# NOISE/NEWS INTERNATIONAL

Volume 28, Number 2
2020 June

*A quarterly news magazine and online digital blog published by I-INCE and INCE-USA*

- Updates on INTER-NOISE 2020 and NOISE-CON 2020
- Calls for papers and reviewers from *NCEJ*
- A novel acoustic camera from Seven Bel
- A workshop on transportation noise

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A quarterly news magazine in PDF format with an Internet supplement published by I-INCE and INCE-USA

**Volume 28, Number 2** **2020 June**

## Features



## Departments





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Business Office
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**ADVERTISING:** For information about advertising, contact John Lessard, INCE Business Office +1.703.234.4147; email: jlessard@virtualinc.com

# NOISE/NEWS INTERNATIONAL

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## I-INCE

The International Institute of Noise Control Engineering (I-INCE) is a worldwide consortium of societies concerned with noise control and acoustics. I-INCE, chartered in Zürich, Switzerland, is the sponsor of the INTER-NOISE Series of International Congresses on Noise Control Engineering, and, with the Institute of Noise Control Engineering of the USA, publishes this quarterly magazine and its blog. I-INCE has an active program of technical initiatives. It currently has fifty-one member societies in forty-six countries.

## INCE-USA

The Institute of Noise Control Engineering of the USA (INCE-USA) is a nonprofit professional organization incorporated in Washington, DC, USA. The primary purpose of the Institute is to promote engineering solutions to environmental noise problems. INCE-USA publishes the technical journal *Noise Control Engineering Journal* and with I-INCE publishes this quarterly magazine and its blog. INCE-USA sponsors the NOISE-CON series of national conferences on noise control engineering and the INTER-NOISE Congress when it is held in North America. INCE-USA members are professionals in the field of noise control engineering, and many offer consulting services in noise control. Any persons interested in noise control may become an associate of INCE-USA and receive both this magazine and *Noise Control Engineering Journal*.

## *NNI* and Its Online Supplement

**www.noisenewsinternational.net**

The PDF and blog versions of *NNI* allow for links to references, articles, abstracts, advertisers, and other sources of additional information. In some cases, the full URL will be given in the text. In other cases, blue text will indicate the presence of a link. The *NNI* blog contains additional information that will be of interest to readers, such as the following:

- The current PDF issue of *NNI* available for free download
- Links to previous PDF issues of *NNI*
- An annual index of issues in PDF format
- A conference calendar for upcoming worldwide meetings
- Links to I-INCE technical activities and I-INCE technical reports

# From the President of I-INCE: A No-Limits INTER-NOISE

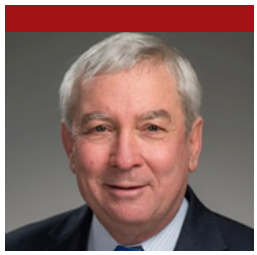
In case you have not heard, the Korean Society of Noise and Vibration Engineering (KSNVE), host of INTER-NOISE 2020, has decided to hold the congress on its originally scheduled days but convert it to an e-congress. The congress will be hosted on an e-conference platform that will provide both the technical paper and either a recorded presentation of the paper or a poster presentation. Registrants will be able to view the presentations and the papers as well as ask the authors questions through a messaging feature on the platform. Registrants will also have a chance to visit an e-exhibition where registered exhibitors will provide materials describing their products and services.

I know I am in danger of sounding like an amateur promoter, but I honestly think this is going to be an interesting experiment with many potential advantages that will be worth "attending." In my best "promoter" style, let me offer my best pitch:

- There will be *no limits* to how many paper presentations you can "attend" (in the week the platform is open).
- There will be *no limits* on how many questions you can ask the authors.
- There will be *no limits* on how many exhibitors you will have time to visit (during the month the platform is open for exhibitors).
- You will have *no* travel expenses.
- There will be *no need to choose* who from your company gets to go to the congress—you can all attend, given the low registration fee and no travel costs. This will be a great opportunity for colleagues who are either unable to attend INTER-NOISE congresses or have not been interested to attend in the past.
- There will be *no limits* on the time you attend the congress—you can sleep late and binge-watch presentations all night or all weekend.
- *No* jet lag.
- *No* coronavirus travel risk.

If you are an exhibitor, you'll have the following advantages:

- *No conflicts* with technical presentations.
- A month on "display" instead of two days.
- *No* travel costs.
- *No* jet lag.
- *No* risk of a bad booth location.
- *No* power outages or other glitches.



***Bob Bernhard***

- *No* downtime while you wait for visitors—you now can handle inquiries on your schedule.

And all of these advantages are available for a reduced registration fee of only US$200. And where else are you going to get your fix for good technical papers on noise and vibration control in 2020?

Our colleagues at KSNVE are working very hard on the transition from a regular congress to the e-congress format, but things are coming together quickly. I hope you will support their efforts by registering for the congress at https://internoise2020.org/. And I hope you and your colleagues will enjoy our first "No Limits" E-INTER-NOISE.

Bob Bernhard
President, I-INCE

# Editor's View

Welcome to the June 2020 issue of *Noise/News International*. In this issue, we feature a novel acoustic camera developed by Seven Bel, we learn about a recent interactive workshop on environmental health in Vancouver, and Eric Ungar writes to tell us what happens at the critical frequency. And, as always, we have our regular NOISE/NOTES roundup of all news making headlines around the world.

The focus of this issue's NOISE/NOTES is very much on the COVID-19 pandemic and how it is affecting all aspects of life. It was announced earlier this year that the organizing committee and I-INCE have decided to convert INTER-NOISE 2020 to an e-congress in August. This new format will allow congress registrants to see recorded presentations of papers on demand and participate in discussions with authors and other colleagues. While it is a little disappointing that we won't be able to meet in Seoul, it is also very exciting. The e-congress brings with it a number of exciting opportunities and opens up the conference to a lot of people who might not have been in a position to travel to South Korea—plus, I'm looking forward to seeing how everyone approaches their video presentation.

Unfortunately, NOISE-CON 2020 has also been affected. Having originally been scheduled for June, it has been moved to November 16–18, 2020, still in New Orleans. There is more information on these changes later in this issue.

Let me conclude by wishing that you and your families are home, safe, and doing well. In the words of my favorite Irish poet, "If we winter this one out, we can summer anywhere."

I hope to see you all soon.
Eoin A. King, PhD

***Eoin A. King, PhD***

# NOISE/NOTES

## Eoin A. King, *NNI* Editor

*NNI* is on Facebook and Twitter. We try to keep our readers informed with noise news from all across the globe by highlighting interesting research and projects. Here is a roundup of some of the stories that have been making headlines. Follow @NNIEditor to stay up to date with all noise-related news!

### Special Issues on Acoustic Effects of COVID-19 Pandemic

The COVID-19 pandemic has had wide-ranging effects on all aspects of life, including strong effects on the acoustic environment. A wide array of articles describing these effects have been published in the popular media, and some are summarized in this NOISE/NOTES feature. However, some archival journals are also seeking to publish peer-reviewed publications on the acoustic impacts of the pandemic. The *Journal of Acoustical Society of America* has issued a call for papers for an upcoming special issue on "COVID-19 Pandemic Acoustic Effects." Further, the open access journal *Noise Mapping*, from De Gruyter, has also issued a call for papers for a special issue on "The Noise Climate at the Time of SARS-CoV-2 Virus/COVID-19 Disease."

### Listen to the Lockdown

A recent *New York Times* article compared noise levels before and after lockdown in New York City, featuring measurements and audio recordings from the Sounds of New York City Project (SONYC). SONYC is an interdisciplinary collaboration between researchers at New York University and Ohio State University and includes a distributed network of both sensors and people for large-scale noise monitoring.

### Lockdown Reduces Ocean Noise

The *Guardian* reports that in cities, human lockdowns during the coronavirus pandemic have offered some respite to the natural world, with clear skies, the return of wildlife to waterways, and a drop in underwater noise pollution, which, experts say, is good news for whales and other sea mammals.

### Animals Free to Roam

In keeping with a wildlife theme, another article for the *Guardian* reports how empty streets and skies let the birds be heard and leave animals free to roam as well as allow scientists to examine how humans change urban biodiversity.

### Tips on Reducing Background Noise

The instructions to shelter in place, stay at home, and work remotely where possible have seen a big increase in people relying on teleconferencing tools. Battling siblings, barking dogs, and other noisy things can impact these virtual meetings. INCE-USA recently offered some simple tips on how to reduce background noise in the home.

### In Conversation with the *NNI* Editor

For International Noise Awareness Day 2020, *NNI* editor Eoin King sat down to have a conversation with the folks at Sonitus Systems Ltd. and discuss all things noise related.

### Sound Absorption of the Conifer Tree

The BBC reported on a recent study that tested the sound absorption of 13 different species of trees. The study found that larch was the most effective species, while conifers acted more effectively than broadleaved trees when it came to absorbing sound. It suggests that, besides emphasizing the effects of vision and shade, urban greening could also be considered to achieve noise reduction in cities.

### Tips to Control Background Noise in Video Meetings

INCE-USA president Mike Bahtiarian offers six simple tips to control background noise in video meetings. They range from your choice of room to the consideration of the position of the nearest fan or air conditioner to using a headset.

# INTER-NOISE 2020 to Be Held as an E-Congress

## Eoin A. King, *NNI* Editor

Due to the latest developments in the COVID-19 pandemic and increasing travel restrictions across the world, the organizing committee and I-INCE have decided to convert INTER-NOISE 2020 to an e-congress during the planned period, August 23–26, 2020. The new format will allow congress registrants to see recorded presentations of papers on demand and participate in discussions with authors and other colleagues.

If you have already submitted an abstract, you can go ahead and complete the paper, register for the congress, and record the presentation of your paper. If you have not yet submitted an abstract, you can still take advantage of the the extended deadlines to participate—and even if you don't intend to present a paper but have an interest in the latest noise control engineering, you can still register for the congress at the new lower registration rate and experience the new exciting format.

Those of you who have been to an INTER-NOISE Congress in the past know that it is always jam-packed with the latest in noise control, and you've likely been faced with several tough decisions in trying to decide which papers to attend (and miss!). One massive advantage of this e-congress is that you will be able to view (and re-view) the presentation of any paper during the time the conference portal is open! In the official announcement, I-INCE President Robert Bernhard writes, "This format is an exciting experiment and one that makes great sense in 2020."

In its 50-year history, this will be the first time INTER-NOISE will be held as an e-congress. The new format of the e-congress will offer an exciting new experience for participants, sponsors, and exhibitors, including easy access to video content, reduced registration fee, and an e-exposition. There will also be new online social programs where attendees can meet INTER-NOISE colleagues even in different time zones!

### Important Dates

| | |
|---|---|
| Abstract Submission Deadline | May 25, 2020 |
| Exhibition Application Deadline | May 25, 2020 |
| I-INCE YP Grants Deadline | May 25, 2020 |
| Notification of Acceptance | June 10, 2020 |
| Paper Submission Deadline | June 25, 2020 |
| Video Upload Deadline | July 23, 2020 |
| Poster Presentation Upload Deadline | July 23, 2020 |

### Registration Fee

| | |
|---|---|
| Delegate | US$200 |
| Student | US$100 |
| Additional Paper Fee | US$100 |

# *NCEJ* Needs You

## James K. Thompson

The *Noise Control Engineering Journal* (*NCEJ*) is the number-one journal in the world devoted to noise control engineering. We publish over 40 papers and case studies each year, with a focus on the fundamentals of noise control and the technology of managing noise globally. For more information, go to our webpage: https://www.inceusa.org/publications/noise-control-engineering-journal/.

### *NCEJ* Needs Your Help

To continue to provide this quality technical journal, we need you to participate as a reviewer. From graduate students to retirees, we need your help with paper reviews. If you would like to volunteer to be a reviewer for *NCEJ*, please follow the link to our website and register as a reviewer: http://ncej.edmgr.com/.

You will have to establish a user ID and password for the *NCEJ* editorial website. Also, please take a little more time to select the subject classifications for the types of papers you would prefer to review. Doing so will enable the editorial team to select qualified reviewers, and you will receive papers in your areas of interest for review.

Serving as a reviewer provides the opportunity to see the latest developments in noise control engineering while contributing to the institute. The time commitment is minimal. Reviewing only requires a few hours per month. This is a rewarding way to contribute to the noise control profession.

We hope you can join us in continuing to provide the number-one noise control engineering publication in the world.

If you have any questions or need assistance, please feel to contact me at the address below.

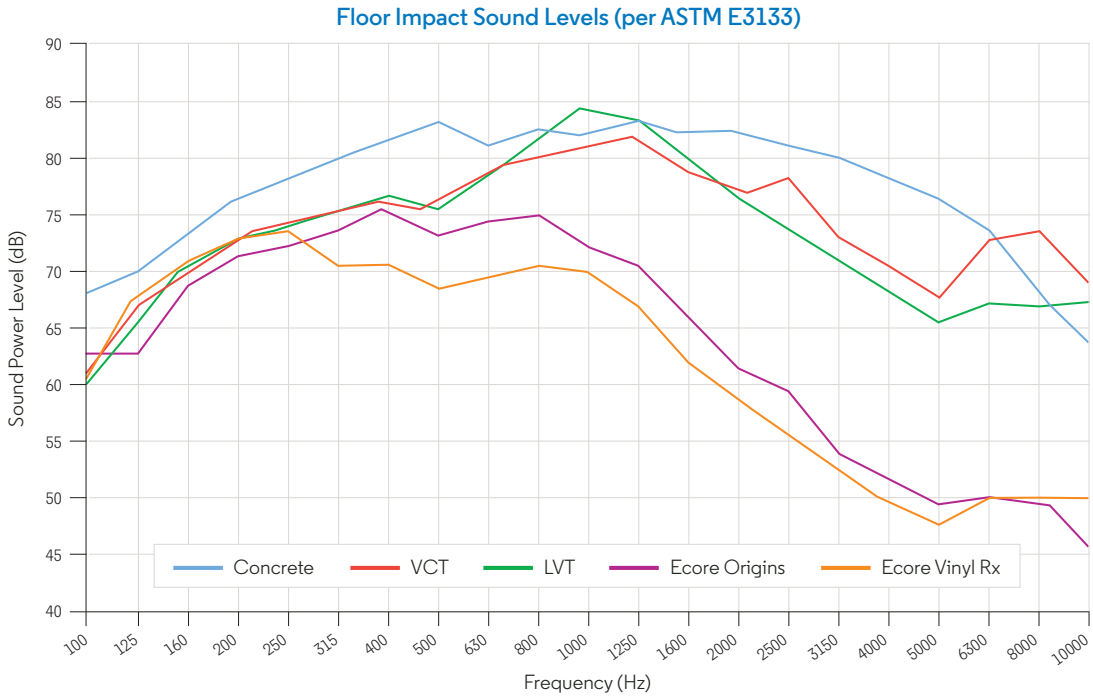
James K. Thompson, PhD, PE,
INCE Bd Cert
Editor, *Noise Control Engineering Journal*
editorNCEJ@inceusa.com
https://www.inceusa.org/publications/noise-control-engineering-journal/

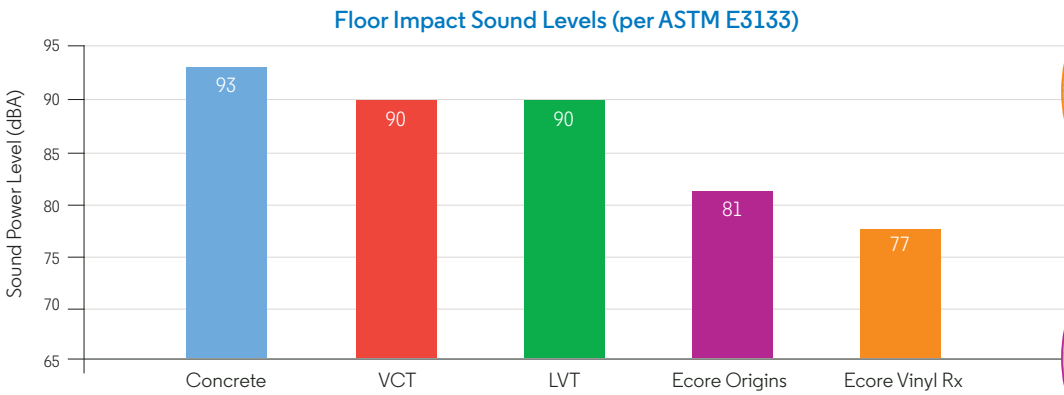
ecore™

# New Floor Impact Sound Test Data available from Ecore

**PERFORMED BY INTERTEK** INDEPENDENT IAS-CERTIFIED LAB IN YORK, PA

Floor impact sound levels from Ecore's Vinyl Rx were 13dB lower than those from generic VCT and LVT. This makes Vinyl Rx an excellent choice for uses like hospitals where the standard flooring choice to reduce noise, carpet, presents many maintenance and health issues.





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# *Noise Control Engineering Journal* Special Focus Area

Artificial intelligence (AI) is a growing area of noise control engineering. It is frequently used to understand the subjective reaction to noise and perception of sonic environments. AI is also used to understand complex acoustic systems and to develop effective noise controls in such systems. The *Noise Control Engineering Journal* (*NCEJ*) plans to place special focus on this topic area in upcoming issues.

Yang-Hann Kim (ncej@ksnve.org) will be coordinating this effort. Yang-Hann will be inviting selected authors to prepare papers focused on this area of noise control and will be coordinating the review of all papers submitted in this special focus area.

A key part of this initiative will be a few outstanding invited papers to be featured in upcoming issues. Yang-Hann will be contacting authors about preparing these invited papers shortly. These papers will receive special designation in *NCEJ* as featured treatments of this focus topic.

If you would like to contribute a paper related to AI in noise control you may contact Yang-Hann Kim or simply submit your paper through the regular website https://www.editorialmanager.com/ncej/default.aspx. When you submit, please include "Artificial Intelligence" or "AI" in the title. Yang-Hann would be eager to discuss possible paper topics with you.

As he will be coordinating the reviews of these papers, please feel free to contact Dr. Kim if you would like to volunteer as a reviewer for AI related papers.

# Quiet, Please! An Interactive Workshop for Environmental Health and Planning Professions on Transportation Noise, Its Health Impacts, and Mitigation Strategies


## Hugh W. Davies, PhD, MSc, BSc, CIH

## Associate Professor, Occupational and Environmental Health Division, School of Population and Public Health, University of British Columbia, Vancouver, Canada


### Introduction

As with many cities in North America, environmental noise in the Metro Vancouver region is regulated at the municipal level. Noise bylaws target high-decibel point sources such as construction sites, leaf blowers, and neighbour noise, such as barking dogs, motorcycles, and loud parties. They are almost entirely based on *community response* (annoyance). There is growing awareness among public health professionals and citizens of the *health* effects of noise, however, and there has been increasing interest in the region to review noise policies to ensure they reflect the current understanding of health effects of noise.

While point sources such as those mentioned earlier are sources of annoyance and contribute to localized noise exposure, the largest body of epidemiological evidence is related to noise from *transportation* sources—from road, aircraft, and trains. Links have been made between transportation noise and various health outcomes, including stress, sleep disturbance, cardiovascular disease, and cognitive effects in children. Unlike in the European Union, where environmental noise has been recognized as a significant public health problem, and investment has been made in better characterizing exposure, educating the public, and reducing noise exposure, few, if any, such health-based policies have been developed in North America, including Canada.

Recognizing this evidence-policy gap, the Environmental Health group at Vancouver Coastal Health partnered with the University of British Columbia's School of Population and Public Health to develop an educational workshop on noise and health. An invited audience comprising over 70 city planners, transportation planners, environmental health officers, and others involved in designing and maintaining a healthy urban

*Fig. 1. Joseph Digerness (Arup Group, New York) challenged the audience to think outside the box both in terms of what our future cities will sound like with respect to how we find new ways to control noise while preserving our cities' "sonic signatures."*

environment gathered on November 25, 2019, for the event.

The objective was to see if we could "move the dial" on the environmental noise hazard in the Greater Vancouver Region, with an initial focus on transportation noise. The event was designed not only to *share* expert knowledge but also to give a *forum for discussion* on both problem identification and solution strategies, to begin to map out a pathway forward for municipalities and for the province.

The one-day workshop was opened by Dr. Patricia Daly, vice president, public health, and chief medical health officer for Vancouver Coastal Health, and chaired by Professor Michael Brauer. Professor Brauer is a world-renowned exposure scientist whose research focuses on linkages between the built environment and human health, with specific interest in the relationships between multiple exposures mediated by urban form and population health. He reminded the audience that during his career, air pollution had gone from meetings such as the workshop to where we are today and that there are lessons to be learned from air pollution and opportunities for co-benefits between the two efforts.

## Sharing Knowledge

The audience heard from five experts, who spoke to local exposure research, the health effects of noise, policy efforts elsewhere in the world, and approaches to mitigation. Professor Hugh Davies, PhD (University of British Columbia; UBC), described a program of research out of UBC that included the creation of the largest "noise map" in North America (see fig. 2) and the use of the map in a series of health studies among adult and birth cohorts in the Metro Vancouver region; these studies are all published in the peer-reviewed literature and summarized recently in Canadian Acoustics.[1]

Dr. Bryony Croft, PhD (SLR Consulting), gave a review of a recently completed acoustical study of the Vancouver light-rail (Skytrain) system. The Skytrain system has substantially altered development patterns in Vancouver, with greater densification close to light-rail stations. The study of 32 locations and 2,000 train pass-bys showed that maximum pass-by noise levels were considerably above the identified 75 dBA goal at some locations and could reach above 90 dBA. Noise from Skytrain affecting any single location was variable over time, depending on track condition and maintenance cycles, and though there are options to mitigate noise, they are not cheap, nor easy or fast.

Dr. Mathias Basner, MD, PhD (University of Pennsylvania), described the current state of knowledge regarding noise and health, particularly the effect on sleep and changes in sleep structure, the effects on the cardiovascular system, the risk to vulnerable groups, and the burden of noise-related chronic disease.

Dr. Eoin King, PhD (University of Hartford), reviewed the European experience, the EU Noise Directive as a cyclical process, and advances such as CNOSSUS-EU. He discussed the planning objectives (protect health and well-being, improve quality of life, structure and prioritize noise abatement efforts, involve general public) as well as the challenges faced (such as different calculation methods, discrepancies in state's reporting numbers, and the lack of requirement to implement), and benefits accrued (such as significant research gains; data created on costs, health; and the focusing of local authorities' attention). Dr. King also reviewed several mitigation studies, including vehicle bans, geo-fencing of buses, noise barriers, and building soundscapes.

Finally, Joseph Digerness, an acoustical engineer with the Arup Group in New York, challenged the audience to think outside the box both in terms of what our future cities will sound like (with air taxis like Uber Elevate on the horizon) and with

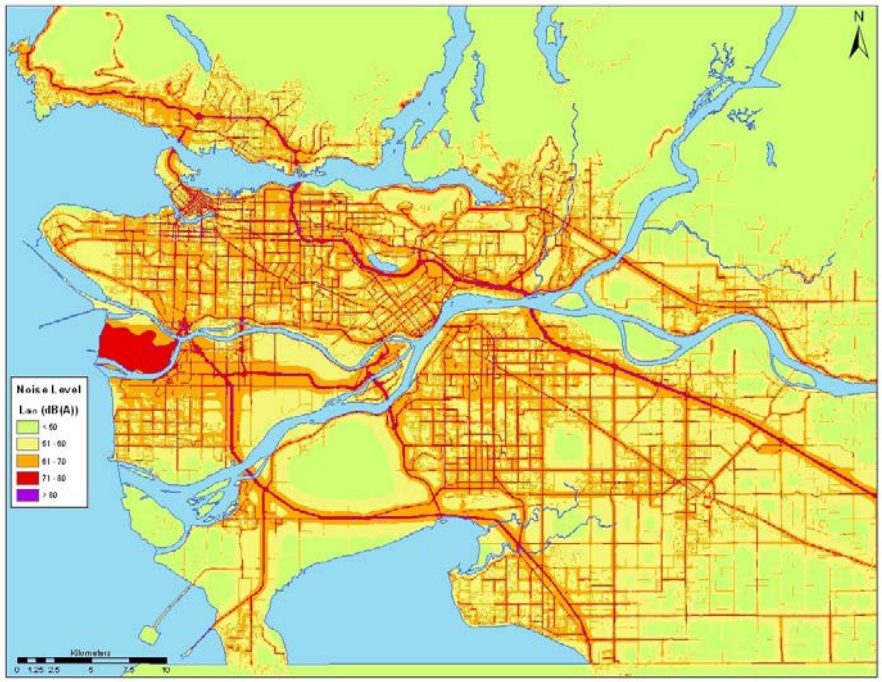


*Fig. 2. The University of British Columbia produced a 2,200 km² noise map of the Metro Vancouver region that has been used in a number of chronic health studies among adults and a birth cohort.*

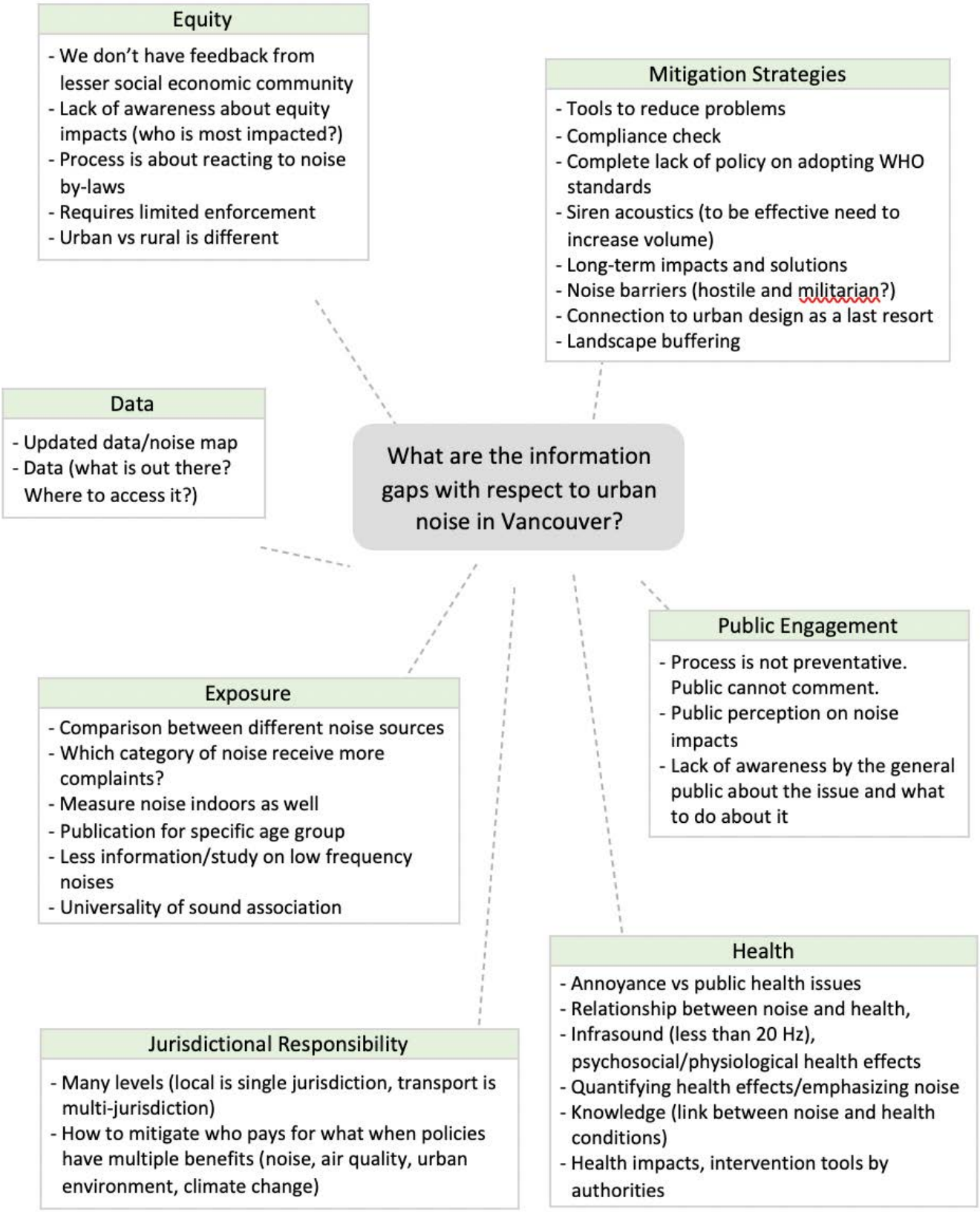


*Fig. 3. A summary of responses from small-group discussions of the question "What are the information gaps with respect to urban noise in Vancouver?"*

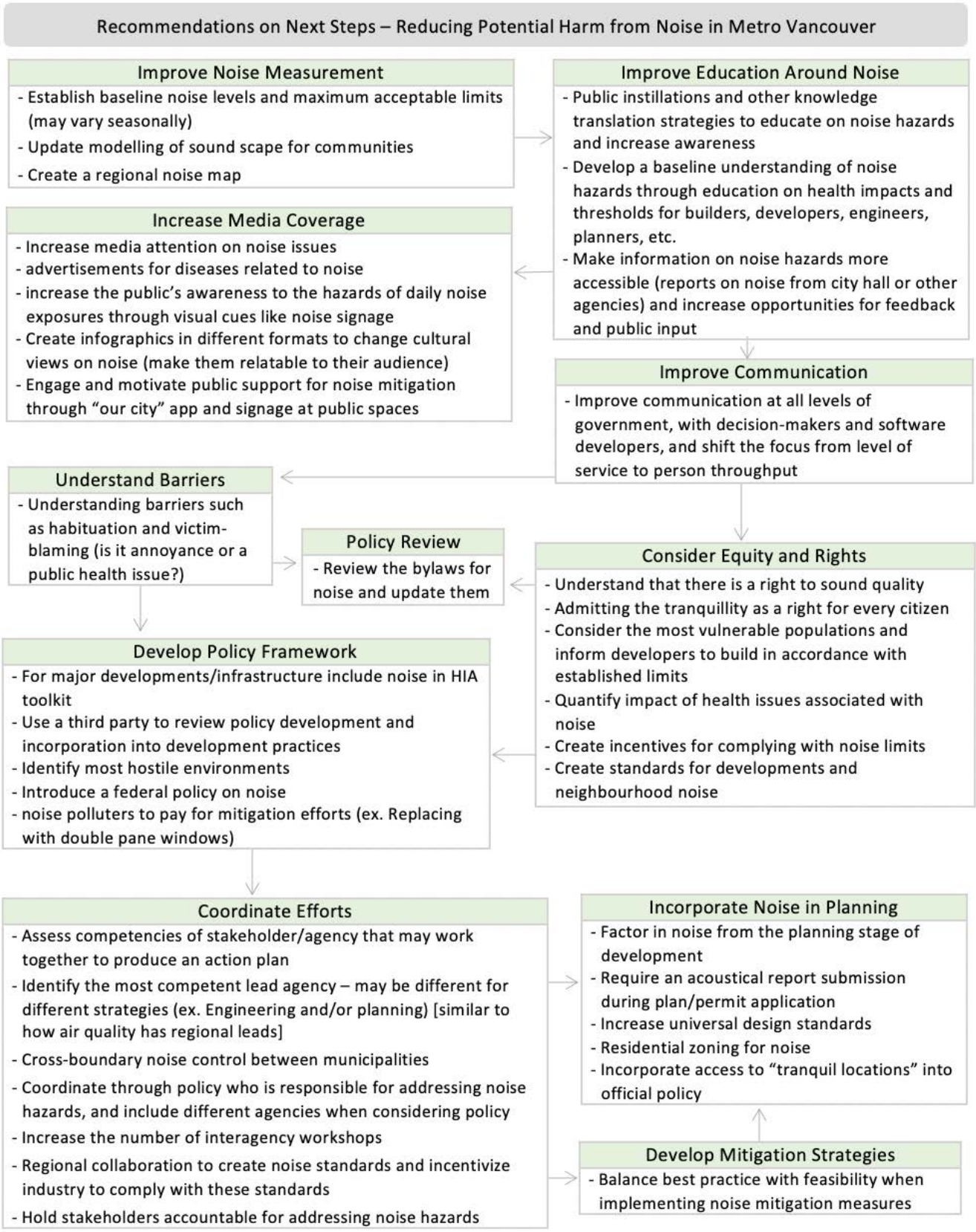


*Fig. 4. A summary of responses from small-group discussions of the question "What are the next steps for reducing potential harm from urban noise in Vancouver?"*

respect to controlling noise. "Yet another Noise Barrier?" was the title of his talk. He cautioned that we must consider our soundscapes and the need to preserve the often unique "sonic signature" of our spaces. He also emphasized the importance of public engagement and use of new tools such as auralization.

## Group Discussions

Following the expert talks, attendees broke into small groups and considered a number of topics for discussion, including "What are Vancouver's regional noise problems?," "What are we doing well with respect to the noise problem, and what are we doing poorly?," and "What noise mitigation strategies/methods may be appropriate for Vancouver?" Responses were summarized for attendees in a workshop report.

Some of the discussions were more generalizable perhaps to a broader audience and are summarized here. For example, figure 3 shows the discussion points arising from the question "What are the information gaps with respect to noise in Vancouver?" Interestingly, attendees felt that there was a lack of data on exposure and health and also a lack of understanding where responsibilities lie. It was telling, perhaps, that despite invitations, not all levels of government chose to participate in the workshop. Figure 4 summarizes responses for the question "What are your recommendations for next steps in reducing potential harm from noise in Metro Vancouver?" This discussion was interesting for quickly and insightfully revealing the complexity of the problem at hand. Figure 5 illustrates some of the broader issues that came to light and interested participants.

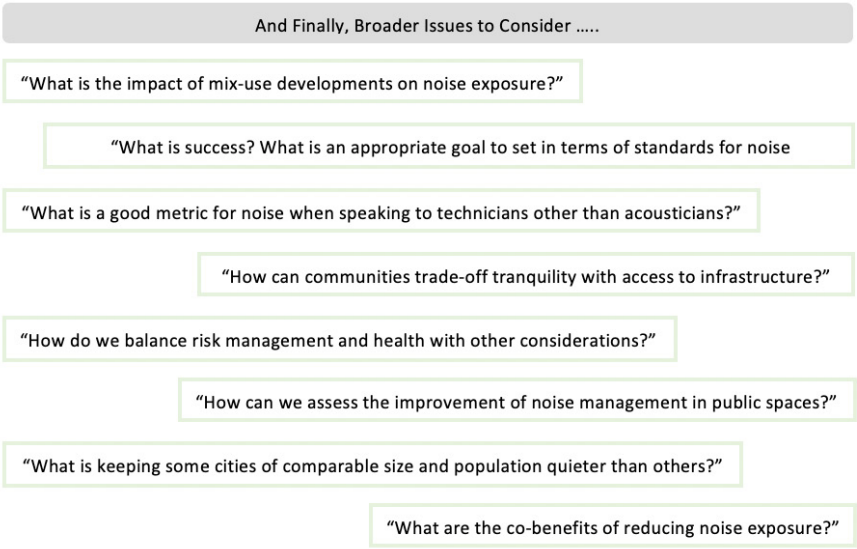


*Fig. 5. Some "big picture" thoughts to conclude the workshop.*

## Conclusion

The workshop concluded with a discussion about next steps, and it was decided to continue to offer additional workshops for different target audiences and to enable discussion of efforts and achievements in different regions (Metro Vancouver comprises more than 20 distinct municipalities). The attendees also identified 15 current or upcoming projects and initiatives (ranging from construction to long-term transport planning) where the handling of the impact of noise effects should be reviewed, offering opportunities for immediate impact. Overall the workshop was considered a success by both attendees (over 90 percent rated it excellent or very good) and organizers. The documents and resources used and generated in the workshop are available at a wiki site.

## Note

1 Davies H. W., "Toward a Better Understanding of the Role of Transportation Noise in Chronic Disease: The Vancouver Studies," *Canadian Acoustics* 47, no. 4 (Dec 2019).

# What Happens at the "Critical" (Trace Matching) Frequency?


## Eric E. Ungar

## Acentech, Inc., Cambridge, MA


Everyone who has studied sound transmission through walls and the like undoubtedly knows that much greater sound transmission occurs at frequencies above the so-called critical frequency than at lower frequencies. Why is that so? Descriptions and analyses abound in textbooks and handbooks, but it might be useful to take another look.

### Trace Matching

Figure 1 shows an on-edge view of a portion of an infinite plate separating two air volumes, in one of which (the upper one in the figure) there is a complex sound field. Let us focus on a component of that field that consists of a sound wave at a given frequency (and wavelength) and that impinges on the plate at a certain angle. Indicated in the figure is a one-wavelength long portion of that wave, together with the pressure distribution it produces on the plate, often called the "trace" of the sound pressure on the plate surface. Also shown is the deflection of the plate that this trace tends to produce. If the plate's vibrational wavelength at the frequency of the sound wave matches the sound trace wavelength, then the sound pressure can deflect the plate very efficiently. In this "trace matching" case, the plate motion also can efficiently give rise to a sound wave propagating at the same angle in the second volume (the lower one in the figure). This transmitted wave is not diagrammed in the figure, but one can readily visualize the wave sketched above the plate continuing below the plate and recognize that good

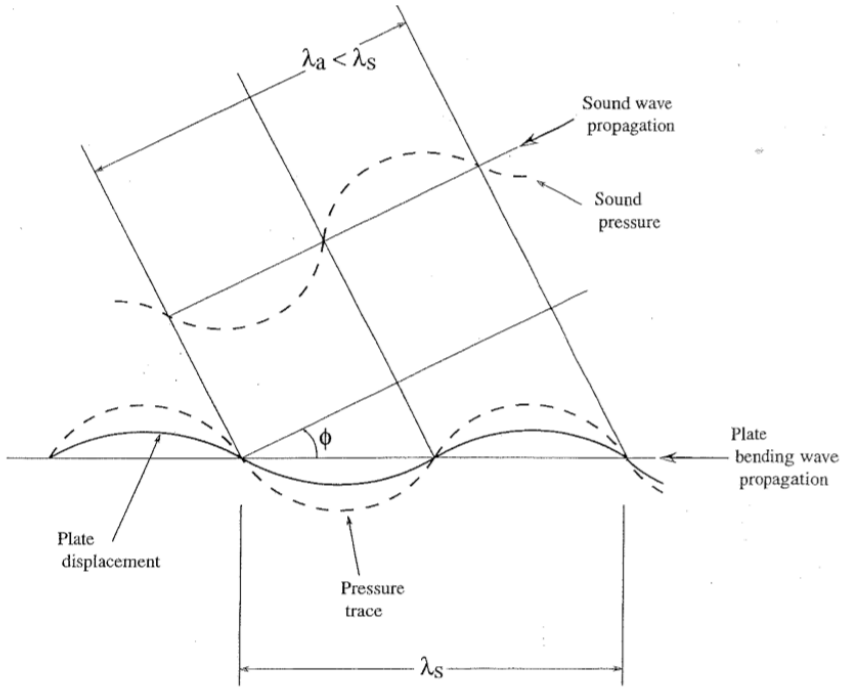


*Fig. 1. Sound wave impinging on plate*

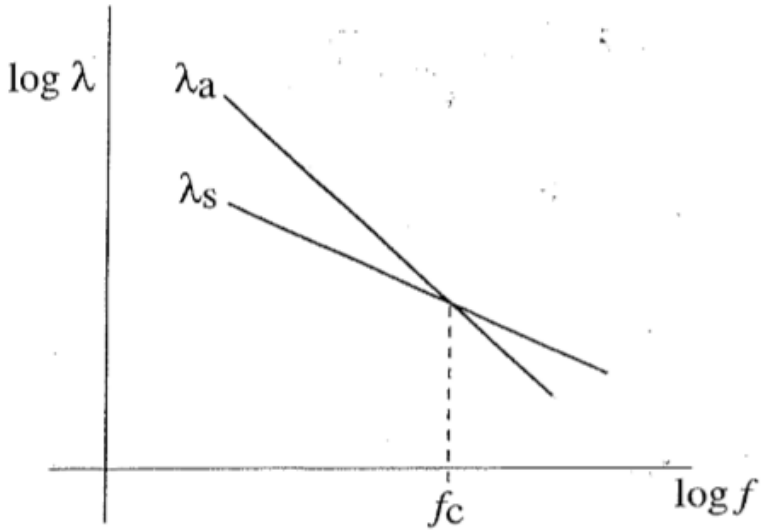


*Fig. 2. Wavelength-frequency relations*

sound transmission can occur in the presence of trace matching.

## Critical Frequency

What are the conditions under which trace matching can occur? Note that in the diagram of figure 1, the sound wavelength $\lambda_a$ is smaller than the structural wavelength $\lambda_s$. For any $\lambda_a < \lambda_s$ one can find an angle $\varphi$ at which the trace of the sound wave matches the structural wave. But if $\lambda_a > \lambda_s$, one cannot construct a diagram like that of figure 1, implying that trace matching cannot occur. Thus, $\lambda_a = \lambda_s$ clearly constitutes a dividing line between good and poor matching of the pressure trace wavelength and the plate wavelength—and thus between good and poor sound transmission. The frequency corresponding to this dividing line—that is, to equality of the two wavelengths—is called the "critical frequency" or, more descriptively, the "trace matching frequency."

As may be found, for example, in the classical book *Noise and Vibration Control* (L. L. Beranek, ed., McGraw-Hill, 1971), the acoustic wavelength at frequency $f$ is given by $\lambda_a = c_a/f$, where $c_a$ denotes the speed of sound in air. Also, the wavelength of flexural vibrations at frequency $f$ of an infinite plate of thickness $h$ and of a material with longitudinal wavespeed $c_L$ obeys $\lambda_s \approx \sqrt{1.8hc_L/f}$. Thus, the frequency at which the two wavelengths match—the critical frequency—is given by $f_c \approx c_a^2/1.8hc_L$. Figure 2 displays these frequency relations.

Infinite plates are hard to find, of course. But the vibrational behavior of a finite plate at frequencies that are high enough so that the plate length encompasses many wavelengths approximates that of an infinite plate. Note that the equation given above for the flexural wavelength on a plate is approximate in that it neglects the effect of Poisson's ratio on the plate bending stiffness and includes rounding-off of the numerical values of the exact expression.

## Broader Applicability

Although the foregoing discussion focused on plates in air, it applies equally to plates immersed in fluids with other sound-speeds—for example, water.

Furthermore, it also permits one to understand what happens if the fluids on the two sides of the plate are not the same—that is, if they have different sound-speeds—as in the case where there is air on one side of the plate and water on the other. In this situation, the angle at which there occurs efficient response of the plate to the sound field incident on one side will differ from the angle at which the plate radiates sound efficiently on the other side. This implies that there will be two different trace matching frequencies, one for each fluid, and good sound transmission may be expected at frequencies above the higher of these two. At these high frequencies, the angle of the incident wave will differ from the angle of the radiated wave.

It is interesting to note that the idea of trace matching frequencies applies not only to the response of plates to acoustic waves and to sound transmission through such plates but also to the transmission of other types of waves through other types of structures, such as the transmission of flexural waves on a plate past a reinforcing beam welded to that plate. (For example, see E. E. Ungar, "Transmission of Plate Flexural Vibrations through a Reinforcing Beam; Dynamic Stress Concentrations," *Journal of the Acoustical Society of America* 33 (May 1961): 633–639.)

# Novel Acoustic Camera Addresses Price-versus-Performance Dilemma

Acoustic cameras are widely regarded as powerful tools for the localization of unwanted noise in products and processes. Engineers from product development, manufacturing, and maintenance who are blessed with access to such technology appreciate the added value of visual information for implementing highly effective technical solutions. In addition, engineering managers and product marketers value avoiding costly trial and error as well as securing timely product launches due to increased predictability during product development, respectively.

## The Dilemma

Unlike thermal imaging cameras, acoustic cameras have not experienced comparable penetration into the equipment portfolio of engineering departments so far, especially in small- to medium-sized companies. One reason lies in the properties of industrial sound emissions, which are typically low-frequency sounds by nature. In such a situation, a microphone array system with a diameter of at least 1 m is typically required in order to reliably separate multiple sound sources. The acquisition cost of such equipment in the range of €40K+ combined with required expert know-how may result in a customer's decision to refrain from purchasing. Over the last couple of years, the trend toward mobile acoustic cameras fueled hopes of accessing to sound imaging devices at a more acceptable price. Yet mobile systems with a diameter of about 30 cm are just not capable of delivering the required image quality for typical industrial applications. Bottom line: we cannot outsmart physics easily, and size simply matters.

## Introducing a Novel Method of Sound Imaging

For this reason, Seven Bel has tasked itself with developing a novel acoustic camera that delivers high image quality for industrial applications and offers superb usability and mobility at an affordable price. The enabling technology is a compact rotating sound scanner with a few state-of-the-art digital microphones. Fine spatial sampling of the sound field over a disc with a diameter of up to 1.32 m results in acoustic images with excellent spatial resolution and dynamic range, which drives confidence in the implementation of technical solutions (see fig. 1).

The benefit of scanning a large area can be easily seen by performing the following challenging experiment, which is encountered in the testing of drivetrains and engines (see fig. 2). Three loudspeakers are excited with white noise, two of them coherently. The selected frequency band is 2,000 Hz +/− 115 Hz, and a dynamic range of 15 dB is chosen. The center loudspeaker's gain is +10 dB versus the outer loudspeakers. The large scanner with a diameter of 1.32 m (*left image*) resolves the right and left speakers sitting 10 dB below the center speaker and shows nice separation of sound sources, while the small scanner with a diameter of 0.5 m (*right image*) clearly struggles with identifying the three sources. Yet the smaller scanner is particularly useful for measuring medium- to high-frequency sound events in confined spaces.

The sound scanner together with the user's mobile device and Seven Bel's number-crunching cloud infrastructure in the background creates a compact high-performance measurement system for the fast analysis of acoustic problems. The developers at Seven Bel paid special attention to designing a massively simplified workflow for measuring and analyzing acoustic images. Automatically generated reports can be easily shared with colleagues, partners, or clients.

The technology has already been successfully demonstrated with products and processes from various industries

*Fig. 1. Sound Scanner P132 with a scanning diameter of 1.32 m (*left*) specifically developed for low-frequency industrial applications. Measurement system includes rotating scanner mounted on tripod, mobile device, and Seven Bel's cloud infrastructure (*right*).*

ranging from automotive to transportation, home appliances, and machinery construction.

## Use Cases

The design of enclosures for machining centers constitutes a particularly challenging task for mechanical engineers. Manufacturers must not only meet corresponding regulatory limits but also increasingly consider the fact that an optimal work environment for the machine operators is guaranteed. Acoustic images support engineers during the development phase in understanding, for instance, the time averaged local sound radiation during a machining process. These insights allow them to build machine housings that are optimal with respect to cost and acoustic effectiveness. In certain cases, sound does not come from where it is initially expected. Grinding the edges of glass plates in glass processing centers leads to critical excitations of eigenfrequencies and eigenmodes of the material being processed. Sound may then not only come from the location where the grinding takes place. Instead, the glass plate being processed acts as a loudspeaker and may dominantly radiate sound from the opposite edge (see fig. 3). It is exactly this sort of insight that gives engineers the confidence to take the right measures when implementing designs for optimal sound reduction.

Another interesting application can be found in the field of automotive engineering, where engineers from vehicle simulation and testing are involved in reconciling simulation models with actual measurement data. Figure 4 shows a motorcycle operated under full load on a roller dynamometer. Engineers are particularly interested in confirming the exact location of sound radiation from the clutch cover in order to update material and geometry parameters in simulation models and thus drive design optimizations.

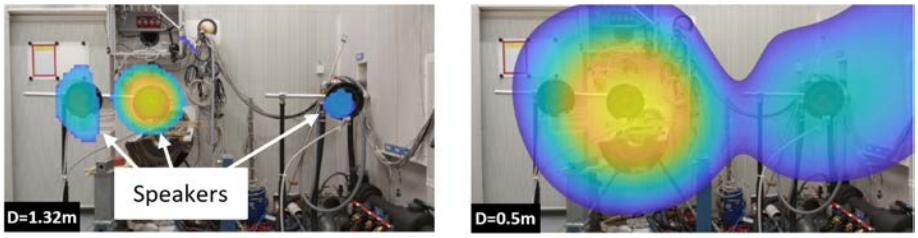


*Fig. 2. Three loudspeakers with white noise excitation measured at a distance of 1.5 m. Selected frequency band is 2,000 Hz +/– 115 Hz, dynamic range is 15 dB, and center loudspeaker's gain is +10 dB versus outer loudspeakers. Comparison of large scanning area (1.32 m diameter) versus small scanning area (0.5 m diameter).*

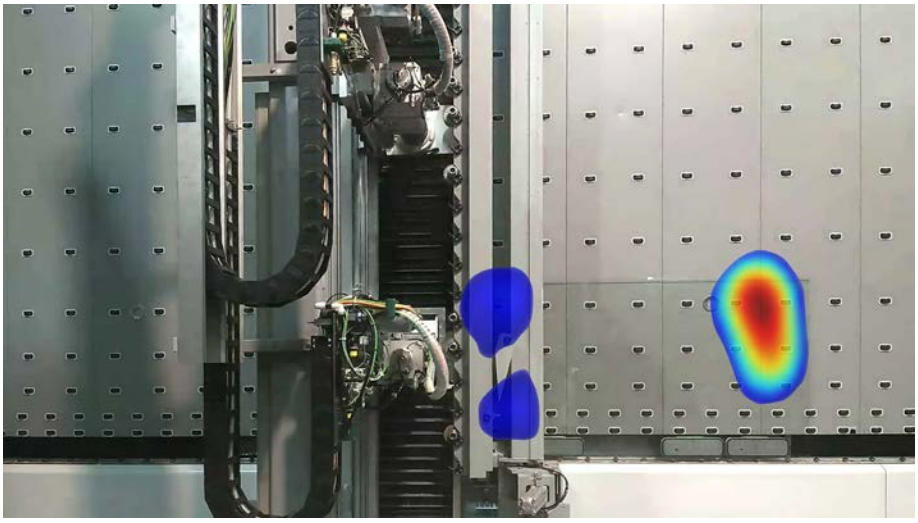

*Fig. 3. Complex machining processes, in many cases, cause complex sound events. Acoustic images support engineers in understanding the time averaged local sound radiation during a machining process and thus allow them to build optimal machine housings.*

*Fig. 4. Investigation of surfaces with dominant sound radiation on a roller dynamometer under full load. Acoustic images support engineers during research and development, in adjusting simulation models of engine and transmission components.*

Seven Bel is currently gearing up to introduce their P50 and P132 sound scanners on the European market. The team is eager to learn more about new potential applications. Contact them today at sevenbel.com and request a demo kit.

# Important Update on NOISE-CON 2020

## Eoin A. King, *NNI* Editor

The NOISE-CON 2020 Organizing Committee and INCE-USA leadership have been monitoring the situation in New Orleans very closely. Given the extraordinary situation created by COVID-19, they have decided to postpone the event. NOISE-CON 2020 will still be in New Orleans but will now take place November 16–18, 2020.

Key changes to dates are as follows:

- Abstract submissions are being accepted through July 1, 2020. If you already submitted an abstract and it was approved, you are all set for the November conference.
- The due date for conference papers is now September 1, 2020.
- The early registration deadline is now September 15, 2020.
- The conference will still be held at the Hilton New Orleans Riverside.

There will be additional changes to the NOISE-CON program, so please check back for further details. We at *NNI* will endeavor to keep you updated as soon as we learn anything, but in the interim, should you have any questions, please email the conference organizers at ibo@inceusa.org.

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## BSWA

***Australia:*** KINGDOM PTY LTD
+61 2 9975 3272
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***Australia:*** Noise Measurement Services
+61 7 3217 2850
bob@noisemeasurement.com.au

***Austria:*** Ing. Wolfgang Fellner GmbH
+43 1 282 53 43
wf@shallmessung.com

***Belgium:*** ABC International Trading B.V.
+31 162520447
nl@abctradings.com

***Canada:*** Soft dB
+1 418 686 0993
contact@softdb.com

***Egypt:*** Elnady Engineering and Agencies
+20 2 23425763
info@elnadycompany.com

***Finland:*** APL Systems Ltd.
+358(0)442199940
Ville.ilves@apl.fi

***France:*** ViaXys
+33 2 38 87 45 35
oliver.blazere@viaxys.com

***Germany:*** ROGA Instruments
+49 (0) 6721 98 44 54
roga@roga-messtechnik.de

***India:*** Welan Technologies
+91 20 25393126
info@welantechnologies.com

***Ireland:*** Sonitus Systems
+353 01 2542560/+44 020 81236009
enquiries@sonitussystens.com

***Israel:*** Emproco Ltd.
+972 (0) 8 6718187
sales@emproco.com

***Italy:*** Spectra Sri
+39 613321
ecaglio@spectra.it

***Korea:*** SM Instruments Co., Ltd.
+82 42 861 7004
youngkey@smins.co.kr

***Serbia:*** NORTH Point Ltd.
+381 24 62 62 72
gajins@north.rs

***Singapore:*** ACOUSTI-TEQ ASIA PTE LTD
+65 6694 4421
sales@acousti-teq.net

***South Africa:*** ESTEQ Test & Measurement (Pty)
+27 12 809 9500
e.murison@esteq.com

***South America:*** SMART Tech
+55 11 3168 3388
marcelo@smarttech.com.br

***Spain:*** Anotec Consulting S.L.
+34 916 897 540
nico@anotec.com

***Spain:*** PROTOS Euroconsultores de Ingeneria S.L.
+34 91 747 5891
Kimono.alexiou@protos-eci.es

***Spain:*** Uros Ingenieria
+34 91 3329621
Jalon_id@uros.es

***Sweden:*** Acoutronic AB
+46 87 650 280
toby@acoutronic.se

***Sweden:*** Arotate-Consulting AB
+46 708 955150
janos@arotate.com

***Sweden:*** Sound View Instruments
+46 (0) 70 681 79 89
Anders.norborg@soundviewinstr.com

***Taiwan:*** OE SCIENTECH CO., LTD.
+886 -2 25115747
terry@oe.com.tw

***Taiwan:*** Tops Technologies, Inc.
+886 932 068 059
kenlee@topstech.com.tw

***Thailand:*** LEGA Corporation Co., Ltd.
+66 2 746 9933
maya@legaeng.com

***The Netherlands:*** ABC International Trading B.V.
+31 162520447
nl@abctradings.com

***Turkey:*** DTA Ltd Sti.
+90 224 280 84 44A
kif.goksa@dta.com.tr

***Turkey:*** VibraTek
+90 0312 479 0302
Ibrahim.Caglayan@vibratek.com.tr

***United Kingdom:*** NTi Audio AG
+44 1438 870632
uk@nti-audio.com

***USA:*** Scantek, Inc.
+1 410 290 7726
PeppinR@scantekinc.com

## Campanella Associates

***USA:*** Campanella Associates
+1 6140 876 5108
a.campanella@att.net

## NTi

***Australia:*** Amber Technology Pty Ltd
+61 2 9998 7600
mharders@ambertech.com.au

***Austria:*** Studiokonzept Medientechnik GmbH
+43 1 815 2624
info@studiokonzept.at

***Belgium:*** Belram sa/nv
+32 2 672 95 90
info@belram.com

***Brazil:*** NTI Audio Inc.
+1 503 684 7050
americas@nti-audio.com

***Bulgaria:*** ATC Ltd.
+35 988 9528 649
hlebarovg@dir.bg

***Canada:*** NTI Audio Inc.
+1 503 684 7050
americas@nti-audio.com

***Chile:*** NTI Audio Inc.
+1 503 684 7050
americas@nti-audio.com

***China:*** NTI CHINA CO., LTD.
+86 10 5791 0038
china@nti-audio.com

***Czech Republic:*** NTi Audio Praha
+420 2209 99992
info@ntipraha.cz

***Denmark:*** Kinovox Pro ApS
+45 44 53 3011
ck@kinovox.dk

***Estonia:*** Noretron Communication Ltd
+358 10 525 8070
timo.kunnas@noretron.fi

***Finland:*** Noretron Communications Ltd.
+358 10 525 8070
timo.kunnas@noretron.fi

***France:*** FREEVOX SA
+33 1 486 322 11
l.delenclos@freevox.fr

***Germany:*** NTi Audio GmbH
+49 201 6470 1900
de@nti-audio.com

***Greece:*** Bon Studio S.A.
+30 210 380 9605 8
bon@bonstudio.gr

***Hungary:*** Elimex Kft
+36 1 239 8270
zsofi@elimex.hu

***India:*** AVF Distributors (I) Pvt. Ltd.
+91 22 2405 1686
info@avfindia.com

***India:*** AVF Distributors (New Dehli)
+91-11-2 874 11 31
info@avfindia.com

***Iraq:*** Wellmar Technology F.Z.E
+971 6 745 9621
sv-sales@wellmaruae.com

***Israel:*** Sontronics Electr. Equipm. Ltd
+972 3 570 5223
sales@sontronics.co.il

***Italy:*** Spectra SRL
+39 039613321
info@spectra.it

***Japan:*** NTI Japan Limited
+81 3 3634 6110
okayasu@nti-japan.com

***South Korea:*** NTi Audio Korea
+82 2 6404 4978
korea@nti-audio.com

***Latvia:*** Audio AE Ltd.
+371 67807310
audioae@audioae.lv

***Lithuania:*** Midiaudio Ltd.
+370-37-223288
sales@midiaudio.com

***Malaysia:*** TekMark Broadcast Sdn Bhd
+603 9057 8999
gs.wong@tekmarkgroup.com

***Mexico:*** NTI Audio Inc.
+1 503 684 7050
americas@nti-audio.com

***Netherlands:*** Ampco Flashlight Sales BV
+31 30 2414070
sales@ampco-flashlight.nl

***New Zealand:*** Amber Technology (NZ) Ltd.
+64 9 443 0753
ross@amber.co.nz

***Norway:*** Benum siv. ing. AS
+47 2213 9900
post@benum.com

***Poland:*** Konsbud Audio Sp. Z O.O.
+48 226 44 3038
info@konsbud-audio.com.pl

***Portugal:*** Wavelan S.A.
+351 916 900 409
Nuno.sousa@wavelan.pt

***Romania:*** db Technolight
+40 268 331 410
dan@dbt.ro

***Russia:*** Audio Solutions
+7 495-730-5368
info@audiosolutions.ru

***Singapore:*** Affinity Engineering
+65 63164432
vincent-hii@affinityec.com

***Slovakia:*** NTi Audio Praha
+420 2209 99992
info@ntipraha.cz

***Slovenia:*** AVC Slovenia
+386-1-530 78 70
jani.medic@avc-group.si

***South Africa:*** Wild & Marr (Johannesburg)
+27 11 974 0633
info@wildandmarr.co.za

***Spain:*** Neotécnica, S.A.
+34 91 542 09 00
neotecnica@neotecnica.es

# International Representatives

***Sweden:*** Sennberg AB
+46 8 566 16400
stephan.segermark@sennberg.se

***Switzerland:*** Contrik AG
+41 44 736 50 10
contrik@contrik.ch

***Taiwan:*** NTI CHINA CO., LTD.
+86 512 6802 0075
china@nti-audio.com

***Thailand:*** Get Best Solutions
+66 62 195 1909
sale@getbestsound.com

***Turkey:*** ASF SES ISIK VE GORUNTU SISTEMLERI A.S.
+90 212 227 6800
ugur.dogan@asf-avl.com

***United Kingdom:*** NTi Audio UK Ltd.
+44 1438 870632
uk@nti-audio.com

***USA:*** NTI Audio Inc.
+1 503 684 7050
americas@nti-audio.com

## Odeon

***Denmark:*** Odeon A/S
+45 8870 8845
info@odeon.dk

## Rion

***Algeria/France/Morocco/Tunisia:*** ViaXys
+33 2 38 87 45 35
info@viaxys.com

***Argentina:*** HIKARI S. A.
+54 11 4811 5767, +54 11 4815 2968
cientifica@opticagriensu.com

***Australia:*** Acoustic Research Labs Pty Ltd
+61 2 9484 0800
reception@acousticresearch.com.au

***Austria/Czech/Slovakia/Slovenia:*** LB-acoustics Messgeraete GmbH
+43 (0)1 270 77 00
Office@LB-acoustics.at

***Belgium/Luxembourg:*** Sysmex Belgium N.V.
+32 (0)2 7697474
info@sysmex.be

***Bosnia and Herzegovina/Croatia/Serbia:*** CERIUM d.o.o.
+385 (0)1 580 59 21
info@cerium.hr

***Brazil:*** TST-Instrumentos de Medição Ltda.
+55 11 4221-6110
marcos.piai@tstm.com.br

***Chile:*** Sociedad Acustical S.A.
+56 2 892 0380
laboratorio@acustical.cl

***China:*** RION SCIENCE & TECHNOLOGY SHANGHAI LTD
+86-21-5423-5082
info-china@rionchina.com

***Colombia/Ecuador/Perú:*** Alava Ingenieros S.A., Sucursal del Perú
+511 447 50 27
alava@grupoalava.com

***Cyprus:*** Panacoustics Ltd
+357 25 822816
info@panacoustics.com

***Denmark/Norway:*** Lesanco ApS
+45 3961 1206
lesanco@lesanco.dk

***Finland:*** MIP Electronics Oy
+358 10 3222 631
info@mip.fi

***Germany:*** ZINS Ziegler-Instruments GmbH
+49 (0)2166-1898-500
zins@ziegler-instruments.de

***Greece:*** G.CHRALAMPOPOULOS-S. MOUZAKITIS G.P./GROUP SCIENCE
+30 210 8053121, +30 213 0311028
info@groupscience.gr

***Hong Kong:*** Che Scientific Co (Hong Kong) Ltd (Distributor for Viscotester)
+852 2481 1323
sales@chescientific.com

***Hong Kong:*** Science International Corporation
+852 2 543 7442
ehs@scienceintel.com

***Hungary:*** ENTEL Engineering Research & Consulting Ltd
+36 (1) 336-0400
rion@entel.hu

***India:*** Mecord Systems and Services Pvt Ltd
+91 22 2500 8128 / 2500 7552
info@mecord.com, sales@mecord.com

***Indonesia:*** PT Transindotama Sinar Perkasa
+62 21 4584 0670 / 4584 0671 / 4584 0672
transindotama@transindotama.com, transindotama@gmail.com

***Ireland/United Kingdom:*** ANV Measurement Systems
+44 1908 64 28 46
info@noise-and-vibration.co.uk

***Ireland:*** Industrial Acoustics Company Ltd
+353 1 2828043
info@iacl.ie

***Italy:*** ntek s.r.l.
+39 334 16 66 958
info@ntek.it, amministrazione@ntek.it, commerciale@ntek.it

***Italy:*** VIBRO-ACOUSTIC
+39 049 9200 975
info@scs-controlsys.com

***Korea:*** SR Tech Co, Ltd
+82-31-754-8481
sunilrion@sunilrion.co.kr

***Malaysia:*** O'Connor's Engineering Sdn Bhd
+60 3 7953 8400
oconnor@oce.com.my

***Malaysia:*** Active Acoustic Engineering Sdn Bhd
+603-6151 8717
enquiry@active-acoustic.com

***Netherlands:*** Sysmex Nederland B.V.
+31 (0)76 5086000
info@sysmex.nl

***New Zealand:*** Machinery Monitoring Systems LTD
+64 9 623 3147
mamos@xtra.co.nz

***Poland:*** EKOHIGIENA APARATURA Sp. zo. o.
+48 71 31 76 850
biuro@ekohigiena.com.pl

***Portugal:*** M.R.A. Instrumentacao S.A.
+351 21 421 74 72
mra@mra.pt

***Romania:*** Spectromas SRL
+40 21 310 10 95
info@spectromas.ro

***Russia:*** Eurotest Ltd
+7 (812) 703-05-55
sales@rion-russia.ru

***Singapore:*** O'Connor's Singapore Pte Ltd
+65 6470 4712 (DID)
enquiries@oconnors.wbl.com.sg

***Singapore:*** Salient Technologies Pte Ltd
+65 6659 2411
sales@salient-tech.com.sg

***South Africa:*** Environmental Instruments International cc
+27 21 914-4408
info@envinst.co.za

***Spain:*** ALAVA Ingenieros S.A.
+34 91 567 97 00
alava@alava-ing.es

***Sweden:*** Acoutronic AB
+46 8 765 02 80
info@acoutronic.se

***Switzerland:*** A - TECH testing GmbH
+41 56 634 26 26
info@a-tech.ch

***Taiwan:*** Ring-In Trading Development Co., LTD
+886 2 2381 6767
ringin@ms6.hinet.net

***Thailand:*** Sithiporn Associates Co., LTD
+66 2 433 8331
sa-epd@sithiphorn.com

***Turkey:*** Cev-Tek Ltd Sti
+90 312 394 15 50
bilgi@cevtek.com.tr

***UAE:*** Enviro Engineering General Trading LLC
+971 44201188
info@enviroegt.com

***USA/Canada/Mexico***

Sage Technologies – Arizona
+1 480 732 9848
coconnor@sagetechnologies.com

Sage Technologies – Michigan
+1 734 525 8100
dsulisz@sagetechnologies.com

Sage Technologies – S. California
+1 310 779 7873
mweesit@sagetechnologies.com

Sage Technologies – N. California
+1 310 503 7890
eweesit@sagetechnologies.com

Sage Technologies – Washington
+1 425 454 9680
tnorsworthy@sagetechnologies.com

Scantek Inc. - HQ
+1 410 290 7726
info@scantekinc.com

Scantek Inc. - West
+1 410 384 4221
infowest@scantekinc.com

***Vietnam (Hanoi):*** Technical Instrument & Consultant Technology (TECOTEC)
(+84-4) 35763500 / 35763501
hanoi@tecotec.com.vn

***Vietnam (Ho Chi Minh):*** MT Scientific Equipment Co., LTD
(+84 8) 3 86 460 51
mtse@hcm.vnn.vn

## Scantek, Inc.

***Mexico and South America:*** CIAAMSA División Acústica
+55 1054 3209/+55 1054 3210
nbenitez@ciaamsa-acustica.com

## SoundPLAN International LLC

***Argentina:*** Dakar ingenieria acustica Argentina,
+54 (11) 4865 79 84; +54 (11) 4 865 79 84;
email: soundplan@dakar-acustica.com.ar

***Australia:*** Marshall Day Acoustics,
+612 9282 9422; +612 9281 3611;
email: soundplan@marshallday.com

***Bangladesh:*** RECL,
+8801713066403;
email: h.ahsan@yahoo.com

***Brazil:*** GROM Acustica & Automacao,
+55 212516 0077; +55 21 2516 0308;
email: comercial@grom.com.br

***Canada:*** Navcon Engineering Network,
+1 714 441 3488; +1 714 441 3487;
email: Forschner@navcon.com

***China:*** Misheng Group Ltd,
+85221654143;
email: info@mi-sheng.com

***Chile:*** Sinruido,
+562 2398736;
email: Ing.mora@gmail.com

***Colombia:*** High Tec Environmental Ltda,
+5716713700; +5716713700x110;
email: soporte@hteltda.com

***Czech Republic:*** SYMOS s.r.o.,
+42 220 999 977; +42 257 225 679;
email: symos@symos.cz

***Denmark:*** SoundPLAN Nord,
+45 (39) 46 12 00; +45 (39) 46 12 02;
email: jkl@soundplan.dk

***Egypt:*** Elnady Engineering and Agencies,
+20 2 23420896; +20 2 23421791;
email: info@elnadycompany.com

***France:*** Euphonia,
+33 (0) 1 42 21 16 05; +33 (0) 9 56 70 71 49;
email: Arnault.damien@euphonia.fr

***Germany:*** Braunstein + Berndt GmbH,
+49 7191 91 44 0; +49 7191 91 44 24;
email: bbgmbh@soundplan.de

***Greece:*** I Acoustics Hellas,
+30210 6630 333; +30210 6630 334;
email: dpramas@acoustics.gr

***Hong Kong:*** Takabama Ltd,
+852 2868 0990; +852 3007 8648;
email: Takabama@gmail.com

***Hungary:*** VIBROCOMP GmbH,
+36 1 3107292; +36 1 3196303;
email: bitep@vibrocomp.hu

***India:*** Adams Engineering Projects Pvt. Ltd. India;
+9144 28173711; +9144 28172676;
email: sales@adams-tech.net

***Indonesia:*** PT.DANANWINGUS SAKTI,
+628161812871; +62215674507;
email: Antonius.wira@ptdws.com

***Ireland:*** Marshall Day Acoustics,
+442830898009; +44788540661;
email: shane.carr@marshallday.co.uk

***India:*** Adams Engineering Project Pvt. Ltd, India,
+9144 28173711; +9144 28172676;
email ganeshhv@adams-tech.net

***Israel:*** RTA Engineering Ltd,
+972 (0) 77 5503994; +972 (0) 77 6499964;
email: Ronen@rtaeng.com

***Italy:*** Spectra s.r.l.,
+39 039 613321; +39 039 6133235;
email: spectra@spectra.it

***Japan:*** Ontek R&D Co., Ltd,
+81 45 935 3818; +81 45 935 3806;
email: Watanan@onosokki.co.jp

***Kenya:*** Machoy cc;
+27 214245719;
email: marketing@soundplan.co.za

***Korea (South):*** ABC TRADING,
+82 2 2226 3161, +82 2 2226 7383;
email: abc@abctrd.com

***Kuwait:*** Elnady Engineering and Agencies,
+20 2 23420896; +20 2 23421791;
email: info@elnadycompany.com

***Malaysia:*** Acoustic & Environmental Solutions Pte Ltd,
+6567762212; +65 6776 2770;
email: Kenny@aes-aes.com

***Mexico:*** Ingenieria Acustica Spectrum Sa Cv,
+52 55 55 67 08 78; +52 55 53 68 61 80;
email: acusticaspectrum@prodigy.net.mx

***Netherlands:*** AV Consulting B.V.;
+31 182 352311; +31 182 354711;
email: info@av-consulting.nl

***New Zealand:*** Marshall Day Associates,
+64 9 379 7822; +64 9 309 3540;
email: siiri.wilkening@marshallday.co.nz

***Norway:*** SoundPLAN Nord,
+45 (39) 46 12 00; +45 (39) 46 12 02;
email: jkl@soundplan.dk

***Peru:*** Global Group S.A.,
+51 1 4464627;
email: globalgroupsa@gamil.com

***Poland:*** PC++ Software Studio S.C.,
+48 606 110 270;
email: support@pcplusplus.com.pl

***Portugal:*** AAC Centro de Acustica Aplicada SL,
+34 45 29 82 33; +34 45 29 82 61;
email: aac@aacacustica.com

***Romania:*** Vibrocomp Kft,
+40 723 614 524; +36 1 3196303;
email: bitep@vibrocomp.hu

***Russia:*** Baltic State Technical University,
+7 812 5338907; +7 812 5338907;
email: marina_butorina@inbox.ru

***Serbia:*** Dirigent Acoustics D.O.O.,
+381 11 763 887; +381 11 763 887;
email: dgtdejan@yahoo.com

***Singapore:*** Acoustic & Environmental Solutions Pte Ltd,
+6567762212; +65 6776 2770;
email: Kenny@aes-aes.com

***South Africa:*** Machoy cc;
+27 214245719;
email: marketing@soundplan.co.za

***Spain:*** AAC Centro de Acustica Aplicada SL,
+34 45 29 82 33; +34 45 29 82 61;
email: aac@aacacustica.com

***Sweden:*** SoundPLAN Nord,
+45 (39) 46 12 00; +45 (39) 46 12 02;
email: jkl@soundplan.dk

***Thailand:*** Geonoise Thailand Co., Ltd.,
+66200235904;
email: contact@geonoise.com

***Taiwan:*** AEC Team,
+886 2 2713 2882;
email: dave@aecteam.com

***Turkey:*** Hidrotek Mimarlik Muhendislik Ltd.Sti,
+90 216 372 20 27; +90 216 384 72 51;
email: aakdag@hidro-tek.com

***United Arab Emirates:*** Vibrocomp Me Fzc;
+971 52 7937216;
me@vibrocomp.com

***United Kingdom:*** SoundPLAN UK&I,
+44 1751 417055; +44 1787 478498;
email: david@soundplanuk.co.uk

***USA:*** Navcon Engineering Network,
+1 714 441 3488; +1 714 441 3487;
email: Forschner@navcon.com

***Vietnam:*** Mr. Hoang The Anh,
+84904326005;
email: vietnam@soundplan.asia

## Zero International

***Australia:*** Hafele Australia Pty. Ltd.
+61 3 9212 2061
djones@hafele.com.ua

***Canada:*** Les Agences Real Demers, Inc.
+1 514 387 7515
realdemers@ard.ca

***Hong Kong:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***Australia:*** Hafele Australia Pty. Ltd.
+61 3 9212 2061
djones@hafele.com.ua

***Indonesia:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***Japan:*** Zero Tokyoman & Co. Ltd.
+048 866-8660
henmi@tokyoman.co.jp

***Korea:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***Malaysia:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***The Netherlands:*** Alprokon Aluminum
+31 180 643962
henk.vanherpen@alprokon.com

***New Zealand:*** F.L Bone & Son Limited
+64 873 0282
ian.h@flbone.co.nz

***Philippines:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***Singapore:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***Taiwan:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***Thailand:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

***United Arab Emirates:*** Zero East
+052 152 7406
kazi@zerollc.com

***United Kingdom:*** Zero Seal Systems Ltd.
+44 1785 282910
sales@zeroplus.co.uk

***Venezuela:*** Jose' Miguel Herrera O.
+58 212 514 7541

***Vietnam:*** Zero Asia Pacific
+81 45 567 4117
zeroasiapacific@gmail.com

# Acknowledgments

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*Below is a list of congresses and conferences sponsored by International INCE and INCE-USA. A list of all known conferences related to noise can be found by going to the International INCE website (www.i-ince.org/).*

Don't forget: 2020 is the International Year of Sound!
http://sound2020.org

**August 23–26, 2020**
**INTER-NOISE 2020**
49th International Congress and Exposition on Noise Control Engineering
E-Congress
https://internoise2020.org

**November 16–18, 2020**
**NOISE-CON 2020**
New Orleans, Louisiana, USA
https://www.inceusa.org/noisecon20/

**June 14–17, 2021**
**13th ICBEN Congress on Noise as a Public Health Problem**
Karolinska Institutet
Stockholm, Sweden
https://www.icben2020.se/

**August 1–4, 2021**
**INTER-NOISE 2021**
50th International Congress and Exposition on Noise Control Engineering
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*Information on listings in the Directory of Noise Control Services is available from the INCE-USA Business Office, 11130 Sunrise Valley Dr., Suite 350, Reston, VA 20191-4371 Telephone: +1.703.437.4073 email: ibo@inceusa.org.*

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