NOISE/NEWS INTERNATIONAL

Volume 27, Number 3
2019 September

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

- The report on INTER-NOISE 2019 in Madrid
- Noise news from around the world
- Vibration control: An overview and checklist
- Quiet deliveries: An update from Stockholm

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Features

Departments

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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

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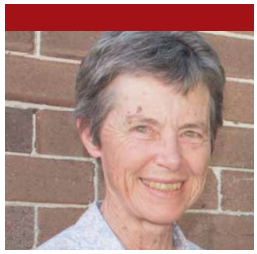
- The current PDF issue of *NNI* available for free download
- Links to previous PDF issues of *NNI*
- An annual index of issues in PDF format
- A conference calendar for upcoming worldwide meetings
- Links to I-INCE technical activities and I-INCE technical reports

From the President of I-INCE

The Spanish Acoustical Society (SEA) was the host for the very successful INTER-NOISE 2019 congress in Madrid. The main organizers were Antonio Perez Lopez, Antonio Calvo-Manzano, and Salvador Santiago from SEA, plus Jorge Patricio from the Portuguese Acoustical Society, and they were ably assisted by a team of enthusiastic acousticians from the region, all of whom deserve thanks for their efforts. Not only was it the time for the congress but it was also a celebration for the 50th anniversary of the SEA. There is a full report on this congress elsewhere in this issue, but I wish to particularly mention the honor bestowed on the I-INCE. The Caracola SEA is the highest award of the Spanish Acoustical Society, and it was presented to I-INCE during the congress for "the important contributions of I-INCE on promoting Noise Control all over the world through the organization of the INTER-NOISE congresses and your strong support to our Association." The award comprises a three-dimensional solid bronze sculpture in the shape of a shell fixed to a wooden base. The award was received by three persons from I-INCE: the past president Joachim Scheuren, the president Marion Burgess, and the president-elect Robert Bernhard. It has now traveled to Korea to be on the table at the board meeting to be held in conjunction with the INTER-NOISE 2020 in Seoul.

The time of the congress is also the time for the meeting of the board of I-INCE and the general assembly of member organizations. In addition to the business undertaken during the year by email, these meetings are important to manage the affairs of the institute. The board meets on Saturday afternoon and again on Wednesday evening, and the general assembly meets on Sunday before the congress opens.

The terms for the board members are between three and four years and the bylaws define that any member can only serve two terms in the same position, unless there are exceptional circumstances. At the end of 2019, the terms of a number of board members come to an end. The board and general assembly approved the recommendations from the nominating committee for the 2020 board composition. There will be three automatic changes. The term of the past president, Joachim Scheuren, ends; however, he has been reappointed as a distinguished board member for 2020, to complete the work associated with the legal status for I-INCE plus work on the planning for the 50th anniversary celebration in 2021 at the time of INTER-NOISE in Washington. The current president becomes past president, and Robert Bernhard becomes president. Luigi Maffei becomes the president-elect for the period 2020–22. Paul Donovan has been reappointed as secretary general for 2020–21, and Otto von Estorff has been elected as a distinguished board member to assist with updating administrative tasks and tools. Doug Manvell has accepted another term as treasurer. We will welcome to the board Gijsjan van Blokland as vice president development and outreach and Antonio Perez-Lopez as a director for INTER-NOISE 2019. Following a vote, the general assembly elected John Davy to serve a term as director-at-large for Asia Pacific.



Marion Burgess

The I-INCE is strongly supporting the International Year of Sound in 2020 (IYS2020). This is an initiative from the International Commission for Acoustics (ICA) with the intent that there will be a particular focus on the importance of sound, and of course, that includes the control of noise, in our world. I-INCE also encourages all member organizations to consider some form of outreach activity in their region in 2020. The activity can take any form but should aim to engage with the wider community and enhance the understanding and appreciation of sound. The ICA has set up a website where organizations can post their events, gain the authority to use the IYS2020 logo, and then provide a report on their activity, which will comprise the historical record for IYS2020 (for more information, visit http://sound2020.org/).

Marion Burgess
President, I-INCE

Fig. 1. Presentation of the CARACOLA SEA *to I-INCE*

Editor's View

Welcome to the September 2019 issue of *Noise/News International*. In this jam-packed issue, we hear from I-INCE president Marion Burges, look back at INTER-NOISE 2019 from Madrid, provide a checklist for vibration control, feature some recent book reviews, and check in with the Stockholm pilot study examining the effect of a ban on truck deliveries at nighttime. Gary W. Elko also remembers Jiri Tichy, a former president of INCE-USA, who passed away earlier this year. And as always, we have our regular NOISE/NOTES roundup of all the news making headlines around the world.

At INTER-NOISE 2019 we announced an exciting addition to our NOISE/NOTES feature. At the Young Professionals award ceremony, we invited all those young professionals to become an NNI international correspondent. I've reached out to all these individuals and invited them to submit links to articles and stories that are catching their attention, from wherever they might be. Keep a look out for these stories from the next generation of noise control professionals. Of course, if you have any stories you would like featured, please email me (kingea@tcd.ie) or let me know on Facebook or Twitter (@NNIEditor)!

More recently, I hope some of you managed to make it to San Diego for NOISE-CON 2019, where we were catching the next wave in noise control engineering. It has just wrapped up, and a full conference report will be presented in the next issue of *NNI*. Until then!

Eoin A. King, PhD

Eoin A. King, PhD

NOISE/NOTES

Eoin A. King, *NNI* Editor, Eva Von Dell, *NNI* Social Media Assistant, and Brianna Cervello, *NNI* Social Media Assistant

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!

Student Project Tracks Noise Pollution in Colorado

A Colorado college study is monitoring sounds (and noise, unfortunately) around natural spaces in Colorado Springs. One of the researchers observes, "You'll start to hear the noise pollution. And eventually, you won't be able to unhear it."

Hand Dryers Can Hurt Children's Ears

According to research recently published in the Canadian journal *Paediatrics and Child Health*, noise from hand dryers in restrooms may be harmful to children's ears. The study found that Xlerator hand dryers were the loudest type, with all noise measurements in excess of 100 dBA with hands in the airstream, while the Dyson Airblade recorded the single loudest measurement of 121 dBA. Hand dryers are all the more serious for children, as their ears will usually be closer to the noise source than adults. The author of the study, Nora Louise Keegan, is writing from experience: she is only 13 years old!

Cruise Liners Warned to Keep the Noise Down in Ireland

Cruise liners docking in Cobh, Ireland, have been warned to keep quiet by the port authority. The busy port sees up to 100 cruise liners docking in the town of Cobh, and the surrounding topography is being blamed for amplifying sounds coming from the cruise liners.

The Importance of Avoiding Noise-Induced Hearing Loss

A study by researchers at Purdue University with the University of Rochester that was recently published in the *Journal of Neuroscience* shows that the source of hearing loss may have a large impact on a person's ability to understand speech and enjoy music. The study measured differences in neural processing between the two most common sources of hearing difficulty: noise trauma and age-related metabolic loss. Results suggest that noise trauma causes substantially greater changes in the neural processing of complex sounds compared with age-related metabolic loss.

Tickets for Noise—Toronto Is Cracking Down on Noise

From October, the police in Toronto will be cracking down on noisy vehicles. Through the Awareness and Enforcement for Unnecessary Noise campaign, the police will hand out tickets for everything from modified mufflers to excessively loud music. Tickets for noise offences will range from $110 to $155.

Using Sound to Save Eagles from Wind Turbine Blades

Researchers at the University of Minnesota are trying to deter eagles from hitting wind turbines' blades by using natural and synthetic acoustic stimuli. Early results show that the eagles paid closer attention to natural calls rather than synthetic signals. The study is ongoing, but the authors hope that it provides a step toward reducing the number of deaths of bald and golden eagles when they inadvertently fly into wind turbine blades.

INTER-NOISE 2019 Report

INTER-NOISE 2019, the 48th International Congress and Exposition on Noise Control Engineering, organized by the Spanish Acoustical Society (SEA) on behalf I-INCE, was held June 16–19, 2019, at the IFEMA Palacio Municipal, in Madrid, Spain.

With 1,188 delegates in attendance, the conference saw 815 oral technical presentations and 79 poster presentations, from a total of 2,925 authors spread over 95 technical sessions. While organizing a conference of this size requires time and help from many individuals, the principal congress organizers were Antonio Perez-Lopez (congress president), Jorge Patricio (congress vice president), and Antonio Calvo-Manzano (general secretary, proceedings editor). Also assisting with the organization and administration of the conference were J. Salvador Santiago (technical program committee chair, proceedings editor); Luigi Maffei (technical program committee chair); Ana Delgado (proceedings editor); and Joan Casamajo, Ana Espinel, Harald Muñoz, Castor Rodriguez, Jose Maria Ruiz (exhibition committee). The exhibition hall saw 55 exhibitors representing 61 companies over a total of 63 separate stands.

This year, the theme of the conference was "Noise Control for a Better Environment," and contributions came from over 60 countries around the world. As luck would have it, it was quite appropriate to have INTER-NOISE in Madrid this year, as the congress was also an opportunity to celebrate the 50th anniversary of the host society, the Spanish Acoustical Society.

Opening the Conference, Sunday, June 16

The opening events for the conference were held on Sunday afternoon, June 16. In the opening ceremony, congress president and SEA president Antonio Pérez-Lopez welcomed all the attendees to the congress and to the city of Madrid. He expressed his gratitude to all involved and promised four days where we would share the most advanced research on noise control and its different technologies. He also explained that the *Madrileños* are sometimes called "cats"; they enjoy a night out, but they do so quietly and enjoy the night without bothering anyone. He invited all attendees to do the same—enjoy Madrid late but don't make any disturbing noise!

There followed presentations from the congress technical chair, José Salvador Santiago Páez, and the vice president of the I-INCE for technical activities, Patricia Davies. After these remarks, there were special presentations of the Caracola SEA, the highest award of the SEA. This year's

Fig. 1. Antonio Pérez-Lopez welcomes everyone to Madrid

Fig. 2. Presentation of Caracola SEA to I-INCE

Fig. 3. Ines López Arteaga delivering the first plenary lecture

Fig. 4. Wrapping up the opening ceremony with a cocktail reception

Fig. 5. Stephen Hambric delivering his keynote lecture

awardees included Marion Burgess, I-INCE president; Joachim Scheuren, I-INCE past president; Antonio Pérez-López, SEA president; and the I-INCE itself. I-INCE received the award in recognition of the important contributions the institute has made in promoting noise control all over the world through the organization of the INTER-NOISE congresses.

The president of I-INCE, Marion Burgess, then took the stage to welcome everyone to Madrid and declare the congress officially open.

The first plenary lecture was delivered by Ines López Arteaga, from the Eindhoven University of Technology and the Royal Institute of Technology of Sweden. The topic of her talk was "Rolling Noise in Road and Rail Transportation Systems." She noted that "long term exposure to ground transportation (road and rail traffic) noise is, after air pollution, the main environment-related health stressor in densely populated areas and compromises the quality of life and, indirectly, the life expectations of millions of people." In an interactive presentation, she frequently asked the audience questions and invited people to stand or sit if they agreed or disagreed with a specific statement. Using a roving microphone, she then delved deeper into the viewpoints of various audience members.

After this presentation, the audience was treated to a performance from the choir of the Polytechnic University of Madrid, which performed pieces from the golden century of Spanish music, works based on Spanish literature, and fragments of zarzuelas. The activities concluded with a tapas and cocktail reception.

Monday, June 17

The technical program began on Monday, June 17. The day began with 19 parallel sessions covering a wide array of topics, from community noise to artificial intelligence.

The day also saw a keynote lecture from Stephen A. Hambric, from Penn State's Center for Acoustics and Vibration. The title of his talk was "To Infinity and Beyond—The Amazing Uses of Infinite Structure Mobility Theory." He started by asking, "What if there were simple formulae you could use to calibrate structural mobility measurements on beams, plates, pipes, large pressure vessels, aircraft fuselages, and other structures? What if those same formulae could be used to estimate the mobilities of structures that haven't been built? How about using them to estimate how mobility might change if you modify the material properties of an existing structure? Great news—these formulae exist, are simple enough to code in a spreadsheet in minutes, and are perhaps the most invaluable tools a structural-acoustician has." Great news indeed, and what followed was a great presentation on infinite structure mobility theory.

The encouragement of young professionals is vitally important, and in recognition of this, I-INCE funds a number of Young Scientists Grants to assist with participation at each congress. On Monday afternoon, the I-INCE Young Professional Workshop was held and was followed by the presentation of travel awards and a social networking hour. The goals of the Young Professional Practice School are to provide mentorship via case studies and professional issues presented by world-renowned experts and to hold informal discussions between young professionals and I-INCE leaders and senior noise control engineers.

Tuesday, June 18

The congress continued on Tuesday and opened with 18 parallel technical sessions covering a wide range of topics. Both the technical sessions and the exhibition continued through this day. There was active participation in both with many excellent papers. The plenary lecture

Fig. 6. Young Professional Awards presentation

Fig. 7. Jun Yang delivering Tuesday's keynote lecture

Fig. 8. Celebrating 50 years of SEA

Fig. 9. André Fiebig delivers the conference's final keynote lecture

Fig. 10. INTER-NOISE 2019 poster session

Fig. 11. INTER-NOISE 2019 Exposition

Fig. 12. 50 Years of SEA

for this day was delivered by Jun Yang, from the Chinese Academy of Sciences (CAS), University of Chinese Academy of Sciences (UCAS), and the director of the Key Laboratory of Noise and Vibration Research at CAS. The title of his talk was "Sound Zone Reproduction Using Loudspeaker Array." The talk considered the reproduction of a desired sound field over a target region, which is a hot topic in the research area of the spatial audio. This presentation proposed a framework for a robust sound field reproduction design, which would allow a physical perspective on the regularization required for a system, increase robustness of the SFR systems against perturbations, and simplify the SFR system design.

On Tuesday evening, an event to celebrate the 50th anniversary of the founding of the Spanish Acoustic Society took place. A number of awards were presented to deserving individuals during the event, including the Caracola SEA to Emilio Lora-Tamayo, who delivered a speech covering the history of the SEA over the last 50 years. The EEA, I-INCE, and the ICA all sent their well wishes and congratulated the SEA on its many achievements since its founding in 1969.

Wednesday, June 19

Technical sessions continued until lunchtime on Wednesday and ended with the final plenary lecture, delivered by André Fiebig, from Technische Universität Berlin, titled "The Perception of Acoustic Environments and How Humans Form Overall Noise Assessments." He noted that, because of the omnipresence of noise, the perception of noise has a strong impact on the well-being and life quality of human beings. The talk outlined the basics of perception and presented some insights into the complex mechanisms of forming overall noise assessments. Those insights are relevant for the fields of psychoacoustics and soundscape or even the experience of product sound quality and might be helpful to effectively protect humans from nuisance and adverse health effects.

The closing ceremony was held on Wednesday afternoon. Antonio Pérez-López thanked all those present for attending the congress and congratulated all on the quality of the papers presented. I-INCE president Marion Burgess declared the closing of INTER-NOISE 2019, and the ceremony concluded with an invitation to Seoul for INTER-NOISE 2020.

Fig. 13. Enjoying tapas and cocktails

Fig. 14. The view from the stage during the opening ceremony

Fig. 15. Follow @NNIEditor for up-to-date news

Obituary for Jiri Tichy, 1927–2019

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Jiri Tichy was born in 1927 in the former Republic of Czechoslovakia (present-day Czech Republic) and passed away on March 27, 2019, in Prague. He studied electrical engineering and physics, received a doctorate in technical sciences (DSc) from the Czech Technical University in Prague in 1952, and was awarded the diploma habil in 1965. He continued to work at the Czech Technical University first as an assistant and then as associate professor in the Department of Physics.

Jiri was acquainted with two well-known American acousticians: Lawrence Batchelder and Leo Beranek, who helped him to immigrate to the United States in 1968 during the Prague Spring. Jiri started at Penn State University as an associate professor of architectural acoustics and the graduate program in acoustics, an intercollege graduate program created in 1965 at Penn State. After promotion to full professor in 1972, Jiri moved full time to the graduate program in acoustics, where he served as chairman until his retirement in 1995. Under Jiri's tenure, the program quadrupled in size and the number of courses doubled. During those years, graduate enrollment also increased from 30 to over 100 graduate students. He established a continuing education program for industry and a certificate program in acoustics. He also mentored 28 MS and PhD students. The graduate program in acoustics has awarded several hundred PhD and MS degrees in a wide range of acoustics topics.

Jiri's principal academic interests were architectural acoustics, noise control, the acoustic intensity technique, active noise control, and virtual reality. He taught courses in architectural and building acoustics, theoretical acoustics, active noise control, and the intensity technique at Penn State, at the Czech Technical University in Prague, and to various industrial groups.

Jiri was well known throughout the world as a leading researcher and educator in acoustics. He published over 80 papers in journals and conference proceedings, a majority coauthored with his students; coauthored seven books; and presented many invited and contributed papers and keynote lectures at professional meetings around the world. His most recent book, titled *Acoustics of Small Rooms*, coauthored with Mendel Kleiner and published in 2017, comprehensively covers his unwavering devotion to understanding the influence of room acoustics on sound propagation and perception. The book contains a comprehensive view of room acoustics from the basic theory of room modes to room treatment, sound field playback, measurement, and the psychoacoustics of the perception of spatial audio in rooms.

Jiri loved music and was determined to create the best audio playback from his extensive record collection of classical music. He spent many evenings with friends, colleagues, and students assessing the playback quality of various

loudspeakers and hi-fi components that paraded through his living room. He took great joy in hearing his prized B&W 801 loudspeakers almost always come out on top.

In 1999, Jiri organized the first joint international meeting of the Acoustical Society of America with the European Acoustical Association, held in Berlin, Germany. This was the largest meeting on acoustics that took place in the previous century. In addition he organized or coorganized seven national or international meetings on active control of sound and symposia on sound intensity technique for industry.

Jiri's involvement with professional societies was quite intensive. His home society was the Acoustical Society of America, which he joined in 1960. He served or chaired many of its professional

committees such as medals and awards, architectural acoustics, noise, publication policy, and others. He was elected fellow to the society in 1970 and was the president of the society from 1994 to 1995. For his contributions to acoustics and its education, Jiri was awarded the gold medal by the society, the most distinguished award given by the Acoustical Society of America.

Jiri also played a prominent role in the Audio Engineering Society and was elected the fellow of the Audio Engineering Society in 1984. He was also active in the Institute of Noise Control Engineering, (1986–87), where he served as president, among other functions. The Czech Acoustical Society elected him an honorary member of the society. Also, he was a member of the Acoustical Society of Japan and the New York Academy of Sciences.

Jiri was an excellent professor and mentor to his many students. Although his lectures typically ended with chalkboards full of equations, he taught by focusing on the underlying physics of a problem and explained what the equations represented from a physically intuitive perspective. He was always interested in making sure that students were learning and thinking beyond the equations. Jiri also was diligent in helping students in their careers, both before and after graduation.

Jiri and his wife Dagmar, who passed away in 2003, were married in Prague in 1955. Their daughter, Dagmar, and her husband, Howard Stein, have three boys: Andrew, Sean, and Cory. They all work in various areas of medicine, except for Sean, who is a lawyer. In 2005, Jiri married Iva Apfelbeckova-Tichy, a former patent lawyer and longtime family friend from the Czech Republic. They split their time living in the Czech Republic and the United States. He will be greatly missed by all his students, colleagues, friends, and family.

Quiet Deliveries Make for More Livable Cities

Paul McDonald, Sonitus Systems

Editor's Note: This article is a follow-up to an article published in June 2018 (NNI, vol. 26, no. 2), considering a pilot study in Stockholm that examines the effect of a ban on truck deliveries at nighttime. Paul McDonald from Sonitus Systems writes to give us an update.

According to the World Health Organization (WHO), noise pollution is an underestimated threat that can cause hearing loss, cardiovascular problems, cognitive impairment, stress, and depression. Generally speaking, noise pollution in cities can be attributed to traffic, conversations, audio systems, construction, or entertainment, and it is a growing problem for local governments and city residents. As measures are required to reduce environmental noise, cities are turning to smart technology to manage noise levels and reduce the impact it has on its communities. As the global trend of urbanization intensifies, the neighborhood lines between residential and commercial are blurring. This is actually a positive thing from a placemaking perspective; however, it brings its own particular challenges. For example, nighttime deliveries in cities are now impacting residents in a more pronounced and unsustainable way.

This global urban problem has been identified by the city of Stockholm in Sweden, which is home to approximately 965,000 residents. As the largest city in the Nordic countries, Stockholm is tackling the noise issues associated with being a fast-growing, bustling city. In fact, many cities and countries have laws that limit noise in residential areas; however, there is still a lot of work to be done to roll out workable solutions. While noise is a completely normal part of life, people in cities can minimize traffic noises by altering their habits from driving to walking or using public transport. Cities can also reduce vehicle speeds, increase bicycle lanes, construct sound barriers, or maintain busy roads to help noise control; however, without proper monitoring systems in place, this can be challenging.

Having trucks or lorries delivering to shops or restaurants in the morning, during rush hour traffic, is generally not ideal. Stockholm recognized the need to consider overnight deliveries; however, as heavy-duty commercial vehicles are restricted from driving in Stockholm's city center at night because of the associated noise, a pilot study to test silent overnight deliveries was introduced

earlier this year at six McDonald's restaurants in Stockholm, using a hybrid truck from Scania and operated by HAVI.

The deliveries to McDonald's restaurants used silent electric-powered vehicles, which was a collaborative project between the city of Stockholm, HAVI, KTH, EU, McDonald's, and Scania. Sonitus Systems worked with KTH University to provide a technological solution. Sonitus Systems provides user-friendly and reliable noise monitoring systems, and the technologies developed have been transforming the international noise monitoring industry for more than a decade, with automated technology that allows users to monitor data online from anywhere in the world. With proven international experience, competency, and innovation, the team at Sonitus Systems is paving the way for disruption in the noise monitoring sector globally. Experts in smart city solutions, Sonitus Systems is currently measuring noise in 20 locations around Dublin, which can be accessed by the public.

The initiative in Stockholm was supported by Civitas Eccentric, which is an EU initiative for cleaner and better transport in cities. As Stockholm is growing quickly, the local government recognized the need to invest in smart solutions for sustainable mobility. The initiative involves other European cities including Madrid, Munich, Ruse, and Turku, and it aims to have fewer cars on the city roads, good cycling lanes, designated walking areas, cleaner vehicles, and increased civic support and participation. For Stockholm especially, the hope is to reduce car ownership, increase commercial bus speed, and reduce travel times in the city.

Motor vehicle noise is regarded as a nuisance, and with the noise caused by engine braking, exhausts, and displacement of air, the team in Scania knew they had to find a solution that would reduce the range of noises a lorry emits. For Stockholm to allow for deliveries during the twilight hours, there was no exception; the deliveries had to be silent, without causing noise disturbances to residents living nearby. A hybrid was the likely answer, and following a huge amount of work and collaborative research, Scania developed the hybrid truck.

The hybrid truck is run on a combination of electricity and fossil-free fuel, which greatly reduces the emissions of particles and carbon dioxide, thereby being better for the environment. Geofencing technology was fitted and connected to the truck, and with this technology, the truck is able to adapt to its environment and driving conditions in a predefined area. Traffic zones that are virtually available decide on how the vehicle will motor and alters its speed to the speed limits allowed in the city center, providing reduced emissions and noise. With the ability to drive quietly (in silent mode for up to 10 km) and a capability to drive for longer distances, the hybrid can deliver at night without disturbing residents. This change allows for fewer trucks on the roads during busy periods and actively aids the city's traffic jams. The truck's battery is charged by external power sources by regeneration, which means the movement of the truck is turned into electricity when the brakes are pressed. In this case, an electrical charging center was placed near one of the restaurants, allowing for the charging of the battery. Longer routes were another consideration between the city and the warehouse, so the vehicle is designed to run its internal combustion engine on HVO, allowing for a 90 percent reduction in carbon emissions. The software is so smart with Scania Zone (a software tool), virtual fences, and geofences, it automatically changes over to the "quiet mode" when it is in the city area.

The pilot study proved to be successful with the team, and the modified vehicles showed significantly reduced noise levels in sensitive areas. The noise monitoring program has now been extended to include an expanded fleet of vehicles across the city. The additional research funding will allow the technical teams to build on their initial findings and demonstrate the environmental and social advantages of their quiet delivery systems.

About Sonitus Systems

Sonitus Systems supplies robust and reliable sound level monitoring equipment globally from its base in Dublin. Its award-winning products and services allow users to easily monitor and assess noise levels in any scenario to ensure compliance. For more information, call the team at Sonitus Systems on +353 1 6778443 or email info@sonitussystems.com.

CAOHC Releases Education Video on Workplace Noise Concerns and Controls

When is the workplace too loud? A new video from the Council for Accreditation in Occupational Hearing Conservation (CAOHC) answers this question for those concerned about hearing conservation and offers noise control options. The video, titled "Workplace Noise: Measurement and Controls," takes the viewer through facts, measures, and strategies surrounding occupational noise.

"While the video was initially created for Course Directors to teach Noise Measurement and Control and the Physics of Sound, it is also ideal for employers who need a starting point in developing a hearing conservation program, for Industrial Hygiene professionals to educate their workforce, for managers, new safety professionals, and educators instructing occupational health," said CAOHC executive director Kim Stanton.

"The accessible and engaging nature of the video makes it ideal to use in training," said Stanton. "It offers a consistent, predictable message whenever you need it, making it cost effective for many audiences." The video also includes digital resources such as a companion manual, reference charts, a glossary of terms, and test questions and answers.

Content for the video was contributed by 17 different experts in the hearing conservation field. "A great deal of editing and rework went on to assure all the facts and images were accurate and approved by the entire CAOHC Council," said Brent Charlton, council member, who served as project manager for the video. The video has six modules of learning that can be viewed as one 40-minute video or individually in 5- to 7-minute segments. The modules are: (1) Characteristics of Sound, (2) Enter the Decibel, (3) Time-Weighted Average, (4) Permissible Exposure Limit, (5) Noise Control Strategies, and (6) Measuring Noise.

To see a video clip or to order, go to http://www.caohc.org/educational-resources/workplace-noise-measurement-and-controls.

About CAOHC

CAOHC is dedicated to the establishment and maintenance of training standards for those who safeguard hearing in the workplace. Its mission is "advancing best practices in occupational hearing conservation worldwide, through credentialing, standards, education, and advocacy."

The CAOHC Council consists of representatives from nine component organizations: American Academy of Audiology (AAA), American Association of Occupational Health Nurses (AAOHN), American Academy of Otolaryngology–Head and Neck Surgery (AAO–HNS), American College of Occupational Environmental Medicine (ACOEM), American Industrial Hygiene Association (AIHA), American Speech Language-Hearing Association (ASHA), American Society of Safety Professionals (ASSP), Institute of Noise Control Engineering (INCE), and Military Audiology Association (MAA).

Vibration Control: An Overview and Checklist

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Motivation

Although professionals in the noise and vibration control area certainly are familiar with what vibration control involves, we often focus on the facets we know best and thus may miss some useful alternatives. For this reason it may be useful to revisit the big picture, the fundamentals, and the range of potential vibration control approaches.

It is important to keep in mind that the basic purpose of vibration control is not the reduction of vibrations per se, but the reduction of the unwanted effects of vibrations. This mind-set enables one to consider a broader range of vibration control options than those typically addressed in textbooks and handbooks.

The Classical Model

It is useful to begin with the well-known source-path-receiver concept, as shown diagrammatically in the schematic figure below (fig. 1). The source—the item that causes vibration—here is illustrated as a cam-driven piston; the receiver—the item that is sensitive to vibration—is shown as a box that supports several cantilevers with masses at their ends, representing elements with different natural frequencies; the transmission path between the two is sketched as a narrow truss structure.

This simple model points to conception of the various vibration control means in terms of the five categories addressed in the next section and facilitates consideration of the associated wide variety of vibration control approaches.

An Outline of Vibration Control Means

A. *Vibration control at the source* (modification of the forces produced by the source)

1. Changing to an alternative system (e.g., by replacement of a reciprocating machine that generates inertia forces along a linear axis with a rotating machine that generates small rotating inertia forces).
2. Changing the orientation of the source so that the forces it generates do not act in the direction in which the path structure accepts and/or transmits motion most readily (e.g., by orienting the forces parallel, rather than perpendicular, to a plate structure).
3. Reduction of the motions and forces generated by the source (e.g., by dynamic balancing, modification of cam profiles, reduction of reciprocating masses).
4. Addition of dynamic absorbers to the source to reduce its motions at selected frequencies.
5. Detuning (changing the operation or the design of the source so that it does not generate vibrations at frequencies at which the path transmits vibrations well and/or at frequencies at which the receiver is sensitive).

B. *Reduction of the forces transmitted from the source to the path structure*

1. Adding inertia to the source (e.g., in the form of an inertia base).
2. Introducing a resilient connection (isolator) between source and path.
3. Adding an active control system between source and path.
4. Reducing the path's acceptance of vibrations at the source attachment

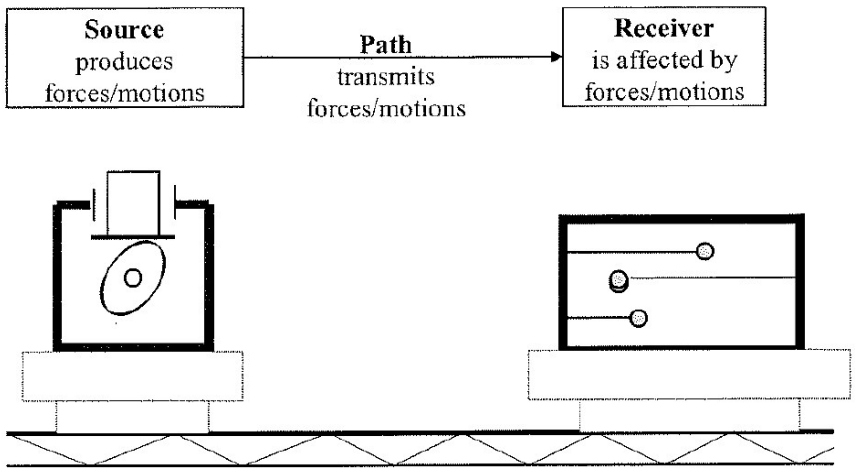

Fig. 1. Source-path-receiver scheme

(e.g., by adding mass, damping, vibration absorbers to the path structure at, or near, the source attachment).

C. *Reduction of transmission along the path*

1. Blocking energy propagation along the structure by adding impedance discontinuities (e.g., cuts or other changes in structural section properties, resilient elements, blocking masses, dynamic absorbers, mechanical filters, active control systems).
2. Enhancing energy dissipation (e.g., by adding damping treatments, localized dynamic absorbers, side paths to divert energy away from the receiver).
3. Detuning (modifying the path so that it does not transmit vibrations well at significant frequencies generated by the source and/or at frequencies at which the receiver is sensitive).

D. *Reduction of transmission from path to receiver*

1. Reduction of motion of path structure at receiver location (e.g., by adding mass, stiffness, dynamic absorbers to the path structure).
2. Insertion of resilient elements or active isolation systems between the path and the receiver.
3. Adding mass (e.g., an inertia base) or dynamic absorbers to the receiver.

E. *Reduction of adverse effects on receiver*

1. Changing to a less sensitive alternative receiver.
2. Reorienting the receiver relative to the path to reduce its reception of path vibrations in its more sensitive directions.
3. Modifying receiver design (e.g., by exchanging components to less sensitive ones, ruggedizing the assembly, adding internal isolation, damping, dynamic absorbers).
4. Detuning the receiver (modifying the receiver so that it is not sensitive at frequencies at which the source produces significant vibration and/or the path readily transmits vibrations).

Concluding Remarks

Obviously, real-world situations generally are more complicated than that represented by the simple classical schematic model. Several sources may be of concern. The behavior of any single source may be complex, giving rise to considerable forces acting in many directions and at many frequencies. A multitude of receivers with many sensitivities may be present as well as several significant transmission paths. Additionally, there tend to be practical (and financial) limits on what vibration control means can be implemented in a given case.

Nevertheless, the basic source-path-receiver view provides a valuable starting point for guiding one's thinking in practical situations, facilitating one's consideration of the variety of potentially useful vibration control approaches and means.

Book Reviews

Audio and Speech Processing with MATLAB

Paul R. Hill
CRC Press, Taylor and Francis Group (2018)
329 pp., hardbound, US$140
ISBN 978-1-4987-6274-8

This is a very well-written book on an important topic of both academic and general interests. The book is intended not only as a textbook for engineering and computer science students but also as a book for audio engineers, technically based musicians, and general readers with science and engineering backgrounds. The book is comprehensive in its approach, including many real-world examples backed up by many MATLAB functions and code snippets in order to illustrate the key topics within each chapter.

A very nice introduction is given at the beginning of the book. Then the book is organized well into 12 chapters. Chapter 1 (along with Appendix B) provides an introduction to the basic capabilities of MATLAB for audio processing. Chapter 2 introduces some of the core concepts that are necessary to understand the techniques and methods described in the book. This is an interesting feature that the reader can focus on to understand the core concepts. Chapter 3 describes frequency analysis for audio. Fast Fourier transform and its applications including its use in MATLAB are well described in this chapter. The basics of acoustics through discussions on vibrations of strings and air columns are given in chapter 4. The descriptions of the auditory system basics, critical bands, and critical band models are given in chapter 5. In chapter 6, the fundamentals of psychoacoustics such as loudness, equal loudness curves, audio masking, and perception of pitch are discussed. Chapter 7 describes audio compression. ISO standards such as MPEG1 are described. Chapter 8 describes automatic speech recognition. The topics for chapter 9 are audio features for automatic speech recognition and audio analysis. Chapter 10 describes hidden Markov models, Gaussian Markov models, and deep neural networks for automatic speech recognition. Chapter 11 describes speech coding. A discussion of speech coding standards is included in this chapter. Till now the various chapters focus on the synthesis and manipulation of audio for utilitarian purposes whereas the last chapter, chapter 12, discusses musical applications with a focus on synthesis and manipulation of audio for creative purposes.

The figures, including spectrograms, and tables in the book are very clear. Each chapter includes both contents at the beginning and a chapter summary at the end. Important equations and figures are enclosed in boxes. A detailed bibliography is included at the end of each chapter. Helpful exercises are provided at the end of each chapter. In summary, this book is a highly valuable addition to the field of audio and speech processing.

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Noise in the Plastics Processing Industry, 2nd Edition

Bob Peters
CRC Press, Boca Raton, FL (2018)
318 pp., hardbound, US$110
ISBN 978-0-367-03025-4

The first edition of *Noise in the Plastics Industry* was published in 1985 and provided the plastics industry with a practical guide to reducing noise from common sources and reducing worker noise exposure. The work was 52 pages long, with about half the pages devoted to case studies in tabular format illustrating successful implementation of noise control techniques. The second edition, 318 pages long, provides additional background on basic acoustics, noise control, hearing conservation, environmental noise impact, standards,

and specification while retaining a practical approach. This is not a text with equations but an industrial reference manual. A handy bullet-point summary at the end of each chapter provides a useful recap and practical advice both as reinforcement to those studying the information in the chapter and the busy professional. While the information presented is clearly focused toward the plastics processing industry, the explanations are applicable to other industries. The book is divided into 10 chapters, and while the basics presented in the early chapters are helpful to understand later discussion, each chapter can be read or referenced on its own.

Chapter 1, "Basic Concepts and Terminology of Sound and Vibration," addresses topics like: What is a decibel, A-weighting, frequency, wavelength sound pressure, and sound power? How do sounds add and subtract? How is noise generated? How does it propagate? And what are some things you can do to reduce it including barriers, absorbers, dampers, and vibration isolation?

Chapter 2, "Principles of Noise Generation and Control," provides commonsense methods to manage and reduce workplace noise. A wide range of noise control techniques is presented, such as vibration isolation, damping, lagging, adding screens, silencers, sound absorption with key items, and the expected range of noise reduction provided.

Chapter 3, "Noise Control in the Plastics Processing Industries," provides specific examples of noise control techniques to various pieces of equipment, the noise reduction provided and the cost (1985 prices). While specific details of the treatments are not included, it does provide a handy tool for feasibility analysis and justification for buy-quiet purchases.

Chapter 4, "Noise in the Workplace," covers how the ear works, the impact of noise on hearing, types of hearing loss, and a summary of the EU Noise at Work regulation. Sections of the regulation are summarized in easy-to-understand sections. Although the requirements are different from those promulgated in non-EU countries, there are still good, solid recommendations for an effective hearing conservation program. Also included is a brief history of noise-induced hearing loss from the early 1700s.

Chapter 5, "Hearing Protection and the Use of Personal Hearing Protectors," starts with a summary of hierarchy of controls. Although it is common to start with PPE, this should be the last step. Next is a summary of the different types of hearing protectors and the different methods to determine the noise reduction provided—both in the laboratory and in the real world and the advantages/disadvantages of each type. The author does include a discussion on overprotection; however, the reviewer would have preferred this be included with the earlier section discussing the optimum range of sound pressure level at the protected ear.

Chapter 6, "Noise in the Environment," discusses potential noise issues with workplace neighbors, including standards and codes, noise-impact assessment methods, criteria, strategies for minimizing noise emissions and disturbances, and additional information on the noise effects on health and BS 8233:2014. While much of the information is based on British standards, there is still good information presented for manufacturers globally.

Chapter 7, "Prediction of Noise Levels," discusses prediction methodology, providing enough information to understand the process and typical levels. Simple calculations, such as calculating the sound pressure level at a distance, given the sound power level, and how to determine the noise reduction from a barrier, are presented. More complex calculations, such as determining the sound pressure level reduction due to the addition of sound absorption, ray tracing, ground attenuation, and including atmospheric effects with outdoor sound propagation, are discussed in a simple fashion.

Chapter 8, "Specification of Noise Emission from Machinery and Machinery Noise Regulations (The European Union Machinery Noise Regulations)," presents an explanation of noise test standards, why specifying noise levels is important, and how noise from equipment should be specified. All the standards referenced are ISO or British adoptions of a European standard.

Chapter 9, "Towards a Quieter Workplace," focuses on the administrative element of noise control: buy quiet, separate quiet and noisy machines to minimize employee noise exposure, add barriers and sound absorption in the space, enclose noisy machines and use automation when possible.

Chapter 10, "Case Studies," as the name implies, presents case studies for various plastics industry noise reduction projects in the United Kingdom. Some of these case studies have been published in other references, and some come from consultants' files. Here, the experienced and novice reader can learn from various projects—learning what treatments were applied, the noise reduction obtained, and the treatment cost.

I enjoyed this book and will personally recommend it to manufacturing and safety managers as well as other noise control professionals who work in the plastics industry.

Charles Moritz
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The Sense of Hearing, 3rd Edition

Christopher J. Plack
Routledge (2018)
329 pp., hardbound, $US140
ISBN 978-1-138-63258-5

This book presents an accessible and comprehensive account of most everything related to the auditory system. It would be of interest to students studying any field related to hearing, especially for students new to the subject, but would also be relevant to students who have some experience in acoustics. As the author notes in the preface, the book is focused on explaining human perceptions rather than providing a comprehensive description of auditory anatomy and physiology. While the book does include details of the anatomy of the ear, the author provides a focus and thorough account of the *sense* of hearing.

The first two chapters provide an overview of the book as well as an introduction into the nature of sound, providing the reader with some basic terminology and concepts. Chapter 3 continues with an introductory feel and describes items such as resonance and sound propagation as well as providing a primer on digital signal processing.

Chapter 4 presents a journey through the auditory system and provides an excellent description of the human ear and how it works, including everything from explaining the purpose of the pinna (and how Van Gogh did not make himself deaf when he cut his "ear") to the auditory nerve.

After this the book moves into a territory that might be described as the sense of hearing. The following chapters discuss frequency selectivity, the ability of the ear to separate out different frequency components (chapter 5), loudness and intensity coding (chapter 6), and pitch and periodicity coding (chapter 7). Chapter 8 discusses how the ear can interpret rapid changes in a sound over time as well as its ability to combine information about sounds over much longer durations to improve understanding. Chapter 9 presents details on spatial hearing and provides an excellent overview of how we can discern the direction from where a sound may be approaching (the key is listening with two ears!).

Chapter 10 introduces the reader to the concept of an auditory scene. By way of introduction, the reader is reminded that the only time you hear a single sound by itself is when doing sound psychoacoustic experiments in a soundproof booth! The auditory system must perform the difficult task of grouping together or separating sound components that originate from either the same or different sound sources—a process called auditory scene analysis.

Chapter 11 is devoted to the main means of human communication, speech. The reader is introduced to the basics of speech production as well as speech perception. Chapter 12 then moves on to music, and the book attempts to explain how some musical rules might be a natural consequence of the way the auditory system operates.

The penultimate chapter deals with the important topic of hearing impairment—the most common physical disability in the West. It discusses different types of hearing impairment as well as describes issues such as tinnitus and hyperacusis. The book finishes with some concluding remarks. Here, the author notes that the book aims to provide an account of human perceptions and as such focuses more on the behavioral aspects rather than physiological aspects (although it is also recognized that the two are heavily interdependent). The book also includes an appendix detailing how research related to the ear is generally undertaken.

Overall, this book is an invaluable resource to any student interested in the ear and the mechanism of hearing but would also be relevant to those studying topics such as acoustics, audiology, and audio design. It is written in a very comfortable style and includes a lot of interesting nuggets that will keep the reader engaged throughout.

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Whole Body Vibrations: Physical and Biological Effects on the Human Body

Redha Taiar, Christiano Bittencourt Machado, Xavier Chiementin, Mario Bernardo-Filho, editors
CRC Press (2018)
252 pp., hardbound, $US160
ISBN 978-1-138-50001-3

This interesting and well-written book deals with an important area: namely, whole body vibrations and their physical and biological effects on the human body. The book is edited by well-known authors, who are researchers and practitioners. The book has 11 chapters contributed by 35 authors. The book is very comprehensive on the topic of whole body vibrations. The book provides not only an understanding of the fundamentals of whole body vibrations but also its effects on humans with various health conditions. The titles of various chapters in the book are well chosen and very clear.

Chapter 1 deals with instrumentation and mechanical vibration analysis. The chapter describes various transducers with their specifications and performance. International standards are discussed. Vibration measurements on the human body are described. Chapter 2

describes the various signal processing approaches with applications to the analysis of vibrations transmitted in the human body. This chapter also describes case studies. Chapter 3 describes the numerical and experimental modeling of mechanical vibrations. Basic vibration analyses based on single, two, and multiple degrees of freedom models are described in this chapter. This chapter also includes experimental modal analysis. Chapter 4 discusses the effects of mechanical vibration on performance. Effects of vibration in sports and motion are discussed. Chapter 5 describes the effects of whole body vibration on the various physiological systems in the elderly. Chapter 6 describes the effects of whole body vibrations in individuals with diabetes and diabetic neuropathy. Chapter 7 describes the effects of whole body vibrations in patients with chronic obstructive lung disease. Chapter 8 describes the effects of whole body vibrations on cognition and the brain. The chapter discusses studies on both animals and humans. Chapter 9 describes the effects of whole body vibrations in adult individuals with metabolic syndrome. Chapter 10 describes the effects of whole body vibrations on bone tissues. Bone mechanics and vibrations are included in this chapter. Discussions include studies on animals and humans. The effects on children, adolescents, women, and adults are also discussed. The last chapter, chapter 11, describes the undesirable and unpleasant adverse side effects of whole body vibration exercises. The chapter also discusses approaches to the safety and care aspects of exercises.

It is nice that at the beginning of each chapter, the contents of the chapter are given clearly, which helps the reader obtain an overview of the chapter. The figures and tables are very clear in each chapter. Another important feature is that each chapter has an exhaustive list of references. This will be highly useful to researchers and students. In summary, the editors and authors have produced an excellent book on this important topic, providing not only the basics of whole body vibrations but also their effects on humans. The book is a highly welcome addition to the literature on this important topic.

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June 29–July 1, 2020
NOISE-CON 2020
New Orleans, Louisiana, USA
https://www.inceusa.org/noisecon20/

15–18 June, 2020
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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http://www.i-ince.org/

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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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