NOISE/NEWS INTERNATIONAL

Volume 23, Number 3
2015 September

A quarterly news magazine with an Internet supplement published by I-INCE and INCE/USA

- Announcing INTER-NOISE 2016
- Learn about the Canadian Acoustical Association
- Hearing loss prevention and the National Institute for Occupational Safety and Health
- Share your thoughts for the future of *Noise/News International*

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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 Internet supplement. I-INCE has an active program of technical initiatives, which are described in the Internet supplement to NNI. I-INCE currently has 46 Member Societies in 39 countries.

INCE/USA

The Institute of Noise Control Engineering of the USA (INCE/USA) is a non-profit professional organization incorporated in Washington, D.C., 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 Internet supplement. 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 Internet Supplement

www.noisenewsinternational.net

The primary change in this PDF-only volume of *NNI* is the ability to have "hot 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, a light blue highlight of the text will indicate the presence of a link. At the end of each feature or department, a light blue back to toc will take the reader back to the table of contents of the issue.

- The Internet supplement contains additional information that will be of interest to readers of *NNI*. This includes:
- The current issue of *NNI* available for free download
- *NNI* archives in PDF format beginning in 1993
- A searchable PDF of annual index pages
- A PDF of the current *NNI* conference calendar and a link to conference calendars for worldwide meetings
- Links to I-INCE technical activities and I-INCE Technical Reports

President's Column

Due to publishing schedules, the Inter-Noise conference in San Francisco will be a distant memory for many of you as you read this, but I am writing this a short time after returning from the conference and am still filled with fresh memories of engaging technical sessions and renewed friendships. Many thanks are due to Copresidents Paul Donavan and Yang-Hann Kimm, Technical Cochairs Courtney Burroughs and Yeon June Kang, Exhibition Manager Rich Peppin, Cathy Vail, Margaret Jamborsky, and many others from the INCE/USA Business Office for an extremely well-run conference. I would also like to thank all the authors and presenters since they are truly the core of the conference.

The conference was held in cooperation between INCE/USA and the Korean Society of Noise & Vibration Control. Though all Inter-Noise conferences are international in nature, I believe this special cooperation between two countries helps both organizations and brings our international community even closer together. This continues an INCE/USA tradition of collaborative conferences. In recent years INCE/USA has held coorganized conferences with INCE Japan in 2006 and the Canadian Acoustical Association in 2009.

Well-run and technically interesting conferences always provide the opportunity for intellectual reinvigoration. This comes through the technical sessions where one hears about the latest research, learning about the newest equipment, software, and materials from the exhibitors, and discussions with colleagues, friends, and acquaintances. I often come away from interesting presentations with new ideas or the realization that there are technical areas with which I need to acquaint or reacquaint myself. I also get some extra motivation to find time once I get back to work to put aside day-to-day tasks and explore new and challenging areas.

Of course, the conferences provide a terrific way to network. There are many people with whom I meet on a yearly basis and over the course of many years have developed a technical and social bond. Inter-Noise conferences also provide a particularly interesting way to develop international contacts and to get a view of similarities and differences around the world.

INCE/USA and I-INCE conferences provide a unique venue for getting a broad view of noise and vibration control. Conferences that deal with a single industry or topic are useful, but I often find it's more interesting to listen to presentations that are outside my main area of expertise. If I hear about something interesting in my own field, anything that I do in the same area will be a "me too" application. On the other hand, if I hear about something in *another* field, I may get some ideas of how to apply it to my own field in a new and unique way.

I would like ask everyone to encourage students to participate in the conferences. Once they join the work force, this is a great place for them to find kindred spirits who will help take the place of their school colleagues, and it's a great place to keep up with alumni and professors. It is also a way for them to stay technically active and acquainted with the latest research. Finally, there are many student awards provided by INCE/USA (in cooperation with the INCE Foundation) and I-INCE that acknowledge outstanding students. INCE/USA and I-INCE also provide generous monetary awards to make conference travel a little easier for students.

If you haven't already started making plans for INTER-NOISE 2016 in Hamburg, Germany, or NoiseCon-16 in Providence, Rhode Island, now would be a great time to start. I hope to see you there.

Gordon Ebbitt
President, INCE/USA

The Future of *Noise/News International*

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I am writing this just after returning from INTER-NOISE 2015. From my perspective this was a phenomenally successful conference. I am not sure what the final numbers will be, but I believe the attendance was close to twelve hundred. There were nearly one hundred exhibitors. The Marriott Marquis was an excellent venue with outstanding service and great food, from my experience. I found the sessions well done and interesting. I will be preparing a report for the December issue for those that did not attend or would like more information.

However, the topic for this column is not INTER-NOISE 2015 but the future of *Noise/News International* (NNI). This publication or its predecessor has been in place since the 1970s, and NNI has played a significant role in providing information about regulations, news in the field, and providing a forum for interesting technical articles. There was much discussion about the future of NNI at both the I-INCE and INCE-USA board of directors meetings held around the conference. Both organizations want to renew efforts to make this a truly joint publication, with news and information useful for members disseminated in a format that is convenient. With this in mind, I thought it would be helpful to get feedback from you, the readers.

Some of the thoughts from the discussions at INTER-NOISE include moving back to a less formal newsletter-type format or even a blog/app concept. This would be a step back from the current, more formal print-magazine style. This would also mean a change from full articles to short summaries with links to complete articles or discussions.

One opportunity arising from this change in format would be more interaction with the members of INCE-USA and I-INCE, including I-INCE member societies. In a blog-style format, readers could post comments and provide further information. For instance, when NNI provides information about the next INTER-NOISE or NOISE-CON conference, there may be technical, industry, or other groups that would like to hold meetings in conjunction with the conference. The blog or app could provide a means to seek additional participants from among all readers.

Going to a less formal medium may also allow some flexibility on publication. For instance, there could be news items added to the website, blog, or app whenever they became available. Another positive aspect would be that the missed opportunities when news of an event arrives the week after an issue is released would no longer be a problem.

What about the negatives of a change in format? Are there many of you that print the magazine or an article from it to read or to keep? Maybe this seems old-fashioned, but I know some still prefer to read the magazine this way. Will going to a less magazine-like, less formal format cause problems for you? There may still be a need for a once-per-quarter compilation to help those not following an online or app update.

I think that a new format could be exciting and provide new opportunities to serve the members of I-INCE and INCE-USA. However, I need your input. What do you want to keep from the current content? What format and means of delivery would you like to see? Please send me your comments and suggestions.

Canadian Acoustical Association

The history of the Canadian Acoustical Association (CAA) dates back to a meeting of eighteen persons interested in acoustics held at the National Research Council in Ottawa, Ontario, on March 29, 1962. The discussions there indicated that activities in acoustics within Canada should be structured and coordinated. The following year, a second meeting was held, and the group adopted the title Canadian Committee on Acoustics for its activities. Tom Northwood was appointed as Chair and Tony Embleton was appointed as Secretary. The group continued its activities for the next nine years, and held regular meetings each year at different locations in the provinces of Ontario and Quebec.

The year 1972 was a major milestone for the committee. During a meeting at McGill University, Montreal, Quebec, the question was raised: "Where do we go from here?" Two items discussed were the publication of a newsletter and a change in the name of the organization. The first issue of the newsletter was published, and a guest article dealt with the question of how the organization should be structured: as a committee, an association, or a society. Regular annual meetings continued, and at the meeting in 1974, the name Canadian Acoustical Association/ l'Association Canadienne d'Acoustique (CAA/ACA) was adopted. The CAA Newsletter continued to be published, and, by 1975, its circulation exceeded 250. The incorporation process was initiated in 1976 by Hugh Jones, and the organization was officially incorporated on April 22, 1977. In 2014, articles of continuance were filed by Frank Russo under the Canada Not-for-profit Corporations Act, along with an update to the bylaw. These were later approved on May 29, 2015.

The CAA became a Member Society of International INCE in 1978, with John Hemingway appointed as the first CAA representative. Work continued on the improvement and upgrading of the newsletter; its format was changed in 1978, and in 1983 it became more of a technical journal with news. Its name was changed to *Canadian Acoustics/ Acoustique Canadienne*. The journal is currently published quarterly, including refereed papers in both of Canada's official languages (English and French), with Jérémie Voix serving as editor-in-chief.

A major event in the history of the CAA was the organization of the 12th International Congress on Acoustics, which was held in Toronto, Ontario, in July 1986, in conjunction with the 25th meeting of the CAA. The meeting was a great success, with 954 participants from 36 countries.

The CAA holds its general conference, Acoustics Week in Canada, in the fall of each year at different locations across the country. Conferences generally draw 100–200 participants, and consist of special plenary seminars, a symposium of two or more days of organized sessions on all aspects of acoustics, laboratory or concert-hall tours, and a social program (reception, banquet, awards ceremony). Summary papers are published in a proceedings issue of Canadian Acoustics. Recent meetings have been held in Victoria (2010), Quebec City (2011), Banff (2012), Montreal (2013), and Winnipeg (2014).

The CAA actively encourages and supports excellence in students and young professionals studying/working in acoustics in Canada, with student travel subsidies available for CAA conferences and other acoustics conferences, student and young-professional paper and presentations awards, a major postdoctoral award (the Edgar and Millicent Shaw Postdoctoral Prize in Acoustics), graduate student awards in a number of specialized areas of acoustics, an undergraduate award, and a high-school award for science fair projects in acoustics. Christian Giguère is presently serving as the CAA awards coordinator.

The CAA currently has more than 300 members. The association is administered by a board of directors, with eight elected directors serving four-year terms, and an executive presently consisting of President Frank Russo, Past President Christian Giguère, Executive Secretary Roberto Racca, Treasurer Dalila Giusti, and Editor-in-Chief Jérémie Voix. More information on the CAA is available at website http://caa-aca.ca (maintained by Sean Pecknold).

Progress on the US National Institute of Occupational Safety and Health Hearing Loss Prevention Strategic Plan

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In 2006, the National Institute for Occupational Safety and Health (NIOSH) entered the second decade of the National Occupational Research Agenda (NORA). NORA is a partnership program to stimulate innovative research and improved workplace practices. NORA has served as an organizing framework to plan and conduct critical occupational research and to promote expanded partnerships between the stakeholders such as universities, large and small businesses, professional societies, other government agencies (federal, state, and local), and worker organizations. Following a review by the National Academies Institute of Medicine of the NIOSH Hearing Loss Research program, a comprehensive strategic plan was developed for the Hearing Loss Prevention cross-sector. Six strategic goals were identified: 1) improved surveillance of occupational hearing loss data; 2) reduced noise emission levels from equipment focused on mining, construction, and manufacturing; 3) development of hearing protector technology; 4) development of best practices for hearing loss prevention programs; 5) identification of hearing loss risk factors; and 6) development of updated hearing damage risk criteria that consider exposures incurred during youth, adolescence, and adulthood. This presentation will review progress towards meeting these goals and propose a research agenda for the third decade of NORA research in hearing loss prevention.

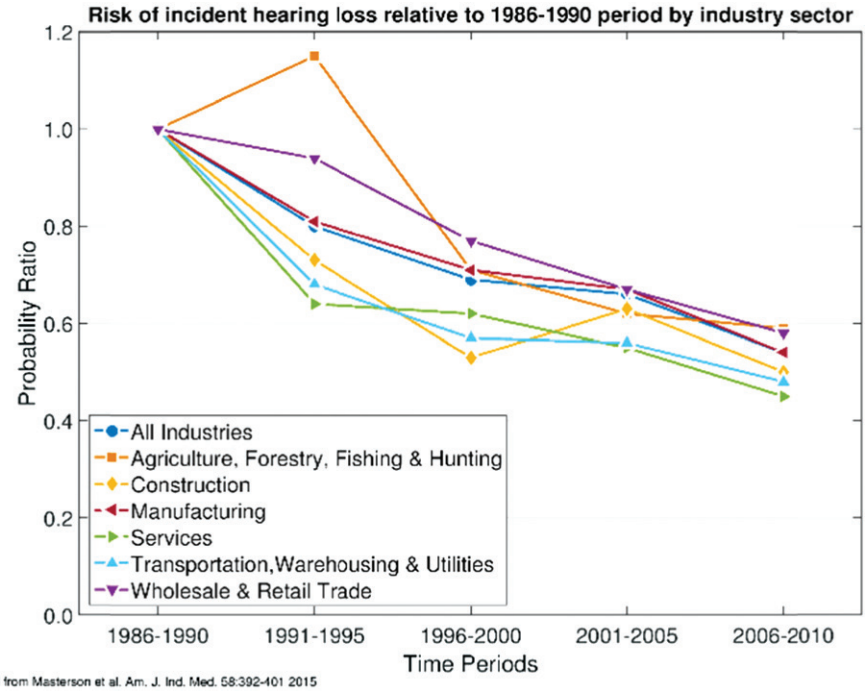
1 INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) established the National Occupational Research Agenda (NORA) as a mechanism to focus research on priority research goals established jointly by NIOSH staff and stakeholders in industry, academia, and other government agencies. In 2005 NIOSH requested reviews of its program portfolio by the National Academies of Science in areas such as hearing loss research, mining, nanotechnology, and the health hazard evaluation program, to name a few. The Hearing Loss Research (HLR) program was the first NIOSH program to be reviewed. The HLR program developed an extensive evidence package that presented to the National Academies—Institute of Medicine (IOM[1]) significant research accomplishments in four areas: hearing loss prevention programs, hearing protection devices, engineering control of noise sources, and surveillance and risk factors. From the evidence package, the HLR program highlights included the 1998 "Criteria for a Recommended Standard—Occupational Noise Exposure Revised Criteria" (NIOSH document 98-126), a seminal paper on occupational exposure to organic solvents and associated occupational hearing loss, development of a new standard protocol for estimating the field effectiveness of hearing protection devices, and noise controls for continuous mining machines [1]. The IOM review resulted in a series of fifteen recommendations for the HLR program. Among the most significant was the charge to develop a strategic plan for the HLR program.

In 2006, the NORA program was reorganized from a disease-centric to a sector-based model. Within the sector-based model, construction, manufacturing, and mining were identified as the sectors for which hearing loss presents the greatest risk to workers within that sector.

Starting in 2004, the Bureau of Labor Statistics within the Department of Labor began to track work-related hearing loss on the OSHA 300 Log. The initial surveillance dataset reported that 28,400 workers suffered a standard threshold shift (STS; average of 10-dB permanent threshold shift at 2000, 3000, and 4000 Hz relative to the employee's baseline in one or both ears) [2]. The manufacturing sector contained the largest proportion of STS incidence. The construction and mining sector are underrepresented in

1 The Institute of Medicine changed its name to the National Academies of Medicine on June 1, 2015.



adapted from Masterson et al. Am. J. Ind. Med. 58:392-401 2015

the BLS statistics. Employers in the construction, agriculture, oil and gas drilling and servicing, and shipbuilding industries are not covered by §1910.95, and therefore are not required by OSHA to provide hearing tests [3]. If employers in these industries voluntarily conduct hearing tests, they are required to record hearing loss cases meeting the recording criteria set forth in the final Section 1904.10 rule [4].

The staff of the NIOSH HLR program developed a long-term strategic plan to address the recommendations of the IOM review. Whereas the HLR program review was focused on four areas, the strategic plan addresses five key areas:

1. Improve surveillance,
2. Reduce noise emission levels from equipment,
3. Develop hearing protector technology,
4. Develop evidence-based best practices for hearing loss prevention programs, and
5. Identify hearing loss risk factors through epidemiologic research.

Significant progress has been made for five of the NIOSH HLR Program strategic goals over the past decade. The sixth goal was added to the HLR strategic plan in the fall of 2014. These achievements will be highlighted in the remainder of the paper.

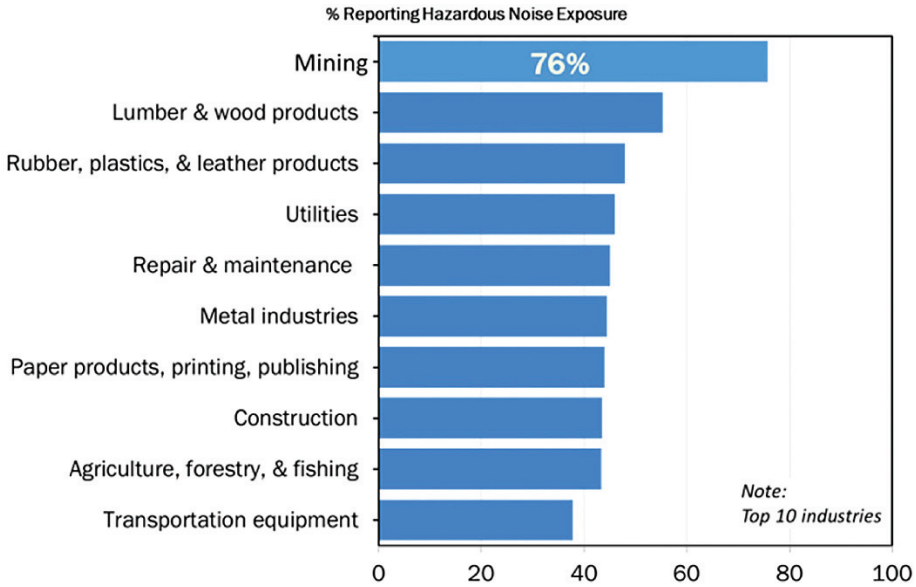
2 HEARING LOSS SURVEILLANCE

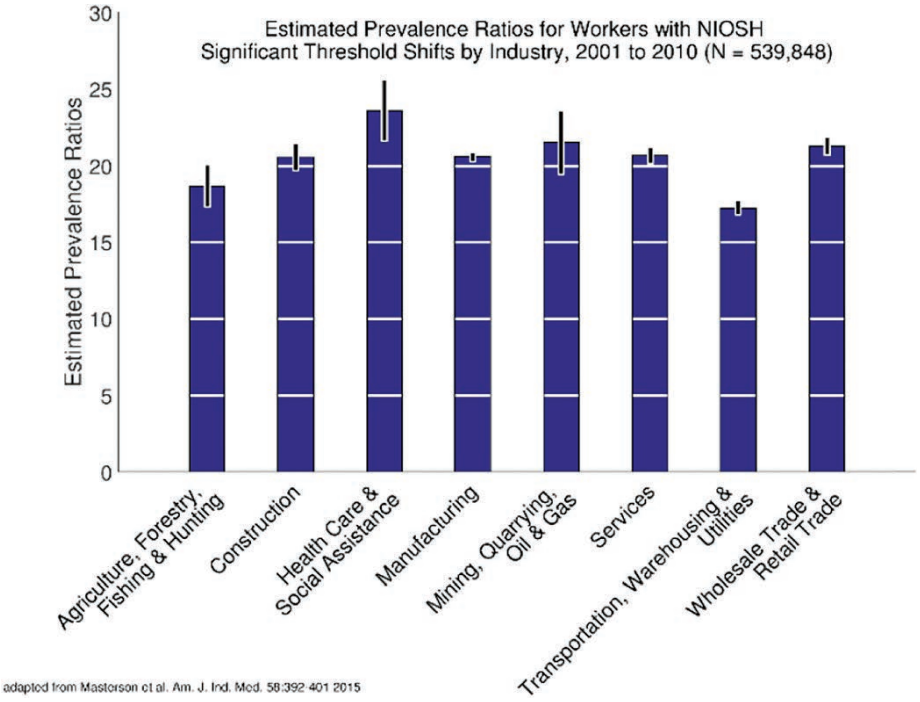
Surveillance is vital to occupational hearing loss (OHL) prevention. It makes possible the establishment of estimates for the prevalence and incidence of hearing loss within various industries. Surveillance also enables NIOSH to identify high-risk groups, guide prevention and research efforts, and evaluate the success or failure of interventions. Without surveillance data, progress in hearing loss prevention efforts cannot be quantified, or the need for improvement in these efforts.

Since 1997, NIOSH has supported the audiometric component of the National Health and Nutrition Examination Survey (NHANES). Approximately five thousand persons per year participate in the NHANES survey, and they are sampled to provide nationally representative estimates of various health conditions in the United States. From 1999 to 2004, NHANES tested hearing in persons twenty to sixty-nine years old. From 2005 to 2010, the sampling evaluated persons age twelve to nineteen; the 2005–2006 and 2009–2010 survey cycles additionally tested persons over sixty-nine years old. The twenty-to-sixty-nine-year-old age range received hearing testing again in 2011–2012 and is currently being sampled in the 2015–2016 cycle. The data from 1999 to 2010 were evaluated and compared against earlier NHANES surveys and found that hearing amongst Americans had improved slightly.

In 2009, the NIOSH OHL Surveillance Project commenced to develop a national surveillance system for OHL. The project uses a novel approach for data collection by partnering with audiometric service providers and others to collect deidentified worker audiograms and related data. This approach has allowed NIOSH to collect millions of audiograms from thousands of workplaces across the United States while protecting the identities of workers, companies, and providers. The North American Industry Classification System (NAICS) is used to classify the industry associated with each audiogram. Data collection, statistical analyses, and dissemination of research results are ongoing.

As of 2014, NIOSH has partnered with eighteen data providers. Over 10.3 million private sector audiograms with related demographic data have been collected and





adapted from Masterson et al. Am. J. Ind. Med. 58:392-401 2015

added to a national repository for OHL surveillance data. The OHL Surveillance Project has also partnered with the United States Air Force to study audiometric, noise, and chemical exposure data for military and civilian participants in their hearing conservation program.

The OHL Surveillance Project has produced seven peer-reviewed publications in addition to newsletters, blogs, a fact sheet, and a topic page on the NIOSH website: (http://www.cdc.gov/niosh/topics/ohl) [5]. The topic page provides a wealth of findings and includes the data set for download and analysis used by Masterson, et al, in their paper entitled "Prevalence of hearing loss in the United States by industry" [6]. NIOSH estimates that 22 million workers are exposed to hazardous noise in the United States. Among noise-exposed workers, 18 percent have hearing loss, meeting the NIOSH definition for material hearing impairment [7].

The NHANES data have been utilized in the updated International Standards Organization acoustic standard, ISO 1999:2013 [8]. ISO 1999 allows estimation of expected hearing loss due to varying intensities and durations of noise exposure during employment. ISO 1999 provides hearing practitioners with normative data against which a particular exposed population can be compared. The NHANES data have been used to update the hearing tables for unscreened normal populations and expand the tables to include data at 8000 Hz.

NHANES data will be used to develop updated age-correction tables for OSHA. The original age-correction tables were developed from a data set that was small and predominantly male and Caucasian. The new data set will include representative samples of males and females and should have sufficient statistical power to separate known effects due to ethnicity.

3 ENGINEERING NOISE CONTROL

NIOSH continues to expand and grow the breadth and depth of noise control technologies being used to prevent hearing loss. Significant measurement capabilities have been added and major strides in the ability to model noise generation and radiation have been made. These capabilities are now industry leading in their technical sophistication.

A major new capability for NIOSH has been the incorporation of source path contribution technology by Brüel and Kjaer. This technology uses volume velocity sources and multiple methods of transfer function analysis to determine the characteristic noise sources for a machine and to precisely define the acoustic and structural paths for sound energy from these sources to the worker. The procedures use large numbers of microphones and accelerometers to gather

THE NOISE-CON 2014 proceedings and additional proceedings

NOISE-CON 14 was the twenty-ninth in a series of National Conferences on Noise Control Engineering organized by the Institute of Noise Control Engineering of the USA, Inc. (INCE/USA). The conference was held September 8–10 at the Westin Beach Resort and Spa in Fort Lauderdale, Florida, USA.

A USB Flash Drive containing the NOISE-CON 14 Proceedings and 16 additional proceedings is now available online from the INCE/USA page at Bookmaster's Atlas Bookstore.

This USB Flash Drive contains the conference proceedings with 154 papers and was prepared by Courtney Burroughs and George Maling. Steve Marshall served as conference chair with Gordon Ebbitt and Steve Sorenson as technical co-chairs The subject index for the NOISE-CON 2014 Proceedings is available on the Internet.

The URL is
http://www.noisenewsinternational.net/nc14/SubjectIndex.pdf

This UBS Flash Drive also contains the proceedings of ALL NOISE-CON conferences held since 1996. This includes the years 1996, 1997, 1998, 2000, 2001, 2003, 2004, 2005, 2007, 2008, 2010, 2011, 2013, and 2014. Also included are the proceedings of three sound quality symposia, 1998, 2002, and 2008.

Including the NOISE-CON 2014 papers, a total of 1927 technical papers are included on this drive. All papers are in PDF format, and the drive is searchable by any string of text.

These papers are a valuable source of information on noise control that will be of value to engineers in industry, acoustical consultants, researchers, government workers, and the academic community.

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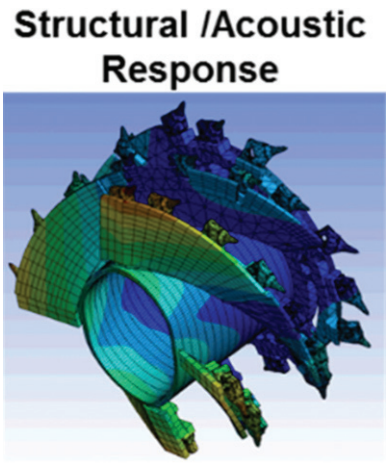
the necessary information and complex computational routines to define the sources and paths. Using this technique one is able to better define the noise problems with a complex machine and to evaluate possible control solutions in the software environment. For the first time, this technology has been applied in underground mining. With innovative approaches and close cooperation with stakeholders, source path contribution has been applied to haul trucks and load-haul-dump trucks, where it identified the engine cooling fan as a primary noise source. The identification of the engine cooling fan was an unexpected result and led to innovative noise controls that have gained support from the equipment manufacturer.

NIOSH noise control technology has been expanded through the design, development, and installation of an engine cooling system test stand. The test stand was developed to evaluate noise controls on the load-haul-dump and haul truck engine systems noted in the studies above. The stand accurately represents the airflow through the entire engine cooling package. The geometry of the entire package is replicated including flow obstructions from the engine and ancillary equipment. The test stand provides the ability develop noise controls on engine cooling systems

Bit Isolator



and increases the team's experimental capabilities. For the first time, controls have been developed that can be easily retrofitted to existing equipment and used as part of a low-noise package for new equipment, thus increasing the impact.

Another major capability for NIOSH noise control has been the development of a full suite of tools for modeling vibration and noise radiation from complex machines. Using the ANSYS simulation software package (ANSYS Inc.), finite element modeling has been used to predict of vibration in complex structures to high frequencies. In a recent project, using innovative substructuring techniques, vibrations were accurately predicted to 2000 Hz in a machine-cutting drum measuring 1.5 meters in diameter. Boundary element modeling tools are used to make accurate predictions of sound radiation. This tool permits the prediction of the noise at a worker's ear in complex acoustical environments. Finite and boundary element techniques have greatly improved the identification of noise sources and the effectiveness of potential controls.

The NIOSH portfolio of successfully commercialized noise controls has continued to grow and the usage in industry has also expanded. In addition to earlier NIOSH-developed noise controls such as the dual sprocket chain, coated flight bars, and constrained layer damping for the tail

Dual Sprocket Chain

rotor for the continuous mining machine, other controls have reduced the noise exposure for miners. The drill bill isolator provides 3–6 dB of noise reduction for roof bolting machine operators. Corry Rubber and Kennametal have commercialized this control. The dual sprocket chain has been commercialized by Joy Global and is currently in use in over 40 percent of the continuous mining machines used in underground mines in the United States and in at least four foreign countries.

4 HEARING PROTECTION

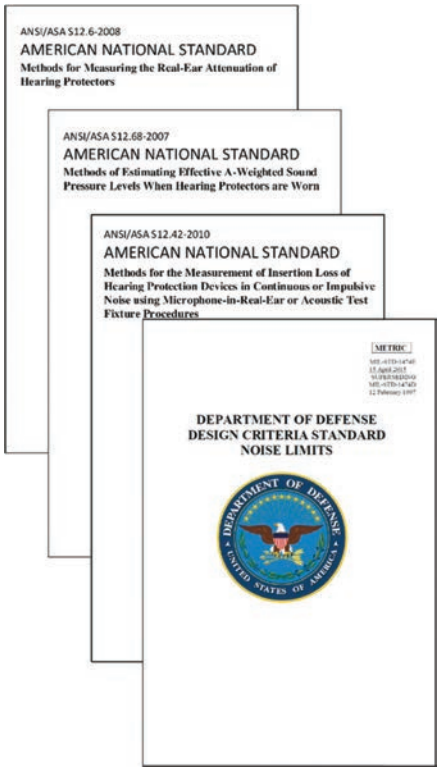
Hearing protection devices (HPDs) have been a strong area of research for the HLR program. At the time that the IOM review was commenced, NIOSH was involved in a multilaboratory, international evaluation of the ANSI S12.6-1997 standard for measuring the attenuation of hearing protection devices using the Real-Ear Attenuation at Threshold (REAT) method [9]. At the same time, the United States Environmental Protection Agency (EPA) planned to update their regulation for labeling hearing protection devices for sale in the United States. This effort included developing guidance for rating the performance of new types of HPDs: nonlinear filter devices, electronic sound restoration earmuffs and earplugs, and electronic active noise-cancellation protectors. NIOSH organized the interlaboratory study and worked closely with industry, academic, and government partners to revise the ANSI/ASA S12.6 standard in 2008 [10]. The effort also led to the development of a new hearing protector rating standard, ANSI/ASA S12.68-2007 [11]. Measurement and rating

of typical earmuffs and earplugs could be accomplished with the two aforementioned standards. However, developing ratings for the nonlinear, electronic, and active noise-cancellation devices required new measurement methods for active noise control and for impulsive noises.

Active noise control presents a unique challenge. The narrow-band noise stimulus used in the REAT procedure could potentially be cancelled if tested in a diffuse sound field. Some protectors produce a small residual noise in the cancellation process that would affect the threshold measurement used in the REAT procedure. To avoid this problem, the ANSI/ASA S12.42-2010 standard prescribes a method to assess the active attenuation component on an acoustic test fixture and then combines the active component with the passive measurement of REAT when the electronics are not turned on [12]. The data from the active and passive components can be entered into a noise reduction rating calculator (HPDCalc, http://www.cdc.gov/niosh/topics/noise/hpdcomp/about.html) that NIOSH has developed. Both the active and the passive ratings are provided as outputs from the application.

For impulse noise exposure, the REAT procedure fails to work with earplugs and earmuffs that utilize a nonlinear valve or filter. The nonlinear element relies upon the increased acoustic resistance of air as the particle velocity increases when air flows through a small orifice. A larger pressure differential between the inlet and outlet of the filter increases the particle velocity and the attenuation increases correspondingly. Consequently, the response of the filter at levels below about 130 dB will yield minimal attenuation. However at high levels, the attenuation will approach that of the same protector with a completely blocked filter pathway. The ANSI/ASA S12.42-2010 standard specified an acoustic test fixture with approximately 60 dB acoustic isolation and realistic surfaces for the portions of the head and ear canal in contact with the protector. NIOSH worked with two manufacturers to develop acoustic test fixtures that satisfied the S12.42 specifications and to develop a pencil probe microphone suitable for measuring impulses between 130 and 170 dB. NIOSH also conducted a series of evaluations of different types of protectors, passive, nonlinear, and electronic to better understand the measurements according to the standard.

NIOSH's role as a scientific advisor to the EPA during the development of a proposed hearing protector labeling rule was crucial to incorporating the best acoustic science into the proposed rule [13]. EPA held a public comment hearing in November 2009, and NIOSH served as an advisor to EPA throughout the development of the final rule. The docket remains open at the EPA, although final promulgation of the rule has been delayed. However, the development of the standards has influenced the process in the international acoustics community. The ISO 4869-6 standard for measurement of active noise cancellation HPDs is currently in a draft standard and is quite similar to the ANSI/ASA S12.42-2010 standard [14]. The US Department of Defense recently revised their MIL-STD-1474E to incorporate the impulse peak insertion loss statistic from S12.42 in a new design criteria standard for noise limits [15].



5 BEST PRACTICE FOR HEARING LOSS PREVENTION

In the 1990s, NIOSH published "Preventing Occupational Hearing Loss—A Practical Guide" [16]. The guide assembled in one document the information that is necessary for implementing and maintaining a successful hearing conservation program. The written guide, while still useful, may be considered "yesterday's technology." With the advent of a mobile culture, the Internet, and smartphone applications, NIOSH researchers recognized the need to identify proven solutions for reducing workplace noise, educating workers, and encouraging a more holistic approach to hearing loss prevention. NIOSH partnered with the National Hearing Conservation Association (NHCA) to develop the Safe-In-Sound Excellence in Hearing Loss Prevention Awards to identify and honor excellent hearing loss prevention (HLP) practices and innovations in the field of occupational hearing loss prevention [17]. Key performance indicators are used to evaluate hearing loss prevention programs

in each of three work sectors: construction, manufacturing, and services. In addition, an award for Innovation in Hearing Loss Prevention recognizes individuals and/or a business entity, regardless of sector/NAICS code affiliation.

The selection of these outstanding companies is a competitive process that can be either a self-nomination or third party application. The Safe-In-Sound expert committee evaluates the applications and conducts site visits to determine the awardees. The award winners from 2009 to 2015 are listed in Table 1. The Safe-In-Sound Awards not only recognize a job well done but they motivate other companies to follow suit. For instance, one of the first recipients, Pratt & Whitney, influenced the efforts for reducing noise in the manufacturing processes of their parent corporation, United Technologies, a recipient in 2015. United Technologies was able to reduce the number of employees exposed to noise greater than 85 dBA, eight-hour time weighted average from over ten thousand workers to about two thousand workers. Thus nearly eight thousand employees have a reduced risk of noise exposure and physical stress directly attributable to efforts of dedicated individuals employing best practices. Likewise, Shaw Industries has been able to further reduce noise exposures following receipt of the Safe-In-Sound Award. Factory levels were in excess of 105 dB in some areas. With the use of best practices and encouraging employees to seek practical solutions, the noise levels were reduced to less than 95 dB SPL.

Table 1—Safe-In-Sound Awards 2009–2015

Recipient	Year	Category
Pratt & Whitney	2009	Manufacturing
Domtar Paper Company	2009	Manufacturing
Montgomery County Water Services	2009	Services
Sensaphonics	2009	Innovation
Etymotic Research	2010	Manufacturing
NYC Department of Environmental Protection	2010	Construction
Kris Chesky	2010	Services
Fort Carson	2010	Services
Shaw Industries	2011	Manufacturing
Colgate Palmolive	2012	Manufacturing
3M Hutchinson	2012	Manufacturing
Vulcan Materials	2013	Manufacturing
Johns Manville	2013	Manufacturing
Dangerous Decibels	2013	Innovation
Benjamin Kanters	2014	Services
Northrup Grumman	2014	Manufacturing
United Technologies	2015	Manufacturing
Mahrt Mill Employees of Mead Westvaco Corporation	2015	Manufacturing

Best practices can be found in areas besides noise control. Since 2010, NIOSH and NHCA have partnered to organize and edit annual special supplements to the International Journal of Audiology highlighting research from the annual NHCA conference. NIOSH has organized and developed workshops for hearing protector fit-testing in the workplace at multiple safety and health conferences (e.g., NHCA, National Safety Council, Ohio Safety Congress, and the Iowa Governor's Safety Conference). A NIOSH scientist was the guest editor for an issue of the Noise and Health journal that was entirely devoted to research on HPDs [18]. Hearing protector fit-testing was featured prominently in several articles, in addition to best practices for promoting hearing conservation in underserved populations such as musicians and construction workers. NIOSH has developed and commercialized a fit-testing system that

works with a laptop computer and a pair of circumaural sound-isolating headphones. The practical effect of developing guidance for fit testing is that workers and hearing conservation providers no longer need to guess at the level of protection provided by HPDs. Several fit-testing systems are commercially available: IntegraFit, EARFit, FitCheck Solo, VeriPRO, and SafetyMeter. The Council for Accreditation in Occupational Hearing Conservation will soon publish their expanded hearing conservation training manual that will include a NIOSH-authored chapter on fit testing. HPD fit testing has an added benefit. 3M Hutchinson was able to identify which protectors were most effective and popular amongst their employees. They were able to reduce the inventory of HPDs from about twenty products to nine products. Their employees were encouraged to think about noise exposures beyond just the workday, twenty-four-hour safety. The percentage of employees who were able to correctly fit and achieve adequate attenuation improved from 55 percent to 98 percent. Good hearing loss prevention practices will result in fewer persons adding to the Bureau of Labor Statistics tally for hearing loss.

Lastly, in 2012, NIOSH coauthored a Cochrane Systematic Review on the effectiveness of interventions to prevent occupational hearing loss Cochrane systematic reviews try to help with the decision-making process by synthesizing the results of multiple studies and finding out, for example, what are the best ways to protect workers against health risks and dangers that exist in the workplace [19]. The Cochrane Collaboration is internationally recognized as the leader in producing high-quality systematic reviews about the effectiveness of health interventions.

6 HEARING LOSS RISK FACTORS THROUGH EPIDEMIOLOGIC RESEARCH

Research topics that don't fit well with the previous four categories are represented within this strategic goal. Examples include research on the effects of ototoxic chemical exposure, pharmacologic intervention for traumatic noise exposure, and new techniques to assess noise exposures.

In the area of ototoxic chemicals, NIOSH has partnered with the Nordic experts group to provide guidance for combined exposures to noise and chemicals [20]. Exposure to noise and organic solvents such as toluene, xylene, or styrene are now recognized to be more hazardous to hearing than just one agent in isolation. Synergistic interactions have been observed in both animal exposure models and in human epidemiologic studies. The Nordic experts group issued guidance on reducing the exposures and raised the need for awareness when potential mixed exposure occur.

Animal research has progressed through investigative research grants funded through the NIOSH Office of Extramural Programs. Initial efforts in identifying the mechanisms and effectiveness free-radical scavenger compound (e.g., N-acetyl cysteine or D-methionine) were a direct result of this work. Other federal research programs have funded continued work on the basic science of the actions for preventing apoptotic hair cell death following traumatic noise exposure. Currently, a Food and Drug Administration

Figure 6. Typical firing position for official using a starter pistol with the firearm raised above the head and angled away from the athletes. Note the burning powder showering down after the weapon is fired. These particulates fall back onto the arm of the official and generally follow the path of the gas escape.

clinical trial is underway investigating the effectiveness of a formulation of D-methionine to reduce hearing loss [21]. These treatments may prove to be useful for persons exposed to blast noise to prevent unnecessary hearing loss.

Finally, an area of significant research is the development of metrics for assessing the differential effects of impulse noise versus continuous noise of the same equivalent energy. An early NIOSH study demonstrated that exposure to impulse noise produced a greater magnitude of hearing loss in animals than an equivalent exposure to continuous noise [22]. In fact the ISO 1999:1990 standard suggests adding 5 dB to the noise exposure if a significant portion included impulsive noise [23]. Recent animal studies have demonstrated that at the lower exposure levels, impulse noise is not more hazardous than continuous noise. As the equivalent energy level and the kurtosis of the noise increase, the hearing loss in animals increases and plateaus. In 2010, the first evidence of this effect in humans was reported, and a kurtosis correction for noise exposure was proposed [24]. Subsequent research has validated this finding in a second noise exposure and hearing assessment study. While this research is still ongoing, it suggests that instead of applying a simplistic rule of thumb, an analysis of the noise exposure waveform will provide a better prediction of the risk of noise-induced hearing loss. NIOSH has demonstrated that the other metrics can be incorporated into noise measurement applications. For research on high-level impulse noise, we have incorporated kurtosis, a cochlear model-based metric, A-weighted equivalent energy (L_{Aeq}), and MIL-STD 1474E to provide rapid assessment of the allowable number of rounds that a person can be exposed to.

7 CONCLUSIONS

Over the course of the second decade of NORA, the NIOSH HLR program has made considerable progress. More than two hundred peer-reviewed journal articles and close to one hundred NIOSH reports (Health Hazard Evaluations, Technology News, and Survey Reports) have been published covering the breadth of research within the Hearing Loss Prevention cross sector. NIOSH has been successful in developing strong partnerships with regulatory agencies such as MSHA, OSHA, and EPA as well as partnering with the Department of Defense, Department of Interior, academia, and industry stakeholders. NIOSH has been successful in commercializing noise control technologies and developing applications that facilitate the implementation of progressive hearing loss prevention programs. The NIOSH acoustical test laboratories are accredited by the National Voluntary Laboratory Accreditation Program. The NIOSH HLR program adopted new media venues to reach a broader audience, beyond peer reviewed publications. In particular, the group utilized the NIOSH blog platform to engage partners and the public in scientific discussions about noise and hearing loss prevention. The group authored a series of fifteen blogs on the topic, and some of them are among the most visited of the NIOSH science blog. This effort received an external Media Award by the National Hearing Conservation Association. Finally, NIOSH has developed a strong program for occupational surveillance of hearing loss data that has the potential to influence new standards on occupational safety and health.

8 ACKNOWLEDGEMENTS

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Disclaimer: The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention or the National Institute for Occupational Safety and Health.

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VENUE

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TOWARDS A QUIETER FUTURE

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REGISTRATION

Delegate

485 € early bird registration until May 17, 2016
535 € standard registration until August 17, 2016
585 € on-site registration from August 21, 2016

Student

150 € early bird registration until May 17, 2016
200 € standard registration until August 17, 2016
200 € on-site registration from August 21, 2016

Accompanying person

120 € standard registration until August 17, 2016

Further information available at: **www.internoise2016.org**

IMPORTANT DATES

Abstract deadline: March 10, 2016
Final paper deadline: May 17, 2016
Early bird registration until: May 17, 2016

SATELLITES IN BERLIN, AUGUST 25–26, 2016

- Room Acoustics – towards a better understanding
- European Noise Policy – status, aims, vision
- Soundscape and Psychoacoustics – using the resources for environmental noise protection

New England NoiseCon-16: Revolution in Noise Control

June 13-15, 2016
Providence, Rhode Island

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Important Dates

Abstracts Due:
BY January 31, 2016

Papers Due:
BY March 31, 2016

Early Registration:

Opens:
December 1, 2015

Expires:
January 31, 2016

Hotel Information

Omni Providence Hotel
1 West Exchange Street
Providence, Rhode Island

Special Technical Sessions

- **Community Noise/Wind Turbines**
- **Sound Mapping**
- **Transportation**
- **Marine & Ship Noise**

Typical Technical Areas

- **Active Noise Control**
- **Passive Noise Control** *(includes products, e.g. absorbing materials)*
- **Aircraft/Airport Noise**
- **Noise in Buildings and Methods for Control**
- **Surface Vehicle** *(railway, highway and ships)*
- **Consumer Products** *(including IT)*
- **Measurements**
- **Vibration and Structural Acoustics**
- **Effects of Nosie** *(P&P and Health)*
- **Noise and Education**
- **Tire/Pavement Noise**
- **Modeling** *(Analytic and Numeric)*
- **Noise Propagation and Barriers**
- **Occupational Noise and Hearing Conservation**
- **Flow Noise** *(including fans)*

Social Event

Details to come.

Vendor Exposition

As many as 60 suppliers of instruments, services, software and materials

Accompanying Persons Opportunities

- **Shopping**
- **Downtown Providence**
- **Providence Place**
- **Wickenden Street**
- **Thayer Street**
- **Warwick**

Day Trips from Providence

- **Newport, Rhode Island**
- **Block Island, Rhode Island**
- **Boston, Massachusetts**
- **Foxwoods, Connecticut**
- **Mohegan Sun, Connecticut**

www.inceusa.org

NoiseCon-16 www.inceusa.org

Getting to Providence

Logan Airport *(BOS)*

Situated approximately 49 miles north of Providence. Outlined below are public and private transportation options.

Warwick's T. F. Green Airport *(PVD)*

Located just 10 minutes from downtown Providence, T. F. Green is one of the top five airports in the US by *Travel + Leisure* magazine, and it offers more than 150 flights to 21 destinations. Just off Exit 13 on Interstate Route 95, Green Airport is accessible to Boston, Cape Cod, and Southeastern New England.

Airlines

Delta Airlines/Delta Connections

Discount Program — Conference attendees who book their travel through Delta Airlines are eligible for special discounts for air travel to the conference. Discounts are available on all classes of fares.

You may book online at **www.delta.com/meeting** OR by phone at **1-800-328-1111**, Monday–Friday 6:00 am–6:00 pm using event code: **NMM2P**.

Cape Air

Continental Airlines/Continental Express

Jet Blue

Southwest Airlines

United Airlines/United Airlines Express

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Getting to the Venue

Taxi Service

The distance from T. F. Green Airport to the downtown area is 9 miles and taxis will cost approximately $30.00 each way.

Shuttle Service

The distance from T. F. Green Airport to the downtown area is 9 miles. The airport shuttle is available Monday through Friday from 5:00 am to 7:00 pm and Saturday and Sunday from 9:00 am to 5:00 pm. The shuttle leaves the airport every hour on the hour.

Car Rental

Alamo	**Avis**	**Budget**
Dollar	**Enterprise**	**Hertz**
National	**Payless**	**Thrifty**

Train Service at T. F. Green

T. F. Green Airport is conveniently connected to the MBTA commuter trains through the InterLink train station. Travelers can access the InterLink directly from the airport terminal through the skywalk. To get to the skywalk, proceed down the elevators to the ground level and walk to the far front left of the terminal, past the Visitor Information table, and look for signs directing to the InterLink connector. Train fares and schedules can be found on the MBTA website at **mbta.com**.

About Providence, Rhode Island

Providence is a compact, thriving American capital city that neatly cross-stitches the fabric of New England history with a vibrant dining palate and an edgy arts, music, and cultural scene. "Something for everyone" might be a clichéd phrase, but in Providence it's an everyday reality. This "Creative Capital" boasts the modern attractions and cosmopolitan amenities of big cities, but with unpretentious fun and an enviable array of accessible options.

Providence's celebrated restaurants, award-winning theatre, and vibrant arts scene is enhanced by an elaborate river-walk. With a thriving arts district, a commitment to historical preservation, and a sophisticated nightlife, Providence offers a variety of entertainment options. The Federal Hill neighborhood is brimming with restaurants, galleries, and specialty stores. Tony award–winning Trinity Repertory Company draws throngs of theater-goers into the city. One of Providence's most popular cultural events is WaterFire, a multi-sensory art installation highlighted by a series of bonfires installed on the three rivers of downtown Providence.

There's also plenty to attract the eye of even the most discerning shopper. Providence Place Mall offers visitors a mall with more than 100 shopping, dining and entertainment options. Funky urban chic can be found at one of the many boutiques on Thayer and Wickenden streets, both on the city's tony East Side.

Pan-American News

Stephen A. Hambric

Current I-INCE Pan-American Member Societies and Dues Status

The Pan-American I-INCE member societies are:

- Asociación de Acústicos Argentina (observer only)
- Acoustical Society of America
- Acoustical Society of Chile
- American Society of Mechanical Engineering, Noise Control and Acoustics Division (NCAD)
- Brazilian Acoustical Society (SOBRAC)
- Brazilian Association for Acoustical Quality (ProAcústica)
- Canadian Acoustical Association
- INCE-USA

News and Events

Associación de Acústicos Argentinos (observer)

The International Congress of Acoustics (ICA) 2016 conference will be held in Buenos Aires, Argentina, 5–9 September, 2016.

Acoustical Society of America

The Acoustical Society of America held one meeting in the period between INTER-NOISE 2014 and INTER-NOISE 2015. The spring 2015 meeting was held in Pittsburgh in May and drew about 950 attendees. Several awards were presented at the spring meeting including the Gold Medal to Gerhard Sessler, the Helmholtz-Rayleigh Interdisciplinary Silver Medal to Henry Cox, and the R. Bruce Lindsay Award to Matthew Urban.

Changes have occurred to several ASA leadership positions. These include James Lynch of Woods Hole Oceanographic Institution as editor-in-chief replacing Allan D. Pierce, who has retired; Christopher Struck of CJS Labs in San Francisco as standards director, to replace Paul Schomer, who has retired; and Susan E. Fox as executive director replacing Charles E. Schmid, who has retired.

Christy Holland of the University of Cincinnati is the current ASA president. In the 2015 ASA election, Michael R. Stinson of the National Research Council of Canada was elected president-elect.

Yang Hann Kim has been named the recipient of the ASA's 2015 Rossing Prize in Acoustics Education. He will receive the award at the next ASA meeting (Jacksonville, FL, in November 2015).

ASA's meeting plans for 2015 and 2016 include the following:

- 2–6 November, 2015, Jacksonville, Florida
- 23–27 May 2016, Salt Lake City, Utah
- 28 November–2 December, 2016, Honolulu, Hawaii (5th joint meeting of the ASA with the Acoustical Society of Japan).

ASME Noise Control and Acoustics Division

ASME NCAD is pleased to be a new member of the I-INCE community.

A special supplement on ASME NCAD was published in ASME's primary magazine, Mechanical Engineering.

NCAD participated in ASME's IMECE in November 2014 in Montreal, Canada. The NCAD track was led by Dr. Kristin Cody. The following occurred during the IMECE:

- The yearly Rayleigh Lecture was given by Dr. Mardi Hastings of Georgia Tech, on "Going Underwater with Acoustic Resonators and Waveguides."
- The Per Bruel Gold Medal for Noise Control and Acoustics was given to Dr. Andrew Norris of Rutgers University.

Brazil—ProAcústica

Faced with a scenario of productive industry advances, ProAcústica decided to conduct original research, with its affiliates and future possible associates, on the acoustic market in Brazilian civil construction. This first study had 100 percent participation of the invited companies, demonstrating an extremely satisfying and significant result, which was established in a publication released in a meeting of members on 26 August, 2015.

2014–2015 conferences:

Organized annually the City Council Conference on Noise, Vibration, and Sound Disturbance with over 400 participants:

- About 2014: http://www.conferenciaruidosp.com.br/2014/index.html
- About 2015: http://www.conferenciaruidosp.com.br/index.html

More news is available at: www.proacustica.org.br/noticias/newsletters-com-as-novidades-da-area-de-acustica.html

Canadian Acoustical Association

This year's Acoustics Week in Canada will be held 6–9 October in Halifax, Canada.

INCE-USA

INCE/USA hosted INTER-NOISE 2015 in San Francisco, California. INTER-NOISE 2015 was a well-attended congress with a strong technical program. This was the first INTER-NOISE supported by INCE-USA's new management company, the Drohan Group.

Other activities in the last twelve months include a successful Noise-Con in Fort Lauderdale, Florida, which included an Outreach Workshop. It also included a great tribute session for George Maling, highlighting his contributions in the technical field on noise control engineering; his leadership in the National Academy of Engineering, INCE/USA, and I-INCE; and his significant contributions to the INTER-NOISE congresses and Noise-Con conferences.

The project feature movie *In Pursuit of Silence* is now nearing completion and a prerelease version will be shown at INTER-NOISE 2015 free to attendees.

An effort is underway to create a product-noise rating (PNR); a preliminary website has been developed. Watch for additional news on this topic in the very near future.




The 22nd International Congress of Acoustics and the 10th Ibero-American Federation of Acoustics (FIA) Congress will be held jointly in Buenos Aires, Argentina. This will be the first time that an ICA Congress is held in Latin America.

ICA 2016 is being organized by the FIA and the Argentinian Acousticians Association (AdAA), in cooperation with the Chilean Acoustical Society (SOCHA) and under the endorsement of the International Commission for Acoustics (ICA) and the sponsorship of the Acoustical Society of America (ASA).

Jointly, the X Ibero-American Federation of Acoustics Congress will also be held, incorporating the IV Argentinean Congress of Acoustics and the XXVI Meeting of the Brazilian Acoustical Society.

Furthermore, ICA 2016 has the official sponsorship of the Acoustical Society of America, of the International Union of Pure and Applied Physics (IUPAP), and the National Council of Acoustical Consultants (NCAC).

Buenos Aires is one of the largest cities in the world. It has a lovely combination of European culture and Latin American spirit.

Call for Papers

Papers related to the technical areas listed below are especially welcome for presentation at the ICA 2016 Congress, but technical papers in all areas of acoustics may be submitted for inclusion in the program. The official language of the International Congress on Acoustics is English.

Peer review of contributed papers will be available as an option to be selected by the author. Abstracts will be submitted online via the congress website. As with all ICA congresses, ICA 2016 will feature include a proceedings. All technical presentations will have a corresponding proceedings manuscript.

Areas of interest include:

Acoustics Metrology	Noise: Sources and Control
Animal and Bioacoustics	Numerical Techniques
Biomedical Acoustics	Physical Acoustics
Computational Acoustics	Physiological and Psychological Acoustics
Communication Acoustics	Room and Building Acoustics
Community Noise, Environmental Acoustics	Signal Processing and Analysis
Electroacoustics and Audio Engineering	Soundscape
Hearing Protectors	Speech Communication
Legislation and Regulations	Structural Acoustics and Vibration
Musical Acoustics	Ultrasound
Non-linear Acoustics	Underwater Acoustics

Important dates

Call for Papers	December 1, 2015
Deadline for receipt of abstracts	March 1, 2016
Invitation to submit manuscripts sent to authors	April 15, 2016
Deadline for receipt of manuscripts (with payment of registration fee)	May 31, 2016
ICA 2016	**September 5–9 2016**

Please visit our website at ica2016.org.ar for updates and other relevant information.

For any further enquiries, kindly email info@ica2016.org.ar

Buenos Aires looks forward to welcoming you!!

Asia-Pacific News

Ichiro Yamada

News from Australia

Joint Australasian Conference 2016

The Australian Acoustical Society and the Acoustical Society of New Zealand are excited to announce the Second Australasian Acoustical Societies' Conference. This joint meeting between the allied societies will be held at the Brisbane Convention and Exhibition Centre from Wednesday to Friday, November 9–11, 2016. The website should be functioning soon, but in the meantime advance information on the joint undertaking can be obtained from Conference Secretary Richard Devereux (rdevereux@acran.com.au).

12th International Workshop on Railway Noise (IWRN)

The 12th International Workshop on Railway Noise will be held in Terrigal, New South Wales (NSW), Australia, from September 12–16, 2016. The IWRN offers a unique forum for meeting and interacting with international experts in the fields of railway noise and vibration. More information: http://iwrn12.acoustics.asn.au

Revised Traffic Noise Guidelines

Within Australia, the Roads and Maritime Services (RMS) state of NSW has updated their Noise Criteria Guideline and Noise Mitigation Guideline with corrections and additional information following public consultation. The new guideline supersedes Practice Note I from the 2001 Environmental Noise Management Manual. It differs from the previous method in that road criteria are now based on the road project near a receiver rather than the existing noise exposure. For new roads the total noise level from all roads is assessed against the new road criteria. This differs from the 2011 edition of the Road Noise Policy where consideration is only given to the noise levels contributed by the new road. This ensures that noise mitigation provides a benefit by reducing noise levels at a receiver.

David Bies, 1925–2015

David Bies passed away on April 6, 2015, ending his six-decade career in the physics of vibration and noise. David graduated from UCLA; his PhD investigated the puzzle of why sound absorption was so much greater in seawater than in fresh. After graduation he worked in private industry until he was enticed to Adelaide University in South Australia in 1972. There he was instrumental in evaluating the quality of anechoic and reverberant rooms in Australia and in the introduction of rotating diffusers. He also contributed a lot of work on noise control of presses, particularly the shearing process, where the energy is released suddenly, and in noise control of circular saws, by damping the blade. His invention of a hydraulic oscillator became a sonar source still used by navies today and capable of mimicking any ship's sound signature and thereby fooling mines into exploding harmlessly. The same oscillator hooked up to steel construction piles proved capable of vibrating them at frequencies sufficient to liquefy many soils, allowing the piles to slide into position without days of laborious pile-driving. It was at Adelaide University that David and Colin Hansen coauthored their book, *Engineering Noise Control*, which went on to become an industry standard.

(News source: Marion Burgess, chief editor, *Acoustics Australia*)

News from Japan

Sixtieth anniversary of ASJ Tohoku Chapter

The Tohoku Chapter of the Acoustic Society of Japan will celebrate its sixtieth anniversary on September 15, 2015, the day before the opening of the autumn annual research meeting at the University of Aizu. It will hold a commemorative meeting of ceremony and lectures with a theme of Science of Sound Utilized in Life. There will be three lectures on where we hear the sound, Outdoor Broadcasting Public Address Systems that protect our lives, and the diagnosis of our body using sound.

Social-Contribution Activities of ASJ Research Committee on Education in Acoustics

The ASJ sets up ad hoc research committees to carry out interdisciplinary research on specific issues, when necessary, in addition to standing technical committees on individual research fields. Currently, the society has seven research committees including Road Traffic Noise, Acoustic Barrier-Free, Sound Design, and Education in Acoustics, among others. The research committee on Education in Acoustics coorganized a joint event called Science Square in Summer Vacation on August 1–2, 2015, in Tokyo together with National Science Museum. The committee is planning another event, Science Classroom Making Headphones Using Plastic Bottles, for children, in collaboration with the Research Committee on Acoustic Barrier-Free and Sony Taiyo Corporation on October 17, 2015.

INCE-J Organizing a Standard Drafting Committee

The INCE-J recently finished organization of a committee (Chair: Prof. H. Yano, Chiba Institute of Technology) on drafting a few "Japanese Industrial Standards" (JIS) in response to the amendment of IEC 61672 series in 2013. The committee is planned to make (1) revision of JIS C 1509:2005 -1 and -2, "Electroacoustics−Sound Level Meters" as IEC/IDT to conform to IEC 61672 -1 and -2:2013, (2) enactment of a new part of JIS C 1509-3 as a translation of IEC 61672-3, and (3) revision of JIS C 1513:2002, "Octave and Third-Octave Band Analyzers for Sounds and Vibrations" and JIS C 1514:2002, "Electroacoustics Octave and Fractional-Octave Band Filters" to conform to IEC 61260 -1 2014.

INCE-J Research with the Ministry of the Environment

INCE-J carried out three research works under contracts with the Ministry of the Environment and Fukuoka city government since last year:
1) reviewing regulatory regimes for railway noise in foreign countries in order to prepare for revision of noise impact evaluation methods for railway noise in Japan, 2) revising three guidance manuals for measurement and evaluation of transportation noise along roads and railways as well as around airports in order to examine if sound environment conforms to noise limits specified in noise guidelines under the Basic Environment Law, so that the specification on the method of calibrating sound level meters conforms to the revision of Japanese Industrial Standards for trading or certification, and 3) investigation of environmental protection measures for aircraft noise around Fukuoka Airport, where construction of a parallel runway is planned. The society organized an ad hoc committee for fulfilling each research work and summed up the result into reports. Reports for the Ministry of the Environment will be available on the relevant web pages, but in Japanese.

Plenary Lecture at the INCE-J Technical Meeting: Professor Takanobu Ogawa

At the coming INCE-J autumn technical meeting being held in Tokyo on September 10–11, Professor Takanobu Ogawa of Seikei University will make a plenary lecture titled Low-Frequency Noise Problems in High-Speed Railways: Their Physics and Countermeasures. The lecture will deal with noise issues on high-speed rails and the solution for low-frequency noise when trains rush into tunnels.

(News source: secretariat offices of ASJ and INCE/J)

Book Reviews*

*** Reprinted from Noise Control Engineering Journal**

Dynamics of Cyclic Machines

Iosif Vulfson
New York: Springer, 2015
390 pages hardcover
179 USD, e-book 139 USD
ISBN 978-3-319-12633-3

This book is for advanced practicing engineers and academics who are focused on the development of machinery and mechanisms. The text bridges the gap between mechanical vibration and mechanism synthesis and analysis. These topics are commonly considered separately, but the combination provides a more comprehensive approach to the design of cyclic machinery. This approach is increasingly important as production rates are increased at end-user process facilities and optimal use of material becomes key to the developers of process machinery. The techniques described also have potential for application in such fields as locomotive and automotive technologies, engines and power-generation technologies, electrical-power distribution systems, and robotics.

The twelve chapters are titled:

1. Cyclic Mechanisms
2. Dynamic Models of Cyclic Mechanical Systems
3. Mathematical Model
4. Dynamic Models with Constant Parameters
5. Dynamic Models with Variable Parameters
6. Nonlinear Dissipative Forces
7. Clearances
8. Vibration Analysis of Cyclic Machines Using Modified Transition Matrices
9. Regular Torsional Cyclic Systems with Branched Structure
10. Regular Cyclic Systems with Ring and Branched-Ring Structure
11. Regular Cyclic Systems with Translational Motion of the Actuator
12. Energy Exchange in the Regular Cyclic Oscillatory Systems. Spatial Localization of Vibrations

The book opens with introductory chapters on rigid mechanisms, mechanism synthesis and laws of motion, and basic dynamical and oscillatory models, as well as an introduction to the analytical mechanics used to model the systems of interest. This includes practical considerations of basic methodologies to drive mechanisms, such as cam versus lever drive, along with detailed theoretical discussion. The book then quickly grows more advanced and combines introductory concepts to discuss such topics as systems with constant and variable parameters; the evaluation of system nonlinearities; consideration of the effect of mechanical clearances; regular systems with branched, ring, and branched-ring structures; and spatial localization of vibrations.

Dynamics of Cyclic Machines is written in an approachable and articulate prose, which is a relief in comparison to the general nature of today's technical literature. This, however, is not in lieu of technical completeness of the book. To the contrary, the author provides ample references and shows a strong command of knowledge. A significant portion of the references are Vulfson's own publications, which date back to the late 1960s. Many of the references are published in Russian or German, which may impair the reader's capability to use them directly. All discussions are supplemented theoretical mathematical relationships and equations. The author consistently defines the previously unknown variables of each equation, further improving the capability with which the reader can understand topics discussed. There are no "back-of-the-chapter" example problems, but the author frequently employs examples within the text of each chapter, accompanied by ample descriptive diagrams and plots. Analytical and simulated numerical results are employed throughout.

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Proactive Condition Monitoring of Low-Speed Machines

Zhaklina Stamboliska, Eugeniusz Rusiński, and Przemyslaw Moczko
New York: Springer, 2015
186 pages hardbound (including Index)
99 USD, e-book 59.99 USD
ISBN 978-3-319-10493-5

Some books are more difficult to review than others, and this reviewer has just found a new standard in *Proactive Condition Monitoring of Low-Speed Machines* by Zhaklina Stamboliska, Eugeniusz Rusiński, and Przemyslaw Moczko. My primary issue was with the evident lack of editing, which translated into a somewhat strange structure (an abstract and keywords are provided for each chapter) and many grammatical and stylistic mistakes. In this context it was not an easy book to read.

The allocation of the chapters is straightforward. A short introduction is followed by a general review of the concepts associated with various approaches to maintenance. Then comes a chapter that introduces the specific issues associated with low-speed machines (i.e., machines having operational speeds of less than 600 RPM). The authors then go on to synthesize some of the previous material to focus on the notion of "proactive condition monitoring of low-speed machines" (i.e., the title of the book).

The next chapter deals with "Condition Monitoring Techniques for Low-Speed Machines" and with some tables and flowcharts; it is quite complete. Many direct and indirect condition-monitoring (CM) techniques are presented and the authors provide scenarios that could be used to implement a proactive approach to CM; however, the details are sparse. The next chapter is a survey of how the finite-element method (FEM) can be applied in the context of proactive CM, and it will be of interest to those who are not familiar with FEM techniques, as the explanations are clear and the figures are useful.

The last chapter is called "Case Studies of Proactive Condition Monitoring Applications," but it a misnomer. As it deals with the only example of low-speed machines presented so far (a cement rotary kiln), a better title would have been "A Case Study of Proactive CM: Monitoring a Cement Rotary Kiln." This being said, this is by far the most interesting chapter in the book, as it follows a step-by-step process that draws upon materials presented earlier. Furthermore all figures, photographs, graphs, and tables are excellent and logically laid out. Many stray typos and grammatical mistakes (and sometimes nonsensical sentences) detract from what seems to be a complete and focused treatment of a narrow topic by people who understand it extremely well.

I am sure that maintenance engineers dealing with low-speed machines will find useful information in this book, but I hope that the authors will have their work edited prior to the publication of a future edition.

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Acoustical Imaging: Techniques and Applications for Engineers

Woon Siong Gan
West Sussex, UK: John Wiley & Sons Ltd., 2012
426 pages hardbound
150 USD, e-book 120 USD
ISBN 978-0-470-66160-4

Woon Siong Gan's *Acoustical Imaging* is a comprehensive coverage of the important aspects of acoustical imaging. It includes mathematical derivations of the theory of sound propagation and includes the nonlinear effects that may be evident in materials. It further discusses the mathematics used in signal processing and the common methodologies used in acoustical imaging. It covers a multitude of applications, such as medical diagnostics, nondestructive testing, underwater imaging, and geophysical exploration, and includes derivations of the mathematics particular to those fields. It also includes the acoustics as applied to metamaterials and finally concludes with a discussion on future directions and technologies.

In covering the broad range of subjects within one text of modest size, the author condenses the discussion of mathematical derivations and signal processing techniques and in doing so somewhat limits understanding to those readers who have a sophisticated background and advanced expertise in mathematics and mathematical techniques. Practicing engineers and scientists in the field may feel at a loss in understanding and comprehension of the subject material due to the utilization of a sophisticated treatment of mathematics without inclusion of sufficiently detailed background. The derivations and their explanations are simply too condensed. This is perhaps a somewhat understandable procedure, considering the broad range of subject coverage coupled with the possible intention of keeping the text of modest length.

As may be assumed in any first edition, there are typographical and grammatical errors, but most do not significantly compromise the understanding of the material.

Despite the above limitations, the book does provide an initial reference to serve as a resource for those interested in exploring the usefulness of a particular acoustics-based technique in the pursuit of their own research and/or development endeavors. Certainly the broad range of coverage provides an insight into the diversity of applications which can and do utilize acoustical imaging techniques.

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Acoustic Analyses Using Matlab and Ansys

Carl Q. Howard and Benjamin S. Cazzolato
Boca Raton, FL: CRC Press, 2014
708 pages hardbound
111.96 USD, 97.97 USD e-book
ISBN 9781482223255

Howard and Cazzolato, from the University of Adelaide, have produced a useful book explaining how to perform acoustic analyses using ANSYS, a commercial finite element software package widely used in academia and industry. The book comprises a number

of test cases worked out using the newer ANSYS Workbench as well as the older ANSYS Parametric Design Language (APDL). The text takes advantage of the new Acoustics Application Customization Toolkit (ACT) that is essentially a toolbar or shell for ANSYS Workbench, making it simpler for acoustic analysis.

Though the title of the book appears to give equal weight to MATLAB and ANSYS, the text is primarily directed towards the ANSYS user. That is to its benefit. Though the authors provide MATLAB scripts to determine theoretical solutions and postprocess data, little additional background is provided on the use of MATLAB, and an understanding of MATLAB scripting is assumed.

The book will be especially useful to students who are taking a course in which ANSYS will be used for acoustic simulation. Acoustic sources, boundary conditions, and different material models are explained in detail. Over twenty test cases are described, including analyses of simple mufflers, lined ducts, reverberation rooms, baffled pistons, and sound transmission through a panel.

With the large number of test cases, the book functions as a de facto verification manual for the ANSYS acoustic capabilities. Most test cases include a step-by-step tutorial for solving the problem using the Acoustics ACT in ANSYS Workbench. Accordingly, the book is ideal for the first-time user learning how to use ANSYS for acoustics.

The book covers some fundamentals, but primarily those that are germane to ANSYS. For example, the book discusses basic muffler and silencer considerations, room-acoustics theory, different sound absorbing material models, and determining panel transmission loss. However, it leaves topics such as A-weighting, 1/3-octave bands, perforate models, and determination of insertion loss of mufflers to standard noise and vibration texts. Since the number and range of test cases is fairly comprehensive, much of the theory used by a student in an introductory acoustics course is included. However, I believe it is best if the book is used in conjunction with an applied noise and vibration control text.

Though ANSYS does not have the capabilities of the more specialized acoustics software packages, it is widely used at most universities and is likely more available to students. ANSYS is also widely used in industry, and the capabilities in ANSYS are adequate for many industrial users. Moreover, users of the more specialized packages can model the included test cases to gain confidence in their software use. Hence, I think that the book will find a wide audience.

In summary, my students have found the book invaluable for learning how to use ANSYS Workbench for solving vibro-acoustics problems. The examples are numerous, detailed, well chosen, and complete with theoretical solutions. For these reasons and others, I believe ANSYS users will keep a copy of the book nearby and refer to it often.

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Frontiers in Aeroacoustics

Ganesh Raman and K. Srinivasan, editors
Essex, UK: Multi-Science Publishing Co. Ltd., (2014)
viii + 510 pages softbound
125 USD
ISBN 978-1-907132-44-5

This book is composed of twelve review articles on various aspects of experimental, theoretical, and computational aeroacoustics. All twelve of these articles (now chapters) were originally published in the *International Journal of Aeroacoustics* between 2009 and 2013. Each article is unaltered from the original published paper. The twelve chapters are the following:

1. "Advances in experimental aeroacoustics," Ganesh Raman, Rakesh Ramachandran, K. Srinivasan, and Robert Daugherty
2. "Recent developments in the application of the Generalized Acoustic Analogy for jet noise prediction," M. E. Goldstein
3. "The instability of high speed jets," Philip J. Morris
4. "Jet noise measurements: past and present," Marcus Harper-Bourne
5. "On Prandtl's formulas for supersonic jets cell length," Alan Powell
6. "Aeroacoustics of twin supersonic jets: a review," Ganesh Raman, Praveen Panickar, and Kanthasamy Chelliah
7. "Evolution from 'tabs' to 'Chevron' technology—a review," K. B. M. Q. Zaman, J. E. Bridges, and D. L. Huff
8. "Vortex sound with special reference to vortex rings: theory, computer simulations, and experiments," Tsutomu Kambe
9. "Green's functions in computational aeroacoustics," C. L. Morfey, C. J. Powles, and M. C. M. Wright
10. "Multidimensional generalized functions in aeroacoustics and fluid mechanics: basic concepts and operations," F. Farassat and M. K. Myers
11. "Aeroacoustics of pipe systems with closed branches," Devis Tonon, Avraham Hischberg, Joachim Golliard, and Samir Ziada
12. "Flame dynamics and combustion noise: progress and challenges," S. Candel, D. Durox, S. Ducruix, A. L. Birbaud, N. Noiray, and T. Schuller

All papers reprinted in this book are quality papers written by respected experts in the field of aeroacoustics. All, of course, were peer reviewed prior to their publication. The editors included the names of the presumed reviewers in an acknowledgments section. The book lacks an index, which would be very useful if one were searching for a particular topic. The cost of this book is quite high given the fact that one can go to the *International Journal of Aeroacoustics* website (http://multi-science.atypon.com/loi/ija) and download a pdf file of ten of the twelve papers for free. The other two cost thirty-five dollars each.

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Nonlinear Vibration with Control for Flexible and Adaptive Structures, **Second Edition**

David Wagg and Simon Neild
Switzerland: Springer, 2015
xi + 453 pages hardcover with 142 Illustrations, 3 Illustrations in color
179 USD, e-book 139 USD
ISBN 978-3-319-10643-4

It really was a pleasure reviewing the latest edition of Wagg and Neild's graduate-level textbook. The text reads like a guided logical inquiry into the field of nonlinear control, drawing upon the student's understanding of linear vibration theory with good and relatable examples of the demising boundaries between the two. Each chapter begins with an abstract that serves as both a summary for the concepts to be discussed and an explanation of how the concepts fit within the study and application of nonlinear vibration control. Each chapter ends with chapter notes that relate the text to references for further study. Problems are given to exercise the student's understanding of chapters 2, 3, and 4, with complete answers worked out in chapter 9. Chapter 1 introduces the concept of smart structures and the naturally occurring causes of nonlinearity that require control. Causes are grouped into material hysteresis, geometric nonlinearity such as pendulums under large displacements, and externally applied forces and constraints such as those that occur for airfoils, ferrofluidics, mechanical freeplay, and control system delays.

Starting with sinusoidal analysis of linear systems, chapter 1 shows how similar mathematical modeling of nonlinear systems results in harmonics within the response. The response becomes increasingly complicated as the displacement grows. Therefore, the convenient method of superposition no longer holds for the study of nonlinear systems, and other methods must be used.

With a lack of exact solutions, chapter 2 introduces methods of numerical simulations, dynamical system theory, and state space mapping for the study of nonlinear systems. The chapter reviews these methods as applied to linear harmonic systems and progresses to linear approximation, bifurcation systems, and harshly nonlinear systems such as friction oscillators (e.g., squealing brakes) and impact oscillators (e.g., light standard chain dampers). The chapter ends by introducing higher-order nonlinear phenomena such as solitons, chaos, localization, and mode veering and the methods being used to study them.

Chapter 3 develops the methods for control of nonlinear vibrations. Passive methods include tuned mass dampers, inerters, and nonlinear isolators (e.g., negative stiffness spring mechanisms). Semiactive methods center on the skyhook high/low viscosity damper. Active methods expand control theory to nonlinear systems and adaptive control for systems with variable parameters.

Chapter 4 introduces approximate methods for analysis, beginning with finding the "backbone curve" effect of nonlinearity, which warps resonance peaks into the shape of a dorsal fin. Perturbation theory applications are followed by normal form transformations of weak nonlinear systems (used to solve the near linear responses while maintaining information about the nonlinearities).

Chapter 5 builds upon normal form transformations to define nonlinear modal deflections and resonance peaks and to develop nonlinear modal analysis in general.

Chapter 6 expands linear beam theory to the nonlinear realm of large deflections and axial loading. An example of vibration control of a piezoelectric bimorph beam is given.

Chapter 7 extends the linearized cable equations to include nonlinear dynamic tension and cross-coupling between quasi-static and modal terms. Case studies are given to demonstrate nonlinear effects.

Chapter 8 expands linear plate theory to include nonlinear effects of in-plane loading and then develops the equations for shells, demonstrating how higher-order terms introduce nonlinearity and subharmonics as the shell becomes less shallow. The chapter ends with a short introduction to the study of adaptive structures such as bi- and multistable composites.

Chapter 9 gives thoroughly worked-out solutions to problems within the book.

Wagg and Neild's *Nonlinear Vibration with Control* is an easy study for the student and a valuable reference for the engineer.

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Design and Simulation of Rail Vehicles

Maksym Spiryagin, Colin Cole, Yan Quan Sun, Mitchel McClanchan, Valentyu Spiryagan, and Tim McSweeney
Boca Raton, FL: CRC Press Taylor & Francis Group, 2014
337 pages hardbound with 289 B/W Illustrations
135 USD, e-book 118.57 USD
ISBN 9781466575660

As stated in its title, this relatively concise book attempts to cover all aspects related to the design and simulation of railway vehicles in ten chapters. The authors are six professors and railway professionals associated with the Centre for Railway Engineering at the Central Queensland University (CQU) in Australia. The center was involved in a number of valuable research projects on railway engineering, including rail noise studies that are not discussed this book. The book is an ambitious undertaking, and it appears that the authors were given strict page limits, which explains why the discussions of an extensive variety of simulation and design topics fit into a 323-page book. This book is at least indirectly relevant for anyone with projects related to rail noise. However, I never noticed noise or vibration being mentioned.

As an example, this book would have been useful during a multi-disciplinary study I performed several years ago to understand why a new light rail system was louder than expected. In some locations, the noise levels were up to ten decibels greater than expected, which resulted in some very uncomfortable community meetings. The study included noise measurements, rail roughness measurements, computer modeling of the vehicle/track interaction using VAMPIRE (one of the tools discussed in this book), tribology, and approaches to rail grinding. There were a number of discussions between professionals from diverse fields about how to best approach the various issues and how to combine all the different pieces of the study into concise recommendations. The other professionals knew as much about noise as I know about tribology. If this book had been available, it would have helped me in these discussions because I would have had a better idea of the scope and limitations of the tools (such as VAMPIRE) that others were using.

The first three chapters provide a brief introduction and discuss the general design of unpowered vehicles and locomotives. This introductory material outlines the evolution of rail vehicles going back to 1814, when George Stephenson built the first locomotive that used friction forces between smooth flanged wheels and smooth rail for the tractive effort. Also, apparently Stephenson was the one who selected a rail gauge of 4 feet 8.5 inches, which is the standard gauge in Western Europe and North America. I did a quick Google search, and it appears to be an urban myth that Stephenson selected that measurement because it was the width of Roman chariots. Apparently chariots were obsolete well before the Roman Empire formed and extended to England.

Chapters 4 through 9 cover general-modeling techniques, multibody dynamics, long-train dynamics, rail-vehicle-track-interaction dynamics, cosimulation and its application, and advanced-simulation methodologies.

Each chapter could probably be a separate book. For readers who want to dig deeper into any of the topics, most chapters provide an extensive list of references. One factor that I found interesting is just how many aspects of railway vehicles need to be analyzed. A short list of topics is as follows:

- Longitudinal dynamics, which relates to how a ten-thousand-foot-long freight train negotiates curves without derailing.
- Vehicle dynamics, which includes the interaction between a vehicle and the track. Some of the modeling programs discussed are NUCARS, GENSYS, VAMPIRE, ADAMS/VI-RAIL, and others. Each seems to have different strengths and weaknesses.
- Modeling of the wheel-rail contact patch, which relates to creation of surface cracks and actually relates to wheel-rail noise.
- Air brake systems on freight trains where it will take several seconds for the pneumatic signal from the front of the train to reach the rear of the train.
- The effects of slack in the coupling system when trains accelerate and brake. An interesting factoid is that without some slack in the coupling systems, it would be extremely difficult for a long-freight train to start from a stop.

The bottom line is that this is a specialized book that is only relevant to acoustical professionals when they have projects involving detailed evaluations of railway noise and vibration. However, if you are involved with such a project, this is a good book to have on hand for reference. It also might be of interest to some hardcore, very technical rail fans.

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Active and Passive Vibration Control of Structures

Peter Hagedorn and Gottfried Spelsberg-Korspeter, editors
Springer, 2014
311 pages hardcover
209 USD, e-book, 159 USD
ISBN 978-3-7091-1820-7.

This book has been written with a focus on linking the gaps between structural mechanics, vibrations, and modern control

theory. The contents should be very helpful to young scientists and graduate-level students and could also bring certain guidance to engineers working in the vibration-control fields. This book was also prepared as the CISM International Centre for Mechanical Sciences) course No. 418, held in Udine, Italy, from the 27–31 May, 2013.

Some chapters are fully illustrated and some are fundamentally introduced. The authors give some links between the vibration, mechanics, and control theory, which fits the title of this book as *Active and Passive Vibration Control of Structures*. However, there are certain weak points dealing with control because it is very difficult to cover most of the state-of-the-art advances. Hence, readers should not use this book as a sole reference, especially dealing with the adaptive-control algorithms that have been widely adopted in active-vibration control (i.e., engine vibration) and structural-vibration control using smart actuators and/or sensors. More specific comments for individual chapters are as follows.

Chapter 1 covers relatively a large portion of this book. It gives an introduction and fundamentals of vibrations for both discrete and continuous mechanical systems. This part may be very helpful for graduate-level students to understand the vibration problem and how it is explained mathematically, as well as how the design of vibration-control systems will be made by knowing the plant dynamics. In addition, the hybrid modelling of the continuous system with the discrete system is very important to the understanding of vibration isolation in civil structures later covered in chapter 3.

Chapter 2 tends to lay out the adoption of variational principles for the derivation of equation of motion for discrete and continuous systems and the links to their control. This part is good for young researchers to understand modelling other than the classic Newtonian mechanics.

Chapter 3 gives a tutorial on the use of hybrid mass damper that is typically applied on building-vibration control. Three different approaches in reducing the dynamic response of buildings are covered: the dynamic vibration absorber, active mass damper, and hybrid mass damper.

Chapter 4 presents the physical modelling of two primary types of transducers employed in the active-vibration control: electromagnetic and piezoelectric types. The electromagnetic actuator is also known as voice-coil type, such as the typical loudspeaker used in the active-noise control, while the piezoelectric is mainly for smart materials, used also in various applications in structural-vibration control. The fundamental mathematical modelling of these standard transducers could be very helpful to young researchers and engineers. At the end of this chapter, the application of the modelling in vibration control is illustrated, in terms of vibration isolation using voice-coil type and in structural-vibration control using the piezoelectric type. It seems the functions of these two actuators are explained most in the context of adjusting the damping effect of the coupled system, which could only belong to passive control. However the authors did not discuss the active-vibration control through generating "antiphase" response by the external forces from these actuators, using the adaptive digital filter controller configured with the adaptive algorithms. Some of the applications that could have been treated include the active-engine mount and active-suspension system in automotive industry, as well as the active-flutter control for airplane wings.

Chapter 5 gives a brief introduction on the LMIs (linear matrix inequalities) used in control optimization. This part is probably simplified since there are many textbooks on control theory. This optimization method normally requires more in-depth understanding, without which it may be difficult for engineers or young researchers to employ this approach in active-vibration control. Actually, there is an increasing interest in the adaptive algorithm, like the LMS (least mean square) algorithm, that is also part of the optimization that is very effective for the active-vibration control. It could be beneficial to future readers if the authors could give some indications on this part.

Chapter 6 shows various damping mechanisms on vibration response. After that, various mechanisms of damping in structures and dissipation mechanisms are given. The categorization and summary made by the authors are very educational. It would be very nice to see more discussions on the MR (magnetorheological) or ER (electrorheological) damping mechanism from the fluids since there are quite a few applications in semiactive suspension and engine mount in road disturbance and engine-vibration control in the automotive industry.

Chapter 7 shows the typical application of vibration-path control using active magnetic bearings and shows how the active bearings can be employed for identification, failure diagnosis, and so forth. I liked this part: it should be very useful for new researchers. In the vibration control of rotatory machines like the geared-rotor system, the vibration and radiated noise is primarily due to the dynamic mesh force of the gear teeth, which subsequently generate vibrations propagated along the shaft and through the transmission path of bearing; this results in the vibration of housing radiating noises. The path control using the active bearing is an effective way to suppress unwanted responses; however, the cost of the active bearing system has been a big concern.

Overall, I like this book because it does give a general introduction on vibration

modelling and its control. This fundamental theory is very important for young researchers to use as a reference to further conduct research and apply techniques in noise control engineering fields.

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Essentials of Applied Dynamic Analysis

Junbo Jia
Heidelberg: Springer, 2014
xviii + 424 pages hardbound
229 USD, e-book, 179 USD
ISSN: 2195-433X
ISBN: 978-3-642-37002-1

1. Overall Comments

This book provides an excellent introduction to system dynamics and understanding the dynamic response of structures. The author begins from basic principles and builds the reader's understanding in a relatively rapid manner. He does not immediately simplify the approach and ignore the nontrivial issues. He introduces the complexities and tells the reader where they will be dealt with in detail in later chapters. Instead of talking about square boxes with *M*'s, squiggly lines with *K*'s, and dashpots with *C*'s, this author talks about real problems with excellent examples and helps the reader to see how to apply fundamental analysis to real systems.

It is important to note that the focus of the text is marine engineering and that the vast majority of examples and illustrations focus on oil exploration and production platforms in the ocean. There is a great deal of discussion of topics such as the support of flares, sea states, wind loads, seismic excitations, and other topics unique to this specific application. However, this should not detract from the outstanding coverage of basic principles including multiple degrees of freedom, damping, complex loading, strength of materials, and other fundamental topics.

The author's approach is to use a number of short chapters on specific topics. He uses this approach to build knowledge in small steps. One wonders if these short treatments are sufficient for those not familiar with the topics. Clearly this book could be a great refresher, but it may be a challenge as the first text on these topics.

Later chapters, after chapter 6, are heavily focused on ocean structures even when illustrating basic concepts. For those dealing with these sorts of structures, this is very helpful. For the more general audience, this may not be as helpful in understanding some of the basic concepts of dynamics and analysis.

For those working on the dynamics of ocean structures or planning to work in this area, this would be an excellent text to begin. The numerous references would also be helpful for detailed analysis and more difficult topics. For a student or those unfamiliar with system dynamics, the first fourteen chapters provide a very good introduction to the topics with both the theoretical framework and some good, practical insight for marine-engineering-type structures.

Toward the end of the text, chapter 17, Fatigue Assessment, stands out. The author includes a lot of information with coverage of several different methods of accounting for fatigue and crack propagation. A novice to this topic area may be left with a lot of alternative approaches, and it may be difficult to grasp and determine what is useful and appropriate, especially for nonoffshore problems. Since there are whole textbooks devoted to this topic, it is not surprising that the author found a challenge in covering it in one chapter.

Below are comments and notes for each of the chapters to better describe the book and its value.

2. Chapter 1—Introduction

The author provides good examples with coverage of a wide range of issues. His examples and descriptions of excitation include sloshing fluids, earthquakes, and trains to name a few. He does well in giving the student/reader a perspective of the wide variety of dynamic problems and their importance. As one would expect relating dynamics to risk, a great deal of this material deals with resonances and damage. At the end of the chapter, the author does a good job of illustrating when the complex topics introduced will be covered in later chapters.

One error: the reference to section 1.2 in the first paragraph under 1.4, Solving Dynamic Problem, should be 2.2.

3. Chapter 2—Governing Equation of Motions

Like most such texts, the author starts with a single degree of freedom problem with a typical, simple diagram. He does an excellent job describing how Hamilton's principle is used as a tool with Newton's law to create an equation of motion. He provides a good, multidegree example of freedom problem and takes it to the point of showing the matrix formulation. At first sight this seems like a rapid progression, but it provides a good foundation for later treatments and helps the student/reader be prepared for what comes later.

4. Chapter 3—Free Vibrations for a Single Degree of Freedom (Sdof) System—Translational Oscillations

This is the typical approach to describing single degree of freedom systems and the solutions. It is clear and well done. I really like the discussion of modeling beams and stiffness documentation. The discussion of damping is well done. It covers the topic well in terms of the magnitude of damping and its effects.

5. Chapter 4—Practical Eigenanalysis and Structural Health Monitoring
This is a good approach. The author uses standard terminology in the field. He is forced to explain this to the reader, but it is much better than using simple terms that are required to understand those terms like eigenvalue, which are used as a standard in the field. The author does an excellent job developing and documenting the analysis of beams by showing the basic principles and providing a chart of eigenvalues for several beam configurations. His treatment of equivalent mass and stiffness is quite comprehensive and should be useful for many readers. The treatment of symmetry, while an important topic, is not presented in great depth. The reader will certainly understand the basic concepts. There is no discussion of resolving symmetry problems or a reference to a more detailed discussion later in the text.

6. Chapter 5—Solving Eigenproblem for Continuous Systems: Rayleigh Energy Method
This chapter presents a good discussion of the Rayleigh Method with solid examples of its application. The author does a nice job of explaining and demonstrating the importance of choosing a good deflection shape to get accurate results.

7. Chapter 6—Vibration and Buckling Under Axial Loading
Overall this chapter is a good introduction to buckling formulation and problems. This is definitely not a thorough treatment, but it provides a foundation for later treatment. The example provided shows a set of interesting conditions for higher-order modes. This should cause the reader/student to think about the state of loading throughout a structure and to realize the complexity of such problems. There is a problem with the definition under Equation 6.9. One is said to be a buckling load, but by definition it is dimensionless.

8. Chapter 7—Eigenfrequencies for Non-uniform Beams, Shallow and Deep Foundations
This is a very short chapter that introduces the concept of foundation effects. The example shown has an unexplained factor R, which is disconcerting for the reader.

9. Chapter 8—Deterministic and Stochastic Motions
This chapter provides a good introduction to the concepts of time signals and their characteristics. With the examples provided, the reader can understand the important characteristics in categorizing signals. It might have been helpful to have had an example illustrating how properly categorizing a signal or forcing function is important.

10. Chapter 9—Time Domain to Frequency Domain: Spectrum Analysis
A good introduction to spectral analysis is presented in a very few pages. The major elements are represented. The emphasis is on describing the Fourier series and its many representations in terms of parameters and graphs. There is not an in-depth treatment of the statistics or statistical parameters for characterizing signals or motion.

11. Chapter 10—Statistics of Motions and Loads
The chapter discusses basic concepts of statistics and statistical distributions. Gaussian, Weibull, Rayleigh, and Poisson distributions are covered. The concepts are discussed in terms of characterizing ocean waves for the most part. This was the first chapter for which there were not sufficient examples to help the reader/student clearly understand the application of the concepts presented.

12. Chapter 11—Forced Vibrations
This chapter presents a comprehensive discussion of forced vibration. It covers the basic concepts from simple harmonic forcing functions to random functions. The examples and the way in which much of the material is presented are oriented toward ocean structures and their loading. The segment on page 147 dealing with how to handle dynamic loading on ocean structures is useful to those working with such structures. The definition of wave-related transfer functions and the example on page 148 again will benefit those working with ocean structures. The example does an excellent job of illustrating the basic concepts of period of static versus dynamic loading. In segments of the chapter, terms like *jacket* and *top side* may be unfamiliar to the reader. A short explanation of ocean structures and the terminology may have been helpful. The author does an excellent job of presenting the concepts of transfer functions and coherence. This is done in a logical and intuitive fashion that should aid the reader in understanding the underlying concepts. Instead of just presenting the functions, the author takes the reader through a process that highlights the concepts behind the functions. Section 11.5 is particularly well done. It would have been helpful if the author had spent more time explaining the concepts of noise. This is discussed in the final page of the chapter. While this treatment is accurate and highlights important concepts, it may be too short for the reader to understand the importance the impact of noise.

13. Chapter 12—Calculation of Environmental Loading Based on Power Spectra
This chapter focuses on loading calculations for wave and wind loads. There are also descriptions of loading spectra for ice impacts and earthquakes. As in the preceding chapter, the applications used for examples and to illustrate basic principles are ocean structures such as drilling platforms. The author is thorough in his explanation of the basic principles and the concepts of the theories behind

some of the loading functions. In many instances the complex representations are finally expressed in a simple formula based on rules of thumb or approximations based on typical circumstances.

Two typographical errors were noted in this chapter:

- In the first paragraph on page 175, "below" should be "blow."
- On page 179 under equation 12.25, "gis" should be "g is."

The treatment of ocean waves and wind loading by the author is extensive. While I am not an expert in these areas, the discussions seem comprehensive and provide the reader a lot of information and numerous references. The ice-loading segment was interesting and quite enlightening. The treatment on earthquake loading was short but provided an introduction, knowing there was a more in-depth treatment in a later chapter.

14. Chapter 13—Vibration of Multi Degrees of Freedom Systems
This chapter provides a thorough discussion of multiple-degree-of-freedom problem formulations and solutions. It provides a sound foundation for the reader in understanding and working with such problems. There is a lot of good information about different solution methods. Both implicit and explicit integration methods are discussed. The author describes several classic methods and provides references to the methods not discussed. Overall this is a comprehensive introduction to the topic that should provide much insight for the reader. There seems to be a word omission in the first line of the definition of terms under Equation 13.26. In the second paragraph on page 221, the second sentence has a phrase "a Sec. 15, a..."; it seems like something is missing or the reference is incomplete.

15. Chapter 14—Damping
This is the most engaging chapter in the book. It presents a thorough discussion of damping and damping equivalences. The author does an excellent job of presenting the theory of energy dissipation and the characterization of this loss in terms of different types of damping. The reader can find a very well-done explanation of the loss mechanism and how the damping can be represented in the basic equations of motion. In addition, the author provides very useful rules of thumb and tables of realistic values for damping for engineering structures. There are discussions and tables specific to ocean structures, but there is also a lot of material relevant to a wide range of vibration issues. On page 242 in the third paragraph, "nature Frequency" should be "natural frequency."

16. Chapter 15—Nonlinear Dynamics
This chapter presents a comprehensive treatment of the strength of materials related to stress-strain behavior and nonlinearities in materials and material sample tests. Overall, this chapter presents the concepts and the principles behind nonlinear behavior and the solution of the equations of motion. It provides an excellent introduction to the topic. To apply these techniques, one would have to have additional knowledge. Perhaps the author assumes the reader will be using a finite element code that has implemented these techniques and only an introduction to provide a basic understanding is needed. There is extensive discussion of the effects of nonlinearities on dynamic equations and the solutions of these equations. Beam strain hardening and strain softening effects are discussed in some detail. Tables of changes in the natural period are provided due to these changes in material properties. The effects of large deformations are also discussed with a solid example of a vertical column. The author discusses in some detail snap-through and snap-back phenomena and how they can be predicted. In the final segment, the author discusses load and displacement control methods of solving nonlinear dynamic systems of equations. While not describing the details of such methods, the basic premise is present and simple examples are used to illustrate the simple approach.

17. Chapter 16—Structural Response Due to Seismic Excitations
This chapter provides an introduction to ground vibration and some of the considerations related to seismic activity in building and structural design. As with much of this text, the focus is on ocean structures such as drilling or production platforms. The discussion of excitation period and response utilizes concepts of transient and steady-state response along with stiffness and damping controlled regimes without using such terms. For the reader who has gone through the previous chapters, this may be disappointing to not utilize the concepts and good fundamental foundation provided previously. However, for those going directly to this chapter, there is no need to understand the details behind modal response, isolation, and frequency response.

The author provides an insightful discussion of soil effects and effects of multiple layers of material to provide a good base for the following analysis. There is a short but useful discussion of ground motions and the effects on extended structures. This is helpful in understanding issues with respect to damage and failure in such structures. The author does an outstanding job presenting some of the "rules of thumb" related to seismic periods, duration, and magnitude to provide a context for consideration of the possible impact on structures. Typical spectra envelopes are presented along with a discussion of when deterministic and statistical approaches should be used. Several different methods are discussed for computing the maximum or representative

response in the system. The strengths and weaknesses of these methods are discussed and compared with rough estimates of potential errors in the computer response amplitudes. Other effects such as ice on a drilling or production ocean platform are discussed. Though the general effects are noted, there is no discussion of analysis behind these results.

While the author is talking about a broad topic that does not permit comprehensive coverage technically, it would have been nice to have at least one example illustrating the analysis process and some of the concepts and simplifications noted.

18. Chapter 17—Fatigue Assessment
This chapter begins with a discussion of different methods for fatigue analysis or assessment. Utilizing the references, the reader will be able to understand what is being presented, but it will be difficult without studying the references for some time. This is the most challenging chapter in the book for the reader. The author presents a lot in an often terse fashion with all the discussion left to references. For those familiar with fatigue analysis, this will not be a major problem. For those having their first exposure to fatigue analysis methods and concepts, this will be a very difficult chapter. Toward the later portions of the chapter, the discussion lists numerous alternatives and empirical approximations for the reader to consider. While such information is useful, the reader will have a hard time determining what is useful and provides real value. More practical examples would have been helpful for the reader. There is only one example in this chapter, but it is very difficult for the reader to understand and apply in a realistic way. A few simple examples would have been very helpful for the novice. Figure 17.11 was particularly frustrating. It appears to be a color chart presented in grayscale. It is very difficult for the reader to understand, other than the items identified by the author. The fracture mechanics segment is well done and comprehensive in defining and illustrating the basic principles. The segment on FE modeling is limited. The author defines some of the most significant concepts and difficulties but provides little else in the one-page presentation.

19. Chapter 18—Human Body Vibrations
This chapter presents a very brief introduction to whole-body vibration. It describes some of the basic principles and concepts of human discomfort due to vibration. Allowable magnitudes of acceleration are described in terms of international standards and recommendations. The reader is given some sources of information and basic guidelines for whole-body vibration. Detailed analysis is not provided. This chapter only discusses potential discomfort, not injury.

20. Chapter 19—Vehicle-Structure Interaction
This chapter presents a general discussion of the topic. It does not discuss the details of interactions or the interface between vehicle and ship models. This chapter is more of an overview than a detailed technical presentation. The primary focus of this discussion is vehicles on ships. For someone new to the topic, it would provide a good starting point with some references for more detailed treatments. The author introduces the basic concepts of different levels of vehicle-modeling details depending on the frequency range of interest and the types of interaction.

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Ecore

Ecore Prevails in Lawsuit against Pliteq

Lancaster, Pennsylvania (July 7, 2014)—Ecore, a company that transforms reclaimed waste into unique performance surfaces, has successfully settled a lawsuit against Paul Downey and Pliteq, a business that creates building products for commercial sound control. The lawsuit arose as a result of Pliteq buying Ecore products through third parties and selling those products as its own manufactured product.

"We discovered that Paul Downey and Pliteq were having third parties buy our products and having them shipped to a warehouse in Allentown, Pennsylvania," said Arthur Dodge III, president and CEO of Ecore. "We learned from an employee of that warehouse that Pliteq was instructing the warehouse to take the Ecore labels off of our products and replace the Ecore labels with labels identifying the products as being manufactured by Pliteq."

Pliteq was simultaneously representing on the Pliteq website that the material was manufactured by it in Lancaster, Pennsylvania. Once Ecore learned of the relabeling activity, the company initiated a lawsuit against both Downey and Pliteq. A federal judge issued an immediate order requiring Downey and Pliteq to stop the activity of identifying the Ecore manufactured product as being made by Pliteq, which Pliteq agreed to.

Ecore's lawsuit continued and, shortly before trial, Ecore and Pliteq settled. Downey and Pliteq agreed to never engage in the activity of relabeling or representing any of Ecore's products, including Ecore's manufactured sound control underlayment, as their own products or implying that Ecore's products were manufactured by them.

"We are pleased to put this matter behind us and ensure that no further confusion will possibly occur due to the activity of Downy and Pliteq relabeling our products and telling the consuming public that they, rather than Ecore, manufactured them," said Dodge.

For more information about Ecore, visit http://www.ecoreintl.com/. For more information about Ecore's sound control underlayment products, visit http://www.qtsoundcontrol.com/.

Noise Control Engineering, LLC

Engineering Solutions to Noise & Vibration Problems

Recent Conference Appearances: GreenTech and IMX

NCE has recently participated in two marine conferences. Michael Bahtiarian addressed the GreenTech conference on May 28 in Seattle, Washington. He spoke about the mitigation of underwater ship noise. NCE has completed many quiet-vessel designs including ships for NOAA, the US Navy, and the National Science Foundation. GreenTech is the annual conference of Green Marine, a voluntary environmental certification program for the marine industry in North America. In the future, they may be adding underwater noise as one of their compliance points.

Mr. Bahtiarian also addressed the Inland Marine Expo (IMX) in St. Louis, Missouri, on June 16. This talk discussed inland towboat noise control and was part of a talk organized by Matt Coombs, VP of North American Operations for Christie & Grey and vibration isolation supplier from the UK.

NCE is the Premier Noise Control Consulting Firm for Ship Noise & Vibration

Our services include:

- compartment noise analyses
- vibration analyses
- underwater Noise
- mitigation/treatment design
- specification preparation
- design reviews
- diagnostics
- ABS certified environmental surveys

Go to our website for more info.

TECH TALK: Singing Propellers—Why They Happen and How to Fix Them

A "singing propeller" occurs when the blade's natural frequency of vibration is excited by a "vortex shedding" phenomena. When the vortex has the same shedding frequency as the blade's natural frequency, a resonant response occurs. The result can cause high underwater noise levels, high compartment noise, or unwanted vibration on-board the ship. The worst case is structural damage to the propeller itself.

NCE can determine when and if a singing propeller is likely to occur. The controlling factors are the thickness of the trailing edge and the flow speed over this edge. During the initial design phase, the likelihood of a singing propeller can be evaluated, and modifications to the propeller's trailing edge can then be implemented to avoid this phenomenon.

E-mail NCE for more information.

Quieting Shipyards, Not Just Ships: Clients Seeking Help in Minimizing Yard Noise

NCE has worked to reduce airborne noise for crew and passengers on hundreds of ships. Recently, NCE's work has been with shipyards to mitigate the sound generated during ship construction. These sounds include welding, grinding, and other mechanical noise emanating from equipment such as cranes and auxiliary power generators. The noise mitigation has been performed to reduce noise to a yard's employees in order to reduce OSHA noise exposure. This work has also been performed to reduce sound impact to neighboring properties, causing local municipality noise code violations.

NCE uses different tools in the evaluation of shipyards, including Cadna/A sound propagation software. NCE is also working on specialized low-noise equipment (see Tech Talk below).

E-mail NCE for more Information.

TECH TALK: Quieter Sandblasting

The Department of Interior, Bureau of Reclamation is the second largest producer of hydroelectric power in the United States. Like many of the branches of the military, Reclamation is seeing an increase in hearing loss disability claims. One of the noisiest operations at the Bureau of Reclamation's hydro-electric plants is abrasive (sand) blasting.

To help alleviate the noise exposure at these plants, NCE is investigating a quiet abrasive blasting nozzle. NCE has teamed with computational fluid dynamics (CFD) experts to model the complicated flow present in sandblasting nozzles.

Recently, NCE has tested a series of prototype nozzles and will be incorporating findings from these tests in their design.

E-mail NCE for more Information.

PCB Piezotronics, Inc.

PCB Introduces ½" Low-Frequency Microphone for Infrasound Measurements

Low-frequency range extends below the human audible range.

May 28, 2015, Depew, New York—A new 1/2" microphone and preamplifier system, model 378A07 from PCB Piezotronics, Inc., aids in low-frequency testing, ideal for studies ranging from wind turbines to natural events like tornadoes.

Low-frequency measurements are commonly required for wind turbines, sonic booms, diesel engines, and specialized loudspeaker systems, to name a few. Natural events such as tornadoes and earthquakes emit very low-frequency pressure waves that can travel long distances without being blocked. Model 378A07 microphones can detect these low-frequency signatures as potential danger.

This free-field prepolarized microphone has a frequency range of 0.13 Hz to 20 kHz (+/- 2 dB) which meets the IEC 61094-4 standard for test and measurement microphones. This covers infrasound, which is below the normal hearing range for adults.

PCB carries a full complement of prepolarized and externally polarized condenser microphones and preamplifiers. Prepolarized microphones use standard coaxial cables and are ICP compliant, allowing power supplies to be shared with other ICP compliant products such as accelerometers. This interchangeability can result in significant per-channel cost savings as well as reduce test set-up time. The 378A07 microphone is A2LA and ILAC accredited. Like all PCB products, it comes with a total customer satisfaction guarantee.

Microphone model 378A07 is in stock and available for immediate shipment. For additional information please visit www.pcb.com/acoustics or contact Mark Valentino, product manager, at +1.866.816.8892 or e-mail at mvalentino@pcb.com.

NTi Audio

XL2 Sound Level Meter—Just Turn It On!

The XL2 Sound Level Meter is renowned for providing precise measurements through a simple user interface. Now it just got better! The newly available "Locked Run" mode of operation means that the XL2 only has to be switched on for measurements to happen automatically. To further ensure continuation of sound level logging, all keys on the device are locked.

Get full press release and press pictures for download.

Loudspeaker Testing—Simple and Reliable Like Never Before

Testing your loudspeakers, transducers, or subassemblies has never been easier. Just connect your device under test (DUT) directly to your FX100 Audio Analyzer and begin measuring. No more hassle with external amplifiers and shunt resistors, cable dangle, or measurement errors due to uncalibrated gain. The new, integrated FX-SIP module with its powerful amplifier and impedance measurement capability offers unrivalled performance, reliability, and ease of use.

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Controlling the XL2 from Your PC Just Got Better

With the XL2 Remote Measurement option, you can connect your XL2 via USB to your PC and access a wealth of API commands. Control your XL2 from within your favorite application and pull the

sound measurement results in remotely. If you are already using this Remote Measurement option, you'll be pleased to hear that it just got even better; now you can query ten individual levels with a single command, plus you can retrieve FFT and 1/12 Octave data sets through the API.

Get full press release and press pictures for download.

XL2 at "We Love Green" Festival in Paris

Thirty thousand visitors turned up in Paris on the weekend of May 30–31, 2015, to enjoy the "We Love Green" Festival. XL2 Sound Level Meters were there monitoring the sound levels and keeping the peace in the surrounding neighborhood.

Get full press release and press pictures for download.

NTi Audio Experts at Swiss Acoustical Conference

This year's spring meeting of Swiss acousticians provided NTi Audio with an extraordinary forum for presentation of their wide range of professional expert measurement solutions. The day consisted of a series of practical demonstrations led by engineers from all major manufacturers. Visitors learned how to determine speech intelligibility as well as measure reverberation time, sound insulation, and environmental noise.

Get full press release and press pictures for download.

pinta acoustic

pinta acoustic Introduces SONEX Linear Absorbers

Streamlined appearance offers excellent sound absorption.

Minneapolis, Minnesota—pinta acoustic announces the introduction of SONEX Linear Absorbers. These straight-line baffles provide excellent sound control with a modern appearance. Highly customizable product design and shape options offer new optimum form and function possibilities in a variety of interior ceiling applications.

Class 1 fire-rated, SONEX Linear is constructed of pinta's willtec foam and is offered in natural white or light gray willtec and HPC color coatings.

SONEX Linear Absorbers standard and custom sizes include lengths up to 96 inches (2438 mm), 6- to 24-inch (152 to 610 mm) depths, and a set thickness of 2.03 inches (51.56 mm). These baffles are easily slip fit into two-inch-wide (51 mm) channel trim typically fastened in place to wall or ceiling substrates.

"SONEX Linear Absorbers are ideal for reducing sound reverberation in new and renovated spaces," says Joerg Hutmacher, CEO at pinta acoustics. "Custom shapes, sizes, and color options, as well as virtually unlimited ceiling plan and elevation arrangements, can provide a signature look to suit virtually any decor."

For more information or to find a representative, visit www.pinta-elements.com or call 1.800.662.0032 or +1.612.355.4200. To download "The Science of Better Acoustics" white paper, go to www.pintaacoustic.net/acoustic-information.

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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 on the Internet (www.i-ince.org).

June 13–15, 2016
NOISE-CON 2016
Noise Control Engineering Conference
Providence, Rhode Island, USA
www.inceusa.org

August 21–24, 2016
INTER-NOISE 2016
2016 International Congress on Noise Control
Hamburg, Germany
www.internoise2016.org

June 11–14, 2017
NOISE-CON 2017
Noise Control Engineering Conference
(with SAE Noise & Vibration Conference)
Grand Rapids, Michigan, USA
www.inceusa.org

August 27–30, 2017
INTER-NOISE 2017
2017 International Congress on Noise Control
Hong Kong, China
http://www.i-ince.org/

Directory of Noise Control Services

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