone | 1999 |
| Robin O. Cleveland | 2000 |
| Andrew J. Oxenham | 2001 |
| James J. Finneran | 2002 |
| Thomas J. Royston | 2002 |
| Dani Byrd | 2003 |
| Michael R. Bailey | 2004 |
| Lily M. Wang | 2005 |
| Purnima Ratilal | 2006 |
| Dorian S. Houser | 2007 |

## CITATION FOR TYRONE M. PORTER

*. . . for contributions to ultrasound-guided drug delivery*

### PARIS, FRANCE • 2 JULY 2008

Tyrone Michael Porter was born in Detroit, Michigan on July 21, 1973. His parents, Dr. Elijah and Laverne Porter were teachers in the Detroit public school system. Elijah taught high school math early in his career and later served as Principal of Henry Ford High School and Laverne taught third through fifth grade at Vetal Elementary until their retirement a few years ago. Elijah and Laverne were strict disciplinarians and kept a close watch on Tyrone and his friends when they were teenagers. What Tyrone initially interpreted as an infringement of freedom was soon seen as a concern for his welfare, and he attributes much of his success in life to the important values he learned from his parents. Tyrone is a middle child with an older brother, Elijah Porter, II, and a younger sister, Dr. Dawne Jones. This birth order served as the quintessential training for Tyrone as a lively listener, a tolerant team-builder and a patient peacemaker. He continues to enjoy his role as proud uncle of five nephews and nieces. Tyrone is newly married to Dr. Monica Hall-Porter, and they reside in Roxbury, MA. Tyrone attended Renaissance High School in Detroit and graduated in 1991. While attending high school, Tyrone participated in the Detroit Area Pre-College Engineering Program, which served as a platform for pursuing a degree in engineering.

He left Michigan to attend Prairie View A&M University, a historically Black university in southeast Texas. While earning a Bachelor of Science degree in Electrical Engineering (Magna Cum Laude), Tyrone participated in several organizations, including the National Society of Black Engineers (NSBE) and Alpha Phi Alpha Fraternity. He was later named 2002 Graduate Student of the Year by NSBE, and now directs their Bioengineering Special Interest Group. At the NSBE 2007 national convention in Columbus, Ohio, he organized a special session entitled, Sound Therapy: Innovation in Biomedical Acoustics. As an undergraduate, Tyrone also co-founded Peers Advising, Counseling, and Teaching (PACT) to motivate high school students to strive for academic excellence and attend college. In 1996 he was featured in *USA Today* as one of the nation's top undergraduate engineering students, and was awarded a position on the Collegiate All Academic Team.

Tyrone was encouraged to pursue a doctoral degree in engineering and a career in higher education. He attended graduate school at the University of Washington (UW), where he was awarded the Doctor of Philosophy in Bioengineering in 2003. Tyrone came cheap as a graduate student, arriving at UW with a National Science Foundation Fellowship, and when that ran out, a fellowship sponsored by the United Negro College Fund (UNCF) and Merck. Tyrone was so well known at the UW that the three recommendation letters for the UNCF/Merck award came from his thesis advisor, and the Provost and the President of the University of Washington. As a graduate student, Tyrone co-founded the Minority Think Tank, a social-activist group created to discuss and develop solutions to common problems among underrepresented groups. During his graduate days, Tyrone was always organizing things from trips to Whistler for skiing to faculty-student softball games. As an outspoken proponent of social justice, he soon gained the attention of local politicians, and was regularly on the evening news and in the local paper with an articulate defense of affirmative action or equal opportunity.

For his dissertation, Tyrone helped to develop a new class of "smart" polymeric carriers that could destabilize biological membranes to enhance DNA or protein drug delivery. Tyrone worked on the novel idea that the synergistic effects of ultrasound and these polymeric carriers might be used to enhance their biofunctionality by triggering membrane destabilization. In this way, drug delivery might be stimulated with an on/off type of switch by application of an acoustic stimulus. This project embodied the spirit of interdisciplinary study and collaborative research that is the cornerstone of biomedical engineering. To be successful, he had to learn the fundamental concepts of acoustics, polymer chemistry, biochemistry and biology. Tyrone was so well known as a graduate student at the University of Washington that he was asked to serve on the Search Committee for a new President...a committee that included the founder of Costco Wholesale Corporation, the CEO of Recreational Equipment, Inc. (REI), and the CEO of Delta

Airlines. When he defended his dissertation, a lecture theater for over 200 people was reserved and it was nearly filled to capacity, including three Deans and a Vice Provost in attendance.

Tyrone was awarded the ASA's Frederick V. Hunt Postdoctoral Research Fellowship in Acoustics in 2003-04, which he chose to undertake at the University of Cincinnati. He worked with scientists in biomedical engineering, cardiology, biochemistry, and immunology to characterize the acoustic properties of echogenic liposomes, submicron-sized phospholipid vesicles that contain both gas and fluid. With antibody conjugation and drug incorporation, these liposomes can be used as novel targeted diagnostic and therapeutic ultrasound contrast agents. In addition to his scientific expertise, his sports acumen was legendary, and often led to rather heated and highly opinionated discussions on the merits of the Detroit Pistons versus anyone else. A detailed plan for the rehabilitation of the Cincinnati Bengals as a professional football team also resulted from these talks with his fellow researchers, as did some suggestions regarding recruitment ideas for the Reds.

At Boston University (BU), where he serves as a member of both the Department of Aerospace and Mechanical Engineering and the Department of Biomedical Engineering, Tyrone is crafting a world-class research program combining basic principles in chemistry, acoustics, and thermodynamics to develop novel drug delivery strategies for cancer therapy. He maintains research laboratories in both Departments and is forging true interdisciplinary collaborations involving team members with diverse interests and expertise. His research is currently focused on the development of targeted ultrasound contrast agents for image enhancement (molecular imaging), perfusion imaging, and image-guided drug delivery. Ultrasound-enhanced transport of drugs and genes across cell membranes and ultrasound-enhanced drug activity play an important role in this research.

At BU, Tyrone has been tasked with teaching the introductory dynamics course, which is a key college-wide curricular requirement populated by sizeable classes and students with diverse backgrounds. In this significant effort, Tyrone has acquitted himself extremely well, garnishing some of the finest teaching evaluations ever bestowed upon a freshman professor in the AME Department. Tyrone is destined to be a pedagogical star in a department populated with some of the best teachers in the BU College of Engineering. He is committed to the highest quality of education of students. His impeccable integrity and an infectious enthusiasm entice students to flock to him. Tyrone has the heart and heritage of an educator, and he will have a huge impact on younger people.

Tyrone has also been very active in the affairs of the ASA, having served on the Student Council, as a member of the organizing committee for the joint ASA/ICA meeting in Seattle in 1998, as one of the nine special presenters at ASA's 75th anniversary celebration, and as an organizer of several special sessions for the Technical Committee on Biomedical Ultrasound/Bioresponse to Vibration, of which he is also a member.

Tyrone Porter's parents, siblings, aunts and uncles, and a host of friends and colleagues are very proud of Tyrone's accomplishments and look forward to the exciting career that lies before him.

CHRISTY K. HOLLAND
RONALD A. ROY
LAWRENCE A. CRUM

# ACOUSTICAL SOCIETY OF AMERICA

## Helmholtz-Rayleigh Interdisciplinary Silver Medal in Signal Processing in Acoustics and Underwater Acoustics


## James V. Candy

## 2008

The Silver Medal is presented to individuals, without age limitation, for contributions to the advancement of science, engineering, or human welfare through the application of acoustic principles, or through research accomplishment in acoustics.

## CITATION FOR JAMES V. CANDY

*. . . for contributions to signal processing and underwater acoustics*

**PARIS, FRANCE • 2 JULY 2008**

We have all heard the saying "Them that can, do; them that can't, teach." We also know that one exception disproves the theory. In the case of Jim Candy, we have that exception. He is a born teacher with a highly creative mind. When one first meets him, he comes across as a rather unassuming person. But once he becomes interested in a problem, he dives into it with a tenacious passion until he solves it. The teacher in him comes through by his ability to use simple analogies drawn from his wealth of knowledge and ideas. His intuitive creativity is displayed in clever innovative solutions to complex problems.

Many of his creative solutions are based on his background in control theory and recursive estimation theory. When he joined the staff of the Lawrence Livermore National Laboratory, Dr. Candy quickly found himself dealing with problems in electromagnetics, lasers, nuclear physics, internal waves, nuclear fusion, ultrasonics, array processing and inverse problems in general. It was not long before he gained the reputation as the "go to" guy when there was a need for a new approach in modeling, classification, estimation and detection, regardless of the subject. And anyone who deals with him on a collaborative basis walks away all the richer for it.

James Vincent Candy was born in Astoria, New York, on January 21, 1944. He received a B.S. in Electrical Engineering from the University of Cincinnati in 1966, an M.S.E. in Electrical Engineering from the University of Florida in 1972, and a Ph.D. in Electrical Engineering in 1976, also from the University of Florida. During the period, from 1967 to 1971, he served as a Captain in the United States Air Force and from 1966 to 1967, he worked as an Engineer for the General Electric Company. In 1976, Dr. Candy began his employment with the University of California, Lawrence Livermore National Laboratory (LLNL) as a scientist for the Engineering Directorate. At present, he is Chief Scientist for the Engineering Directorate and an Adjunct Professor at the University of California, Santa Barbara.

He began working in the field of oceanic signal processing during a short-term assignment at the NATO SACLANT ASW Research Center in 1987. Since that time, he has developed the "Model-Based" approach to oceanic signal processing. This has produced a wealth of applications in underwater acoustic signal processing to localization, tracking, signal enhancement, sound-speed inversion, noise cancellation, sequential detection and internal wave signal processing. His work led to the Bayesian solution for dispersive wave propagation, most notably as applied to internal waves in imaging and detection applications.

This model-based approach to signal processing evolved from Jim's intimate knowledge of Bayesian statistics and the Kalman filter. This type of processor has been used in the area of optimum control for many years, but it was not until he pointed out that in principle, there is really no limit to the sophistication of the physical models one can use in these processors, that it was recognized that they had great value in areas outside of control theory. This insight has laid the framework for a general scheme for including a priori information, in the form of physical models, into basically any processing scheme. This provides a self-consistent Bayesian structure, that avoids many of the difficulties associated with the use of physical models, including the so-called "mismatch problem," that arises when the physical parameters are not well known. Dr. Candy has closely followed, applied and contributed to advances made in recent years in this field, including the Unscented Kalman Filter and the particle filter, which avoid some of the limitations of the original Kalman filter, such as its inability to handle the cases of nonlinearity and non-Gaussian statistics.

Jim is a former Director of the LLNL Center for Advanced Signal and Image Sciences. He has been an Adjunct Professor at San Francisco State University, University of Santa Clara, and the University of California, Berkeley Extension, teaching graduate courses in signal and image processing. He is a Fellow of the Acoustical Society of America (ASA), the Institute of Electrical and Electronics Engineers (IEEE), and was recently elected as a Life Member (Fellow) of Clare Hall College at the University of Cambridge in the UK.

He received the IEEE Distinguished Technical Achievement Award in 2002 for contributions of signal processing to oceanic engineering. Along with his many other publications, he has produced three texts: *Signal Processing: The Model-Based Approach, Signal Processing: The Modern Approach, and Model-Based Signal Processing and Bayesian Signal Processing: Classical, Modern and Particle Filtering Methods* (in press). He has conducted many short courses and tutorials on applied signal processing at meetings of the Acoustical Society of America and the Oceanic Engineering Society. He has also presented short courses in Applied Model-Based Signal Processing for the SPIE Optical Society. He is currently the Chair of the IEEE Technical Committee on Sonar Signal and Image Processing and was the Chair of the ASA Technical Committee on Signal Processing in Acoustics as well as an Associate Editor for Signal Processing for *JASA Express Letters* (JASA EL).

In addition to his technical accomplishments, Dr. Candy has been a mentor to many junior colleagues. His enthusiasm for signal processing in the ASA was contagious as he worked to bring the Signal Processing Committee into existence starting from an interdisciplinary technical group. He was its first Chair. He has also persuaded colleagues to become active members of the ASA and almost all of the active Society members from the Lawrence Livermore National Laboratory began their involvement through Jim's encouragement. His commitment and enthusiasm for acoustical signal processing is evidenced by the visibility of our Society at the Lawrence Livermore National Laboratory.

EDMUND J. SULLIVAN
WILLIAM M. CAREY

# GOLD MEDAL
# of the
# Acoustical Society of America


# Patricia K. Kuhl

# 2008

The Gold Medal is presented in the spring to a member of the Society, without age limitation, for contributions to acoustics. The first Gold Medal was presented in 1954 on the occasion of the Society's Twenty-Fifth Anniversary Celebration and biennially until 1981. It is now an annual award.

PREVIOUS RECIPIENTS

| | | | |
|---|---|---|---|
| Wallace Waterfall | 1954 | Richard K. Cook | 1988 |
| Floyd A. Firestone | 1955 | Lothar W. Cremer | 1989 |
| Harvey Fletcher | 1957 | Eugen J. Skudrzyk | 1990 |
| Edward C. Wente | 1959 | Manfred R. Schroeder | 1991 |
| Georg von Békésy | 1961 | Ira J. Hirsh | 1992 |
| R. Bruce Lindsay | 1963 | David T. Blackstock | 1993 |
| Hallowell Davis | 1965 | David M. Green | 1994 |
| Vern O. Knudsen | 1967 | Kenneth N. Stevens | 1995 |
| Frederick V. Hunt | 1969 | Ira Dyer | 1996 |
| Warren P. Mason | 1971 | K. Uno Ingard | 1997 |
| Philip M. Morse | 1973 | Floyd Dunn | 1998 |
| Leo L. Beranek | 1975 | Henning E. von Gierke | 1999 |
| Raymond W. B. Stephens | 1977 | Murray Strasberg | 2000 |
| Richard H. Bolt | 1979 | Herman Medwin | 2001 |
| Harry F. Olson | 1981 | Robert E. Apfel | 2002 |
| Isadore Rudnick | 1982 | Tony F. W. Embleton | 2002 |
| Martin Greenspan | 1983 | Richard H. Lyon | 2003 |
| Robert T. Beyer | 1984 | Chester M. McKinney | 2004 |
| Laurence Batchelder | 1985 | Allan D. Pierce | 2005 |
| James L. Flanagan | 1986 | James E. West | 2006 |
| Cyril M. Harris | 1987 | Katherine S. Harris | 2007 |
| Arthur H. Benade | 1988 | | |

## CITATION FOR PATRICIA K. KUHL

*. . . for contributions to understanding how children acquire spoken language and for leadership in the Society.*

### PARIS, FRANCE • 2 JULY 2008

Patricia Katherine Kuhl was born and raised in St. Cloud, Minnesota, the second of five children of Joseph and Susan Kuhl. In high school, Pat was involved in many school activities, including the debate club, the honor society, and the basketball team. She was especially interested in music, showing great enthusiasm and talent for voice and piano. Luckily for the field of speech communication, Pat's parents stressed talking in addition to music. Every night before dinner in the Kuhl household, Pat's father unplugged the telephone so that the family could discuss the day's activities, the national political scene, and world affairs. Pat's father always read the newspaper before dinner, and expected the children to as well, so Pat read the papers before her father arrived home. Pat was always ready to debate her dad about anything and everything. For those of you who know Pat, she loves a lively discussion and is always prepared with facts as well as opinions.

Pat is married to Andrew Meltzoff, who along with Pat, is co-Director of one of the more visible research groups at the University of Washington–The Institute for Learning and Brain Sciences. Pat is also the Co-Director of another high-profile interdisciplinary research group on campus, an NSF Science of Learning Center–LIFE–which links neuroscience to education. Pat and Andy have enjoyed a long and productive collaboration in developmental cognitive science. According to Andy, the "best collaboration of all" was one that resulted in their daughter Katherine, who combines Andy's love of swimming and Pat's love of music. Katherine is one of the stars on the swim team at Trinity College in Connecticut and also had the singular distinction of participating in the first test of the acoustics in Seattle's Benaroya Hall by singing while former ASA President Cyril Harris, acoustical engineer for the Hall, dashed around taking measurements.

Pat completed her BA, MA, and Ph.D. degrees in Minnesota at St. Cloud State University and the University of Minnesota. Pat's interest in the development of speech perception in children began with her postdoctoral years at the Central Institute for the Deaf with James D. Miller. Those years led to a series of papers that examined the responses of mammals and children to speech. She established commonalities between mammals and human infants in their response to speech sounds, and, importantly, where their patterns of responses to speech stimuli diverged.

In the early 1980's, Pat's interest expanded beyond the auditory perception of speech to include studies of how infants integrate auditory and visual information about speech, and to the imitation of speech. Especially impressive has been Pat's insights into the future of speech research: She has consistently published important papers that inspire new lines of research, from her animal studies in the 70's and 80's, to her auditory-visual and imitation work in the 80s, to her work on language experience and its effects on learning in the early 90's, and her most recent work which is forging new territory using the tools of modern neuroscience. She has most recently worked to develop baby Magnetoenchephalography (MEG). The technique is completely safe, non-invasive, and noiseless, and Pat and her team worked with engineers in Helsinki to develop ways to track an infant's head movements so the baby's brain activities can be precisely located in the infant brain as the child listens to language or music, and processes complex social information. Pat has a unique talent for spotting where the next interesting finding may lie, and an ability to put together the resources and interdisciplinary research teams needed to conduct work that few others would be able to accomplish. She has forged collaborations with speech scientists from Japan, Taiwan, Sweden, Russia, Finland, Spain, China, France, and Mexico to study how language experience affects speech processing in adults and young children. Pat's students also come from many different countries, and a tour through her Institute introduces a visitor to students from Taiwan, Japan, China, Mexico, and Finland. Once trained, many of these students return to their native countries to set up speech research laboratories of their own.

Pat's research has had theoretical as well as practical impact. If you have ever tried to learn a new language as an adult, you soon recognize that it is difficult to pronounce certain sounds, or even to hear the relevant differences, while your children seem to pick

up foreign languages easily and speak without an accent. Pat has performed pioneering research in this field and learned from her studies with babies as young as 6 months that infants are born "citizens of the world" with regard to language. They can distinguish sounds from languages around the world, even if they have never heard them before. By the end of the first year of life, however, they become "language-specialists"—the ability to attend to native-language sounds increases substantially while the ability with foreign languages diminishes. Pat proposed the Native Language Neural Commitment Theory to account for this dramatic developmental change. The model shows that infants use computational abilities to "crack" the speech code and, interestingly, that infants' social skills may "gate" learning. She and her students showed that infants learn phonemes and words rapidly from a live foreign-language tutor at 9 months of age but that the same foreign-language material presented from a TV or audio-tape produces no learning. The finding has theoretical implications as well as implications for education and society.

Pat's research in acoustics has led to a number of singular honors: for example, she is a member of the American Academy of Arts and Sciences, the Rodin Academy, and the Norwegian Academy of Science and Letters. She was awarded the Silver Medal of the Acoustical Society of America in 1997, and the Kenneth Craik Research Award from Cambridge University in 2005. She received the University of Washington's Faculty Lectureship Award in 1998, and in 2007, she was awarded the University of Minnesota's Outstanding Achievement Award. Pat is a Fellow of the American Association for the Advancement of Science, the Acoustical Society of America, and the American Psychological Society.

Pat has also been an eloquent spokesperson for childhood learning and was one of six scientists invited to the White House in 1997 to make a presentation at President and Mrs. Clinton's Conference on "Early Learning and the Brain." In 2001 she was invited to make a presentation at President and Mrs. Bush's White House Summit on "Early Cognitive Development: Ready to Read, Ready to Learn." In 1999, she co-authored *The Scientist in the Crib: Minds, Brains, and How Children Learn.*

Pat has played an active role in the affairs of the Society for a number of years. She has served as an Associate Editor of the *Journal*, as a member of the Executive Council, and as a member or chair of several committees. Pat was cochair of the joint 135th meeting of the Acoustical Society of America and the 16th International Congress on Acoustics in 1998 as well as coeditor of its proceedings. She was cochair of the ASA's 75th Anniversary Celebration Committee with Leo Beranek in 2004. As part of the celebration, Pat organized a series of presentations by nine young investigators entitled "A Celebratory Look into the Future." She was elected the Society's Vice President in 1996, and in 1999 was the first woman elected President of the ASA. While President, Pat created the Student Council, one of the most successful presidential initiatives, and one that has generated great enthusiasm among our younger members.

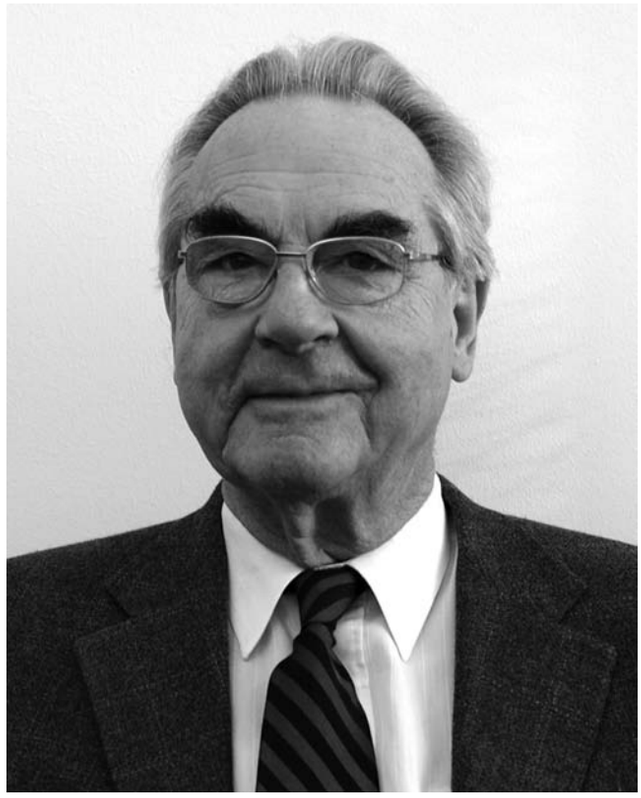
The Gold Medal winners of the ASA are indeed a select group; they have been outstanding innovators and leaders in science and engineering and they have brought great recognition to our Society. Patricia Kuhl now joins this elite group and elevates its stature even more.

FREDERICKA BELL-BERTI
YANG ZHANG
PAUL IVERSON

# EAA AWARD 2008

For lifetime achievements in acoustics

**Gunnar Rasmussen**



*For his outstanding contribution in the field of acoustic measurements and instrumentation*

Gunnar Rasmussen is a pioneer in the construction of acoustic instrumentation, particularly of pressure transducers and related devices. He was employed at Brüel & Kjær Denmark as an electronics engineer immediately after his graduation in 1950. After holding various positions in development, testing and quality control, he spent one year in the United States working for Brüel & Kjær in sales and service. After his return to Denmark in the mid-1950's he began the development of a new measurement microphone. This involved the invention of new methods for manufacturing microphone diaphragms in electro-galvanic deposited nickel, to replace the very corrosive aluminium foil diaphragms in use at that time. Also the mechanical construction was drastically simplified from more than 30 different parts to less than 10 parts. This resulted in superior mechanical stability, increased temperature and long term stability. The resulting one-inch pressure microphone soon became the *de facto* standard microphone for acoustical measurements.

The optimized mechanical design of the new generation of measurement microphones opened up the possibility for reducing the size of the microphones, first to a 1/2" microphone and then to 1/4" and 1/8" microphones with essentially the same superior mechanical, temperature and long term stability. Notably the 1/2" microphone is still the most widely used noise abatement tool today. Since the beginning of the 1960's, this microphone design has been preferred for all types of acoustic measurements and has formed the basis for the IEC 1094 series of international standards for measurement microphones.

Gunnar Rasmussen received the Danish Design Award in 1969 for his novel design of the microphones which were exhibited at the New York Museum of Modern Art. He also developed the first acoustically optimized sound level meter, where the shape of the body was designed to minimize the effect of reflections from the casing to the microphone. This type 2203 sound level meter was for many years seen as the archetype of sound level meters and its characteristic shape became the symbol of a sound level meter. It was also awarded the Danish Design Award in 1965.

Other major inventions and designs include the Delta Shear accelerometer, the dual piston pistonphone calibrator for precision calibration, the face-to-face sound intensity probe and hydrophones, occluded ears, artificial mouth, etc. Gunnar Rasmussen is also the author of numerous papers on acoustics and vibration and has served as chairman and vice-chairman of various international organizations and standard committees. In 1990 he received the CETIM medal for his contributions to the field of intensity techniques. He is also a Fellow of the Acoustical Society of America.

In 1994 Gunnar Rasmussen started his own company, G.R.A.S. Sound and Vibration. Started as a company specializing in precision outdoor microphones for permanent noise monitoring around airports, it is now one of the world's leading companies in acoustic front-ends and transducers forming a wide range of general purpose and specialized microphones, electro-acoustic measurement devices such as ear couplers, precision calibration tools and multi-dimensional sound intensity probes. After many years of rich and fruitful work, Gunnar Rasmussen is still very active with the design of new transducers and solutions. At the same time he is an indispensable partner in discussions of measurement standards, where he provides valuable input and help for younger colleagues who admire his deep knowledge and experience and acknowledge his kindness and modest character.

EAA wishes to honour Gunnar Rasmussen for his tremendous impact on acoustics, for being an example for generations of scientists and engineers dealing with acoustic measurements, for the expertise he has given to us all.

# EAA AWARD 2008

## For contributions to the promotion of Acoustics in Europe

## FASE Federation of Acoustical Societies of Europe 1971-1996

Federation of Acoustical Societies of Europe
Fédération Européenne des Sociétés d'Acoustique
Europäische Föderation der akustischen Gesellschaften
Федерация Акустических Обществ Европы

*For the establishment, organization and support of new platforms of cooperation, partnership and friendship among European acousticians*

Probably very few people in Europe know that on 9 May 1950 the first move was made toward establishing the European Union. On that day in Paris, against the background of the threat of a Third World War engulfing Europe as a whole, French Foreign Minister Robert Schuman read to the international press a declaration calling upon France, Germany and other European countries to pool together their coal and steel production as "the first concrete foundation of a European federation."

Probably very few acousticians in Europe know that on 26 August 1968 during the 6th International Congress on Acoustics in Tokyo, the first move was made towards the creation of the European Acoustics Association (EAA). On that day in Tokyo, on the initiative of Prof. G. Kurtze and Prof. E. Zwicker, a semi-official meeting of the delegates of the European acoustical societies was organized in order to discuss the possibilities of founding the Federation of Acoustical Societies of Europe.

It took three more years to consult with different societies and to establish the main purposes of the new "learned society." Finally on 24 August 1971 in Budapest, representatives of 13 acoustical societies declared the foundation of FASE, the Federation of Acoustical Societies of Europe, and a provisional steering committee was elected.

On 5 May 1972, the first meeting of the FASE Council took place in Paris with the election of officers: Prof. J. Frenkiel (President), Prof. W. Furrer (Vice-President), Dr. F. Kolmer (Secretary), as well as the approval of a program of activities concerning the coordination of scientific acoustical events, information on possibilities of vacancies in acoustical institutions in Europe (universities, research institutes, firms, etc.) and a survey on education in acoustics in Europe.

During the next 25 years more European acoustical societies, academies of sciences and associations joined FASE, 7 Congresses on Acoustics and 12 Symposia on specific acoustic topics and in different European cities were organized, 25 Council meetings were held and more officers and members of the council were involved in these activities.

On a voluntary basis FASE has contributed to establish and sustain the contact between scientists in acoustics in the former Eastern Block countries and in Western Europe during a historical period in which travel and exchange of information was difficult. FASE has established fruitful collaboration, representing Europe, with international societies such as ICA, ASA, EEAA, ESCA, CEC, and ICSU. In 1986 FASE contributed to the publication of the volume *Noise Pollution* of the SCOPE (Scientific Committee on Problems of the Environment, ICSU) through Prof. A. Lara-Sáenz in collaboration with Prof. R.W.B. Stephens who called together 23 specialists in acoustics. FASE has promoted international journals and has organized surveys on education in acoustics.

During the development of the European Union it became necessary to build an association like an image of nations represented by their national societies rather than a group of societies, associations and academies of sciences. Accordingly, on 1 January 1997, with a natural process, FASE was integrated into the European Acoustics Association (EAA) which formally took the inheritance of FASE's purposes and activities.

The Federation of Acoustical Societies of Europe was not only the first and successful attempt of harmonization among acoustical societies in Europe but it also represented a generation of European acousticians, their knowledge and their efforts.

*The award will be presented to Prof. Paul François, Prof. Felix Kolmer and Prof. Andrés Lara-Sáenz on behalf of FASE.*

# EAA AWARD 2008

## For outstanding recent scientific results published in ACTA ACUSTICA UNITED WITH ACUSTICA

The award for outstanding recent research is given to a team of researchers for their contribution in the field of acoustics with the strict requirement that they published their results in the EAA scientific journal ACTA ACUSTICA UNITED WITH ACUSTICA within three years prior to the date that the award is given. In 2008 this EAA award goes to:

Catherine Guastavino, Brian F. G. Katz,
Jean-Dominique Polack, Daniel J. Levitin, Danièle Dubois

*For their work on linguistic exploration of verbal data as a methodology for exploring the cognitive processing of environmental sounds, first published in:*

**Ecological Validity of Soundscape Reproduction**
**ACTA ACUSTICA UNITED WITH ACUSTICA Vol. 91 (2005) 333 – 341**

"A fundamental aim of psychoacoustics is to better understand how acoustic phenomena are perceived and represented at a cognitive level by individuals. Mental representations of sounds cannot be observed directly, but one way to study these representations empirically is through language, specifically, by analyzing how people talk about their sensory experiences." With these opening sentences the authors immediately point to the new line of thinking in psychoacoustics that they propose. Their methodology for digging into the cognitive level seems able to capture both the effect of *source events* and of the effect of *background noise*. Perception of environmental sound based on cognitive processes grounded in source recognition, have been well understood and can be studied using various methods. In environments with multiple sources, the soundscape is processed as a whole since source identification is hindered. The methodology proposed by the authors also allows the investigation of the perception of this background noise. In this case, mental representations related to both physical properties of the acoustic signal and semantic features and psychological effects can be identified.

In the awarded paper the authors apply the proposed methodology to investigate the ecological validity of reproduction of environmental soundscapes. They observed that ecological validity is easily obtained for sound events but that reproducing the urban background noise required immersive multichannel reproduction. This confirms existing knowledge on the cognitive processing of environmental sound. In later publications cited below the team applies their new methodology for exploring the meaning of urban soundscapes for its users and thus proves wider applicability of their methodology.

The awarded team goes beyond the classical paths of psychoacoustics and proposes a methodology for exploring mental representations of environmental sound. The novelty and potential impact of this approach were main motivations for the jury to select this work for the 2008 award for outstanding scientific results published in ACTA ACUSTICA UNITED WITH ACUSTICA.

The full paper can be downloaded from ACTA ACUSTICA UNITED WITH ACUSTICA ONLINE at www.ingentaconnect.com/content/dav/aaua.

Further reading

Dubois, D., Guastavino, C., and Raimbault, M. (2006). "A cognitive approach to urban soundscapes: Using verbal data to access everyday life auditory categories," Acta Acustica United with Acustica 92, 865–874.

Guastavino, C., (2006) "The Ideal Urban Soundscape: Investigating the Sound Quality of French Cities," Acta Acustica United with Acustica, 92, 945–951.

# FOREIGN MEDAL 2007
# of the
# French Acoustical Society


## Walter LAURIKS

**The Foreign Medal** is annually presented to a renowned scientist having strong relations with French acousticians

**PREVIOUS RECIPIENTS**

| | |
|---|---|
| 1966 | BERANEK (USA) |
| 1967 | L. PIMONOW (Poland) |
| 1968 | SACERDOTE (Italy) |
| 1969 | FRENKIEL (Belgium) |
| 1970 | MALECKI (Poland) |
| 1971 | TARNOCZY (Hongrie) et KOBRYNSKI (Poland) |
| 1972 | FURRER (Switzerland) |
| 1973 | STEPHENS (United Kingdom) |
| 1974 | GRUTZMACHER (German) |
| 1975 | RYFFERT (Poland) |
| 1976 | LARA-SAENZ (Spain) |
| 1977 | BOSQUET (Belgium) |
| 1978 | A.STAN (Romania) |
| 1979 | TARABA (Czechoslovakia) |
| 1980 | WANG TE CHAO (China) |
| 1981 | INGERSLEV (Denmark) |
| 1982 | KURTOVIC (Yugoslavia) |
| 1983 | CREMER (Germany) |
| 1984 | LAUBER (Switzerland) |
| 1985 | DOAK (United Kingdom) |

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|---|---|
| 1986 | MYNCKE (Belgium) |
| 1987 | KUTRUFF (Germany) |
| 1988 | W.G. MAYER (USA) |
| 1989 | J.E. FFOWCS WILLIAMS (United Kingdom) |
| 1990 | J. BLAUERT (Germany) |
| 1991 | G. WEINREICH (USA) |
| 1992 | O. B.WILSON (USA) |
| 1993 | Z. SKVOR (Czech Republic) |
| 1994 | F. FAHY (United Kingdom) |
| 1995 | L. BJØRNØ (Denmark) |
| 1996 | H. UBERALL (USA) |
| 1997 | HIRSCHBERG (The Netherlands) |
| 1998 | H. LEVINE (USA) |
| 1999 | W. LAUTERBORN (Germany) |
| 2000 | M. CAMPBELL (United Kingdom) |
| 2001 | O. LEROY (Belgium) |
| 2002 | G. DAIGLE (Canada) |
| 2003 | M. ROSSI (Switzerland) |
| 2004 | J. WOLFE (Australia) |
| 2005 | V. PREOBRAJENSKI (Russia) |
| 2006 | M. LOWE and P. CAWLEY (United Kingdom) |

Walter Lauriks (born in 1961 in Reet – Belgium, married, 3 children) obtained a Master in Physics in 1983 and his Ph.D. in Physics in 1990, both at the University of Leuven (Belgium). Since then he worked as a research fellow at the Laboratory of Acoustics and Thermal Physics of the Department of Physics of the University of Leuven (K.U.Leuven), his main research area being sound propagation in elastic porous materials (also the subject of his Ph.D. thesis). He was responsible for multiple research projects in acoustics (among others for the Scientific Research Fund Flanders).

In 2005, Walter Lauriks became full professor and director of the Laboratory of Acoustics and Thermal Physics of the K.U.Leuven. At present, he is responsible for teaching different courses at the Faculty of Science and the Faculty of Engineering of the university: "Electricity and Magnetism", "Optics, Lasers and Acoustics" and "Physical Acoustics".
Until now, he supervised 13 PhD theses (as advisor or promotor) and he was 37 times Jury member of Ph.D. committees, both national and international.

Walter Lauriks has developed a close and fruitful collaboration with the Laboratoire d'Acoustique de l'Université du Maine (UMR CNRS 6613, Le Mans, France) for more than twenty years and more recently with the LMA (Marseille, France) mainly in the domain of acoustics of air saturated porous media. He pioneered research in this field. The results of these works have many implications, ranging from fundamental studies to Applied Architectural Acoustics and the metrology of sound absorbing porous media.

Walter Lauriks is main author or co-author of more than 100 publications in international peer-reviewed journals and more than 110 conference proceedings for international conferences. At different occasions, he was session organiser and/or session chairman at these conferences. He also contributed to 7 book chapters.

Since 1997, Walter Lauriks is Associate Editor Physical Acoustics "Acustica united with Acta Acustica". He is member of several scientific organisations: Société Française d'Acoustique, Acoustical Society of America, Association Belge des Acousticiens (board member), Netherlands Akoestisch Genootschap (Dutch Acoustical Society NAG, board member), IEEE, The American Association of Physics Teachers.

# FRENCH MEDAL 2007
# of the
# French Acoustical Society

## Vitalyi GUSEV

**2007**

**The French Medal** is annually presented to a French scientist, who has contributed significantly to the reputation of French acoustics.

**PREVIOUS RECIPIENTS**

| | |
|---|---|
| 1966 | CANAC and P. CHAVASSE |
| 1967 | A. BARON |
| 1968 | R. LUCAS |
| 1969 | J. BRILLOUIN |
| 1970 | P. LIENARD |
| 1972 | R-G. BUSNEL |
| 1973 | T. VOGEL |
| 1974 | J-J. MATRAS |
| 1975 | R. CHOCHOLLE |
| 1976 | J. PUJOLLE |
| 1977 | R. SIESTRUNK |
| 1978 | E. LEIPP |
| 1979 | P. RAPIN |
| 1980 | M. BURGEAT |
| 1981 | A. DIDIER |
| 1982 | A. BERGASSOLI |
| 1983 | G. COMTE-BELLOT |
| 1984 | J. MATTEI (refused) |
| 1985 | R. LEHMANN |
| 1986 | P. LORAND |

| | |
|---|---|
| 1987 | P. FRANCOIS |
| 1988 | E. DIEULESAINT |
| 1989 | B. POIREE |
| 1990 | R. CARRE |
| 1991 | C. GAZANHES |
| 1992 | J-F. ALLARD |
| 1993 | M-C. BOTTE |
| 1994 | J-P. HATON |
| 1995 | J. RIPOCHE |
| 1996 | A.M. BRUNEAU |
| 1997 | J. POULIQUEN |
| 1998 | D. ROYER |
| 1999 | P. FILLIPI |
| 2000 | A. DANCER |
| 2001 | G. CANEVET |
| 2002 | P. GATIGNOL |
| 2003 | M. FINK |
| 2004 | M. BRUNEAU |
| 2005 | C. LESUEUR |
| 2006 | D. CATHIGNOL |

Professor Vitalyi GUSEV received degrees of PhD (1982) and Dr. Sc. (1991) in Physics and Mathematics from Moscow State University (Russia). After several years of being researcher and assistant professor at the same university, he joined in 1990 the International Laser Centre at Moscow State University where he was associated professor. In 1998, he joined University of Maine in Le Mans (France) where he became professor in a national engineering school (ENSIM). He is now full professor of University of Maine at the highest grade and he is since 2006 the Senior member of the "Institut Universitaire de France" (Institute of French Universities) because of his outstanding research achievements.

Pr. Gusev is the recipient of several awards, including the Lenin Comsomol Prize in Science and Technology (1987, Russia), the distinction of the International Science Foundation (1994), Senior Prize of International Photoacoustic and Photothermal Association" (2004).

He was invited in several universities (Sapporo, Japan - Heidelberg, Germany - Brown, USA - Toronto Canada - Leuven, Belgium - Paris, France) as fellow, visiting scientist, visiting professor, etc. He gave more than 50 lectures and seminars as an invited speaker. He is member of international scientific committees, among them: International Congress on Ultrasonics, International Conference on the Emerging Technologies in Quantitative Nondestructive Testing, International Conference on Photoacoustic and Photothermal Phenomena...

He is the author of more than 400 scientific publications, among them more than 180 are in international scientific journals or are book chapters. He also published a book "Laser Optoacoustics" with A. Karabutov (translated from Russian into English in 1993 by the American Institute of Physics, New York, USA).

His fields of research can be summarised mainly as: photothermal and photoacoustic phenomena, picosecond ultrasonics, nonlinear acoustics, acoustics of micro-inhomogeneous media, thermoacoustics. He has made deep and original contributions in all of his fields of interest and even he had a pioneering role in tackling theoretically several challenging