New Zealand Acoustics

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2nd Quarter

Lightweight Floor/Ceiling Systems
with Improved Impact Sound Insulation

Understanding the Lombard Effect

Echolocation: An Action-Perception Phenomenon

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Features

Regulars

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From the President and Editor

From the President

Dear Members,

As has been my habit of the past few columns, I'm going to fill you in on how the Membership regime has progressed over the last few months. To date, we officially have 10 Affiliate Members, 21 Members, and 5 Fellows. I confess I forgot to check how many memberships have been received and are pending Committee approval... But, to be honest, the Committee has undertaken the task of reviewing Membership applications very seriously, so the turnaround time has generally been very timely.

I would actually like to thank the Committee members for their dedication to this task – it's been a relatively smooth process, and all have taken a share of the onus of responsibility for reviewing and approving around a dozen applications each, and generally in their own time. We've had some applications which have given us pause for thought, for a variety of unforeseen reasons, but ultimately the conclusion has been that the Society's rules of Membership have been thoroughly thought out.

Similarly, thanks must go to Cathy Clow, who has been foremost in coordinating the distribution of applications received by the Committee for approval (and chasing us up if we are slow to respond), and subsequently arranging for the certificates of Membership to be sent. Thanks Cathy!

The organisation of the Society's biggest event of the year is also now well under way – the ASNZ's 2012 New Zealand Conference. As you will have heard by now, this is to be held in Wellington on 6th and 7th September, and the call for

papers has been sent out. Please go to page 18 for further details, and of course to the ASNZ website for the paper template and instructions for submitting of abstracts – these are due on June 29

Publication Dates and Deadlines

New Zealand Acoustics is published quarterly in March, June, September, and December.

The Deadline for material for inclusion in the journal is 1st of each publication month, although long articles should ideally be received at least 2 weeks prior to this.

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(*ed. deadline extended*), so get writing!

We should not forget to look across "the ditch" to the goings-on of the Australian Acoustical Society, which is holding its annual conference this year titled "Acoustics 2012 Fremantle: Acoustics, Development and the Environment" and is to be held from November 21 – 23 in Fremantle, Western Australia. All members are of course encouraged to consider attending.

The AAS is also hosting INTERNOISE 2014 in Melbourne from 16 – 19 November, 2014. Even further afield, there is also some preliminary discussion between the two Societies about the possibility of having a joint conference in 2016, to coincide with the 10th anniversary of the joint conference held in 2006 in our very own Christchurch. Watch this space!!!

Best regards to all until the next edition...

Rachel Foster

Editor's Ramble

Hi Everyone,

I would like to start this ramble by drawing your attention to our fabulous new website, which can be found at: http://www.acoustics.org.nz.

The site has a new look and now contains archived electronic versions of papers from our past issues (we are working on making more of these available). Thanks to Grant Emms for some hard work on this site. By making the articles open access, we are hoping to increase the attraction of publishing in New Zealand acoustics. That said, we are always looking for contributions; if you have something that you would like to let the community know about, then please make a submission!

Recently, I participated in an idenpendent study of wind farm noise near a farm in South Australia; the study is ongoing, but I learnt that many, if not most, of the issues around assessing the impact of disturbances on the community are phycological; an area where I am not an expert. It seems that frank engagement between operators and residents is essential and has a direct effect on perceptions of noise. This is an area that I know is of interest in New Zealand and I hope to have a feature in the next issue for you.

In this issue we start with an article about a timber floor/ceiling construction with a set of promising alternatives for superior acoustic insulation.

The next paper is an original contribution on the Lombard effect, where speakers increase their voice levels in a noisy environment, with particular reference to school classrooms.

The final article in this issue is a little longer than those we usually publish, but it contains an interesting review of the work done on the phenomenon of echo-location, ending with a description of some current projects. This is work that I became aware of when I visited Rio de Janeiro last year for the ISCV, and I am personally excited by the possibilities of integrating echolation information with new simulation technologies.

This issue also has some information about the upcoming conference, and an acoustics crossword from a new contributor.

All the best, until the next issue,

John Cater ¶

Lightweight Floor/Ceiling Systems with Improved Impact Sound Insulation

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A paper previously presented at ISSA 2010, 29-31 August 2010.

Abstract

Contrary to common belief, a relatively simple and practical lightweight timber based floor/ceiling can have impact sound insulation superior to that of concrete slab based systems. This paper presents examples of such systems that include vibration isolation/damping features, such as rubber ceiling batten clips, glass fibre wool, and a sand-sawdust mixture layer. We give enough details to reproduce our experiments and build the proposed lightweight systems.

INTRODUCTION

A room with good heat and sound insulation can make us feel secure and comfortable. Our interest in this paper is in sound insulation that can be achieved using lightweight floor/ceiling systems or lightweight timber-framed systems (LTFS). In general, the more money and time one spends, the higher sound insulation performance one can achieve. In the past, thick and heavy, e.g., concrete slabs, has been a well-accepted method to achieve good sound insulation. However, timber-based lightweight construction methods are more favourable in countries, such as New Zealand, Canada, and Scandinavian countries where timber is more economical and environmentally sustainable. In this paper we present several examples of lightweight timber based floor/ceiling systems that have higher sound insulation performances than the concrete slab based systems.

As the popularity of LTFS grows, the systems weakness in sound insulation in the low- to mid-frequency range has become apparent. The lightness of the system, which is an advantage in terms of construction, in this case a main reason for the poor performance. Our objective is then to improve the low to mid-frequency sound insulation without increasing the total weight of the system. In this article we describe how the theory and the experiments have been used together to come up with novel designs of the lightweight floor/ceiling systems. In 2006 the authors produced a technical report [3] for Forest & Wood Products Australia (formerly Forest and Wood Products Research and Development). This article gives structural vibration and subjective listening test parts of the report.

During the project, 26 variations of LTFS were built. The designs were made incrementally complex. At each step of design changes, a theoretical model and architectural practicalities contributed to choose which component and how to change it. The theoretical model was built to predict the low-frequency vibrations of the floor and the ceiling surfaces when damping, stiffness, or size of various components are changed. Thus it kept us from wasting our time on building obviously inferior designs.

The designs we present were also evaluated in listening tests [3]. These verified that in realistic settings the lightweight floor/ceiling systems can have better sound insulation than a 150mm thick concrete slab with suspended ceiling panels. The use of a sand and sawdust mixture in the upper layer of the system improves the performances significantly. This debunks the widely held belief (e.g. [2]) that LTFS cannot perform as well as their concrete counterparts.

In the following sections we will present:

1. Detailed measurements of the surface motion using a laser-vibrometer.
2. Recording and recreating the impact sound from the structure.
3. Listening tests to assess the performance of the systems.

Design specifications of selected experimental floor/ceiling systems will also be given. Material properties and details of proprietarily products are given in the appendix.

EXPERIMENTAL SETUP

Two series of experiments were conducted to assess the performances of each floor/ceiling design. First, detailed vibration measurements of the ceiling and floor surfaces gave us the low-frequency behaviour of the structure, such as resonance frequencies and modal shapes. Second, we recorded the sound from each structure resulting from various impact sources on the floor surface. The recordings were then played back to human subjects, who graded the LTFS.

Vibration of the floor and the ceilings

Each design was constructed and tested in a purpose-built test rig (see Figure 1). An electrodynamic shaker provided a localized vertical force on the upper surface, connected through a wire stinger and a reference force transducer. The force transducer measured how much force was applied to to the floor. The shaker body was mounted on a beam resting on supports, which sat on the concrete collar surrounding the floor, and the beam itself was isolated from the concrete collar by very resilient pads made of polyester fibre infill. A pseudo-random signal was used as excitation, with a bandwidth from 10Hz to 500Hz, for a duration of 2 seconds (to achieve a frequency resolution of 0.5Hz).

We used a scanning laser vibrometer (Polytec PSV 300) to measure the velocity normal to the surface of the floor and ceiling for each of the test designs. A grid with a spatial resolution of 10-14cm was obtained to map the surface velocity of the floor and ceiling relative to the input force. Both amplitude and phase information were recorded at each frequency. Figure 1 shows the laser-vibrometer setup for measuring floor and ceiling vibrations. The scanning vibrometer can capture fine details of the surface motion as shown in Figure 2. The overall vibration response was measured in terms of the root-mean-square (RMS) velocity in dB (also shown in Figure 2), as this gives a measure of average radiated sound power at each frequency.

Recording impact sounds and listening tests

Experimental floor/ceiling systems were constructed in the ceiling opening (7m by 3.2m) of a purpose-built concrete block reverberation chamber. In total 26 systems were built and tested according to ISO 140-6. We made near-field recordings underneath the ceilings (70mm from the ceiling) at 4 microphone positions spaced across a diagonal of the chamber of a sequence of impact excitations of each floor/ceiling construction. These excitations comprised –

1. The standard tapping machine at a central floor position
2. Heavy tyre drops at 4 positions along a diagonal (above the mic positions)
3. A 72kg male walking along the diagonal
4. The same male running along the same diagonal
5. Light impact ball drops at the 4 diagonal positions

In each case simultaneous recordings were made from the 4 near-field microphones. The RT (Reverberation time) of the chamber was reduced for these recordings by laying out a complete floor covering of thick polyester sound absorber. The aim was to reduce reverberant sound picked up by the near-field microphones. The recordings were played back in a simulated living room that conforming to IEC 268-13. The room itself was equipped with 4.2 loudspeaker reproduction system (4 loudspeakers in the ceiling cavity and 2 sub-woofers in the room). Our approach was novel in the following ways:

1. The listening room (Figure 3) was furnished to look and feel like a domestic environment
2. The hidden loudspeakers provided directional realism for the impact sound
3. The system was designed to equalized to provide a flat frequency response down to 16Hz (see Figure 4)

The individual loudspeakers in the ceiling of the listening room were each fed with one channel of the recordings. The 2 woofer loudspeakers were fed an average mix of the low frequency signals from the 4 microphones. The levels at the subject's listening position were adjusted to account for differences in RT between the reverberation chamber and the listening room based on the ISO 140 impact measurement spectra.

31 subjects were invited to participate as assessors for the initial experiment. They were chosen to provide a group spanning a wide age range (mean age 31 years, maximum 61 years) and between males and females. Also they were only included if, based on the subjects' own reporting, they were free from any hearing impairment. Each participant was asked to complete profiling questionnaires to collect information on their listening habits, noise sensitivity, and privacy rating.

Figure 1. An electrodynamic shaker (top) and setup of the laser vibrometer to measure the ceiling (bottom).

The impact insulation performance of a concrete slab floor (150mm thick) with a suspended plasterboard ceiling was taken as a reference and the LTF floor recordings were paired with the equivalent recording from the concrete slab and presented in an A/B comparison for assessment of (a) preference and (b) difference. A selection was made of 8 floors considered most relevant to the overall project. This, together with 4 impact types (walking on bare floor, walking on carpeted floor, tapping machine and ball drop), gave 32-paired assessments for each subject.

The preference question took the form of a 2-Alternative-Forced-Choice experiment with no ties allowed [5] and for this the subjects were asked to imagine they were going to live in an apartment where they had to choose a floor/ceiling construction to separate them from the apartment above. The presented sounds in each pair being the typical sounds they might hear from 2 alternative floor/ceiling constructions. In each case one of the pair was the sound from the concrete reference floor although this was not communicated to the subjects.

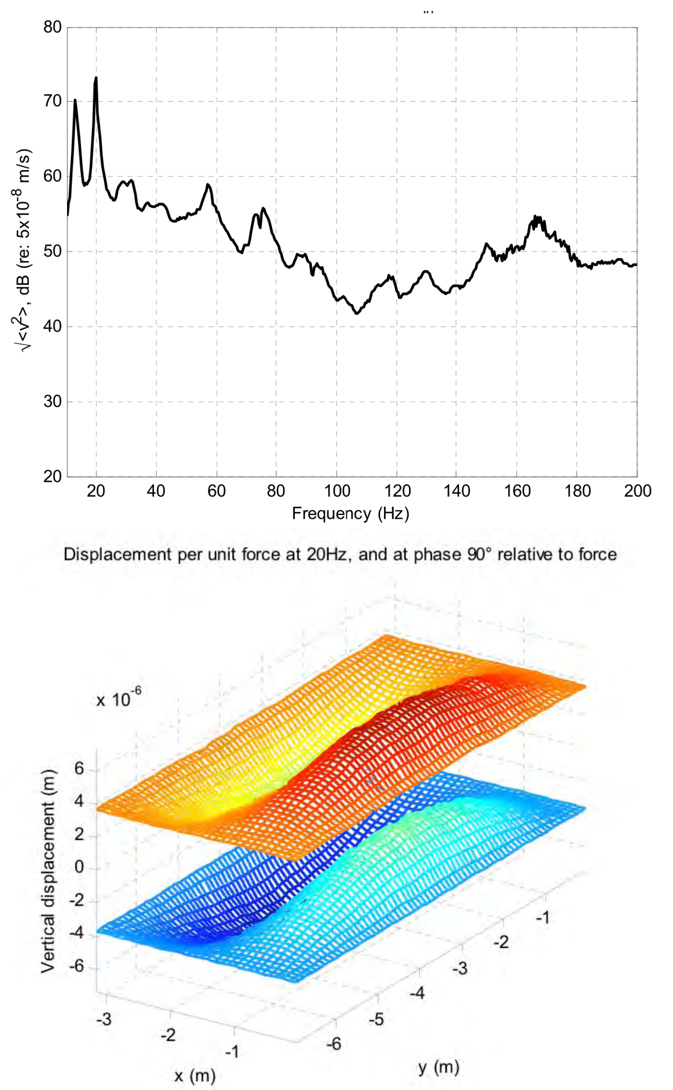

Figure 2. Top: the RMS velocity of the ceiling, as a function of frequency. Bottom: a mesh plot of the amplitude of vertical displacement of the ceiling and floor for the second resonant mode (at 20Hz).

The difference question took the form of asking the subjects to mark on a continuous semantic differential scale how different the pair of sounds seemed. The extremes of the scale were marked Not significantly different and Markedly different and the mid point was marked Noticeably different.

DESIGN AND PERFORMANCE

Figure 5 shows the design of a common joist floor, which has a plywood upper layer, supporting timber joists, and a suspended ceiling panel underneath. All other designs we present are developments on this basic configuration. We made three kinds of changes to the top layer: variation of its mass, its stiffness, and its damping. Our experiments have shown that increasing damping between components, rather than increasing the mass or the stiffness, is most effective at reducing the vibration response of this type of floor.

Multiple plaster board top layer

Adding multiple layers of plaster board (see Figure 6 increases the mass and stiffness of the top layer, and moves the first an second resonant frequencies. However the increased mass and

Figure 3. Listening room simulating an average living room with common furniture settings.

stiffness did not lower the vibration level.

Sand-sawdust upper layer

The design shown in Figure 7 gave the best performance in terms of the sound insulation perceived by listeners, based on listening experiments using recordings in the room below the floor of impacts on the floor. We tested this design with sand only, and with various sand and sawdust mixtures. Figure 8 shows the positive effects of including sawdust in mixture in the top layer, by comparison with a sand-only damping layer. Above 80Hz, the vibration and radiated sound is significantly damped more by mixing in sawdust. The best mixture we tested had 80% sand and 20% sawdust, by loose volume.

Aerated concrete top layer

We also tested the basic design built with aerated concrete (Hebel) panels as the upper layer. These have comparable mass density to the sand fill, so provide a direct test of whether it is the mass or the damping in the sand-sawdust that is giving good performance. Figure 9 shows the system, and the performance of the system, with the sand-sawdust system results for comparison. The comparison shows that the dampingcontributed by the sand-sawdust cannot be replicated by simply adding equivalent mass. The sand-sawdust fill dampens the vibration above 60Hz more effectively than the aerated concrete upper layer. It should be noted that timber I-beams were used for joists in this system, however our numerical modelling showed that the same result would have been achieved with standard timber joists.

Figure10 shows numerical simulations of the effect of using various values of stiffness and mass density in the upper layer [1]. The mass density and the stiffness were varied in order to confirm that the damping by the sand-sawdust could not be achieved by replacing it with layers that provide only mass and stiffness. That is, we want to confirm and extend the conclusion reached from the comparison in Figure 9. Both simulations in Figure 10 show that an increase in mass and stiffness certainly lowers the vibration level above 80Hz. However the vibration level is still highly varying with frequency compared to the near flat response of the sand-sawdust floor. Furthermore, it takes an impractical amount of mass and stiffness to achieve a performance comparable to that achieved with a sand-sawdust layer.

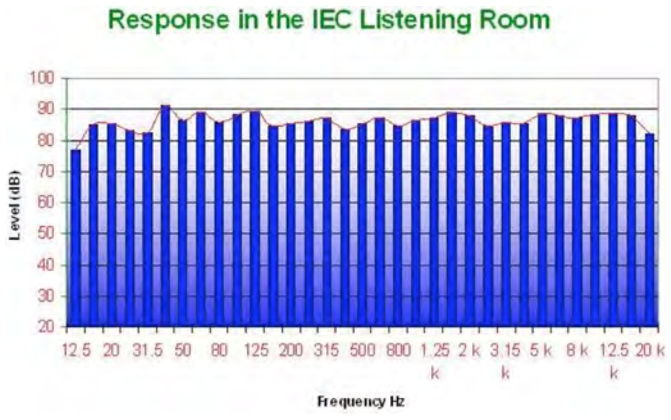

Figure 4. Listening room sound level across the frequency range.

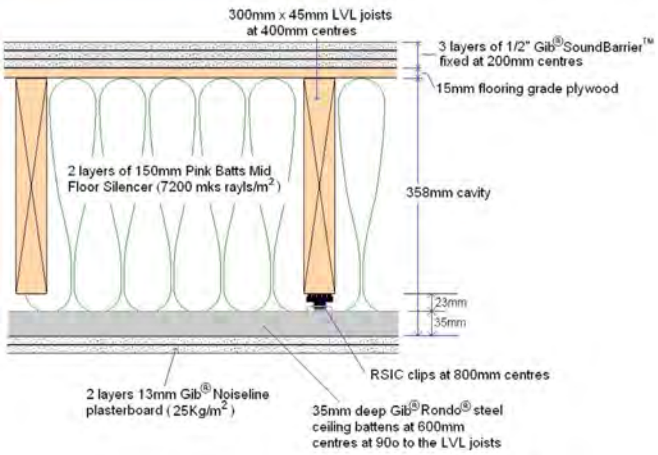

Figure 6. Cutaway schematics of a floor ceiling system with three plaster boards as the upper layer.

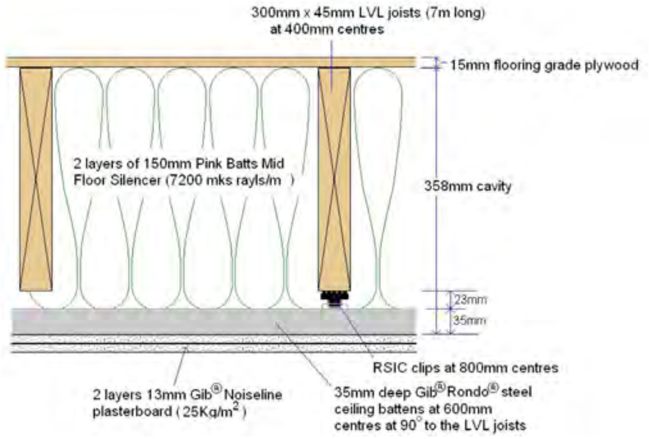

Figure 5. Cutaway schematics of a floor/ceiling system with a single plywood upper layer.

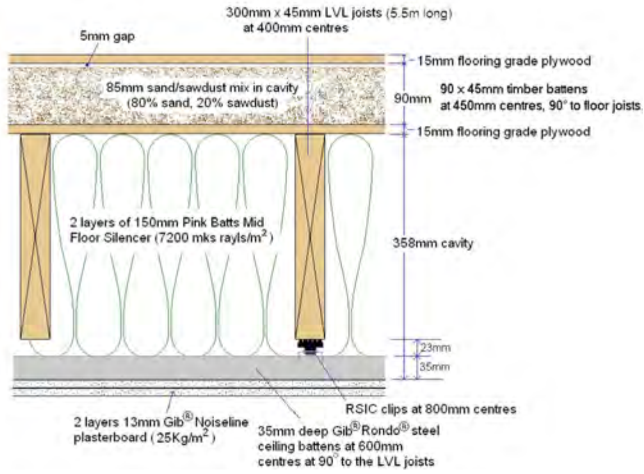

Figure 7. A sand-sawdust damping layer.

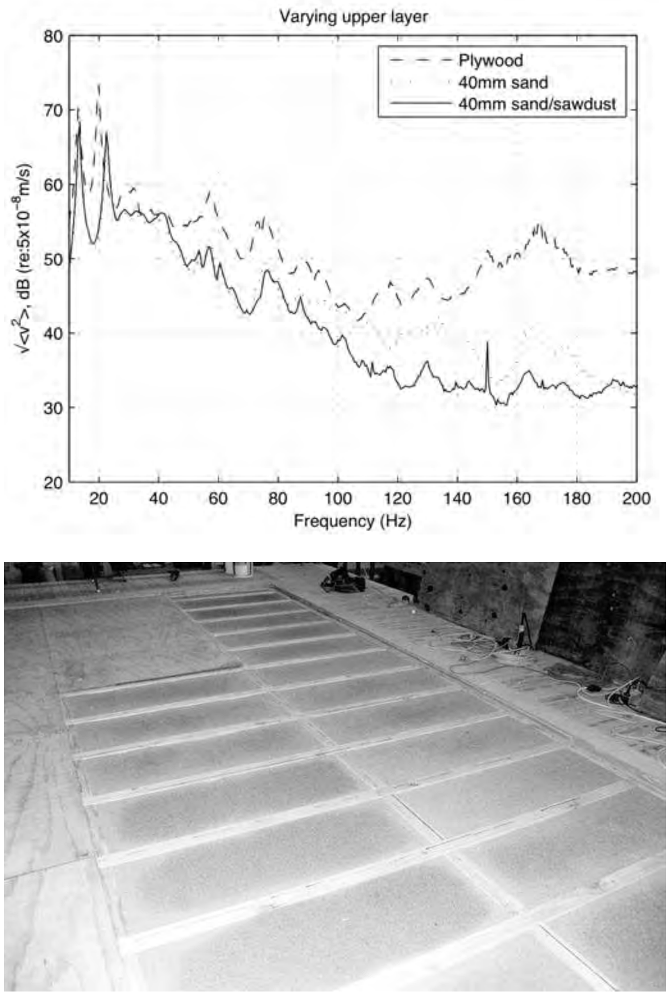

Figure 8. Top: RMS velocity comparison between sand-sawdust and sand-only upper layer. Bottom: Photo of sand-sawdust layer before plywood cover.

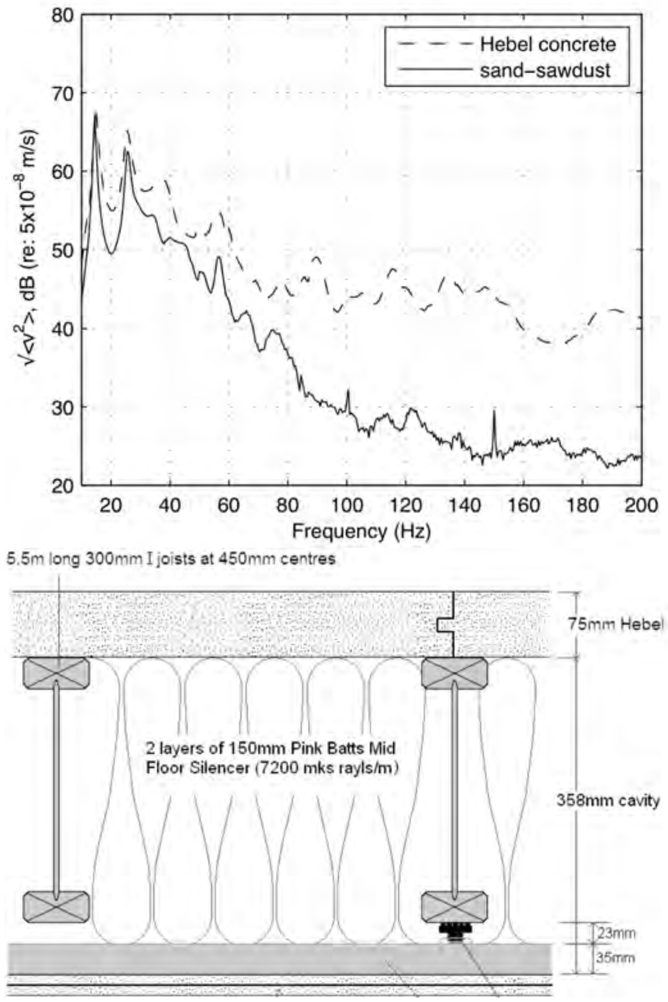

Figure 9. Top: RMS velocity comparison between the structures with sand-sawdust and equivalently weighted upper layers. Bottom: Cutaway schematic of the floor/ceiling system with aerated concrete upper layer and timber I-beams for the joists.

Transverse stiffening

In order to stiffen the floor perpendicular to the joists, we tried transverse stiffening as shown in Figure 11. The addition of transverse stiffeners was found to increase the fundamental frequency of the floor, and therefore to make it potentially noticeable to human hearing. This is particularly the case if the floor is relatively narrow. Thus, transverse stiffeners should not be installed between the floor edge and the next joist. As a consequence though, this introduces a rotational vibration mode in the floor, which depends on the bending stiffness of the upper layer. However, since it is an odd type mode (and hence having a tendency for canceling for radiated sound) the sound radiation efficiency would be low.

The effect of the stiffeners was to produce little change at frequencies below 100Hz, but a poorer performance for frequencies above 100Hz. Transverse stiffeners made from I-beam sections were also added to the Hebel floor and their effect was again insignificant. Thus we conclude that transverse stiffeners in floor designs provide little acoustical benefit.

Tapping machine results

Table 1 shows the results of tapping machine experiments. A standard tapping machine was used on the bare floor surface to measure the standard single figure ratings. We did not use any additional surface cover (e.g. carpet) in order to create the most demanding condition, and because it is common to have bare floors or parquet directly on top of concrete. The overall Ln,w rating of each floor was obtained using the relevant part of ISO 140 and ISO 717-2. The table shows IIC ratings in accordance with ASTM E989 (Standard Classification for Determination of Impact Insulation Class) and spectrum adaptation terms $L_{n,w} + C_I$. Note that $L_{n,w} + C_I$ tends to have mid-frequency emphasis. The worst performing floors for high-frequency impact insulation as indicated by a high Ln,w values are the systems with a 150mm concrete slab, and with aerated concrete panels. Although these systems would meet the Australian building

Table 1.Standard single figure ratings of the various floor/ceiling systems

Top layer	IIC	$L_{n,w}$	C_I	$L_{n,w}+C_I$
Concrete slab	37	69	-12	57
Single plywood	49	61	-1	60
3 plaster boards	61	45	1	46
Hebel panel	35	72	-10	62
Sand-sawdust	62	48	-2	46

code requirements ($L_{n,w}$+C_I ≤62), they would not meet the New Zealand building code requirements (IIC≥55).

Listening test results

The intention was to use the difference judgements to provide a ranking of the different floor constructions relative to one another. It became evident, however, that subjects approached their judgement in two differing ways. This difficulty has prompted a repeat stage of experimentation but the results from the 2AFC question do in general support the rankings found by the difference method (see Table 2). Use of the SI units of measurements is recommended. Other units (e.g. American) are allowed only next to the SI units and then must be given in parentheses, for instance, 404kPa (58.6psi) or 63.7m^2 (685.7ft^2).

The cohort of subjects was too small to allow any clear indications of differences between subjects of significantly different Noise Sensitivity or Privacy Rating. When the subjects were divided into Low, Average and High groups for Noise Sensitivity and Privacy Rating the results showed no consistent trend, but with such small numbers of subjects in the extreme groups (e.g. the High Noise Sensitivity and Low Privacy Rating groups each comprised only 3 subjects) this cannot be relied on as indicating no dependency.

When divided by sex a small but consistent difference between men and women was evident (e.g. an average of 0.32 for the tapping machine and 0.53 for the Ball drop - these values being distances on the continuous scale of length 10) with women judging differences overall to be slightly smaller.

When the subjects were divided into two age groups first those aged <30 (n=14) and those aged >40 (n=10) the judgements were not different for the tapping machine sounds but for the Ball drops the younger subjects consistently judged the differences larger by an average of 1.2.

Apart from providing a direct indication of the relative satisfaction to occupants of LTFS and standard concrete floor constructions we hoped that the subjective experiment results would help clarify if existing objective measures are adequate for ranking occupant preference. The issue here is that the standard building insulation measures [4] – even with the ISO low frequency extensions [6] – do not cover the full bandwidth used in this experiment. However, Loudness (in Sones) and A-weighted SPL are both standardised measures and can be extended to include all the low frequencies (see [3] for the Loudness calculation). The correlations between Loudness and the subjective preference scores are given in [3], and the results show surprisingly good correlations for both the A-weighted SPL (Leq 10s) and Loudness with the subjective judgements.

The rankings consistently show sand-sawdust system as either close to, or better than, the concrete reference construction whatever the impact source or floor covering. But can we conclude that overall it is as satisfactory a construction as the concrete slab? The critical condition is when the floor is subjected to heavy impact where the Loudness and A-weighted SPL results and the subjective preferences do distinguish the floors as different (we note that $L_{n'w}$ and IIC values are not helpful here because the tapping machine has such a different excitation spectrum). However, are these differences likely to be significant and to make the floors differ in the acoustic comfort they provide?

Table 2. Rankings by Preference and Subjective Difference scores. Only the LTFS mentioned in this paper are shown

Top Layer	Tapping Machine	Ball-drop	Walking
Concrete slab	5th	1st	3rd
Single plywood	4th	5th	5th
3 plasterboards	2nd	4th	2nd
Hebel panel	3rd	3rd	4th
Sand-sawdust	1st	2nd	1st

Guidance can be found from the way in which semantic difference scale processing has been carried out in other research on subjective judgements. We processed our scale with a resolution of 1% but others divide their scales into categories with a much coarser resolution. For example in the most recent work (see [9] and [10]) it is recommended to use a scale divided into only 5 categories. This would imply that subjective differences less than 2 in our results put the sounds in the same category of acoustic perception and the associated floors into the same class of acoustic comfort. This is clearly the case for sand-sawdust system in the case of the ball drop where, although the mean preferences indicates a bias for the concrete slab floor, the subjective difference is less than 2 (i.e. 1.61 for the Ball drop).

Further guidance is found in the acoustic quality categories and classes of acoustical comfort that are used in Europe (e.g. in the Nordic countries and Germany). Typically different categories or classes span a range of 5 - 7dB, and so impact levels that differ by less than 5dB would be regarded as being subjectively in the same category. This is consistent with the 5dB increments that are used in audiometry in order to create level changes, which are just noticeable to the average listener. The A-weighted SPL (L_{eq} 10s) values for sand-sawdust system and the reference concrete system in the above situation differ by less than 1dB.

It is therefore a conclusion from this experiment that sand-sawdust system – and any similarly performing LTFS – provides a subjectively perceived performance, which is at least as acceptable as that of the 150mm concrete reference floor. This is true, at least, for the range of normal impacts represented by the sources used in this experiment, but, as the reproduction system did not adequately reproduce the very lowest frequencies, confirmation is necessary from the next stage of planned subjective testing.

CONCLUSIONS

A lightweight floor/ceiling system requires a range of components to achieve effective isolation of the ceiling layer from vibration induced in the floor surface above. The inclusion of a sand-sawdust mixture layer has been found to provide effective vibration damping of the whole composite structure over a wide frequency range. In fact, a sand-sawdust layer results in a performance which is superior than the addition of mass or stiffeners to the upper layer. A notable advantage of the sand-sawdust design is that the bottom and top plywood panels in

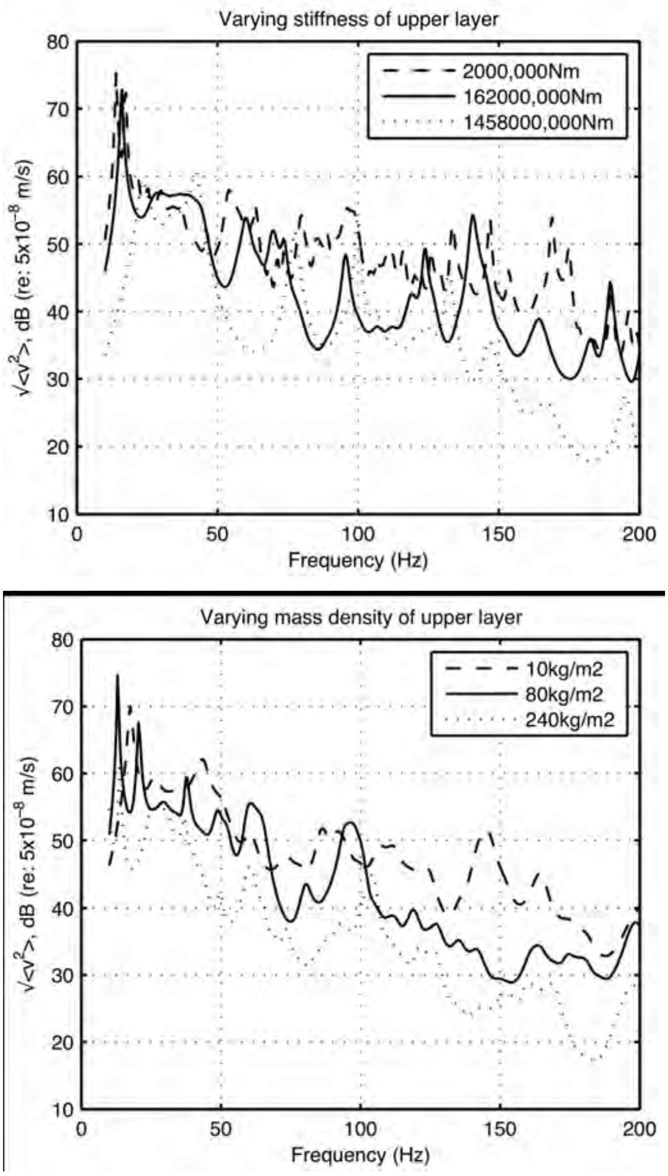

Figure 10. Simulations with various upper layer stiffness (top) and mass density (bottom).

the upper layer are directly con nected through the separating battens (see Figure 10), which makes the system robust to building mistakes. Another advantage of such a highly damped system is that flanking transmission is well attenuated.

The ultimate aim of research on the insulation provided by floor/ceiling systems must be to determine what is required to render impact noises completely non problematic. In this project we have addressed an interim goal of demonstrating that LTFS can be designed to match, or exceed, the insulation achieved by a concrete-based floor (interpreted as 150 mm slab with a plasterboard suspended ceiling). In addition we have demonstrated that a Loudness calculation suitably extended to include the very low frequencies provides a reasonably acceptable means for rank order LTFS for their ability to insulate against heavy and light impacts.

AKNOWLEDGEMENTS

The authors would like to acknowledge G. Schmid of the Acoustics research Centre at the University of Auckland for the photos and design schematics of the floor/ceiling systems.

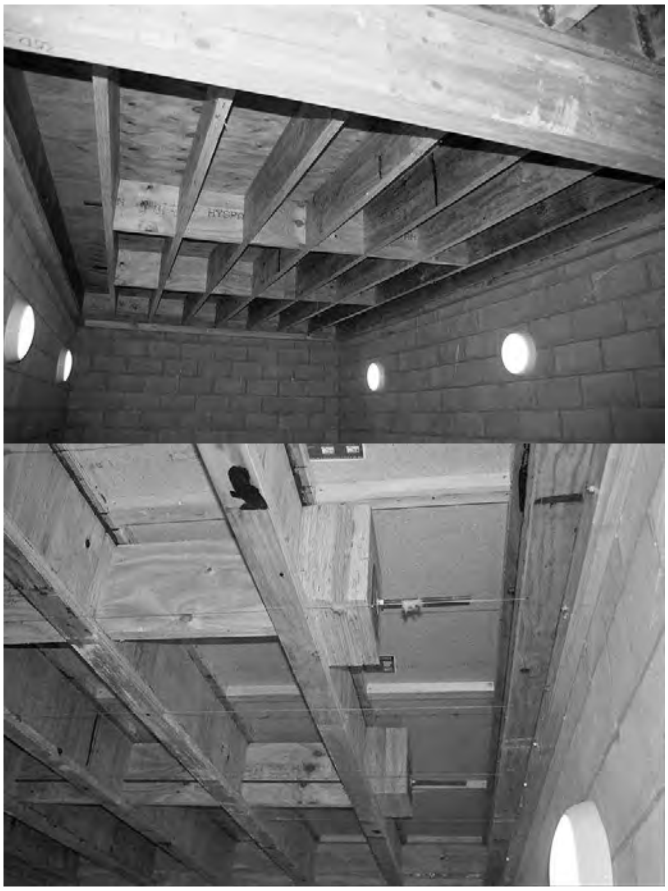

Figure 11. Sytem with the transverse stiffeners.

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Acoustic Fire Extinguisher

DARPA (USA) has theorized that by using physics rather than combustion chemistry, it might be possible to manipulate and extinguish flames. To achieve this, new research was undertaken to understand and quantify the interaction acoustic waves with the plasma in a flame.

Fire in enclosed military environments such as ship holds, aircraft cockpits and ground vehicles is a major cause of material destruction and jeopardizes the lives of soldiers. For nearly 50 years, despite the severity of the threat from fire, no new methods for extinguishing or manipulating fire have been developed. Traditional fire-suppression technologies focus largely on disrupting the chemical reactions involved in combustion. However, from a physics perspective, flames are cold plasmas.

In the research programme the DARPA scientists evaluated the use of acoustic fields to suppress flames. Flames were extinguished by an acoustic field generated by speakers on either side of a pool of fuel. Two dynamics are at play in this approach. First, the acoustic field increases the air velocity. As the velocity goes up, the flame boundary layer, where combustion occurs, thins, making it easier to disrupt the flame. Second, by disturbing the pool surface, the acoustic field leads to higher fuel vaporization, which widens the flame, but also drops the overall flame temperature. Combustion is disrupted as the same amount of heat is spread over a larger area.

However, it was not clear from the research how to effectively scale these approaches to the levels required for defense applications.

© Adapted from DARPA USA

Acoustic Tweezers

A device, called acoustic tweezers, is the first touchless technology capable of trapping and manipulating Caenorhabditis elegans (C. elegans), a one millimeter long roundworm that is an important model system for studying diseases and development in humans.

The tweezers, which can also precisely manipulate cellular-scale objects that are essential to many areas of fundamental biomedical research, use ultrasound, the same noninvasive technology doctors use to capture images of the fetus in the womb.

The device is based on piezoelectric material that moves when under an electrical current. The vibrations pass through transducers attached to the piezoelectric substrate, where they are converted into standing surface acoustic waves (SAWs). The SAWs create pressure fields in the liquid medium that hold the specimen. The simple electronics in the device can tune the SAWs to precisely and noninvasively hold and move the specimen or inorganic object.

For many biological systems, acoustic tweezers could provide an excellent tool to mimic the conditions inside the body where cells are subject to waves of pressure and pulses of chemicals, write the researchers online in Proceedings of the National Academy of Sciences.

Acoustic tweezers are very versatile, the researchers have demonstrate that they can manipulate a single cell or manipulate cells at the same time. Currently, the size of objects that can be moved with acoustic tweezers ranges from micrometers to millimeters, although with higher frequencies, it should be possible to move objects in the nanoscale regime, the researchers believe. Further work will include modifying the device to accommodate more fundamental biomedical studies.

Ultimately, the technology could lead to compact, noninvasive, and inexpensive point-of-care applications, such as blood cell and cancer cell sorting and diagnostics. For now, the ability to trap and manipulate a living C. elegans for study is proof of their device's potential utility.

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Acoustic Diode

An acoustic diode, enabling the one-way transmission of sound waves, could dramatically improve the quality of medical ultrasound imaging and lead to better sound dampening materials. Such a device has now been created by researchers at China's Nanjing University. The team, led by professor Jian-chun Cheng, described their work at the Acoustics 2012 meeting in Hong Kong, May 13-18.

Acoustic diodes are analogous to the electric diodes that produce unidirectional flow of current through electronic devices, protecting them from sudden and damaging reversals of flow. Such unidirectional flow is far tougher to achieve with acoustic waves than with electric current because sound waves travel just as easily in both directions along any given path.

The acoustic diode consists of two parts. The first is an ultrasound contrast agent (UCA), made from a suspension of microbubbles. The UCA has a strong acoustic nonlinearity, which means it converts the acoustic energy of an incident wave into a wave with twice athe frequency. The UCA microbubbles come in a broad range of sizes, so they can produce acoustic nonlinearity over a broad frequency range.

The second part of the acoustic diode is a superlattice consisting of thin alternating sandwich-like layers of water and glass. The superlattice acts like a filter that allows the sound waves with the doubled frequency to pass through the material but not the original sound waves.

Acoustic diodes might be applied to diverse situations where a special control of acoustic energy flux is required, for example, to improve the quality and effect of medical ultrasound diagnosis and therapy, or the design of unidirectional sound barriers.

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Understanding the Lombard Effect

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An original contribution to New Zealand Acoustics

Abstract

The Lombard Effect continues to breed noisy spaces, and as the current trend towards open plan spaces (particularly offices and classrooms) continues, understanding this effect so we can predict activity noise levels in reverberant spaces becomes all the more crucial. In this paper, we review previous work on experimental testing of the Lombard Effect in children and adults and the resulting prediction model. We highlight the limitations and unexpected outcomes of that work and investigate a new testing method that will lead us towards more robust real-life Lombard Effect data, which can be used to refine our prediction model.

INTRODUCTION

In 1911, French otolaryngologist Étienne Lombard discovered a psycho-acoustical effect, whereby a speaker involuntarily raises their voice level when speaking in a loud environment (Lombard, 1911).

The ramifications of this 'Lombard Effect' on speech communication are immense, particularly in a modern society tending towards ever-increasing noise levels and chock-a-block social calendars.

Our research focus is on primary school classrooms, where a tendency for crude (and cheap) room design, teaching philosophies which favour group-work activities, and the natural effervescence of children result in high noise levels through the Lombard Effect. However, a classroom cannot afford to have issues with speech communication!

MEASURING THE EFFECT

In 2002 we began investigating the acoustical mechanisms that affect speech intelligibility for children in primary school classrooms, and undertook measurements of the Lombard Effect in children (Whitlock, 2003).

These early measurements were undertaken in an anechoic chamber. Subjects were asked to wear a set of insert earphones and read a book out loud while a white noise masking signal was delivered to them at increasing levels (10 – 90 dB L_{Aeq}). The subjects' voice levels were measured in free-field at 1 metre and correlated with the masking noise level.

The slope of this correlation (approximated as a linear fit) was termed the 'Lombard Coefficient' and the value for children was measured as 0.19 dB/dB (i.e. 0.19 dB rise in speech level for every decibel rise in masking noise).

We then developed a prediction model which predicts speech noise level in an occupied room, using this Lombard Coefficient in addition to some other parameters measured during the experiment. The model is as follows:

$$F = \frac{B - SL + 10\log N - 10\log V + 10\log T + 25}{(1-L)}$$

Where:
F = Final L_{Prev}
B = Base (resting) Voice Level
S = Masking level at which Lombard Reflex starts
L = Lombard Coefficient
N = Number of speakers
V = Room Volume (m³)
T = Reverb Time (s)

Equation 1: Model for predicting speech level in a room with multiple talkers

For a typical classroom (i.e. V = 200m³, T = 0.6 s, N = 30) this model predicts F = 74 dB which correlates well with actual measured levels in classrooms e.g. MacKenzie & Airey (1999), Wilson et al. (2002), Lubman & Sutherland (2002) and Shield & Dockrell (2003).

In 2005 the exact same method was used to measure the Lombard Effect in adults (Francis, 2005). Francis discovered a lower Lombard Coefficient (0.13 dB/dB) for adults, indicating that children are more susceptible to the Lombard Effect (highlighting the need for well designed classroom acoustics!). The results of both experiments are shown in Figure 1.

IDENTIFYING THE LIMITATIONS

Subsequent experiments (Whitlock & Dodd, 2009) showed that the Lombard Effect may be heavily dependent on the type of masking signal.

Figure 2 below shows the results of the same Lombard experiments, but with a speech babble masking signal (four-person multi-talker babble) instead of white noise.

The results are surprising in two ways:

- The Lombard Effect on adults was greater than on children i.e. the opposite to the white noise results
- The adults were more affected by speech babble than white

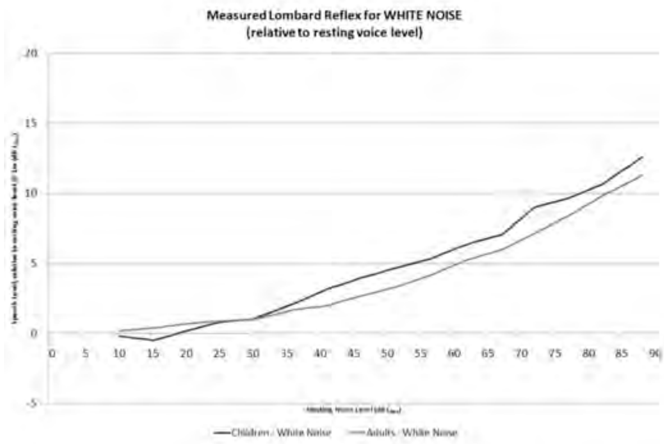

Figure 1. Lombard Effect curves for Children and Adults – White Noise Masker.

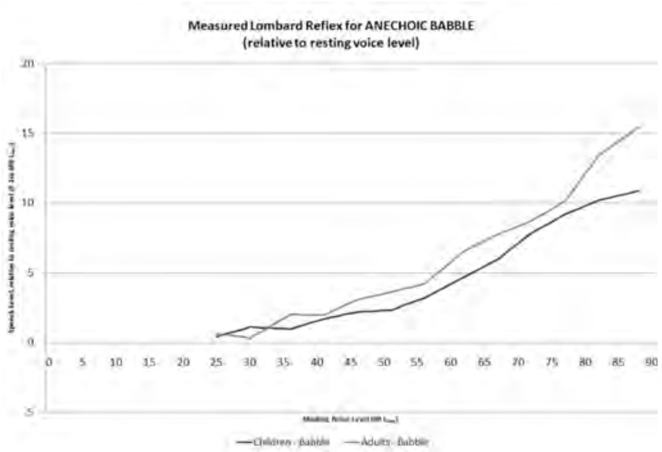

Figure 2. Lombard Effect curves for Children and Adults – Babble Masker.

noise, whereas the children were less affected

Possible explanations for these results are:

- The adults were more distracted by the information content of the speech babble i.e. they were more able to isolate and discriminate individual words etc.
- The children (all primary school age) may be accustomed to operating in the presence of masking speech sources in their classrooms. Perhaps classrooms are training children to ignore speech babble..?
- The masking for children may have been less because the babble signal spectrum had a greater low-frequency component c.f. white noise, which may have had less masking effect on their self-hearing ability as a child's voice spectrum is typically richer in higher frequencies
- Experimental limitations giving rise to skewed results

To investigate these unexpected findings further, we decided that the experimental limitations should be addressed. Testing in a laboratory environment could be giving rise to results which do not translate back to the actual situation we experience every, so we started to look into a 'real world' testing method.

REFINING THE TEST METHOD

The challenge in a real world test method is isolating the speaker's voice level from the masking (or any other background) noise. Previously, this was successfully achieved in the anechoic chamber, using insert earphones to deliver the masking noise,

Figure 3. E2 Earset microphone by Countryman Associates.

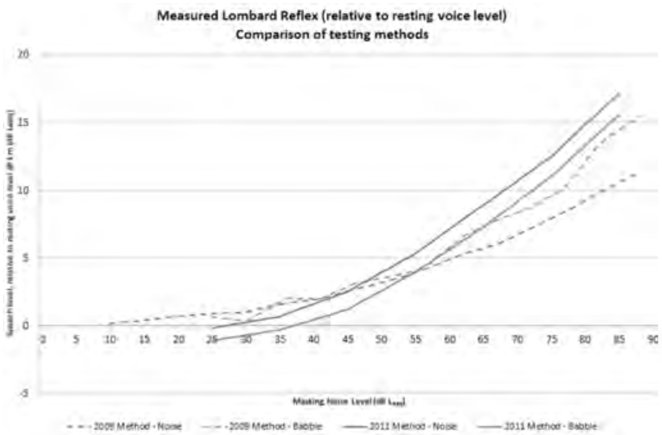

Figure 4. Lombard Effect curves for Adults, using 2009 method (dashed) and 2011 method (solid).

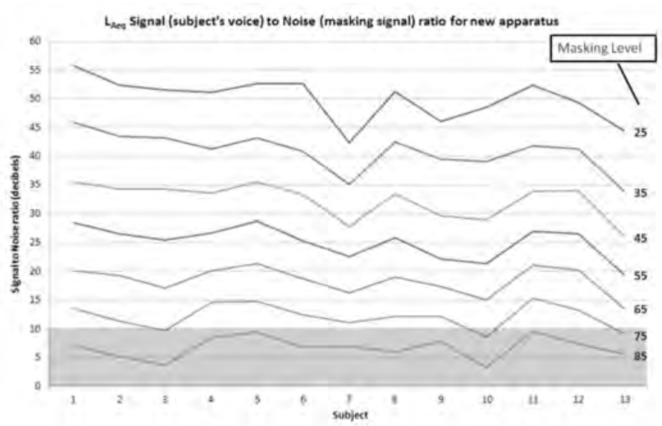

Figure 5. Signal to Noise correlations for each subject, highlighting the 10dB SNR level.

but we want to make use of real masking noise and measure the voice levels independently.

In our most recent work (Whitlock, 2011) we tested a solution in the form of a headset microphone (E2 Earset by Countryman Associates – See Figure 3). This is a small discrete mic., worn on the ear and positioned close to the edge of the mouth.

The idea is to isolate the speaker's voice level from the background noise simply through proximity to the mouth. Of course there will be a limit to this isolation, so part of the recent work has been to identify how loud the background noise can be before it starts affecting the speech level measured in the microphone.

Experiments were undertaken with adults only this time (because of the relative ease of working with them, compared with children!) in a standard living room environment. Both speech babble and white noise were used as masking signals. The L_{Prev} of the masking signal was measured using a Type 1 sound level meter, and to enable comparison with our previous experiments the levels measured at the microphone position were corrected to 1 metre.

The results (in Figure 4) indicate the following:

- The speech/noise correlation has flipped again i.e. noise elicits a higher Lombard Effect
- Lombard Coefficients are the same for noise and babble, and higher than previously measured (0.3dB/dB)
- Stunning consistency between the two 'new method' curves
- Subjects with higher resting voice levels showed less Lombard Effect

In terms of microphone limitations, Figure 5 below shows that signal to noise ratio (i.e. subject's voice to masking L_{Prev} ratio) was generally greater than 10dB for masking levels up to 75dB. Generally speaking, 10dB is the minimum separation between two noise levels to ensure their energies do not significantly add together. So, this apparatus can be used for Lombard field tests in sound environments up to 75dB, and possibly higher if we correlate the L_{Aeq} and L_{Amax} speech levels to artificially produce a greater headroom.

We have identified a viable method of measuring the Lombard Effect of subjects in real world environments. This paves the way to large scale experimentation involving a range of noisy environments such as cafes, restaurants and most importantly, classrooms. Once collected, this data will provide more accurate values for the Lombard Coefficient that can be used to continue validation of our prediction model.

ACKNOWLEDGEMENTS

Thank you, as always, to Dr. George Dodd, my research collaborator and mentor and Gian Schmid of the Acoustics Centre at the University of Auckland, and the willing participants of the numerous listening experiments we have conducted throughout the years.

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ASNZ 2012 Conference Announcement

The 21st Biennial Conference of the Acoustical Society of New Zealand will be held in Wellington on September 6th and 7th, 2012.

The conference venue will be Te Raukura-Wharewaka, overlooking Wellington harbour. Early September is a blustery time in Wellington. Nonetheless Te Raukura-Wharewaka lies in the heart of this trendy city. Come and join us for what should be a great conference.

Participants are invited to submit papers on topics relevant to the society. Subject areas include, but are not limited to:

- Environmental acoustics
- Building and architectural acoustics.
- Underwater sound
- Ultrasonics
- Physiological and psychological acoustics
- Bioacoustics, Acoustic signal processing

The abstract submission deadline is July 13th. Authors may optionally choose to have their papers reviewed. In this case, papers must be submitted by August 7th, will be returned to authors by August 16th and final papers must be submitted by August 24th. In the case of early submissions, we will endeavour to review and return the papers early. The paper deadline for non-reviewed papers is August 24th.

Submission Procedure

The deadline for abstract submission is 13th July 2012. Prospective authors are asked to fill out the abstract submission form. Submitted abstracts will then be managed by authors on the OCPMS website. For any difficulties regarding submissions, please email the editor.

Full Papers

Full papers are due Friday 24th August 2012. Full paper uploads are to be submitted via the OCPMS website. Authors may optionally choose to have their papers reviewed. In this case, full papers must be submitted by Tuesday August 7th.

The paper template is available both for Word and Latex. Papers must be converted to PDF for submission.

Each paper submitted for review will be refereed by at least two reviewers. Only papers being presented at the conference will be published in the conference proceedings. Authors are fully responsible for their papers, which should not have been published elsewhere. They must have taken necessary steps to obtain permission to use any material that might be protected by copyright. Please note that on delivery of your manuscript you transfer your publication copyright to the Acoustical Society of New Zealand.

Seminar G6 Building Code (see opposite)

A half-day seminar will be held on the morning of September 6th on the proposed revision of G6 Building Code, with presentations from the G6 committee members Richard Findlay, Stephen Chiles, Jeremy Trevathan and Jeff Mahn.

Conference Fees:

Students	$ 200	Members and affiliates	$ 400
Non-members	$ 500		

Relevant Dates

Registration from:	June 29th	Abstract submission deadline: July 13th		Decision on acceptance: July 17th
Reviewed papers				
Paper submission:	August 7th	Review returned to author:	August 16th	Final paper submission: August 24th
Non-reviewed papers				
Paper submission:	August 24th			

Building Code Clause G6 Workshop

The Department of Building and Housing issued a proposed revision to Clause G6 of the New Zealand Building Code in October 2010 for public comment. The Department then established a technical reference group to develop the proposed revision taking into account feedback received. The members of the reference group are Stephen Chiles, Richard Finley, Jeffrey Mahn, and Jeremy Trevathan.

The Acoustical Society of New Zealand has organised this workshop as part of its 21st Biennial conference in conjunction with the now Building and Housing Group of the Ministry of Business, Innovation and Employment. The main aim is to provide an opportunity for attendees to discuss the technical challenges associated with the potential Clause G6 revision, and provide comment on the options proposed by the technical reference group. The workshop will be facilitated by the members of the technical reference group. The programme is:

Introduction	A representative of the Ministry of Business, Innovation and Employment will provide an overview of the development and consultation undertaken for Clause G6, and their expectations and goals for the workshop. They will also explain possible implications of moving towards performance specification and risk based consenting.
International benchmarks	Jeffrey Mahn will compare the performance requirements of the existing and proposed Clause G6 with those used in other countries, and with respect to occupant satisfaction.
Testing and compliance	Members of the reference group will give short presentations on sound insulation standards and options for demonstrating compliance. There will be an open discussion on issues associated with laboratory versus field ratings, verification by design or pre-completion testing, and use of Acceptable Solutions.
Open session	The agenda focusses on the key areas where there are technical challenges, and does not cover all proposed and possible issues associated with Clause G6. This open session has therefore been set aside in the programme for attendees to raise any other topics that they would like to discuss. All attendees are encouraged to re-review the 2010 consultation draft (www.dbh.govt.nz/consultingon-noise) prior to the workshop and identify any questions they may have.
Impact sound	Case studies will be presented illustrating challenges associated with impact sound performance requirements, particularly associated with issues such as horizontal impact and impacts on walls. There will be an open discussion on appropriate control measures and metrics, including suggestions by the reference group such as a ΔLw requirement for horizontal impact and inclusion of construction gaps/ isolation for cupboard door slams.
Environmental sound	The issues associated with regulating sound levels inside dwellings from external sources will be summarised. Case studies will be presented showing possible interactions between controls under the Resource Management Act and the Building Act, and the challenges in establishing the appropriate demarcation. There will be an open discussion on which external sound sources should be under Building Code control, and appropriate performance requirements and acceptable solutions.
Closing	The Ministry representatives will summarise the key messages heard during the workshop. It is intended that this may also be formally recorded in a technical note in the ASNZ Journal later in the year.

Echolocation: An Action-Perception Phenomenon

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An early version of this work appeared at the 18th International Congress on Sound and Vibration (ICSV 18), Rio de Janeiro, Brazil, 10 to 14 July 2011.

Abstract

Echolocation is a genuine human ability that is closely related to localization of reflected sounds. It is part of the scarcely studied and promising field of the percepto-cognitive processes involved in everyday audition of non-verbal sounds. It implies the use of self-generated sounds (original or direct signal) with the specific purpose of obtaining auditory information (reflected signal) to locate and recognize unseen silent objects. This ability turns out to be crucial for the achievement of the independent mobility of the blind person, an aspect that is severely affected by blindness. During the 40's a rigorous research program was put forward in order to elucidate the sensory basis of echolocation. A series of ingenious tests was designed in which tactile or auditory input was artificially suppressed, one at a time. None of the subjects was able to perceive the object in the last case. Later studies inquired into the discriminatory aspects of echolocation and two auditory fusion phenomena, repetition pitch and the precedence effect, have recently been postulated as possible underlying psycho-acoustic mechanisms. According to the new cognitive and ecological paradigms in perception, it is assumed that the primary function of the auditory system is to determinate (to localize and recognize) the characteristics of the sound source through the sounds emitted by it. Within this context, it has been argued that echolocation is a variant of that general process. Two recently established scientific paradigms have enriched the study of this ability: the sensorimotor contingency theory and the sensory substitution perspective. We present a brief historical revision of the main studies that have been carried out on this particular phenomenon, our own included, with special emphasis in its treatment within the context of embodied cognition theories.

INTRODUCTION

Cognitive and ecological approaches to perception deal with abilities which the individual uses in his daily life. Under these recent paradigms, it is thought that the main function of audition is to determine the characteristics of the sound source. This complex process involves localization, recognition, and identification of the primary sound source through the sounds it produces. Within this context, echolocation, i.e., the ability to determine biologically relevant secondary sound sources from the acoustic information contained in a unique relational stimulus (the self-generated / direct-reflected pulse), may be viewed as a variation of this general process[1].

Two recent scientific paradigms have particularly enriched the study of this ability: sensorimotor contingency theory and the particular approach of sensory substitution. The former revolves around the idea of a continuous feedback between agent and environment. The ability to perceive is thought to be constituted by the so called sensorimotor knowledge, i.e., the practical and implicit knowledge of the way sensory stimulation varies as perceiver and object move. Instances of perception-cognition-action are mutually coupled processes which require an inexorably unified analysis[2]. The second approach maintains that losing vision (or other senses) does not imply losing the ability to see, since it is thought possible "to see" with the ears or the skin[3]. The main idea is that information that is normally acquired through vision can instead be captured through touch or audition on account of brain plasticity, i.e., the ability of the brain to modify its own structural and functional organization according to specific functional demands.

This article presents relevant theoretical aspects and a historical journey through the main breakthroughs made on this subject, including our own studies, with a special emphasis on the research developed in the context of the new paradigms. Finally, some remarkable conclusions are presented.

THEORETICAL CONSIDERATIONS

Echolocation: conceptualization, modalities, possible underlying mechanisms

Human echolocation is a genuine but unexploited ability that is closely related to the localization of reflected sounds; it belongs to the scarcely studied though greatly promissory field of percepto-cognitive processes involved in everyday nonverbal audition. It implies self-producing sounds (for example, tongue clicks, cane tapping sounds) with the specific purpose of obtaining echoic information in order to detect, localize and recognize / identify unseen silent objects. This ability turns out to be crucial for the blind person in order to achieve her independent mobility, i.e., one of the most severely aspects affected by blindness. It has also recently been claimed that most (sighted) persons can regularly use echolocation in everyday situations without being conscious of it.

Two complementary echolocation modalities have been described: long distance (between 2m or 3m and 5m) and short distance (up to 2m or 3m). In this last modality, the direct and the reflected signals are not perceived as separate but fused. It is the most significant modality in the daily life of a blind person, inasmuch as it is important not only for spatial orientation but also to protect physical integrity by avoiding obstacle collisions. It is probable that two auditory fusion phenomena are involved in this modality: repetition pitch and precedence effect[4,5]. The first one takes place when a sound and its delayed repetition are added together and listened to. The presence of the object could be determined by the presence (or change) of a pitch in the self-generated signal while its physical characteristics would be extracted from the spectral and spatial cues contained in the fused stimulus[6, 7, 8]. The precedence effect is an unconscious strategy used to solve conflicting auditory information in closed environments. It occurs when two similar sounds, lead-lag stimulus, are presented from different locations with a brief delay between them and only one sound is heard whose perceived location is dominated by the first arriving sound (the lead). Traditionally, it has been described as an echo-suppression mechanism that helps the person to precisely localize the primary sound source, which has the most relevant ecological information[9,10]. However, recent findings suggest that the auditory system does not eliminate, but on the contrary, maintains the information contained in the reflections, even when fusion and dominance localization occur. Certain changes in the acoustical environment, especially those that do not match the subject's expectations[11], release the suppression mechanism, which allows extracting spatial information from the retarded sound (the lag). Along these lines, it has been mentioned that it is possible with enough practice, to "turn off" this mechanism and extract useful information; also, a good sensitivity of experimental subjects to perceive several non-directional parameters (for example, intensity and spectral content) of the lag has been reported[12, 13].

Echolocation in the light of new scientific paradigms

During the last decades, a group of research programs and theoretical proposals that can be dubbed embodied cognitive science[14,15] developed within the multidisciplinary field of the cognitive sciences. It settled in the behavioural sciences from a rupture with the linear explanatory scheme sense-model-plan-act[16] in which the control system of an agent can be neatly divided in a central system (properly cognitive operations) and two peripheral systems (perception and motor control). The new approaches redefine the basic processes of intelligent behaviour and try to integrate the physiological, perceptual and motor aspects of the cognitive system in interaction with the physical and situational restrictions of its environment. Accordingly, the person seeks and builds rules of the continuous coupling that is obtained between the action performed and subsequent changes occurring in her sensations. In this way, perception implies the activity of sensory pathways as well as the exploratory activity performed by the agent in a dynamic environment. In other words, perceiving is a phenomenon fundamentally oriented to action in a dynamic environment.

Echolocation is an ability in precise accordance with the theoretical basis of the new perception paradigms. In this case, information regarding the agent-environment system is obtained from a unique relational stimulus, the direct-reflected pulse. It is considered to be a closed loop behaviour, just as active touch, where the subject modulates action to control perception[17]. The former is represented by the exploratory activity (self-generation of sounds and head or cane movements) performed by the subject to optimise proper information capture. Perception is represented by certain tonal and spatial percepts related to the object presence and its features, that the person (implicitly) learns to perceive probably as auditory Gestalts[18,19]. Besides, as already mentioned, the particular approach of sensory substitution claims that it is possible "to see" with the ears or skin due to the brain's ability to remap itself in the presence of determined functional demands. A technological projection of this approach is the sensory substitution system (SSS), a special device that transforms the sensory information the person cannot process on account of her impairment into information that stimulates some of her other intact senses[20]. On the other hand, nature offers clear examples of simple, efficient, and natural SSSs: a blind person reading Braille (through haptic perception she acquires information normally obtained by vision) or echolocating using tongue clicks or cane tapping sounds. Along these lines, echolocation has recently been considered a natural SSS of the kind seeing-with-the-ears that humans are equipped with. The "device" which transforms sensory information is the central nervous system through implicit learning, i.e., learning that occurs in an unconscious fashion in persons which undergo a natural training due to particular working or daily-life conditions (as that of blindness imposes)[3,21].

RESEARCH ON HUMAN ECHOLOCATION

Echolocation, also called "obstacle sense" and "facial vision", refers to the ability that some blind persons possess to detect obstacles, judge relative distance, and avoid them. It has been object of speculation and scientific interest for a long time:

How do they manage to accomplish these "feats"? What is its sensorial basis? What sensory stimuli are the necessary and sufficient conditions? These were some of the main questions that were initially asked. The in-depth bibliographic study that we carried out has disclosed the scarcity and discontinuity of the scientific publications. Recently, there has been a renewed and growing interest around this complex phenomenon from different disciplinary fields. In what follows a historical synthesis of relevant research studies is presented.

Previous research

Diderot, in 1749, was the first in the scientific community to mention this special capacity of the blind person. He claimed that she judged object and person proximity by air pressure. Levy[23], a blind author of a classic book about blindness, explained the "feats" he attained in terms of the great sensitivity to perceive subtle cutaneous pressure stimuli on his face's skin. Dresslar[24] concluded that the sensory cues involved were the sound differences generated by the presence or absence of an obstacle. Heller (1904 cited in Hayes, 1935[25]) commenced scientific experimentation and concluded that the blind person could perceive obstacles placed up to 3m by audition, while for short distances (~0.80m) a tactile sensation could be useful. Lamarque[26] was the first to take interest in the physical changes produced in the stimulus when an object was placed at different distances. He verified that sound amplitude remained constant, although its envelope varied according to distance. Other researchers considered that a "sixth sense" or extra-sensorial powers, such as telesthesia or paroptic vision was involved[27]. Dolanski[28] carried out studies under controlled conditions and proposed that sound cues warned about the presence of the object and that the tactile sensation on the face was due to a kind of self-conservative response to collisions. Hayes[25] elaborated the first and only one state-of-the-art on echolocation available, until very recently[21,22,29].

The term echolocation was coined in the 40's to describe the ability of bats to navigate, feed and avoid obstacles using echoes; at this time the first formal relations between human and animal echolocation were also established. The Cornell group lead by Dallenbach, one of his collaborators being blind and a very skilled echolocator, elucidated important aspects of the phenomenon through a series of rigorous and ingenious experiments. The conclusions drawn were forceful: audition was the sensorial basis of echolocation and pitch changes were its necessary and sufficient condition[30]. During the next twenty years, researchers inquired about the discrimination strength of this ability and its underlying psychophysical mechanisms. It was possible to conclude that blind and blindfolded sighted subjects made precise judgments about distance, size, material, and shape of the objects. Also, that blind participants spontaneously use different echolocation signals according to specific demands: vocalizations and clicks to detect the presence/absence of an obstacle and sibilant sounds to perceive its shape[31,32,33,34]. It was argued that the superior performance observed in blind participants was due to the fact that they learn to process auditory information more efficiently on account of the intensive practice to which they are daily exposed[33].

Recent research

In the 80's, Schenkman[5] analysed the effect of several factors (sound sources, physical parameters of the object and tasks) on the performance of blind persons and explored the underlying psycho-acoustic mechanisms for echolocation. His main conclusions were: (a) to perceive objects using only the cane tapping sounds turned out to be a hard task; (b) self-made vocalizations and clicks were the most effective echolocation signals; (c) impulsive signals were more effective for object detection and localization, and continuous signals were better to discriminate its physical features; (d) an auditory analysis similar to the autocorrelation function could represent its underlying psychophysical mechanism. Ashmead et al.[35] carried out an important study in a real scenario to evaluate the ability to perceive obstacles by congenitally blind children from 4 to 12 years of age. They concluded that the children effectively used auditory information to solve the task and that this ability does not require previous viso-spatial experience or formal training.

In the 90's, Seki et al.[36] were the first to explicitly relate echolocation and the precedence effect. They evaluated the performance of blind and sighted subjects in a (passive) localization task under the precedence effect condition in the vertical plane, which simulates a particular echolocation situation. They reported that all subjects experienced fusion although the former were more resistant to it; also, they observed that performance accuracy decreases as the (reflected) sound source distance decreases. Stoffregen and Pittenger[17], in an innovative theoretical article within an ecological context, stated that echolocation is a closed loop behaviour. Stimulus energy of the self-generated sound (direct signal) propagates into the environment, is structured by it and then returns to the receptor (reflected signal). Relevant information is to be found in the relation between outgoing and returning patterns. They argued that certain physical variables and other higher order variables unknown in the literature underlie this ability. In other research, Ashmead et al.[37] compared the auditory-spatial ability of visually handicapped children with that of children and adults with normal vision through spatial hearing and motor tasks (walking without visual cues to the sound source). They observed that the performance of the first group was comparable or even better, some congenitally blind children showed exceptional performance, than that of the second and third groups. They concluded that auditory calibration does not depend on visual experience and that it is likely accomplished through repetitive exposure to sound variations generated by the perceiver's movements. More evidence was presented in a second article[38] related to the performance of visually handicapped children in active locomotion tasks. They elaborated an acoustic model to explain the physical basis of obstacle perception based not on self-produced sound reflections but rather on naturally produced variations in the proximity of a large object's sound field. They proposed the term "auditory space perception" as a more appropriate construct for echolocation.

In the 2000's, Kish and Bleier[39] held that echolocation is a natural animal and human ability to perceive the environment. They developed theoretical and methodological concepts setting a parallel between reflected sound and reflected light and presented a practical teacher's guide to teach echolocation to young blind persons. Additionally, Kish, as a double expert in the field of human echolocation (he is a highly skilled user and a specialist in Orientation and Mobility), has developed the first systematic and comprehensive program for advanced training in echolocation, the FlashSonar. The blind person, for instance, learns to generate and use five kinds of clicks with differential acoustic characteristics to be used for different echolocation requirements[40]. Rosenblum et al.[41] carried out one of the first experiments on echolocation from an ecological perspective. Based on evidence obtained from visual perception studies and previous research on human echolocation, they implemented an action-based protocol in order to determine whether active locomotion facilitates distance judgment tasks through echolocation by blindfolded sighted participants. Results showed that, for some distances, participants were somewhat more accurate with moving rather than stationary echolocation. Hughes[42] evaluated the potential utility of a sonar device to provide effective information about three-dimensional (3D) spatial layouts in four complementary experiments. The blindfolded sighted participants equipped with the sonar had to approach, explore, and finally categorize as "passable" or "unpassable" the openings between two aligned and non-aligned panels. The participants showed an immediate ability to use the sonar-generated echoic information although position and approaching angle affected their performance. The results highlighted the fundamental role played by exploratory movement in perceptual learning. The author also carried out spectrographic analyses to identify the potential acoustic information for decision about potential movements.

Recently, Schenkman et al.[43] studied the relative influence of pitch and intensity of reflected signals on echolocation ability. Stimuli consisted of white noise recorded with an artificial head in an ordinary room with and without the presence of a reflecting object placed at 1m, 2m and 3m, in which the two parameters of interest were digitally manipulated. The sighted participant had to determine which of two sounds was recorded in the presence of the reflecting object. A good performance was observed at a short distance (1m), at a long distance (3m) performance was near random level, and at the intermediate distance (2m), sounds with only pitch information gave a higher performance compared to sounds with only loudness information, for which the performance was close to random. Later, the authors[44] inquired about the influence of reverberation on the ability of sighted and blind persons to detect recorded sounds in the presence of reflecting objects. With a similar strategy, they made recordings of noise bursts of different durations in an ordinary room and an anechoic chamber, with the object placed at distances from 0.5m to 5m. In general, the blind participants performed better than the sighted ones; all participants correctly determined when the object was placed at a distance of up to 2m; detection increased with longer signal durations and performance was slightly better in the ordinary room than in the anechoic chamber.

Finally, in 2008 Rieser et al.[45] edited a valuable interdisciplinary book as a result of scientific collaboration between neuroscientists, cognitive and developmental psychologists, rehabilitation specialists and educators. It presents researches about how perception, action and knowledge couple together when vision is absent. It is noteworthy, for example, the reported evidence about recruitment of occipital cortex in congenitally blind persons performing non-visual tasks.

The Argentinean research approach

Our long-term research program also reflects a gradual movement from psycho-acoustics towards ecological and cognitive perspectives, which extended our scope of study to other phenomena of (audio) perception-action without visual cues. It is oriented by two main convictions: (1) learning unexploited but genuine abilities is the most promising direction to overcome serious independent mobility limitations imposed by blindness and assistive technology must be considered just to promote it; (2) embodied cognition theories and interdisciplinary approaches are a proper framework to study comprehensively these phenomena.

Our scientific trajectory can be divided into three periods: the first was focused on psycho-acoustic aspects involved in human echolocation; the second one inquired into cognitive contexts; the current period is firmly situated in embodied cognitive approaches.

First period (80' – 90')

A classical experiment of object detection (presence/absence), localization (position) and feature discrimination (shape, size and material) was run in an anechoic chamber. Six blind subjects with good independent mobility participated in this experience. The results agreed with those reported in previous experiments[5, 31, 32, 33, 34, 46], that is, it was easier to detect presence/absence of obstacles than to discriminate differences between them. Moreover, size discrimination was the easiest task and shape recognition the most difficult one. Two types of broadband signals were spontaneously generated by subjects: tongue/fingers clicks or hissing/clapping sounds. Erratic behaviour was not observed in the participants, on the contrary, they intentionally generated sounds, made head "scanning" movements, listened to subtle changes and replied as required by the instructions[47].

In another study, the peripheral and central auditory functioning, including brainstem evoked responses (BERA), of eight blind subjects who were skilled echolocators and eight sighted control subjects were evaluated. The echolocation paradigm consisted of trains of a single click, the standard stimulus, simulating the absence of an obstacle. The presence of an obstacle at short distance was simulated by trains of pairs of identical clicks (direct and reflected signals in an ideal echolocation situation) with two different delays (two distances) between the clicks of each pair. The results of the BERAs seemed to indicate that echolocation signals are processed more slowly than standard stimuli and at a lower level in the auditory pathway (possibly in the superior olivary complex of the pons). This result is in line with findings that indicate better non visual sensory processing by blind persons[48].

Besides, it was carried out two studies on facial vision phenomenon, that is, a particular subjective sensations that blind persons -also some sighted subjects that participated in the experiments- reported to feel in his face in the presence of an obstacle. Thirty sighted people with occluded vision and one blind person participated in the first study, while 20 sighted subjects with occluded vision participated in the second one. All sighted subjects obtained high hits rates with obstacles locate at short distance (up to 1m), which confirms that echolocation is a genuine human skill; the blind participant reached one of the best performances. They reported sensations feels like: a cobweb grazing the face; a soft breeze; a slight tingling in the face; a shadow in front. Some subjects also reported the "siren effect"[49], i.e., the pitch of the clicker that the subject hold in his chest continuing to rise as the obstacle drew nearer[50].

Several auditory tests were implemented to study the two auditory fusion phenomena that seem to be involved in echolocation: repetition pitch and the precedence effect. All tests were specially designed to simulate acoustic conditions in the short distance echolocation modality and were administered to blind and sighted participants. The main results taken together indicated that the subjects: (a) actually perceived repetition pitch when they were stimulated with echolocation signals[51]; (b) experimented the precedence effects percepts, fusion, localization dominance and lag-discrimination suppression[52] and (c) the blind skilled echolocator participant performed better than sighted ones, particularly in the third percepts, the most difficult experimental conditions which are closely related to echolocation[53].

Second period (up to 2007)

1) Echolocation and the precedence effect

Blind independent traveller and sighted participants resolved, without visual cues, three auditory tests under precedence conditions (lateralization, localization and fusion tests) specially designed to study the possible relation between this effect and echolocation. The main results taken together can summarized as follows: 1) it could be demonstrated the occurrence of the two first percepts of the precedent effect and the possibility to extract spatial information from the lag (third percept) even when it is a harder task than the second one. 2) Blind participants performed better than the sighted one, particularly in the most difficult condition (lag discrimination) which is related to echolocation. These results are consistent with the implicit learning hypothesis and agree with very recent studies that evaluated blinds people with advanced neuro-imaging techniques[54].

2) Developmental aspects

Three auditory tests were carried out in total darkness by blind and sighted infants (6 to 36 months old) in order to study repetition pitch and precedence effect phenomena. These tests were: a) localization of direct sound test through a reaching task in the dark, b) localization of reflected sound test through the estimation of the minimum audible angle (MAA) under precedence effect condition, and c) repetition pitch perception test using a head-turn conditioning technique.

The results obtained with sighted infants agreed with previous studies: an effect of age on performance was observed; already at 6 months of age, infants were able to determine whether a sounding object was at near (15 cm) or far (60 cm) distance only guided by auditory information and to discriminate trials with from trials without repetition pitch stimuli; all infants found it easier to localize direct sounds than reflected ones and


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the poorest performance was observed in the most difficult precedence effect task, i.e. to process spatial information about the lagging stimulus relative to the leading one (lag-discrimination suppression percept). The group of blind children performed similarly to the sighted one in the easier conditions, while their performance was superior in the hardest condition closely related to echolocation[55, 56].

3) Dynamical aspects of spatial audition

Head movements made by adults with and without sensory impairment (blindness or profound unilateral deafness) while performing hearing tasks were characterized through direct and reflected sound localization tests. The results showed good agreement with previous studies: a) the head turning task produced similar results to those obtained with classical sound localization tasks, thus the hypothesis of a tight auditory psychomotor coordination (ears-head) was supported[57]; b) it was easier to localize direct sounds than reflected ones and the hardest precedence effect condition was to process spatial information on the lag; c) blind participants performed better than the other two groups in the most difficult conditions (lateral regions and lag spatial discrimination) d) interesting qualitative differences were observed in the head movement patterns of participants with and without sensory impairment, pointing towards the hypothesis of implicit learning[58].

Third period (Contemporary)

Each project in the current research program is briefly described:

1) Object localization and recognition by blind and sighted participants equipped with SSS

In the context of the sensorimotor contingency approach[2] this project seeks to characterize the structuring processes of auditory space perception without visual cues in adults with and without visual impairment equipped with natural (via echolocation) and artificial (via vOICe) SSS or assisted with specific computer games. Preliminary results of different auditory tests are consistent with previous findings: it is possible to solve object localization and recognition tasks and to explore virtual scenarios only with auditory information; blind people have an enhanced auditory processing in the most difficult experimental conditions; this is probably an implicit learning effect. The use of SSS and virtual games without visual cues clearly evidences the structuring processes of perceptual space through sensorimotor contingency laws[59].

2) Embodied music: perception in blind and sighted musician and non musician participants

Based on very recent theoretical perspectives of embodied and musical cognition (enactive, experientialist, the theory of metaphor and new approaches of spatial music), this project studies embodied spatial music perception through analysing the perceptual-cognitive mechanisms involved. Participants have to listen to music pieces especially designed to analyse the “living space” experiences induced by its spatial qualities. Verbal and nonverbal responses (gestures and graphics) are analysed.

3) Sensorimotor knowledge without visual cues in dancers and non dancers

Dance, as echolocation, is a paradigmatic phenomenon in the context of embodied cognitive sciences, which has received little scientific treatment. It offers a valuable example of sensorimotor knowledge, that is, the practice and implicit understanding of the sensory effects of movement[60]. The objective of this project is to study how such knowledge emerges in a sensorimotor synchronization (feet) tapping task. Groups of dancers and non dancers are evaluated with different specialised rhythmic patterns.

4) Interactive audio-games for blind users

This project arises in the context of recent developments on Enactive Interfaces, an approach characterized by putting emphasis in the fundamental role of motor action for storing and acquiring knowledge, which represent a revolutionary concept of human-machine interactivity. The project aims to design and construct an integral game platform based on a surround sound system and adaptive interfaces. Different types of audio games will be created; all of them will seek to encourage users with and without visual impairment to develop and to train perception-action skills in an interactive entertaining environment. It aims to promote social inclusion of blind people.

5) Interdisciplinary dialogues in human echolocation research: embodied cognition and robotics

This project proposes to establish relations between our own Psychology of Perception research team and a Robotics laboratory with the purpose of making scientific contributions in two directions: 1) the inclusion of motion trackers and advanced processing techniques used in Robotics to optimise research tools to implement more dynamic and realistic tests; and 2) performance characterization of blind skilled echolocators can be used to bio-inspire auditorily guided robot motion.

CONCLUSIONS

Most of what is known about audition comes from studies concerned with peripheral processing and carried out under artificial conditions very different from real life. Additionally, an outstanding proportion of studies on auditory cognition are related to spoken language or music perception. There is practically no research on everyday auditory cognition processes on non-verbal sounds. Luckily, scientific breakthroughs in computational sciences, virtual environments, neurophysiology and neuro-imaging and the valuable contributions from ecological and cognitive psychology, are enabling us to link the existing psycho-acoustic knowledge with the growing experimental evidence that is currently being obtained from auditory cognition and perception-action coupling studies[61]. The recent embodied cognition approaches, based on evidence from daily performance and sensory substitution experiments, state that perception is not possible without action, and highlight the crucial role of sensorimotor knowledge, which is inseparable from exploratory activity, in the progressive structuring of the perceptual act.

Here, we have presented echolocation, a natural seeing-with-the-ears SSS, as a closed-loop perception-action behaviour, in which the subject modulates action (self-generated echolocation signals, exploratory head movements) to control perception (auditory Gestalts learned through implicit learning). The historical path of the study of this ability reflects the paradigmatic changes occurred in the cognitive and behavioural sciences: from being considered a paranormal phenomenon to being treated as a genuine and unexploited ability that can daily and unconsciously be used by persons with or without visual impairment[17]. In this way, echolocation earns prominence as an example of a phenomenon which requires an inescapable extended and unified approach over and above the traditionally fractured study of cognitive, perceptual, and behavioural abilities.

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Opinion: Insulate for Good Acoustics Too?

What responsibility should a publisher take for the technical content of an "advertising feature"?

Stuart Camp, 2012

Whilst this is a question that New Zealand Acoustics should always take seriously, my concerns are aimed more at local newspapers which aim to inform the public about important issues.

On 13th June 2012, the Christchurch Mail carried an article entitled "Insulate for good acoustics too" (opposite) I was intrigued by this, and hoped to see some useful advice for home owners wanting to address some of the common acoustic shortfalls in many modern houses.

The article appeared in a section titled "your PLACE", which is subtitled as an advertising feature. An inauspicious start. In addition, try as I might, I couldn't find anything showing who the article was advertising. Not only was there no indication of the authorship of the article, there were no advertisements on this or other pages of the section which bore any relationship to insulation or acoustics. Still, as long as the article was useful, it wouldn't be important to know who penned it.

So, on to the article...

The opening paragraph held promise: "We tend to think of insulation in a thermal sense but it also has an acoustic application—after all none of us like living in a house where sound passes easily from outside or between rooms". So far, so good. I for one don't like the idea of anything passing easily from outside or between rooms.

Paragraph 2 continued to hold my attention: "It may be a good idea to understand the nature of sound before undertaking building or renovations". Oh, so now we're in for "acoustics 101". This takes me back quite a few years to a small stuffy room with a certain Dr Dodd holding sway in front of a group of barely awake students.

Unfortunately, here's where things start to go awry. Paragraph 3 is unlikely to make it to said Dr Dodd's lecture notes: "Sound is a form of energy produced when things vibrate. This energy has to go somewhere, so it travels outwards from the source, making objects and the air vibrate in sympathy...". Suddenly sounds more like somebody has died, and there is a lot of sympathy for those left behind. But I digress, and it keeps getting better—or is that worse? "In short, sound starts at a source, travels through media, enters our ears and lights up our brains. If you want to stop it you need to interrupt it somewhere along this route." Sounds to me like the simplest place to stop it for this anonymous author would be between the ears and the brain. And is the term "media" simply another reference to the newspaper publishing this increasingly dubious diatribe?

Paragraph 4 explained a lot to me. I didn't know that "...sound waves will also quite cheerfully travel through solid objects and emerge, just as loud on the other side...". No wonder I've been having problems with some serious noise control problems—the sound is coming out the other side "just as loud"!

Now to see how we deal with this problem. The article offers some interesting advice.

"...The first step to reducing noise is to block off pathways—extra layers of glazing for a start...". Some semi-scientific information to get us started. I just hope that lay people don't read this as encouraging thermal double glazing–something which would make no difference at all to a typical house.

"...Absorbing helps—using rubbery materials that soak up sound energy...". My, oh my. Now I can see where I've been going wrong. I need more rubbery materials. Such a shame that many rubber based materials do nothing

CHRISTCHURCH MAIL, JUNE 13, 2012 25

your **PLACE** advertising feature

Insulate for good acoustics too

WE TEND to think of insulation in a thermal sense but it also has an acoustic application – after all none of us like living in a house where sound passes easily from outside or between rooms.

It may be a good idea to understand the nature of sound before undertaking building or renovations.

Sound is a form of energy produced when things vibrate. This energy has to go somewhere, so it travels outwards from the source, making objects and the air vibrate in sympathy, including the air inside our ears, banging on our eardrums, stimulating tiny hair cells deep in our heads and registering in our brains. In short, sound starts at a source, travels through media, enters our ears and lights up our brains. If you want to stop it you need to interrupt it somewhere along this route.

Unlike the shorter wavelengths of light, sound waves can bend (diffract) around corners and filter through cracks. Sound waves will also quite cheerfully travel through solid objects and emerge, just as loud on the other side. Sound travels through steel around 15 times faster than through air.

Well, we could turn off the source, move farther away, or wear ear muffs – but none of these are really viable under normal living conditions.

The first step to reducing noise is to block off pathways – extra layers of glazing for a start. Remember that if air can get in, so can sound. Sealing leaks and drafts in your home can help.

Absorbing helps – using rubbery materials that soak up sound energy. Dampening means using solid, acoustically 'dead' walls that do not readily vibrate. Fitting solid doors rather than hollow ones can help. You might have to think of walls made of dense materials, filled with materials that soak up vibrations – such as fibreglass, neoprene rubber or viscoelastic foam.

Decoupling involves creating a room within a room; each with heavy solid materials, but not touching each other directly. The inner room is supported by small clips and the walls lined with sound-absorbing material.

You probably won't want to go to extreme lengths though.

Making a room quieter involves a two-pronged attack: noise reduction and noise absorption.

The first step is to identify every possible access point where sound can get in and block that path if you can.

Try altering the interior of your room so that sound is absorbed rather than reflected. Carpets work better than bare wooden floors, and rugs can help too. Soft furnishings such as wall hangings, sofas and cushions soak up sound well. Curtains absorb sounds from inside or outside, as long as they are dense, and reach the floor.

Talk to your architect and your builder so that they are aware of your needs. You want that teenager of yours to be out of sight and out of earshot when that sound system is cranked up!

ACOUSTICS AND INSULATION: Sound-proof your home and remember that if air can get in, so can sound.

acoustically, and even if they did, this recommendation would be a complete waste of a homeowner's money.

"...Dampening means using solid, acoustically 'dead' walls that do not readily vibrate... you might have to think of walls made of dense materials, filled with materials that soak up vibrations—such as fibreglass, neoprene rubber or visco-elastic foam...". There are so many ways this is technically wrong, I won't even try to explain. However, it would be simple to read this sentence as meaning that as long as I use a dense gypsum board and put some batts in the cavity, everything will be alright. Complete nonsense.

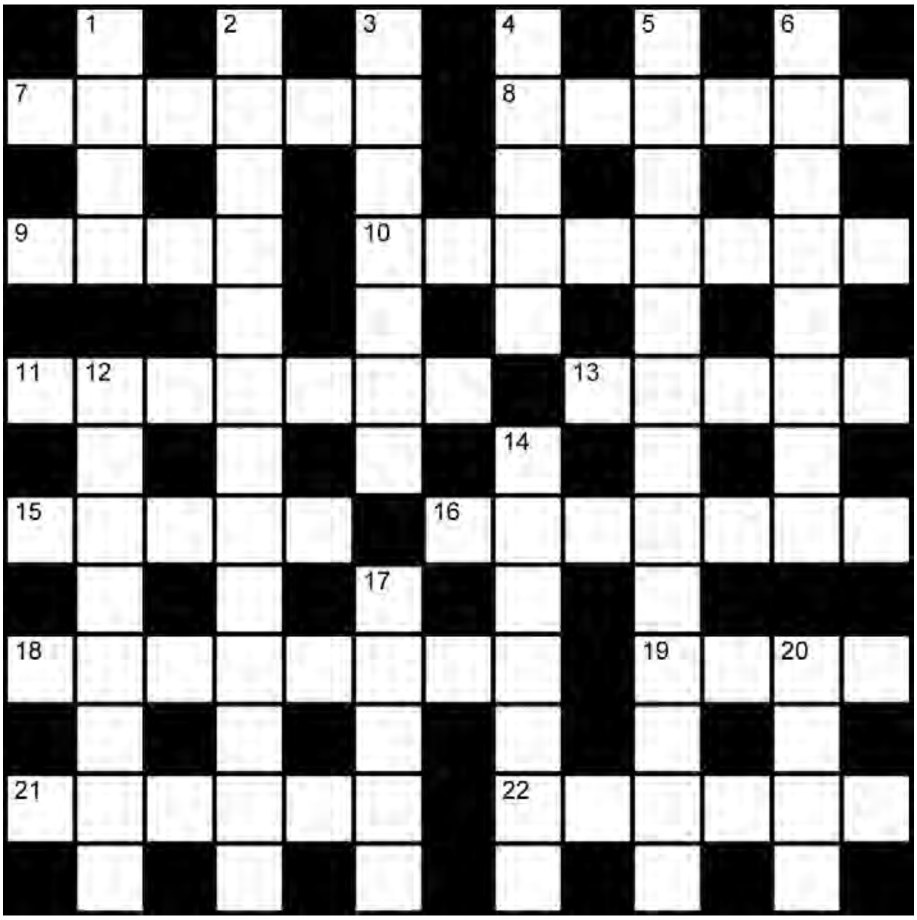
"...Decoupling involves creating a room within a room...". Correct, but I have undertaken the acoustical design of a large number of houses over the past 30 years, including some with home studios and similar critical rooms, and I don't think I have ever needed to create a room-within-a-room to achieve the required result.

I could go on, but I suspect you already get the idea. The final sentence of the article is the nail in the coffin for me. "You want that teenager of yours to be out of sight and out of earshot when that sound system is cranked up.". This suggests that the aim of the article is to allow families to ensure that they don't hear their noisy teenagers. This is certainly possible, but none of the vague, inaccurate advice in the article will ever give anybody a sense of what might be required to achieve that.

Is it time publications took responsibility for what they publish? Is a simple peer review by somebody in the business too much to ask for? And, at the very least, own up to writing the article, and be prepared for critique.

This article is an op-ed that does not reflect the views of the Acoustical Society of New Zealand nor the Editors of New Zealand Acoustics.

Acoustic Crossword #6



CLUES ACROSS

7. They say it deteriorated for a long time. (6)
8. Love assessed as one spoke. (6)
9. A ring arranged in the Spanish sun will be alone. (4)
10. In a lacy tin lies the exact solution. (8)
11. Dream-space? (7)
13. It is in the pot for measuring pressure. (5)
15. He worries about divisions. (5)
16. Change log to be an illegal recording. (7)
18. A handicraft over tea makes for a short note. (8)
19. Not applicable with South African agency. (4)
21. A key for a child perhaps. (1,5)
22. Nil returns with a head of corn are proportional. (6).

CLUES DOWN

1. The next in line, we hear has nothing to do with flying. (4)
2. A venue, if tutor composes a popular melody. (9,4)
3. Some are chosen at origin to be a leader. (7)
4. The most common type of harmony. (5)
5. Eavesdropping isn't difficult. (4,9)
6. Half a step emits one abstract. (8)
12. Aural-instruments? (8)
14. Left some also for the tunnels. (7)
17. A group of notes in some march-order. (5)
20. Look around for recycled tins. (4)

Crossword submitted by:

Oyster

Solutions to Crossword #5

Across:

7. Sound, 8. Earlobe, 9. Electro, 10. Doors, 12. Prediction 15. Excite ears, 18. Tonal 19. Pullout, 21. A tenner, 22. Tap on

Down:

1. Assessment, 2. Quiet, 3. Edit, 4. Record, 5. Producer, 6. Monotic, 11. Sing in tune, 13. Rattling, 14. Scanner 16. Expert, 17. Loops, 20. Lute ¶

Acoustical Dispersant For Subsea Oil Spills

Two years ago oil began streaming from the seafloor into the Gulf of Mexico following the explosion of the Deepwater Horizon platform. The disaster cost 11 lives, released 4.9 million barrels of crude oil, and caused an unspecified amount of damange on the marine life and Gulf economy.

A pair of researchers at the Virginia Institute of Marine Science is using a $350,000 contract from the U.S. Department of the Interior to test whether sound waves can be used to determine the size of oil droplets in the subsea—knowledge that could help guide the use of chemical dispersants during the cleanup of future spills.

The effectiveness and safety of deep-sea dispersant application remains unknown, at least in part because of the difficulty of monitoring the size of the oil droplets within the subsea plume.

Tools do exist to measure droplet size within dispersed oil slicks at and just below the sea surface—including ultraviolet fluorometers and LISSTs (for Laser In-Situ Scattering and Transmissometers). But these optical devices are poorly suited for use within highly opaque plumes of oil. Acoustic instruments and techniques offer a promising alternative.

"There's a reason that many marine mammals use sound rather than sight for long-distance communications," says team member Carl Friedrichs, Chair of Physcial Sciences and head of the Coastal Hydrodynamics and Sediment Dynamics lab at VIMS. "Light can't go nearly as far in water—let alone turbid water—as compared to sound waves." Friedrichs notes that acoustic instruments also tend to be less delicate than their optical counterparts, and are better able to withstand "biofouling" and the high pressures of the deep sea.

During their Ohmsett tests, the scientists compared the performance of optical and acoustic instruments borrowed from their labs, transmitting, receiving, and interpreting sound waves and light as they reflected against an aqueous slurry of 20 parts of oil to 1 part dispersant.

A second experiment was on a much smaller—and simpler—scale. This time they compared the performance of their optical and acoustical instruments in a small bucket, adding dispersants to the same crude oil used at Ohmsett and creating turbulence with a drill-powered paint mixer.

The team's preliminary results qualitatively confirm the potential superiority of an acoustic approach to monitoring oil dispersion. Initial measurements indicate that the acoustic measurements can track the droplet size for a subsurface release of oil.

This information would be valuable to the people spraying the dispersants, and valuable to the people modekling the fate of the oil, because during the cleanup of an oil spill, the size of the oil droplets affects everything.

© Adapted from the Virginia Institute of Marine Science

Whales Can Adjust Their Hearing

For many whales and dolphins, the world is shaped by sound; they hunt and navigate by listening for echoes. Navigating in this way requires sensitive hearing. And recent results indicate that, for some whales, this sense is adjustable. The researchers presented their findings at the Acoustics 2012 meeting in Hong Kong.

The scientists were monitoring the hearing of a false killer whale called Kina as she hunted. False killer whales belong to a group of species known as toothed whales, which includes dolphins, sperm whales and killer whales. These mammals hunt using echolocation - producing high-frequency buzzing or clicking sounds and decoding the echoes they produce to locate prey.

To study Kina's hearing, the researchers needed an insight into what was happening inside her head as essentially the whole head transmits vibrations. The researchers placed sensors contained within soft latex suction cups on Kina's body to measure the electrical activity in Kina's brain as it responded to sound.

The researchers played Kina a "neutral tone" - an innocuous bleep - then followed that with a five-second pulse of 170dB. Over time, Kina learned that this neutral tone was a warning signal and turned down her hearing sensitivity when she heard it, so in subsequent experiments, the sensors recorded a smaller signal from a noise of the same loudness.

Echolocating marine mammals may have evolved this rapidly adjustable hearing to protect themselves from their own clicks and buzzes.

The team hopes that their findings will eventually be applied to the protection of wild marine mammals. There is evidence that whales and dolphins are disturbed or damaged by man-made undersea noise, such as naval sonar and the loud seismic airguns used in oil and gas exploration.

© Adapted from an article by Victoria Gill, Science reporter, BBC Nature 2012

Dolphin Speaker

To gain new insights into how dolphins communicate, researchers in Japan created a prototype of an extremely broadband "dolphin speaker" capable of projecting dolphins' communication sounds, whistles, burst-pulse sounds, as well as detection sounds such as echolocation clicks.

Yuka Mishima, a student at the Tokyo University of Marine Science and Technology, along with collaborators at Fusion Inc., presented their research at the Acoustics 2012 meeting in Hong Kong.

Dolphins can hear and produce high-frequency sounds of up to 150 kHz, which are too high for humans to hear. Not only can dolphins produce tonal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sound like humans, they're capable of vocalizing at a variety of frequencies simultaneously.

"Acoustic studies of dolphins that have been done so far focus mainly on recordings of vocalizations and hearing abilities, but relatively few playback experiments have been conducted," explains Mishima.

Since playback experiments are a very important part of gaining a better understanding of dolphins' communication and detection abilities, the researchers decided to create their own "dolphin speaker."

Mishima says. "We succeeded in developing a prototype broadband transducer for an echosounder by using new types of piezoelectric elements that had never been used for underwater acoustic transducers". They applied this technique to their dolphin speaker prototype, and it can now project sounds in the 7 to 170 kHz range.

© *Adapted from ScienceDaily (May 8, 2012)* ¶

Did I Say That?

A few blunders in acoustic reports. These are quotes taken directly from published documents within the acoustic fraternity. Contributions to this page, and comments, are encouraged.

From a website tracksandtires.com comes a lovely statement about how effective it is to use rubber tracks on your excavator:

"...Our OEM quality rubber tracks use the most advanced metal assemblies available in the design of our excavator tracks. Depending on your machine, our tracks can reduce vibration and noise levels up to 100%..."

That's some noise control programme!

From a consultant report:

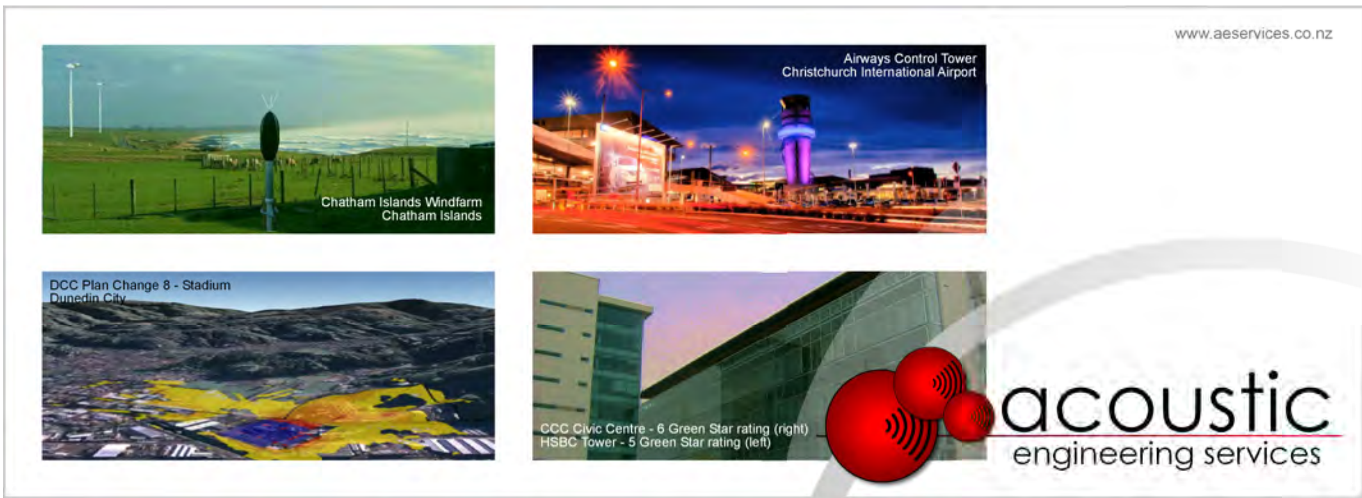
"...Any external noise sources... must be located inside the building..."

Well, that will be interesting - external noise sources inside?

From another report:

"...Sound is amplified coming off of ridgelines into valleys. This is because the background noise in rural valleys is low to begin with..."

So, a quiet environment somehow causes amplification that a noisy one doesn't?



2012

19 - 22 August, New York, N.Y., USA. Internoise 2012

We hope you will join us at Internoise 2012 at the Marriott Marquis Hotel in New York City, USA, 19-22 August 2012. We are planning a large congress of over 1000 delegates, including:

- Three days of technical papers spanning many areas of noise and vibration, including our congress theme “Quieting the World’s Cities™”
- A large vendor exposition (60+) of noise and vibration control materials, analysis software, and measurement systems and instrumentation
- Three plenary sessions on City Noise Codes, the Effects of Noise on Children, and Airport Noise
- A series of short courses on noise and vibration control

We will be issuing our call for abstracts (due 15 February 2012) shortly. In the meantime, please visit our website: www.internoise2012.com to learn more about what promises to be the premier vibration and acoustics conference of 2012.

Dr. Stephen A. Hambric

www.internoise2012.com

9 - 13 September. Portland, Or. USA. Interspeech 2012.

http://interspeech2012.org

12 -15 September, Granada, Spain. 30th European Conference on Acoustic Emission Testing (EWGAE) and 7th International Conference on Acoustic Emission (ICAE)

http://2012.ewgae.eu/

21-23 November 2012 AAS2012: Acoustics 2012: Acoustics, Development and the Environment.

I would like to advise that the 2012 Australian Acoustical Society annual conference will be held in Fremantle, Western Australia. We have received a record 154 abstracts to date on a wide range of relevant topics regarding the environment, infrastructure and specialist fields, and will also be running several workshops prior to the event. ASNZ members will be entitled to discounted member rates, and can find out more at the conference web page.

Luke Zoontjens, AAS WA Division Chair

http://www.acoustics.asn.au/joomla/acoustics-2012.html

2013

26 - 31 March, Vancouver, Canada. 2013 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)

http://www.icassp2013.com

1 - 4 May, Singapore 3rd International Congress on Ultrasonics (ICU 2013) concurrently organized with the 32nd International Symposium on Acoustical Imaging (AI 2013)

http://www.epc.com.sg/PDF%20Folder/ICU%202010%20Phamplet%20v1%20(12%20Jul%202010).pdf

02 - 07 June, Montreal, Canada 21st International Congress on Acoustics(ICA 2013)

http://www.ica2013montreal.org

1-3 July 2013, RASD 2013, International Conference on Recent Advances in Structural Dynamics

Colleagues,
RASD will be held at the University of Pisa, Pisa, Italy, 1-3 July 2013. The eleventh in the RASD series, the conference will bring together researchers working in all areas of structural dynamics. The ten previous conferences have been held every three years or so since 1980. As on prevision occasions, this conference is devoted to theoretical, numerical and experimental developments in structural dynamics and their application to all types of structures and dynamical systems. It will be an opportunity to exchange scientific, technical and experimental ideas.

The Call for Papers will be made in June 2012 with the deadline for the submission of abstracts being 28th September 2012. Submission and Registration to the conference will be done through the University of Southampton Open Conference System (www.ocs.soton.ac.uk/index.php/rasdconference/RASD2013).

Dr Emiliano Rustighi (on behalf of the RASD2013 Organising Committee)

Further information is available at https://www.soton.ac.uk/rasd2013

7-11 July 2013, 20th International Congress on Sound and Vibration (ICSV20), Bangkok, Thailand

The 20th International Congress on Sound and Vibration (ICSV20) will be held 7-11 July 2013 in Bangkok, Thailand. The ICSV20 is sponsored by the International Institute of Acoustics and Vibration (IIAV) and the Faculty of Science; Chulalongkorn University, the Acoustical Society of Thailand and the Science Society of Thailand; the ICSV20 is organized in cooperation with: the International Union of Theoretical and Applied Mechanics; the American Society of Mechanical Engineers International and the Institution of Mechanical Engineers. The ICSV20 Congress will be held at Imperial Queens Park Hotel, Bangkok, Thailand.

Theoretical and experimental papers in the fields of acoustics, noise, and vibration are invited for presentation. Participants are welcome to submit abstracts to www.icsv20.org and companies are invited to take part in the ICSV20 exhibition and sponsorship. For more information, please visit:

http://www.icsv20.org

CRAI Ratings

Auckland

215, Dominion Rd	(1)	★★★★½
Andrea (form. Positano), Mission Bay	(1)	★★★
Aubergine's, Albany	(1)	★★★★½
Backyard, Northcote	(1)	★★
Bask, Browns Bay	(1)	★★★
Bay (The), Waiake, North Shore	(1)	★★★★★
Bolero, Albany	(1)	★★★★
Bosco Verde, Epsom	(1)	★★★★½
Bouchon, Kingsland	(1)	★★
Bowman, Mt Eden	(1)	★★★★½
Bracs, Albany	(1)	★★★★
Brazil, Karangahape Rd	(1)	★★★
Buoy, Mission Bay	(2)	★★★★½
Byzantium, Ponsonby	(1)	★★★
Café Jazz, Remuera	(1)	★★★★½
Carriages Café, Kumeu	(1)	★★★★
Charlees, Howick	(1)	★★★★★
Cibo	(1)	★★★★★
Circus Circus, Mt Eden	(2)	★★
Cube, Devenport	(1)	★★
Del Fontaine, Mission Bay	(1)	★★★★★
Deli (The), Remuera	(1)	★★★★
Delicious, Grey Lynn	(1)	★★★★★
De Post, Mt Eden	(1)	★★
Dizengoff, Ponsonby Rd	(1)	★★
Drake, Freemans Bay (Function Room)	(1)	★★
Eiffel on Eden, Mt Eden	(1)	★★
Eve's Cafe, Westfield Albany	(1)	★★★½
Formosa Country Club Restaurant	(1)	★★★★★
Garrison Public House, Sylvia Park	(1)	★★★★½
Gee Gee's	(1)	★★★
Gero's, Mt Eden	(9)	★★★
Gina's Pizza & Pasta Bar	(1)	★★★½
Gouemon, Half Moon Bay	(1)	★★
Hardware Café, Titirangi	(1)	★★★★★
Hollywood Café, Westfield St Lukes	(1)	★★½
IL Piccolo	(1)	★★★★
Ima, Fort Street	(1)	★★★★
Jervois Steak House	(1)	★★★
Kashmir	(1)	★★★★
Katsura	(1)	★★★½
Khun Pun, Albany	(2)	★★★★★
Kings Garden Ctre Café, Western Springs	(1)	★★
La Tropezienne, Browns Bay	(1)	★★
Malaysia Satay Restaurant, Nth Shore	(1)	★★★★★
Mecca, Newmarket	(1)	★★★★★
Mexicali Fresh, Quay St	(1)	★★
Mezze Bar, Little High Street	(16)	★★★★
Monsoon Poon	(1)	★★★★★
Mozaike Café, Albany	(1)	★★
Narrow Table (The), Mairangi Bay	(1)	★★★★½
One Red Dog, Ponsonby	(1)	★★★
One Tree Grill	(1)	★★★
Orbit, Skytower	(2)	★★★★
Patriot, Devonport	(1)	★★★½
Pavia, Pakuranga	(1)	★★★★★
Prego, Ponsonby Rd	(2)	★★
Remuera Rm, Ellerslie Racecourse	(1)	★★★★★
Rhythm, Mairangi Bay	(1)	★★
Rice Queen, Newmarket	(12)	★★★★
Sails, Westhaven Marina	(2)	★★★★★
Scirocco, Browns Bay	(1)	★★★
Seagers, Oxford	(1)	★★★★
Shahi, Remuera	(1)	★★★½
Shamrock Cottage, Howick	(1)	★★
Sidart, Ponsonby	(1)	★★★★½
Sitting Duck, Westhaven	(1)	★★★½
Sorrento	(1)	★★½
Stephan's, Manukau	(1)	★★★★★
Tempters Café, Papakura	(1)	★★★★★
Thai Chef, Albany	(1)	★★★★★
Thai Chilli	(1)	★★★★★
Thai Corner, Rothesay Bay	(1)	★★★★★
Tony's, High St	(1)	★★★
Traffic Bar & Kitchen	(1)	★★
Umbria Café, Newmarket	(1)	★★★★½
Valentines, Wairau Rd	(1)	★★★★★
Vivace, High Street	(2)	★★½
Wagamama, Newmarket	(1)	★★★★½
Watermark, Devonport	(1)	★★
Woolshed, Clevedon	(1)	★★½
Zarbos, Newmarket	(1)	★★
Zavito, Mairangi Bay	(1)	★★ ★

Arthur's Pass

Arthur's Pass Cafe & Store	(1)	★★★½
Ned's Cafe, Springfield	(1)	★★★★

Ashburton

Ashburton Club & MSA	(1)	★★★★½
Robbies	(1)	★★★
RSA	(1)	★★★★
Tuscany Café & Bar	(1)	★★★

Readers are encouraged to rate eating establishments which they visit by completing a simple form available on-line from www.acoustics.ac.nz, or contact the Editor.
Repeat ratings on listed venues are encouraged.

★ Lip-reading would be an advantage. ★★ Take earplugs at the very least. ★★★ Not too bad, particularly mid-week. ★★★★A nice quiet evening. ★★★★★The place to be and be heard. (n) indicates the number of ratings.

CRAI Ratings (cont.)

Bay of Plenty

Alimento, Tauranga	(1)	★½
Imbibe, Mt Maunganui	(1)	★½
Versailles Café, Tauranga	(2)	★★

Blenheim

Raupo Cafe	(1)	★★

Bulls

Mothered Goose Cafe, Deli, Vino	(1)	★★

Cambridge

GPO	(1)	★★★★★

Christchurch

@Tonys, Ferrymead	(6)	★★½
3 Cows, Kaiapoi	(1)	★★★★
Abes Bagel Shop, Mandeville St	(1)	★★★★
Addington Coffee Co-op	(4)	★★★★
Alchemy Café, Art Gallery	(1)	★★★★★
Anna's Café, Tower Junction	(1)	★★★★
Arashi	(1)	★★
Azure	(2)	★★★
Bamboozle, Sumner	(5)	★★½
Becks Southern Ale House	(11)	★★★★½
Buddha Stix, Riccarton	(1)	★★★★
Bully Haye's, Akaroa	(1)	★★
Cashmere Club	(1)	★★★★★
Cassels & Sons, The Brewery	(5)	★★★★
Christchurch Casino	(1)	★★
Christchurch Museum Café	(1)	★★★★
Cobb & Co, Bush Inn	(1)	★★★

Coffee House, Montreal Street	(1)	★★
Cookai	(3)	★★½
Corianders, Edgeware Road	(11)	★★★
Costas Taverna, Victoria Street	(1)	★½
Decadence Café, Victoria St	(1)	★★★★★
Drexels Breakfast Restaurant, Riccarton	(1)	★★★★
Edisia, Addington	(1)	★★★
Elevate, Cashmere	(1)	★★★
Fava, St Martins	(1)	★★
Flying Burrito Brothers, Northlands	(12)	★★½
Foo San, Upper Riccarton	(1)	★★★½
Fox & Ferrett, Riccarton	(1)	★★★★★
Gloria Jean's, Rotheram St	(1)	★★★★
Golden Chimes	(1)	★★★★★
Governors Bay Hotel	(1)	★★★★
Green Turtle	(1)	★★★★
Harpers Café, Bealey Ave	(1)	★★★★★
Holy Smoke, Ferry Rd	(1)	★★
Indian Fendalton	(2)	★★
Kanniga's Thai	(1)	★★★
La Porchetta, Riccarton	(4)	★★½
Little India	(2)	★★★★★
Lone Star, Riccarton Road	(6)	★★★
Lyttleton Coffee Co, Lyttleton	(1)	★★★★
Manee Thai	(6)	★★½
Mexican Café	(6)	★★★
Myhanh, Church Corner	(4)	★★★½
Number 4, Merivale	(2)	★★★★
Oasis	(1)	★★★★½
Old Vicarage	(2)	★★★½
Phu Thai, Manchester Street	(1)	★★★
Pukeko Junction, Leithfield	(1)	★★★★
Red, Beckenham Service Centre	(1)	★★★★
Red Elephant	(1)	★★★★
Retour	(1)	★★★
Riccarton Buffet	(2)	★★★★½
Robbies, Church Corner	(2)	★★★★½
Route 32, Cust	(1)	★★★★
Salt on the Pier, New Brighton	(6)	★★★½
Speights Ale House, Tower Junction	(1)	★★★★
Spice 'n' Life, Church Corner	(4)	★★★★½
The Bridge, Prebbleton	(1)	★★★★★
The Bicycle Thief	(1)	★★★★½
The Sand Bar, Ferrymead	(2)	★★★½
Tokyo Samurai	(1)	★★★★★
Tutto Bene, Merivale	(2)	★★
Untouched World Cafe	(1)	★★★★★
Wagamama, Oxford Terrace	(6)	★★★
Waitikiri Golf Club	(1)	★★
Waratah Café, Tai Tapu	(1)	★★★

Clyde

Old Post Office Cafe	(1)	★★★★★

Dunedin

A Cow Called Berta	(1)	★★★½
Albatross Centre Cafe	(1)	★★★★★
Bennu	(1)	★★★★
Bx Bistro	(1)	★★★★
Chrome	(1)	★★★★½
Conservatory, Corstophine House	(1)	★★★★★

Fitzroy Pub on the Park	(1)	★★★★★
High Tide	(2)	★★
Nova	(1)	★★★★★
St Clair Saltwater Pool Cafe	(1)	★★★★½
Swell	(1)	★★
University of Otago Staff Club	(1)	★★

Feilding

Essence Cafe & Bar0	(1)	★★★★

Gore

Old Post	(1)	★★★
The Moth, Mandeville	(1)	★★★★★

Greymouth

Cafe 124	(1)	★★★

Hamilton

Embargo	(1)	★★★★★
Gengys	(1)	★★
Victoria Chinese Restaurant	(1)	★★★★★

Hanmer Springs

Laurels (The)	(2)	★★★★★
Saints	(1)	★★★★½

Hastings

Café Zigliotto	(1)	★★★

Havelock North

Rose & Shamrock	(1)	★★★½

Levin

Traffic Bar & Bistro	(1)	★★

Masterton

Java	(1)	★★

Matamata

Horse & Jockey	(1)	★★★★★

Methven

Ski Time	(2)	★★★

Napier

Boardwalk Beach Bar	(2)	★★★★★
Brecker's	(1)	★★★★★
Café Affair	(1)	★★
Cobb & Co	(1)	★½
Duke of Gloucester	(1)	★★★★½
East Pier	(1)	★★
Estuary Restaurant	(1)	★★★★★
Founder's Cafe	(1)	★★★★★
Napier RSA	(1)	★★★★★
Sappho & Heath	(1)	★★

Nelson/Marlborough

Allan Scott Winery	(1)	★★★★★
Amansi @ Le Brun	(1)	★★★★★
Baby G's, Nelson	(1)	★★★★★
Boutereys, Richmond	(1)	★★★★
Café Affair, Nelson	(1)	★★
Café on Oxford, Richmond	(1)	★★★
Café Le Cup, Blenheim	(1)	★★★
Crusoe's, Stoke	(1)	★★★
Cruizies, Blenheim	(2)	★★★★½
Grape Escape, Richmond	(1)	★★★★★
Jester House, Tasman	(1)	★★★★★
L'Affaire Cafe, Nelson	(1)	★★
Liquid NZ, Nelson	(1)	★½
Lonestar, Nelson	(1)	★★★★
Marlborough Club, Blenheim	(1)	★★
Morrison St Café, Nelson	(1)	★★½
Oasis, Nelson	(1)	★★★★★
Rutherford Café & Bar, Nelson	(1)	★★★★★
Suter Cafe, Nelson	(1)	★★
Verdict, Nelson	(1)	★★
Waterfront Cafe & Bar, Nelson	(1)	★★★
Wholemeal Trading Co, Takaka	(1)	★★★★★

New Plymouth

Breakers Café & Bar	(1)	★★★
Centre City Food Court	(1)	★★★★
Elixer	(1)	★★★★
Empire Tea Rooms	(1)	★★★★½
Govett Brewster Cafe	(1)	★★
Marbles, Devon Hotel	(1)	★★★
Pankawalla	(1)	★★★★★
Simplicity	(1)	★★★
Stumble Inn, Merrilands	(1)	★★★
Yellow Café, Centre City	(1)	★★★
Zanziba Café & Bar	(1)	★★★

Oamaru

Riverstone Kitchen	(1)	★★★★★
Star & Garter	(1)	★★★
Woolstore Café	(1)	★★★★

Palmerston North

Café Brie	(1)	★★★
Café Esplanade	(2)	★★★★
Chinatown	(1)	★★★★
Coffee on the Terrace	(2)	★★★
Elm	(1)	★★★★½
Fishermans Table	(1)	★★★★★

Gallery	(3)	★★★★
Rendezvous	(1)	★★½
Roma Italian Restaurant	(1)	★★★
Rose & Crown	(1)	★★
Tastee	(1)	★★★
Thai House Express	(1)	★★★★★
Victoria Café	(1)	★★★★

Queenstown

Bunker	(1)	★★★★
The Cow	(1)	★★★
Sombreros	(1)	★
Tatler	(1)	★★★★
Winnies	(1)	★★★★★

Rotorua

Cableway Rest. at Skyline Skyrides	(1)	★★★★★
Lewishams	(1)	★★★
Woolly Bugger, Ngongotaha	(1)	★★★
Valentines	(1)	★★★★★
You and Me	(1)	★★★★★
Zanelli's	(1)	★★

Southland

Lumberjack Café, Owaka	(1)	★★★★★
Pavilion, Colac Bay	(1)	★★
Village Green, Invercargill	(1)	★★★★★

Taihape

Brown Sugar Café	(1)	★★★★½

Taupo

Burbury's Café	(1)	★★★
Thames		
Thames Bakery	(1)	★★★
Waiheke Island		
Cortado Espresso Bar	(1)	★★★★
Cats Tango, Onetangi Beach	(1)	★★★★

Timaru

Fusion	(1)	★★★★★

Wanganui

3 Amigos	(1)	★★★½
Bollywood Star	(1)	★★★½
Cosmopolitan Club	(1)	★★★★
Liffiton Castle	(1)	★★½
RSA	(1)	★★★½
Stellar	(1)	★★★★½
Wanganui East Club	(1)	★★★★

Wellington

162 Café, Karori	(1)	★★★★★
180°, Paraparaumu Beach	(1)	★★
88, Tory Street	(35)	★★
Anise, Cuba Street	(1)	★★
Aranya's House	(1)	★★★★★
Arbitrageur	(2)	★★★
Arizona	(1)	★★
Astoria	(2)	★★★
Backbencher, Molesworth Street	(1)	★★★
Bordeaux Bakery, Thorndon Quay	(1)	★★
Brown Sugar, Otaki Railway Station	(1)	★★★
Buzz, Lower Hutt	(1)	★★½
Brewery Bar & Restaurant	(5)	★★★★
Carvery, Upper Hutt	(1)	★★★★★
Chow	(1)	★½
Cookies, Paraparumu Beach	(1)	★★★½
Cosa Nostra Italian Trattoria, Thorndon	(1)	★★★★
Gotham	(6)	★★★½
Great India, Manners Street	(2)	★★★★★
Habebie	(1)	★★
Harrisons Garden Centre, Peka Peka	(1)	★★★★
Hazel	(1)	★★
Katipo	(1)	★★★★★
Kilim, Petone	(4)	★★★★½
Kiss & Bake Up, Waikanae	(1)	★★★
La Casa Pasta	(1)	★★★★½
Lattitude 41	(3)	★★★★
Legato	(1)	★★
Le Metropolitain	(1)	★★★★★
Loaded Hog	(5)	★★★★½
Manhatten, Oriental Bay	(1)	★★★★
Maria Pia's	(1)	★★★
Matterhorn	(1)	★★★
Meow Café	(1)	★★
Mungavin Blues, Porirua	(1)	★★★★★
Olive Café	(1)	★★★★★
Olive Grove, Waikanae	(1)	★★★½
Original Thai, Island Bay	(1)	★★★★
Palace Café, Petone	(1)	★★½
Parade Café	(1)	★★
Pasha Café	(1)	★★★★
Penthouse Cinema Café	(2)	★★★½
Pod	(1)	★★½
Rose & Crown	(1)	★★★★★
Shed 5	(1)	★★
Siem Reap	(1)	★★
Speak Easy, Petone	(1)	★★
Speights Ale House	(1)	★★
Sports Bar Café	(1)	★★★★
Stanley Road	(1)	★★★
Stephan's Country Rest., Te Horo	(1)	★★★★★
Wakefields (West Plaza Hotel)	(1)	★★★
Windmill Café & Bar, Brooklyn	(1)	★★
Yangtze Chinese	(1)	★★★★½
Zealandia Café, Karori Sanctuary	(1)	★★★½

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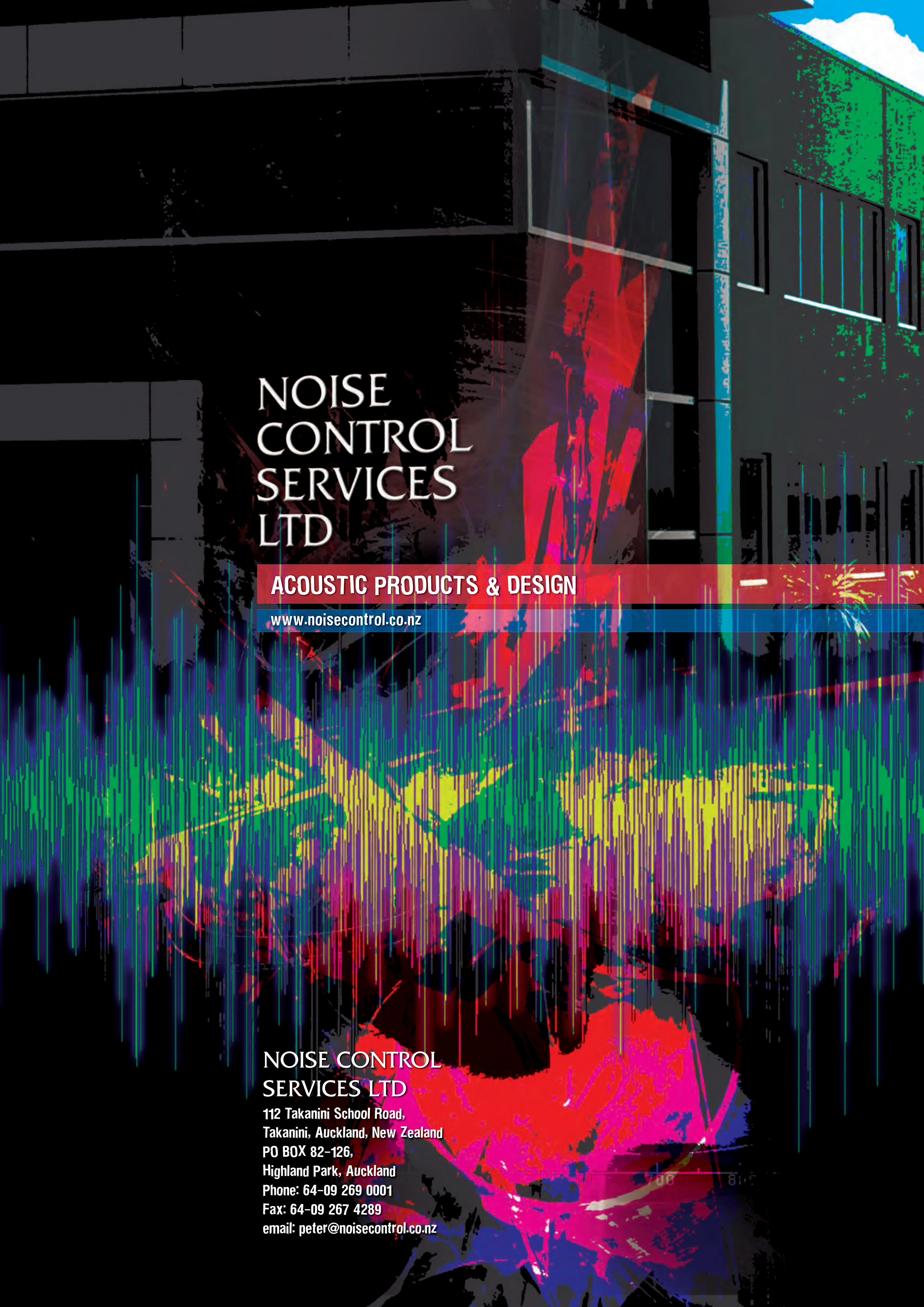

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