NOISE/NEWS INTERNATIONAL

Volume 17, Number 1
2009 March

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

- **INTER-NOISE 2008**
  Report
- **SPECIAL ISSUE**
  Noise Control Engineering Education in Europe
- **MEMBER SOCIETY PROFILE**
  The Swiss Acoustical Society

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Noise Control Engineering Journal

— An International Publication —

NOISE-CON

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Features

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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 Internet Supplement

www.noisenewsinternational.net

- Links to the home pages of I-INCE and INCE/USA
- Abstracts of feature articles in the printed version
- Directory of the Member Societies of I-INCE with links, where available, to the Member Society Profiles and home pages
- Links to I-INCE Technical Initiatives
- Calendar of meetings related to noise—worldwide
- Links, where available, to NNI advertisers
- Links to news related to the development of standards
- Link to an article "Surf the 'Net for News on Noise," which contains links to noise-related sites—worldwide

International INCE: Past and Present

This is my first president's column for *NNI* after assuming responsibility as president of International INCE on 2009 January 1. I take over from Prof. Hideki Tachibana who completed a five year term as President. The organization has continued to develop under his leadership and it will difficult to maintain the momentum. I would like to take this opportunity to sincerely thank Prof. Tachibana on behalf on International INCE for his years of dedicated service. Prof. Tachibana will, of course, remain in the Board of Director as the immediate past president.

Over the last ten years or so, International INCE has engaged in a number of new initiatives. In particular, these initiatives have significantly increased the responsibilities of the General Assembly. For example, a number of Technical Study Groups (TSG) have been established. Some TSGs have completed their work and have published their report. Several new TSGs are still active and many are focused on global noise policies issues. Please visit the International INCE web site (http://www.i-ince.org) for a summary of active TSGs and to download PDF files of completed reports.

A new Congress Selection Committee (CSC) was also established. The CSC has representation from the three main geographical areas where INTER-NOISE congresses are held. These representatives are appointed by the General Assembly; the purpose of the committee is to provide guidance in the selection of venues for future INTER-NOISE Congresses. Beginning at the INTER-NOISE congress in 2003, meetings of five Technical Divisions were held over the lunchtime hour on Monday and Tuesday. The main task assigned to the Technical Divisions was to encourage participants to offer suggestions for Special Sessions at the next and future Congresses. Beginning in 2008, the Technical Divisions were replaced by the Future Congress Technical Planners. The Technical Planner is now scheduled on Wednesday afternoon in parallel with other technical sessions. It is hoped that this new format will provide more encouragement for participants to assist with the organization of future INTER-NOISE congresses.

In addition to these new initiatives, the International INCE Board of Directors is currently giving serious consideration to provide travel grants to young scientist to attend INTER-NOISE congresses beginning with INTER-NOISE 2010 to be held in Lisbon, Portugal. The grants would be targeted to candidates relatively early in their professional careers and would be awarded by an International INCE Grants Subcommittee. I hope to be able to provide more details on this initiative in a future president's column.

The INTER-NOISE congresses remain the backbone of International INCE. This year the 38th International Congress and Exposition on Noise Control Engineering (INTER-NOISE 2009) will be held at the Westin hotel in Ottawa, Canada on 2009 August 23-26. The 2009 International Symposium on Active Control of Sound and Vibration (ACTIVE 2009) will also be held 20-22 August, immediately before the INTER-NOISE 2009 congress. Over 800 abstracts have been received for both congresses. In addition, a forum to be held during INTER-NOISE 2009 is being organized by former International INCE President Bill Lang. The forum will be held under the auspices of the International Council of Academies of Engineering and Technical Sciences (CAETS). The objective of the workshop is to identify and prepare an inventory of the technology available today for the design of low-noise products and equipment and to assess what is needed to be developed in future technology for the reduction of noise emissions of these products and equipment. This technology assessment will provide CAETS with the background information and recommendations on the state of noise control technology in order for CAETS to support the recommendations to be developed by the CAETS Study Committee on the noise issue. The forum, "Low-noise machinery and equipment for workplaces, building noise, and standardization," will consider non-vehicular noise sources in occupational, domestic, and community environments where noise must be considered. The forum will be run as a parallel technical session beginning early on Monday afternoon and ending on late Tuesday afternoon. Participation by congress attendees will be encouraged.

I conclude this editorial by extending a warm invitation to join INTER-NOISE 2009 and or ACTIVE 2009 in my home town of Ottawa. The organizers are planning a full technical and social program that is expected to make this an exiting event.

— Gilles Daigle
President, International INCE

Gilles Daigle
President, International INCE

A Convenient Non-Truth

Paul R. Donavan
Pan-American News Editor

Before you go any further, please be assured this is not about global warming. It is more about "political acoustics" or the use and misuse of noise. To illustrate some of my points, I draw upon experiences in environmental noise assessment and product development, but I am sure you can fill in some of the spaces from your own experiences in noise control engineering.

The last thing I want to do is downplay the need for environmental quiet. However, whether it is really true or not, noise is often tacked onto a litany of objections to new projects when the underlying issues are really not noise. A classic example is building a new "big-box" store. For any number of other reasons, people can become very set against such projects and noise often surfaces as one of the negatives. Most likely, these stores are proposed in an area that already has good vehicular access and hence the resultant existing noise levels to go with it. With some reasonable constraints, such placing loading docks and mechanical equipment away from any nearby houses, the remaining sources—such as low speed parking lot noise—will likely be masked by existing roadway traffic. No matter what the noise truth is, however, it is often too convenient not to get it off of the list of objections. In some cases, noise fear may be understandable even if not warranted. Skate parks can be a good example. The impression people have of skateboard noise can easily be driven by the experience they have of hearing them up close on the sidewalk. At two meters, this sound can stand out quite well against the ambient noise even in a congested area. However, at 100 meters, this sound will likely be barely audible. But the opposition to the proposed "hangout for kids" may still linger. On a similar vein, biking and walking paths often take a bad rap for noise, especially neighboring on a residential property. In most of these situations, it is difficult to build any case for noise impact even in quieter settings, but the loss of privacy or sense of insecurity can be a real and underlying truth.

In product noise control, noise can also become a convenient non-truth. In the automotive business, an almost invariable phase is something like: "this outside rear view mirror has great rearward vision, and it's good for noise, too." If you allow for the definition that being good for noise means that it does not increase the noise, there is a chance that this might be true. However, it is most likely that this statement is tacked on with little or no facts behind it and is primarily for selling the part. This can occur especially when interior quiet is an imperative of the program and having an extraordinarily large field of vision for the mirror is not. This type of convenient non-truth also has the negative effect of desensitizing decision makers for those cases when the part really is good for noise. The opposite case of a convenient non-truth can occur when a part for noise control conflicts with other performance or cost issues. In the days of prototype vehicles in the development process, the last thing an automotive noise control engineer wanted to hear is that final decision will be based on a subjective vehicle ride evaluation rather than by data. In this case, the non-truth is that the noise control part really does make a difference and the convenience is that those opposed to it get to "hear" the difference.

I am certain that convenient non-truths are far from unique to our specialty. Further, they are most assuredly not going to go away. The challenge is then to expose them through education and to be certain we do a thorough and unbiased assessment of what the noise effects are in terms of impact, benefits, and disbenefits. This falls on both sides of the issue, those who "cry wolf" and those who ignore situations where legitimate noise issues are present.

— Paul R. Donavan
Pan-American News Editor

Swiss Acoustical Society Schweizerische Gesellschaft für Akustik/ Société Suisse d' Acoustique *(SGA/SSA)*

The Swiss Acoustical Society, SGA/SSA, was founded in 1971. Since then, the Society has grown continuously. Today (2009), it has about 320 individual and 140 company members. The majority of the members are consultant engineers and practitioners, mostly in the field of environmental noise protection.

The aim of the Society is the promotion of acoustics in Switzerland by supporting studies and research in the area of acoustics, by exchange of experience between experts, by taking positions on questions of noise control legislation, and by strengthening the cooperation of acousticians over the language borders in this multilingual country.

The most important services for the Society's members are the two conferences each year; the spring conference—usually held in the French-speaking part of Switzerland—and the autumn conference with the general assembly. Sometimes they are also organized as joint conferences with the acoustical societies of Germany or/and France.

Four to five times a year, the Society's newsletter—bilingual in French and German—informs the members about news and topics on acoustics in Switzerland and abroad and covers lectures, courses, congresses, new publications, interesting web pages, and job offers.

There is no formal education in acoustics in Switzerland. Therefore the Society offers to its individual members the possibility to pass an examination for the title "Akustiker SGA" and thereby provides proof of their qualifications in acoustics.

Regarding the fields of acoustics SGA's members are interested in, noise control leads with building acoustics and room acoustics coming second. A majority of the members is interested in measuring technique, one-third of the members list physical acoustics among their interests, and one-quarter name musical acoustics and electroacoustics. This priority is reflected in the choice of subjects treated at the Society's events, but other fields and applications of acoustics are not neglected: hearing aid technology (with well-known manufacturers in Switzerland), hearing conservation at work places and during leisure time activities, active noise control, and speech intelligibility in churches. For audio-related topics such as transducers or acoustics in recording studios, SGA has initiated cooperation with the Swiss section of the Audio Engineering Society (AES).

SGA/SSA is member of the European Acoustics Association, EAA, the International Commission on Acoustics, ICA, and the International Institute of Noise Control Engineering, I-INCE. Foreign speakers are heard regularly at conferences of the SGA.

This is the 64nd in a series of articles on the Member Societies of International INCE.

Member Society Profile is a regular feature of *Noise News International*. If you would like to have your society featured, please contact George Maling at inceusa@aol.com.

European Education in Noise Control

Janet Moss, Noise Control Foundation

Introduction

The International Institute of Noise Control Engineering and Noise Control Foundation, in cooperation with the European Acoustics Association's Technical Committee on Noise (EAA TC-NOISE) held a one-day workshop during the 19th International Congress on Acoustics—ICA2007 MADRID—on September 4, 2007 in Madrid, Spain.

The theme of the workshop was "*European Education in Noise Control Engineering,*" and focused on academic training—current and future—in the technical aspects of noise control. The panelists participating in the workshop came from leading universities and institutions of higher learning in the following countries: Belgium, Czech Republic, Finland, France, Germany, Italy, Norway, Spain, Sweden, Switzerland, The Netherlands, Turkey, the Ukraine, and United Kingdom. These institutions are producing graduate engineers with formal training in the control of noise at its source and in the community.

First Session

Panelists and Presentations

The panelists for the first session of the workshop were:

- **Etienne Parizet**, Lab. Vibrations Acoustique, INSA-Lyon, France
- **Gerrit Vermeir**, Katholieke Universiteit, Leuven, Belgium
- **Phil Nelson**, University of Southampton, United Kingdom
- **Mehmet Çaliskan**, Middle East Technical University, Ankara, Turkey
- **Kurt Eggenschwiler**, EMPA, Dübendorf, Switzerland
- **Ondrej Jiricek**, Czech Technical University, Prague, Czech Republic
- **V. I. Tokarev**, National Aviation University, Kyiv, Ukraine

The Situation in France and European Doctorate in Sound & Vibration Studies

Etienne Parizet, *Lab. Vibrations Acoustique, INCS-Lyon*

The Situation in France

Many industrial organizations in France need highly-skilled acousticians. These include the automotive industry (Psa, Renault, suppliers, etc.), the aeronautics industry (Airbus, Eurocopter, Dassault, Snecma, etc.), other mechanical industries, consulting firms, and hardware and software industries (01dB-Metravib, Vibratec, etc.). The dispersal of their research and development departments throughout Europe will present a significant challenge.

INSA Lyon (Institut National des Sciences Appliquées de Lyon)
There are 140 students undergoing training in the mechanical engineering department at INSA Lyon. Their course work includes 14 hours each of industrial acoustics and signal processing, 28 hours on the vibration of discrete systems, and 35 hours on the vibration of continuous media. Also included are 24 hours of practice. These students enter the program with a background in solid mechanics, numerical analysis, and mathematics. In the fourth year of five, students can specialise in acoustics and vibration, with instruction during two months followed by a three-month project directly related to an industrial problem.

Acoustics training for a Master's degree in France

- Universities in France offering training in noise control engineering:
- Université du Maine, Le Mans, vibrations, signal processing, materials, transportation
- Université de Poitiers, Poitiers, aerodynamics, aeroacoustics
- Université de la Rochelle, La Rochelle, civil engineering
- Université Paul Sabatier, Toulouse, acoustics CNAM, aeroacoustics, audio/visual
- Université d'Aix-Marseille, Marseille, vibrations, signal processing, ultrasounds
- Ecole Centrale de Lyon, Lyon, aeroacoustics, civil engineering
- Université Pierre et Marie Curie, Paris, ultrasounds, civil engineering
- Université Technique de Compiègne, Compiegne, vibrations, fluid structure interaction, ultrasounds

Master's degree in acoustics at INSA and Centrale Lyon

For a Master's degree, a student must complete a course in general acoustics (25 hours) and one of two options. The aeroacoustics option includes 25 hours each of environmental noise, aerodynamic noise, active control, aeroacoustics, and waves in moving fluids. The vibroacoustics option includes 25 hours each of car acoustics, building acoustics,

propagation of vibrations, and noise radiation. A Master's project is required, and many of them are supported by industries such as Cetiat, Psa, Renault, Dga, and Lafarge. On these projects, students work half-time from January to March and full-time from April to September.

PhD studies
At INSA Lyon PhD students are supported by industry, by the regional government, or by the Research Ministry of the central government. The base level grants offered by the Research Ministry are not very attractive.

European Doctorate in Sound and Vibration Studies
Under this program a PhD student visits a "host institute" for six or twelve months with an attractive grant. The host institutes are:

- ISVR (Southampton, UK)
- KTH (Stockholm, Sweden)
- INSA (Lyon, France)
- TUB (Berlin, Germany)
- Fac. di Ingegnieria (Ferrara, Italy)
- KUL (Leuven, Belgium)
- Trinity College (Dublin, Ireland)
- DTU (Lyngby, Denmark)

This program is very useful for developing cooperation among European institutions of higher learning with concentrations offered in sound and vibration studies. Up to now 122 students are currently participating or have participated in the past. Eighty-five come from EU countries, 25 from associated EU countries, and 12 from the rest of the world.

Conclusions

At this time in France there is a strong demand for acousticians in industry. Training is offered in engineering schools at the Master's and PhD degree levels. The most effective training is at the PhD level supported by industry. The problems that are recognized include those associated with the delocalisation of research and development teams and the lack of "physical common sense" of today's students.

Education for the Building Acoustics Field

Gerrit Vermeir, *Acoustics and Thermal Physics Section, Building Physics Section, Department of Civil Engineering, Katholieke Universiteit, Leuven, Belgium*

Overview and Context

This presentation discusses education in the field of acoustics for students who will have future responsibilities for the built environment. The focus is primarily on the education program at the Katholieke Universiteit of Leuven (K.U.Leuven). Discussion of the framing questions relates to education in the field of noise control engineering in the country. Urban planners and building developers have a broad influence on our soundscapes. In this specific context, noise control engineering must be referred to in its broadest sense and the education becomes a challenging task. The breadth of the field of acoustics is well illustrated by Lindsay's wheel[1].

Curricula in Acoustics

At the Bachelor's degree level, K.U.Leuven offers five courses in the following: speech therapy, audiology, and mechanical engineering. They offer sixteen courses at the Master's degree level in mechanical engineering, physics, building engineering, speech recognition, and signal processing. Examples of these courses are the Master's degree level course in building acoustics and room acoustics. The former has fifteen two-hour lectures and ten hours of exercise work. The subjects covered include quantities, wave approach, air-borne sound transmission, and impact sound radiation among others. The approach taken is to have the students master quantities and power balances before starting the wave approach. The room acoustics course is covered in ten two-hour lectures that include the historical and architectural contexts, the rationale for the need for design, quantities, measurement, and prediction. Lighting is an important part of the course.

A course on noise control at the postgraduate level, optionally open to Master's degree students, provides basic training for environmentalists. In ten two-hour lectures the focus is on hearing, quantities, source control, and noise propagation indoors and outdoors, an introduction to advanced measurements, and legislative concepts. These courses stimulate increased awareness and feeling for the field of acoustics and noise control by promoting understanding and manipulating quantities, thus providing an insight into the physics and perception of sound/noise. The pursuit of a noise control engineering education demands a strong interest in the subject and a serious personal study effort.

Several opportunities for continuing education are also offered by or in collaboration with K.U. Leuven departments: the internationally renowned ISMA-course and ISAAC-conference, the Netherlands-Flemish NAG-ABAV-KVIV course, and for more than 30 years: Hogere Cursus Akoestiek, Antwerp.

The author discussed some of his opinions and worries. He recalled the huge advantage of the modern communication tools for comfortable visual and auditory illustration especially for the acoustics field. Further it is up to the educator, depending on his audience, to find a good balance between fundamental and pragmatic approaches. Especially to encourage further PhD interest, the message should sound challenging

enough. He expressed the opinion that the educational efforts combined with increased awareness of the noise control topic resulted, over the last 20 years, in state-of-the-art legislation and in high-quality research and consultancy activity in Belgium. But the task to combine optimal education, provision of services and scientific work together with the well-known "publication and citation stress," risks causing the "multi tasking syndrome" and threatens crucial educational efforts.

Belgian Response to Framing Questions

There are 55 institutions of higher learning in Belgium among which are 16 universities. A professional environment is provided by the Belgium Acoustical Society (ABAV) with 150 members plus 50 supporting environmental specialists. Flanders has 30 recognized experts for environmental acoustics. Wallonia recognizes expertise for isolation work around airports (13 advisers, 70 architects, 110 construction firms). The largest private company is LMS with 400 employees in Belgium and 800 internationally. The firm specializes in vibro-acoustics engineering and testing. In addition, there is a large number of speech therapists and audiologists (5000).

No Master's degree is specifically offered in noise control engineering. A PhD is offered in the advanced aspects of noise control engineering. This degree takes approximately four years to complete. Financial support for students and faculty comes mainly from institutions and research foundations, not from private funding.

The capacity of the Belgian educational system to provide trained noise control engineers is generally sufficient, but the training could be improved by orienting it towards a more specific employment market. At present there is a sufficient number of courses for noise control engineering practitioners inside and outside the universities. At K.U.Leuven we intend to meet the specialized interest by a post graduate course under the umbrella of a "Leuven Institute of Vibration and Acoustics," LIVA.

Acoustical Engineering: An Ideal First Degree

P. A. Nelson and T.P. Waters, *Institute of Sound and Vibration Research, University of Southampton, United Kingdom*

The premise upon which the educational program at the Institute of Sound and Vibration Research (ISVR), University of Southampton, is based is that acoustical engineering provides the context for a broad multi-disciplinary engineering training.

Degree Programs

ISVR offers three degree programs: A three-year Bachelor of Engineering (BEng), a four-year Master of Engineering (MEng), and a PhD program. This presentation describes the first two of these programs. The MEng program is an integrated Bachelor's and Master's program that is accredited by both the Institution of Mechanical Engineers (UK) and the Institute of Acoustics (UK). The study of acoustics starts on the first day of each program.

Year 1

In Year 1 the subjects covered include:

- Mathematics
- Engineering design and computing
- Analogue electronics & transducer physics
- Dynamics
- Dynamics of fluids
- Physical acoustics
- Properties of materials
- Sound perception
- Linear systems and transducers
- Vibration

Year 2

In Year 2 the subjects covered include:

- Mathematics
- Design
- Dynamics of fluids
- Vibration and materials
- Vibration
- Acoustics
- Electronics and digital audio technology
- Engineering Applications
- Control systems
- Human effects and regulations
- 10 week industrial placement in summer

Year 3

In Year 3 the subjects covered include:

- Individual project
- Short dissertation, not generally in collaboration with industry
- Acoustical engineering design
- Team-based "real" design project, often conducted in collaboration with industry
- Management
- 4 elective technical modules
- 10 week industrial placement in summer (experience with consulting firms available)

Some Individual Projects for 2007/8

- Fluid-elastic waves in the inner ear
- Moving zones of quiet in a headrest
- Perception of low frequency motion and motion sickness
- Bicycle saddle design and vibration transmission
- Vibration of in-flight refuelling hoses
- Sound radiation from a turbofan intake duct
- Simulation of a cochlear implant
- Bat echolocation
- Shock response of mountain bikes
- Auto transcription of music
- Aeroacoustics of a steam kettle
- Acoustics of tornadoes
- Audio systems and loudspeakers in cars
- Effect of steel sleepers on rolling noise from trains

The requirements for the BEng degree are completed at the end of Year 3. Those students continuing to the MEng degree complete Year 4:

- Acoustical Engineering Design
  - Team-based "real" design project

- Management
- 10 elective technical modules
  - 6 modules at Master's level
  - Synergy with MSc programs

Student Selection and Financial Support

To apply for admission to the program, a prospective student must have taken mathematics and physics at the higher level according to the International Baccalaureate or its UK equivalent. Prospective students must submit a profile of academic achievement, a personal statement giving reasons for their application, a reference from their head teacher, and, most importantly, they must participate in an interview day. The purpose of the interview day is to dispel misnomers regarding "acoustics," to ensure an informed decision on the part of the prospective student, and to give the staff a chance to woo the student. For these courses, students from the EU pay fees of £3000 per annum; UK residents receive UK government grants and loans. ISVR provides up to three entry scholarships of £2000 per annum.

Twenty to twenty-five openings are available annually of which five are usually taken by first-year students, transfers from other courses at the University of Southampton, and students returning to resume studies. About fifty applications are received for the remaining 15-20 openings. Approximately thirty-five offers are extended with an acceptance rate of 40-50 percent. Each applicant typically applies to six universities for admission, so a high acceptance rate is needed.

Demand for Graduates

ISVR achieves a 100 percent employment rate for its graduates every year. Acoustical consultancies are by far the most popular destination for ISVR graduates. Other common destinations include PhD programs at Southampton and elsewhere; manufacturing firms such as Nissan, Land Rover, and Rolls Royce; and audio engineering companies including loudspeaker manufacturers. From the ISVR perspective new graduates in acoustics are in short supply. Those with a few years experience are like gold dust. Manufacturing firms seem less well prepared to take new graduates than are the consultancies.

Noise Control Education in Developing Countries: Turkish Experience

Mehmet Çaliskan, *Middle East Technical University, Ankara, Turkey*

Turkish noise legislation dates back to 1932. When Turkey became a candidate for membership in the European Union (EU), the Ministry of Environment and Forestry adapted EC Directive 2002/49/EC for environmental noise into Turkish Legislation as a requirement for compliance with EU legislation. This has been in effect since July 1, 2005, but is being revised to overcome problems encountered during the two years of enforcement. Meanwhile new legislation for occupational noise was adopted under the supervision of the Ministry of Labor and Social Security on December 23, 2006, in accordance with EC Directive 2003/10/EC.

Because of these legislative developments and recognizing the needs of Turkish industry and Turkish society, a course was designed to train students of engineering in acoustics and noise control at the Middle East Technical University (METU) in Ankara. Students are required to have elementary knowledge of thermodynamics, fluid mechanics and mechanical vibrations. The material is presented in a 14-week semester with 3 lecture hours per week. Several courses on room acoustics and building acoustics have also been developed to teach students of architecture at the same university.

Course Description

The course, ME 432-Acoustics and Noise Control Engineering, is offered as a technical elective in the mechanical engineering curriculum at METU. It is the first course in noise control engineering offered at a Turkish University. First offered in 1984, it has been offered to seniors in mechanical, aerospace, and environmental engineering every year during the spring semester. Between 20 and 80 students have enrolled in the course with an average of 35 students per year.

The following objectives of the course were developed in accordance with the Accreditation Board for Engineering and Technology (ABET) 2000 accreditation process. As a result, the undergraduate mechanical engineering program at METU was found to be "substantially equivalent" in 2004. Upon completion, students are:

- equipped with basic knowledge on sound radiation and sound propagation in an elastic medium;
- able to measure noise in proper terms and to make an assessment based on international standards, common practices and legislative measures;
- able to understand and interpret noise transmission through multimedia of differing properties;
- able to estimate noise levels in an enclosed space as well as in open air and to predict cavity resonances; and
- able to devise proper noise control measure(s) to reduce noise below limits set by legislation, standards and common engineering practices.

The textbook adopted for the course is *Engineering Noise Control* by D.A. Bies and C.H. Hansen. Several other texts are used as references: *Fundamentals of Acoustics* by L.E. Kinsler, A.R.Frey, A.B. Coppens, and J.V.Sanders and *Noise and Vibration Control* by L.L.Beranek as well as the *Handbook of Noise Control* by C.M. Harris. Lecture notes are also made available to the students in the form of handouts.

Two midterm exams account for 35 percent of the grade and a final exam

for 40 percent. Project work constitutes 15 percent of the total grade and the remaining10 percent for weekly homework and laboratory assignments. Every student taking the course is assigned a project. Most of the topics selected are traffic noise surveys to be conducted on different streets of Ankara. Students are asked to make noise measurements while collecting traffic data. Attempts are made to try to fit the noise data with three traffic noise models to find out which model best represents Turkish traffic at a particular location. Students interested in room acoustics are provided with commercial simulation software to design spaces acoustically for a specified function. Laboratory assignments consist of conducting experiments accompanied by report preparation. Measurement of the sound absorption properties of materials is the typical experiment carried out in the laboratory using impedance tube and reverberation methods.

Present State of Noise Control Education in Turkey

Several other universities now offer elective courses on noise control with similar objectives and course content in the mechanical engineering curricula. Istanbul Technical University in Istanbul, DEU (September the 9th University) in Izmir, Gazi University in Ankara are a few. In addition to mechanical engineering programs, schools of architecture in these universities as well as in Yıldız Technical University and Bahçesehir University in Istanbul, Bilkent University in Ankara, and Black Sea Technical University in Trabzon offer courses on room acoustics and building acoustics in their undergraduate curricula.

The Continuing Education Centers of METU, Istanbul Technical University and Bahçesehir University have been authorized to train professionals from the Ministry of Environment and Forestry, municipalities and private sector to enforce the newly-introduced environmental noise legislation and to carry out noise mapping, planning, and noise control. Three certificate programs were designed by the Ministry of Environment and Forestry. About 600 people have been trained for the A Certificate in the past 18-months with a majority attending the program at METU. Bahçesehir University has trained 25 people for the B Certificate during this time. Yeditepe University in Istanbul offers courses on hearing conservation and audiometry for medical professionals.

IZOCAM, a subsidiary of ISOVER in Turkey, offers comprehensive courses on noise measurement, noise insulation, industrial noise control, and architectural acoustics. Since 1998, about 150,000 hours of cost-free training courses have been provided to about 10,000 participants. More than 20 percent of these participants attended 7 courses related to noise out of 21 courses offered.

An intercollegiate competition sponsored by IZOCAM was started in 2000 to build awareness of all aspects of insulation among seniors in mechanical and civil engineering, architecture, interior design and industrial design. The intent was to familiarize them with the insulation sector, to help the energy economy and environmental protection, and to inspire creativity. Teams of seniors from different disciplines and different universities are asked to design a project to comply with the Regulation of Thermal Insulation in Buildings, the Regulation of Fire Safety, and Regulations of Environmental and Industrial Noise in Turkey. To motivate interdisciplinary studies and to increase the awareness of Turkish Regulations which are already in force are among the other goals of this competition. A different theme (e.g. insulation in hospitals, insulation in industrial buildings, insulation in educational facilities) is assigned every year, and the findings of these competitions are distributed to interested parties around the country.

ARTI Consulting, specializing in occupational safety and health, offers courses on industrial noise control. Thirty professionals from industry were trained in the past 6 months. The Turkish Medical Association holds 2-day training courses on hearing conservation for about 50 medical doctors. Three hours are dedicated to basic acoustical concepts, noise measurement, noise legislation, and principles and popular practices related to noise control engineering. About 250 medical doctors have been trained through such courses as of 2007.

Turkey's candidacy for EU membership has had an immense impact on noise control education. Universities, private institutions, and non-governmental organizations all take part in the education process. Turkey, a developing country, forms a model for noise control education. The current capacity to produce noise control engineers in Turkey is estimated to be fewer than ten, which does not meet the demand of Turkish industry. Research assistantships and fellowships are offered by universities and the Technical and Scientific Research Council of Turkey. A few grants are available from private companies, but the most common means of financial support in Turkey is for industry to employ a graduate student as an engineer and hire his advisor as a consultant to the company.

Education in Noise Control Engineering with the Limited Support of Universities

Kurt Eggenschwiler, *Laboratory of Acoustics, EMPA, Dübendorf, Switzerland*

One of the deficiencies revealed in the latest strategy study by the Federal Office for the Environment is the need to expand information sources and education in Switzerland. The topic of education and continuing education was also addressed by the Federal Noise Abatement Commission (FNAC). The Swiss FNAC is an interdisciplinary and independent administrative body concerned with

all aspects of noise abatement. The commission developed an education concept and funded a study that was carried out by Prof. Karl Weber and his co-workers at the Centre for Continuing Education (CCE) of the University of Bern. The results of this study follow.

At the university level there are no acoustics programs in Switzerland, and it is not possible to obtain a Bachelor's or Master's degree in acoustics or noise control. Acoustics courses at the technical institutions are always part of a broader educational program such as environmental or electrical engineering at the ETH in Zurich or Lausanne. In most cases these acoustic courses are not mandatory.

A special case is the "Certificate of Advanced Studies in Acoustics" offered by the University of Applied Sciences, northwestern Switzerland. This program includes 104 lectures where the participants learn the physical basis of acoustics and are taught the latest methods of noise control and architectural acoustics. This degree requires approximately 100 additional hours for a thesis.

Although there are limited possibilities for formal training in acoustics, the Swiss Acoustical Society offers the title of "Certified Acoustician SGA." The candidates are required to have three years of experience. They must present two written projects and pass an examination. Guidelines clearly describing the material to be covered in the examination are available to them.

Noise experts with a basic education in acoustics and noise control are rare in Switzerland. Typically, acousticians have enhanced their knowledge with courses of their choice. Although their backgrounds are varied, the majority have engineering degrees. In their everyday activities, persons engaged in the noise field are often concerned only to a small extent with noise problems. Hence, job opportunities in this field are limited, although noise experts express considerable interest in more courses in noise control engineering.

The courses available conform to the priorities of the Federal Office for the Environment. However, there are deficiencies in areas such as land-use planning, leisure noise, and neighborhood noise as well as courses for contractors, policy makers, and politicians.

A strategic approach, developed by the University of Bern, seeks to meet the goals of the Federal Office for the Environment and is based on an important premise:

> The employment market for noise experts in Switzerland is relatively small, and younger persons specializing in the noise field normally cannot count on a career in "noise." Therefore, training as many highly qualified noise experts as possible is not an option. Other professions should be given more opportunities to enter the field of noise control. A completely new course of study in noise control engineering at a university would exceed national needs. Such a program would only make sense to satisfy international needs.

The strategy for education and continuing education in noise control engineering suggested by the University of Bern is based on three goals:

Goal 1: Use of current knowledge and available capabilities
In order to reach this goal the Federal Office for the Environment should promote research efforts. The relevant knowledge in Switzerland and in foreign countries should be systematically and continually gathered and, when necessary, enhanced by self-initiated research. The transfer of research results and the research itself should be supported, and noise experts should have access to current knowledge and capabilities.

Goal 2: Systematic enhancement of education and continuing education opportunities
With a view toward future demands on noise experts, existing opportunities in education and further training should be enhanced, and educational resources within and outside of Switzerland should be compiled and made available. Publicity for these opportunities should be improved (Internet). A financial incentive scheme should be offered as part of the program. The incentives for continuing education could be given greater significance with more publicity about the Swiss Acoustical Society's "Certified Acoustician SGA."

Goal 3: Initiation of an interdisciplinary forum to encourage networking among noise experts and lecturers.
This forum would help to develop an exchange of "best practices" in noise control.

The creation of a new governmental office is needed to implement the strategy for improving education and to serve as a mediator between research and practice. This office will control the educational opportunities by means of an incentive system so that learning institutes that otherwise could not be self-supporting would be financed.

Furthermore, this office would operate a practice-oriented interdisciplinary forum. It would determine the need for continuing education by means of case studies, would develop an information exchange pertaining to noise abatement questions, and would monitor questions coming from the field.

The public has a right to "quiet." Therefore, the government is obliged to become involved in the education of noise control experts. Experts should be provided with the latest knowledge of the field. This approach does not conflict with the plan of an internationally-oriented university program, e.g. one leading to a Master's degree in environmental acoustics.

Acoustics and Noise Control Education in the Czech Republic

Ondrej Jirícek, *Czech Technical University – Faculty of Electrical Engineering Department of Physics, Prague, Czech Republic*

Czech Technical Universities

There are five technical universities in the Czech Republic which offer courses in acoustics and noise control. The largest course offering is by the Czech Technical University (CTU) in Prague where the Faculty of Electrical Engineering offers eleven courses, the Faculty of Mechanical Engineering, six courses, and the Faculty of Civil Engineering, one course.

Two courses are offered at the Brno University of Technology, one by the Faculty of Mechanical Engineering and the other by the Faculty of Civil Engineering. The University of West Bohemia in Pilsen offers two courses, as does the Technical University of Ostrava. The Technical University of Liberec offers a single course.

Specialization in Acoustics

A major in acoustics is offered only at the Czech Technical University in Prague by the Faculty of Mechanical Engineering as part of the aerospace engineering, mechatronics, or environmental techniques curricula and in the Faculty of Electrical Engineering as part of the radio-electronics or acoustics curricula. Both departments have a maximum capacity of 50–60 students per year.

The Faculty of Mechanical Engineering curriculum includes the following courses:

- Aircraft vibration and aeroelasticity
- Electrical measurements and diagnostics
- Noise and vibration control
- Environmental engineering
- Ecology and acoustics in aeronautics
- Oscillation of mechanical systems

The Faculty of Electrical Engineering curriculum includes the following courses:

- Measurement of acoustical quantities
- Signal recording
- Sound technology
- Electro-acoustics and applied acoustics
- Electro-acoustical and acoustical measurements
- Introduction to acoustics
- Acoustical applications
- Architectural acoustics
- Theory of sound fields
- Noise surveys
- Active methods in acoustics

CTU offers short courses, courses in specialized subjects on contract, as well as regular courses for non-students under a "lifetime education" program.

Some doctoral candidates in both faculties are supported by industry. Although CTU may accept the recommendations or requirements of industry regarding courses and thesis topics, CTU is responsible for both.

Studies in Environmental Noise Monitoring

V. I. Tokarev and O. I. Zaporozhets, *National Aviation University, Kyiv, Ukraine*

Noise control is the process of obtaining an acceptable noise environment for a particular observation point or receiver, involving control of the noise source, transmission path, or receiver, or all three (McGraw Hill Dictionary of Scientific Terms)

This presentation describes engineering education in the National Aviation University (Kyiv, Ukraine) in the specialty, "Ecology and environment protection," and in particular in the curriculum, "Acoustic Ecology."

Engineering education in the Ukraine includes conventional teaching, teaching by correspondence, distance learning, and continuing education. Conventional teaching follows the traditional higher-education model provided by universities with undergraduate and/or graduate degree programs.

A New Approach

Present day higher-educational programs should be modernized as ecologists are being asked to perform new functions. The purpose of the curriculum, "Acoustic Ecology," is to give future ecologists the basic theory and methods of analysis as well as guides for the processing of acoustical information, the forecasting of acoustic environmental changes, and the developing of recommendations for noise control.

Within the framework of the "Acoustic Ecology" curriculum, three basic educational elements are presented: A source of noise, the environment, and a receiver of noise.

The structure of the curriculum is as follows:

- Physical factors that impact the environment (108-hour course for a Bachelor's degree in engineering)
- Meteorology and climatology (108-hour course for a Bachelor's degree in engineering)
- Methods of biosphere protection (243-hour course for a Master's degree)
- Environmental noise monitoring (108-hour course for a Master's degree)

Course in Environmental Noise Monitoring

The lecture topics in the course include: physics of sound, noise metrics, and regulation, fundamentals of hearing, human response to sound, sources of noise and noise control, noise monitoring, interior and exterior noise environments, vibration and structural acoustics, and methods of noise reduction.

The laboratory topics for the course include: instruments for noise measurement, frequency analysis, outdoor noise measurement, reverberation time measurement, sound power measurement, muffler effectiveness, noise barriers, and indoor noise impact assessment.

A modular system is used for teaching the course—Module 1, *Sources of noise pollution,* and Module 2, *Environmental noise assessment*. During the modules the students must write two Environmental Impact Assessment reports. During the last four weeks of the semester, students undertake a project on indoor noise impact assessment in a real-life situation.

Approximately 10 to 15 percent of the ecology students select a project involving methods of noise reduction. About 5 percent of the graduates of the curriculum continue studying as post-graduate students.

The university is equipped with several laboratory facilities to support the teaching of ecology students. These include a 640 cubic meter anechoic chamber with a cut-off frequency of 100 Hz, a 174 cubic meter reverberation chamber for which the lowest frequency band is 125 Hz, and two small reverberation chambers with a volume of about 4 cubic meters each.

Teaching methods

Up-to-date teaching methods are used in this curriculum. Role playing is an important part of the teaching process. The instructor acts as an advisor and not just as a lecturer. Specialized computer programs are used by the student to process the results of the experiments. Outdoor and indoor noise impact assessments are carried out in real-life situations.

Discussion – Morning Session

Bachelor of Engineering in Acoustics

Question for Phil Nelson: When did the Bachelor of Engineering in acoustics start? Have you checked if the students work in acoustics after receiving a Bachelor of Engineering degree?

Answer: I think that over the years at least 50 percent have worked professionally in acoustics. Now it is probably greater than that. Our graduates are in big demand. In the U.K., the supply is less than the demand for acoustical engineers, and many of them go to work in acoustic consultancies. They are the most popular destination for our graduates. However, a few of our graduates go on to do something completely different such as accounting. The main point is that the broad training doesn't restrict the students' choices.

Question for Phil Nelson: In year three of your program the focus is on applying what has been learned in the first two years. If the students show an interest in other fields of engineering after two years, won't they be too specialized in acoustics to go into another discipline?

Answer: That's a good question. One has to be careful not to limit students' options. After the Year 2 modules, during Years 3 and 4, the students have options to study other engineering topics. Those options may be reduced for the acoustical engineers who focus on acoustical topics. The training that we give them—the basic mathematics training and the basic engineering design approaches—enable them to potentially move into other areas of engineering without much difficulty. They couldn't become specialists in electronics without further training after the degree—by taking a Master's program for example. But the Bachelor of Engineering enables them to change engineering fields if they want to.

Architectural Acoustics

Question for Gerrit Vermeir: Do you think architecture and acoustics students should be involved more in each other's studies by doing projects together?

Answer: A very good idea that we try to realize at our university by including the acoustical requirements as well as the architectural requirements in our student projects.

Question for panel: Do you think there's a lack of architectural courses in acoustics departments according to the curriculua presented today?

Answer: At ISVR we offer some work in building acoustics. But we could enhance the teaching in architectural acoustics in the Bachelor of Engineering program.

Comment: So far you have heard about only one part of the UK education in acoustics and noise control. The Institute of Acoustics also offers a diploma in acoustics and noise control that consists of a compulsory module in the general principles of acoustics and includes some laboratory work. In addition, there is a choice between specialist modules which include architectural and building acoustics, noise control engineering, and environmental noise.

Comment: Building acoustics is really an important aspect of an architect's practice. What does the architect need and how can the acoustician respond? A combination of training in both acoustics and architecture is the best solution.

Comment: Apart from the specialist undergraduate degrees in acoustics and noise control engineering there appears to be little training in these subjects in the more standard engineering or architectural programs. There are many engineering and architecture graduates who don't encounter anything to do with acoustics or noise control. Is there anything that can be done about this? Prof. Parizet said there was no way to influence the curricula in mainline engineering degrees. But we've heard examples of where there are engineering degrees that include some acoustics or noise control. Is there any way to persuade those universities that offer engineering and architecture studies to include more courses in acoustics and noise control?

Mobility and the European Research Council

Question for the panel: Industry in Europe tends to move to new EU member or candidate countries. Please discuss the effects of this movement on noise control education at EU member universities.

Comment: Concerning this question of studies in acoustics and noise control in Europe, the focus, at least in the Czech Republic, is on the universities in the UK, Germany, and Austria. The latter is very close to our country and for a long time there has been an exchange of students. Students will travel to Germany and Austria because they like to see the neighboring countries and to study something new. Concerning Eastern European countries, I have never had students who would like to go there. But we have received quite a few students from countries like Sweden, France, and Belgium.

Comment: In Turkey I have many students wanting to learn acoustics and noise control engineering. They would like to continue their studies at ISVR or one of the European universities. I have about 15 students and have had to turn down three in the past week. The students are eager but the numbers are tight. When industry moves out of the EU because of economic reasons, the funding could be affected. The effect might be less funding on education at the university for engineers.

Comment: The mobility of people within the EU has improved as a result of the initiatives for funding research and things like the European Doctorate Programme which has eight European centers involved. They've been extremely effective in moving people around Europe, enhancing the European situation regarding employment opportunities. Culturally, people in Europe work together a lot better than they did in the past, and that's a very positive move on the part of the EU.

Comment: The European Research Council is a new initiative in the EU that will fund high-quality research in schools across Europe. It will be interesting to see how it functions.

Comment: In the Czech Republic we had to change our education system to permit our students to circulate. For the past 3 or 4 years we have been producing adventurous students interested in engineering. It was a trying a situation because we had quite a few students from other countries and nobody knew what to do with them because from a Czech point of view they were not interested in serious study, and to be a graduate in engineering you must obtain a Master's degree. On the other hand, we have a similar system like Germany or Europe so the exchanges were even.

More Acoustics in the Curriculum

Comment: In the U.K., the curriculum in engineering is dictated by the engineering institutions. For example, if you are going to become a chartered engineer in electrical or civil engineering, the curriculum is rigidly determined through accreditation. The route to change in the U.K.would be through the engineering institutions. As a university administrator, it's remarkably difficult to get a university to make what appears on the outside as simple changes to the curricula and to ensure course offerings. If ISVR offerings were to be made available to our electrical engineers, or our mechanical engineers or our civil engineers, then that would be an ideal way to address these issues. But the logistics at a large university make this a surprisingly difficult task. These two factors in the U.K. make the introduction of other courses difficult.

Comment: At INSA-Lyon some lectures in acoustics are given during the undergraduate program. The problem is that we are in a mechanical engineering department. We really cannot justify increasing the number of specialized acousticians because that would mean decreasing the number of mechanical engineers. That's not possible. Of the 140 students who come into the department, 20-50 may have sufficient interest in acoustics to do a three-month project in acoustics. Those 20-50 people will start a career in acoustics. Ten to fifteen years ago industry didn't want to hire PhD graduates, but preferred graduates from engineering schools without advanced degrees. The situation has changed, and most PhDs, instead of choosing a university career, are going into industry.

Question for Prof. Tokarev: You spoke about your institution, the Kiev International University of Aviation. Are you aware of any other universities in the Ukraine that include material on acoustics and noise control engineering?

Answer: No.

Question for Prof. Parizet: You mentioned that because there is more demand for mechanical engineers than for acoustical engineers in France, the universities give more support to the mechanical engineering curriculum. Many university administrations, because they believe that there is no demand for acoustical studies, choose to support other departments or other engineering courses. Should the administrations or the government be pushed for more public awareness campaigns to increase public demand for acoustical engineering?

Answer: Yes, the problem is certainly inside the universities. If we want to increase the acoustics content, then we have to decrease the content of other topics. It's a question of negotiations inside the university. Are such negotiations difficult? I don't know the situation outside, but in France the university is like a ship. You need 20 kilometers to change the direction of the boat. Changes are very slow in the university because we have to negotiate everything with our colleagues.

Question for panel: Don't you think if you demonstrate to the university administration that there's a public demand, it will be easier to move those 20 kilometers?

Answer: The demand is so strong for other mechanical engineering topics that it is easy for our colleagues to demonstrate, and we don't have much leverage to negotiate. Moreover, industrial companies encourage professional mobility so that people would not be acousticians for their entire careers. It may be a good idea to organize continuing education. We have many opportunities for continuing education for people who are moving into acoustics for a little ride in industry. It's a way to solve that problem.

Comment: What you have in France is something like what we have here in Prague. But it's more than the administration at the university—it's also a matter of money because the Czech Technical University has lost students as some of them are in acoustics and been given less support. When it comes to agreements we have a policy in the administration that students must have a good background. Then to study a specialization is important for a diploma.

IOA Diploma in Acoustics and Noise Control

Comment: This diploma is earned after one-year of full-time study or two years of part-time study. There's also a distance learning option. Many of the graduates of this program work as environmental health officers or in consultancies alongside graduates from ISVR.

Comment: There is a contrast between a specialist first-degree and postgraduate education. Typically it has been thought that the best way to convert an engineer or building scientist into a practicing acoustician was to encourage them to get a higher degree—a Master's or PhD. One or two panelists mentioned that there were also certificates. In the U.K the Institute of Acoustics runs three short certificate courses in workplace noise assessment, hand-arm vibration assessment, and environmental noise assessment. Also the Association of Noise Consultants offers a certificate course in pre-completion testing which is a hot topic in the U.K. concerned with Building Regulations. Does anyone have a comment on whether that is a viable way to increase the number of shorter, certificate-type courses for people who are going into professional practice in acoustics or noise control?

Comments: In my experience we have 600 people involved in activities like noise planning, noise mapping, and noise control engineering practice. Most of them work among trained people. These people have completed difficult high school and vocational school projects, but they aren't very good at coping with practical problems. Engineers or those with noise control engineering education certificates specialize in areas such as environmental noise systems or community noise assessment.

Comment: Instead of a big educational commitment, I'm sure what the Institute of Acoustics is doing is right for many people. The answer to the question is that for certain types of activity in acoustics, certificates and very short training schemes are more than adequate. For professional engineers working in acoustics, at least a Master's degree is needed for formal training along with practical training. There are certain activities that cannot be covered with a very short course, so ISVR also offers many continuing professional development courses in specialist topics. Acoustics is a changing discipline and engineers need to stay up to date. We need to keep refreshing professional engineers with new topics, and there are some very popular courses we run to help do that.

Comment: The last point made is interesting because we're running this workshop not only on the assumption that education in noise control engineering is needed but also that there is a need to enhance lifelong education in acoustics and noise control that up to now has not been considered. There's a proposal by the engineering institutions in the U.K. that every engineer should undergo an examination for up-to-datedness on a regular basis. At the moment we can just flourish our status as engineers. In the future we will have to take an annual test to make sure we are worthy still to be called engineers.

Comment: As a chartered engineer, this fills me with fear and dread. I can understand the motivation behind this. Whether it is the right mechanism or not needs to be debated. The engineering institutions have been pushing the notion of keeping records of continuing professional development so you actually assess your own. It's a self-assessment approach which I think is the right way to proceed. Chartered engineers are busy people and to ask them to re-take the basic tests is perhaps asking too much. It's a big issue because the rate of change in the world is increasing. A university education is a preparation for life, but people have to continue to learn.

Continuing Education

Comment: Several opportunities for continuing education are offered in collaboration with K.U. Leuven departments. For example, The Netherlands-Flemish Hogere Cursus Akoestiek has been offered for 34 years in Antwerp. This year we have 35 students which is quite exceptional. These are all people coming from government, industry, and so on, who have interest in knowing more about acoustics because of their job. Participants can select topics of particular interest. We have three sets of examinations at the end of the course, so it's quite an effort to obtain the diploma. In the Netherlands and in France a diploma is accepted as a kind of entrance to the acoustics profession. It's expensive from the point of view of time

because these people have to go fifteen Mondays to Antwerp. I can say that Dutch participants really like to go to Antwerp. It was directed initially by Prof. Myncke.

Keith: I would like to thank the panelists for contributing to this workshop. It has been very interesting to hear about the opportunities available in the different countries. We need to consider whether or not there's a potential market for distance learning materials in acoustics and noise control in order to enable more people to study those subjects.

Highlights of the discussion:

1.Universities should include more courses in acoustics and noise control in their engineering curricula.

2.Acoustics and noise control should be covered in architecture studies and greater cooperation between engineering and architecture faculties should be fostered.

3.The mobility within the EU of students, particularly doctoral candidates, has been improved by the European Research Council and the European Doctorate Programme which has eight European centers.

4.For many activities in acoustics and noise control, certificates and short training courses provide adequate preparation. For professional engineers working in acoustics, a Master's or PhD degree is needed for formal training along with practical training.

5.While a university education is a preparation for life, engineers must continue to learn and some sort of re-certification scheme is necessary, perhaps through continuing education.

Second Session—Panelists and Presentations

Jordi Romeu, Technical University of Catalonia, Spain
Luigi Maffei, Second University of Naples, Italy
Tor Kihlman, Chalmers University, Sweden
Kari Pesonen, Kari Pesonen Consulting Engineers, Finland
Peter Svensson, Norwegian Technical University, Norway
Diemer de Vries, Delft University of Technology, The Netherlands
Gerhard Hübner, Stuttgart University, Germany

How can the EU Directive Boost Noise Control Education in Spain? The Present Situation

Jordi Romeu, *Laboratory of Acoustics and Mechanical Engineering (LEAM), Technical University of Catalonia, Spain*

Can the EU directive on environmental noise really help to improve the development of noise control education in Spain? Looking at the past, the first institutional activities on noise control were carried out during the 1980s when some regional laws and city ordinances about noise were approved and some acoustic mapping was carried out. However, the irregular enforcement of the laws and the absence of action plans led to a slowdown in noise control activity during the 1990s. Directive 2002/49/CE brought new laws to Spain and the need for action plans. At the same time, people have become more sensitive to noise. Thus, professionals in acoustics are now in demand by the public and private sectors to carry out action plans and to help meet the requirements of the acoustic laws. Is the Spanish education system ready for these new demands?

The Spanish higher-education system produces both undergraduate engineers and postgraduate engineers. In undergraduate programs, three years of university enrolment are required for a student to be graduated as a Technical Engineer, similar to the Bachelor of Science. Five years are required for graduation as a Superior Engineer; that is, a degree similar to the Master of Science. At the postgraduate level, in addition to short courses there are programs leading to Masters degrees (requiring more than 450 credit hours) as well as Masters degrees requiring 60 to 120 ECTS. In addition, the PhD degree is awarded for completion of a longer program culminating in the presentation of a thesis.

Among all the studies at the undergraduate and postgraduate level, there is only one degree in Spain related to acoustics—the Diploma in Sound and Image for Telecommunications. At several universities throughout Spain, this curriculum is offered, but there are very few courses related to noise control techniques. The opportunity to study acoustics as part of the curriculum of other engineering degrees or architecture is very scarce. In postgraduate programs, there are some more specific degrees where noise control techniques are taught; for example the PhD in Acoustics Engineering of the Technical University of Madrid and the Master in Acoustics Engineering of the Universities of Valladolid, Leon, and Cadiz.

Considering the subjects covered by the courses, it is felt that matters related to environmental noise (noise mapping, sound propagation, noise models for environmental acoustics, measurement techniques, etc.) are well covered in the degrees mentioned above. However, subjects related to "acoustic designing" such as sound radiation, numerical methods of analysis (FEM, BEM, SEA, etc.), and experimental methods (array measurements, acoustic holography, sound intensity, modal analysis, etc.)

are not covered as well as the first group of subjects. The reason could be Directive 2002/49/CE that first requires the carrying out of noise mapping, and, second, requests detailed reports and appropriate action plans. The knowledge for noise mapping is available, but will it be available for the follow-through? The best solution could be one Master's degree carried out by leading research groups in acoustics from different universities with an enhanced program of grants for the support of students and professors.

The EU Directive and the Master's programs present a framework within which to develop courses on noise control because action plans and consumers require quiet products. If students are not trained in noise control, there will be a lack of quiet products and environmental laws will fail. In Spain one cannot find at the moment a single institution that covers all the topics needed for a good program in noise control engineering. Inter-university Master's or PhD programs would take advantage of the knowledge and interests of local research groups on specific subjects, but financial support would be necessary to support the mobility of students and professors. Engineers should know the basics of acoustics at the conclusion of their undergraduate degree programs so that postgraduate courses may concentrate on subjects oriented to specific topics. The demand for postgraduate courses would be increased if graduates knew the fundamentals of vibroacoustics.

Post Graduate University Education in Noise Control Engineering in Italy

Luigi Maffei, *Built Environment Control Laboratory, Second University of Naples, Italy*

Education in Engineering Prior to 2000

In the former system, graduate engineers completed a five-year course in one of the traditional branches of engineering—civil, mechanical, aeronautical, electrical/electronics, informatics, or chemical. Graduation required 30+ examinations and a final thesis. Fundamentals of acoustics were presented in applied physics courses (15-20 hours), and in some mechanical engineering departments there were elective courses on applied acoustics and/or vibration control (100 hours). A PhD degree required three years of additional study following completion of the five-year course. None of the degrees were specific to the field of acoustics.

Education in Engineering After 2000

The Bologna Declaration of the EU Ministers of Education reshaped engineering education in Europe after 2000. In Italy, the educational programs in the traditional branches of engineering are 50 percent under the control of the Ministry of Universities and 50 percent under the control of the universities themselves. The Bachelor's degree requires three years and 180 credits, the Magistralis degree an additional two years and 120 credits, and the PhD requires an additional three years and 180 credits. One- to two-year Master's programs on specific topics requiring 60 to 120 credits are under 100 percent control of single-university faculties.

Master's programs dedicated to acoustics are currently offered at three universities:

- University of Venice, Architecture Faculty – "Acoustic Designer" (1 year, 60 credits, 10 students per year)
- University of Perugia - "Environmental Acoustics" (1 year, 60 credits, 20 students per year)
- Second University of Naples - "Acoustics and Noise Control" (1 year, 60 credits, 20-30 students per year)

In 2006, Second University of Naples entered into a cooperative effort with Yildiz Technical University, Turkey, to present a Master's course entitled "Experts in Acoustics and Noise Control in Mediterranean Countries." The course is open to students with at least a Bachelor's degree in Engineering, Physics, Architecture, Mathematics, and Environmental Sciences. The course requires completion of 60 credits.

Specialized courses dedicated to noise control are offered at the following universities:

- University of Ferrara - "School of Acoustics" (180 hours per year + short courses, 500 graduate students have participated since 1995)
- University of Padua (180 hours per year, 35 students)
- University of Bologna (160 hours per year, 20 students)
- University of Ancona (180 hours per year, 60 students)
- University of Firenze (120 hours, 30 students)

Italian Policy

Italian law No. 447/1995 on *Policies to Control Environmental Noise* requires that all activities on environmental acoustics be performed by a Noise Technician whose name is recorded on a regional list. These include noise planning, noise mapping, noise measurements, and the noise impact of new activities and infrastructures. To be listed, a technician must have at least two years of experience in the field of environmental noise control. For some Italian regions, technicians may be listed when they complete specialized courses on environmental acoustics organized by recognized entities such as the universities above.

Framing Questions

Capacity

The number of Master's programs dedicated to acoustics and noise control should be increased, but an agreement is necessary among universities on curricula and coordination by the professional societies (Acoustical Society of Italy, EAA, or I-INCE) is suggested.

Curricula

A one-year curriculum after a Bachelor's

degree could be sufficient if students have a good mathematics and physics background. A work project and practice period may require more time.

Support
Students of Master's programs can receive grants from regional governments and other economic support from firms in acoustics.

Short courses
Thanks to favorable legislation, more technicians are needed; consequently, the number of short courses for technicians is increasing. These courses should devote more hours dedicated to field measurements, but this is difficult when the number of students is large.

Schola Project

The European Acoustics Association has a Schola Project that maps all of the educational institutions in Europe that offer courses in acoustics. Links to the individual courses offered by these institutions are available at www.eaa-fenestra.org.

MSc Programs in Sound and Vibration in Sweden

Wolfgang Kropp and Tor Kihlman,
Applied Acoustics, Civil and Environmental Engineering, Chalmers University of Technology, Sweden

International MSc programs in Sweden are offered at the Royal Institute of Technology's Marcus Wallenberg Laboratory (MWL), Stockholm, and Chalmers University of Technology's Applied Acoustics, Gothenburg. The international MSc program at Chalmers has been offered since 1998 and a one-year specialization in sound and vibration since 1992.

These successful programs are strongly linked to research activities with a somewhat different focus at MWL and Chalmers. Chalmers has a traditional program including subjects such as audio technology, noise control engineering, room acoustics, and psychoacoustics. MWL has a focus on acoustics linked to mechanical engineering (e.g. aeroacoustics, numerical methods, etc.). The programs often have an interdisciplinary character, which attracts students from very different areas. It is important to adapt the programs to the background of the students

Nordic Institute of Acoustics (NINA)

NINA is a virtual institute for cooperation in the education of MSc and PhD students between the two Swedish universities and the Norwegian Technical University (NTNU), in Trondheim. This cooperative effort gives students the possibility to specialize. Chalmers offers building acoustics and community noise, noise and vibration quality, audio technology and room acoustics, noise control engineering, and vehicle acoustics. KTH offers flow acoustics, numerical methods, and vehicle acoustics. NTNU offers telecommunication techniques and underwater acoustics.

The objectives of NINA are the following:

- To supply the Nordic as well as the European market with generalists and specialists in the field of sound and vibration. The program is adapted to the northern European needs in the vehicle, building, and marine industries.
- To offer students from different education programs (e.g. from mechanical engineering, electrical engineering, civil engineering, and engineering physics) the opportunity to work towards a professional career in acoustics by combining their fundamental knowledge with competence in the field of sound and vibration.
- To foster the student's interdisciplinary skills, which are vital to address problems in the field of sound and vibration. The program reflects the strong interdisciplinary character of acoustics as a research area.

The NINA program offers both a broad education in acoustics and the possibility of specializing in certain areas in acoustics as well as the possibility of concentrating in one of the different specializations that are unique to northern Europe. NINA supports the "survival" of the individual programs at the different universities, expands the available resources (personnel, equipment, and intellectual) and ensures the continuation of research areas which may not have a critical mass at one university alone. NINA enhances the quality and content of acoustics programs in Sweden and Norway.

Structure of the Chalmers program

The program consists of a compulsory component, Introduction to Sound and Vibration (Quarters 1 and 2—four courses), which offers a comprehensive overview of the field as well as an introduction to advanced areas of acoustics. This overview enables students to continue in different specializations at Chalmers and in the other programs offered by NINA partners. The Chalmers options are:

- *Audio Technology and Acoustics* gives an introduction to the field of acoustics with special focus on air-borne sound, electroacoustics and audio technology.
- *Technical Acoustics I* focuses on structure-borne sound, sound radiation from structures as well as on advanced noise control engineering methods.
- *Sound and Vibration Measurements* offers hands-on experimental work illustrating phenomena and theoretical concepts taught in the courses.
- *Individual Preparation Course:* The content of the course is adapted to the students' individual needs for completing the prerequisites for studies in acoustics. Diagnostic tests are given at the beginning of Quarters 1 and 2. Self-study modules cover relevant skills in mathematics, signal processing, and programming in MATLAB as well as basic acoustics. Each module is classified as "basic,"

"intermediate," or "advanced," and contains questions, exercises, programming tasks (and also solutions) at the level of that module, with "basic" as the minimum requirement. A faculty member is assigned as an advisor for each module.

In Quarters 3 to 6 the program allows for specializing in specific areas of acoustics and gaining a broad knowledge in the field. Possible specializations are building acoustics and community noise, audio technology, electroacoustics and room acoustics, vehicle acoustics (in cooperation with KTH), and marine acoustics (in cooperation with NTNU). At least 15 ECTS from the acoustics program at Chalmers are required to complete the studies in sound and vibration with a Civ. Ing. degree.

Optional courses which may be selected at NTNU are numerical methods (7.5 ECTS, distance learning course), music technology (7.5ECTS, distance learning course), marine acoustics (7.5 ECTS, distance learning course), and room acoustics. Courses which may be selected at KTH are energy methods (6 ECTS) and flow acoustics (6 ECTS). At Chalmers a course from the automotive program, a course from the structural engineering and building performance and design program, active control of vibrations (7.5 ECTS), and experimental dynamics (7.5 ECTS) may be selected.

Quarters 7 and 8 offer an MSc degree in acoustics with the completion of 30 ETCS. This thesis work may be carried out in cooperation with industrial partners inside or outside Sweden, typically in the vehicle and audio industries or with consultancies. Thesis projects carried out at Chalmers relate to ongoing research to allow for a strong coupling between research and education. This is recommended for students interested in continuing as PhD candidates. It is also possible to carry out a 60 ECTS MSc thesis that replaces courses in Quarters 5 and 6.

Background of the Students

Many students at MWL come from mechanical engineering. Most of the non-Swedish students come from Asia. The students at Chalmers have a more varied background—mechanical engineering, electrical engineering, civil engineering, and engineering physics.

The MSc program at Chalmers typically has 20-25 students per year; 40 percent of them are Swedish, 40 percent are from other European countries, and 20 percent are non-European. For example, in 2006/2007 there were 7 students from France, 5 from Sweden, 4 from Germany, 3 from the US, 2 from Spain, and 1 each from Italy, Malaysia, Iran, and Macedonia.

Employment Opportunities

The size of the educational program in Sweden is well-adapted to the present market forces, except in building acoustics where there is a lack of student interest. Chalmers graduates about 50 engineers per year, but some of these students return to their home countries. Many Swedish graduates go into the vehicle industry (Volvo, Scania, Saab) or start with consulting firms such as Ingemansson, SEMCON, or WSP.

Noise Control Engineering Education in Finland

Kari Pesonen, *Kari Pesonen Consulting Engineers Ltd., Finland*

Professionals in Acoustics and Noise Control

In Finland, there are fewer than 300 full-time professionals in acoustics and fewer than 50 noise control engineers. The principal employers of noise control engineers are research institutes, consultancies, government, and industry. New posts for noise control engineers are opening up at the rate of approximately three to five per year.

Educational Infrastructure

There are 19 universities and 29 polytechnics in Finland. None of the polytechnics produce graduate engineers in acoustics or noise control engineering. Of the universities, five offer courses in noise and noise-control:

- The Technical University of Helsinki
- The Technical University of Tampere
- The Technical University of Lappeenranta
- The University of Oulu
- Åbo Academy

Only the Helsinki University of Technology produces graduate engineers in acoustics at the university level. The university has four professors offering 24 courses during the 2007 academic year of which one was in noise control. None of the university faculties/colleges produced graduate engineers in noise control engineering at the university level.

Education in noise control engineering at the university level is given as part of the study in another engineering discipline, e.g. electrical engineering. The courses in noise control engineering are electives, and are not required for graduate degrees. Continuing education courses in noise and noise-control-related subjects are offered according to the demand.

Since the 1970s, a significant fraction of noise and noise-control-related education has been given in continuing education. In the 1970s, this education was focused on the working environment. Since the 1980s and 1990s, the continuing education has been focused on environmental noise control. During the 1990s, there was a diminished demand for continuing education courses. There has been some increase in the demand in recent years, and there has been a significant increase in attendance in the meetings on "noise days." The educational contents of lectures and presentations have been informative and are improving.

National Capacity

Because the demand for new noise control engineers in Finland has been

small, few have been graduated. Those few employed in noise-control-related jobs as well as those engineers who need noise control training in their jobs should have more thorough training in noise control engineering. Today their training consists of one to three short courses and an MSc or BSc thesis. Support for the thesis is usually provided by the employer who hires the junior engineer or from support funds from a research consortium, the employer being a member of the consortium.

Support

During the last ten years, 50-100 million Euros have been invested in noise- and vibration-related technology, product development, and production programs. This represents 1-2 percent of total investment in the technical branch. The principal part of the funding has been given to industries, research institutes, and universities. The quality of the results achieved is often poor because too many researchers are inadequately trained in noise control engineering. The shortage of trained engineers is particularly acute in theoretical work. Some of the shortage can be compensated for with advanced commercially-available computer programs.

The principal supporters of noise- and vibration-control-related technology are The Finnish Funding Agency for Technology and Innovation (Tekes), The Finnish Work Environment Fund (Työsuojelurahasto), the Ministry of Environment, governmental and regional agencies, the European Union, and industries.

Near Future

Universities and polytechnics are experiencing financial problems due to governmental and regional saving policies. It is expected that the number of elective courses will continue to decrease, which may mean the number of courses in noise control engineering will drop. Nonetheless, governmental support for technology development programs and projects is expected to increase.

Summary

The demand and supply of trained noise control engineers is low with some signs of increasing demands. There are at present no career paths for trained noise control engineers. There is a shortage of adequate course material tailored for 1- to 3-credit short courses for the various principal professions (e.g. those in process industries, shipbuilding, machine design, plant design, environmental protection, road/railway engineering, building branch, and administration). An important decision must be made on how to tailor the production of noise control engineers to the low demand and divide it between universities, faculties, and laboratories.

Noise Control Engineering with a Norwegian Flavor

Peter Svensson, Acoustics Research Centre, Department of Electronics and Tellecommunications, NTNU, Trondheim, Norway

What is the Norwegian Flavor?

The Norwegian economy has a strong component of energy production and off-shore industry (oil, gas and other marine resources). Practically all acousticians are educated at the Norwegian Technical University (NTNU) in Trondheim. A majority of these acousticians have a background in electrical engineering and electronics.

Capacity in Norway

NTNU is the only university in Norway with a specialization in acoustics in a five-year Master's program in electronics. This program has produced an average of 18 MSc graduates per year (over the last 5 years) and an average of 1.5 PhD graduates in acoustics per year (over the last 10 years). Even though more students could be accommodated, current demand in Norway seems to be satisfied with this supply.

At other Norwegian universities and colleges at the BSc and MSc levels, acoustics is also taught in single courses in the physics, building engineering, architecture, and music technology departments.

Demand for Acousticians in Norway

Of the 4.7 million inhabitants in the country, 200 are members of the Acoustical Society of Norway. Members in industry and consulting comprise 60 percent; those in universities, colleges, and research institutes, 12 percent; and in other public organizations, 15 percent. Members of other societies (e.g., *Scandinavian Vibration Society*) are not included in these numbers.

Curriculum in Norway, 1

This five-year program offers an MSc in electrical engineering with a specialization in acoustics. During the first two years the requirements on physics and signal processing courses are fulfilled, and an introductory course in acoustics given in the third year. Specialized courses in acoustics are presented in Years 4 and 5. Of the approximately 90 students completing the MSc in electrical engineering each year, there are 10 who specialize in acoustics.

Curriculum in Norway, 2

This five-year program leading to a Master's degree also requires an introductory course in acoustics in the third year. Courses in technical acoustics including music technology, room acoustics, and NINA courses are taken in the fourth year as well as audio/marine acoustics. The fifth year requires the completion of a Master's project. Students receive 75 to 105 ETCS course credits in acoustics.

Curriculum in Norway, 3

The program is offered by the acoustics group in the Departments of Electronics and Telecommunications. The scope of the program includes marine acoustics,

engineering acoustics, noise control, building and room acoustics, and audio and music technology.

Curriculum in Norway, 4

The acoustics groups at NTNU and The SINTEF Group (the largest independent research organization in Scandinavia) have a formalized collaboration, "*The Acoustics Research Centre*," that is responsible for Curriculum 4. NTNU participates in the *Nordic Institute of Acoustics*, NINA, together with Chalmers University, Gothenburg, and KTH, Stockholm, offering a wide range of acoustics courses via distance learning and student exchange. The subjects covered in Curriculum 4 are:

- Mechanical oscillations and waves in gases, liquids, and solids
- Underwater communications
- Mapping of the seafloor and bio-resources
- Untrasonics
- Noise control
- Music technology
- Perception
- Audio technology

Support

Most students are Norwegian; therefore, the instruction is primarily in the Norwegian language. The students finance their studies with student loans from the Norwegian student loan organization. There are no tuition fees for their studies.

Short Courses

NTNU has offered short courses on occupational hygiene, which includes noise, and environmental acoustics. The latter has been offered for the past six years and has attracted approximately twenty participants each year.

Challenges

The acoustics programs at NTNU face a number of challenges. The first is to attract students from a wider range of study programs such as building engineering, physics, and mechanical engineering. The second is to establish stronger acoustics courses in these other programs. The third is to increase the number of students in the electronics program that has decreased over the last 8 years.

Noise Control Education in the Netherlands: A Survey

Diemer de Vries, *Laboratory of Acoustical Imaging and Sound Control, Department of Imaging Science and Technology, Faculty of Applied Sciences, Delft University of Technology, The Netherlands*

The following universities (and Departments) in The Netherlands offer courses in acoustical engineering:

- Technical University of Delft (Applied Physics),
- Technical University of Eindhoven (Architecture, Applied Physics, Mechanical Engineering), and
- Technical University of Twente (Mechanical Engineering, Engineering Technology).

Curriculum

All of the above universities have a five-year curriculum. After three years it is possible to earn a Bachelor of Science degree, and after five years, a Master of Science degree with the title "Ir." It should be noted, however, that the average duration is usually greater than six years. Most of the acoustical engineering material is presented during the last three years of the curriculum in the form of courses and lectures. Those working toward a BSc or MSc will undertake research projects which include other relevant courses. During the second semester of the third year, students working toward a BSc degree will attend 270 hours of courses and produce a thesis. Those working toward a MSc degree will have a full fifth year of acoustical engineering courses and must also produce a thesis.

Financial support

Students following the curriculum according to the regular time schedule get financial support from the government. The universities also receive some basic research and education funding from the government. Research projects can be submitted for funding by semi-governmental organizations such as the Dutch Technology Foundation (STW). Research projects can also be sponsored directly by industry, sometimes by a consortium of companies.

Main fields of acoustical engineering

The Technical University of Delft (TUD) offers courses in the following subjects. The courses below which are *in italic type* relate to noise control engineering.

- room and *building acoustics*
- *outdoor sound propagation*
- *structural acoustics*
- signal processing in audio and acoustics
- medical acoustics
- seismic exploration
- physics of waves (non-acoustics but obligatory for all applied physics students in the second year of curriculum)
- advanced wave propagation
- acoustical imaging
- *sound control*

The Technical University of Eindhoven (TUE) offers courses in the following subjects:

- room and *building acoustics*
- *aeroacoustics*
- *structure-borne noise in buildings*
- signal processing in audio and acoustics
- *fundamentals of systematic low noise design*

The Technical University of Twente (TUT) offers courses in the following subjects:

- *aeroacoustics*
- *structural acoustics*
- signal processing in audio and acoustics
- medical acoustics

- thermo-acoustics (also offered at the University of Rotterdam)
- *engineering acoustics*

Most of the courses are given two hours a week for 14 weeks. The number of students attending each course varies widely by course and year.

Capacity and Demand

Yearly, the three Dutch TUs together grant about 25 Master of Science degrees to graduates specialized in acoustical engineering (some of them specialized in noise control engineering). These graduates are educated so broadly that even those specialists without a noise control engineering major successfully find their way into jobs in the noise control engineering field. However, for all graduates entering this field, much of their knowledge and experience is learned "on the job."

Dedicated post-BSc and -MSc courses

Post graduate courses fully dedicated to noise control engineering are available. There is a four-day course, *Noise Control Engineering*, organized by the Post Academic Technical Education Foundation. There are many courses of ten days or more which offer general acoustical engineering education with ample attention to noise control engineering. An advanced course in acoustics is held in Antwerpen and organized by The Netherlands Aerospace Group and the Belgium Acoustical Association. Also a course, *Environment and Sound*, is offered by a foundation established by acoustical consultancy offices.

The Goal of Education in Machinery Acoustics—Quiet Products without Price Increases

Gerhard Hübner, *Stuttgart University, Germany*

We consider first the requirements for the successful marketing of quiet products. Industry is forced by current legislation either to guarantee the noise emission limit on a product directly or the noise immission of a product indirectly. In developing a low-noise product, industry must keep in mind the need for a low price relative to the competition. For those users who are motivated to purchase quiet products, industry is willing to invest in research to keep up with the state of the technology and the education of consumers.

The public should be encouraged to buy quiet products by stressing that low-noise products are available without an increased price. Those interested in quiet products should be encouraged by the industries producing those products. One requirement for sales is a simple and easily-understood labeling and verification system. An example is the energy consumption of refrigerators in Classes A, B, and C. It can be expected that the free market will work to increase the number of quiet products available.

Industry needs the latest information on product noise control techniques. In particular, it needs the principles of noise generation relevant to the sound sources of the industrial machines or equipment it produces, as well as the relevant laws that give the parameters of physically relevant noise generation. Of lesser importance is the design of features for secondary noise control such as mufflers, covers, and linings that generally increase the cost of the product. Teaching machinery acoustics as a field of concentration at the university level is an effective tool in developing quiet products.

To determine the sound power output of a product, software is available to perform major tasks. The airborne sound in the vicinity of the product is generated by sources that radiate directly to the air and by sources that transmit their energy over structural paths before being radiated as airborne sound. To determine the amount of sound that will be radiated, one needs to know the flow pattern for the sources that radiate directly to the air and the operating conditions, forces, and computer-aided design tools that yield the structure-borne sound.

The core courses that should be covered in teaching machinery acoustics are supplemented with information relating to the usage of the product. The requirements of the purchasing public expressed as noise limits in relevant laws and regulations as well as the latest research results presented at national and international conferences and in the deliberations of standardization bodies including ISO, EN, and DIN.

Machinery acoustics includes four aspects—acoustical measurement techniques, structure and fluid-borne sound, aerodynamically-generated sound, and sound radiation.

There are several topics to be considered insofar as acoustical measurement techniques are concerned. The measurement procedures for determining sound emission and immission should be based on the relevant international standards. Methods are described for locating the principal sources of sound of a machine or piece of equipment. These sources must be rank-ordered for an optimal noise control design. Procedures need to be described for checking the performance of acoustical noise control elements by measurements of reverberation time and the absorptive and sound-isolating qualities of linings, walls, and windows. The characteristics of electro-acoustic transducers must be defined. These include probes for airborne and structure-borne sound measurement, intensity instrumentation, non-contacting vibration measuring devices, and robot-assisted devices. The uncertainty of the acoustical measurements must be carefully studied by statistical analysis, use of the guide to the expression of uncertainty in measurement (GUM),

labeling and verification of guaranteed and prescribed noise limits.

Key items to be covered in aerodynamic machinery acoustics are the basic relations and equations for aerodynamic sound generation (Lighthill's equation, similarity principles and quantities) and the equations for specific sound generation. The sound power *W* generated by machinery rotors and radial fans is dependent on the length and diameter of the element. A fan with irregular blade spacing will avoid the generation of pure-tone components.

For structure-borne machinery acoustics there are several key aspects. When the construction elements are differently shaped bars and plates (curved, twisted, varying cross-sections), this leads to a design restricting the vibrations of outer surfaces and distinguishing such vibrations from airborne sound radiation.

The principal emission quantity for airborne sound radiation as described by ISO TC43 Acoustics is the sound power *W*. The determination of other sound field quantities is of secondary interest. Several methods are available for sound power determinations. The one that is most valuable in machinery acoustics is the direct finite element method (DFEM) that facilitates sound-field calculations.

In machinery acoustics the principal descriptors are the sound power radiated and the source location that together describe the sound emission. This contrasts with architectural acoustics where the principal descriptor is the sound pressure and this leads to the concept of sound immission. For machinery acoustics there is one useful second-order wave equation with frequency range extending up to 10 kHz.

Fundamental work in machinery acoustics leads to the development of low-cost quiet machines by applying the physical laws controlling sound generation at the source. This approach contrasts to the alternative of adding elements such as mufflers to existing designs. Such an approach almost always increases the manufacturing cost of the product. By using the design principles of machinery acoustics, the quietest product can be developed and a low-cost profile maintained.
(A version of this presentation appeared on pages 145-146 of the 2006 December issue of this magazine. —Ed.)

Discussion – Afternoon Session

Interest in Engineering Studies

Keith: We now will ask the panel to answer some questions which arose from the afternoon presentations. One that's a great concern in the U.K. just now has to do with the current interest in engineering and subjects allied to engineering.

Question for Panel: Does interest in noise control engineering follow a similar pattern with respect to interest in other engineering fields among students? Can you summarize the situation in each of your countries?

Answer: It is difficult to generalize across all engineering programs because we have had a decreasing interest in related studies in Norway. A new study program was started two years ago in nanotechnology that has created enormous interest. Another program started several years ago in communication technology generated great interest at first, but then it decreased. It is the goal of the high schools to supply students with interest and a good background in mathematics and physics. Noise control engineering is affected in the same way as other engineering studies because we all have to get our students from the same source. Within engineering, noise control does not have an easy task competing with new programs like nanotechnology. Nonetheless, we have a relatively steady supply of students in Norway, so somehow the market seems to work. Students find acoustics to be a very stimulating field to study.

Comment: In Finland students are interested in acoustics because Nokia is considered a good employer. Noise control engineering is not popular because students do not believe they will have a lifelong career in the field.

Comment: In Sweden we have the same problem as in other countries. The interest in industrial sciences and engineering among our younger persons is decreasing. The number of applicants for our engineering programs is decreasing. We are discussing what to do about it. However, when it comes to how it is in our acoustics department, we have more or less the same number of applicants each year. So it is still quite all right.

Comment: In The Netherlands about ten years ago, noise control was a political topic. It was of great interest to the political parties, so legislation was sharpened. For instance, there was a need for effective noise screens along high-traffic roads. Students read in the newspaper about current social problems, and that attracts them to do something relevant. But now noise is not a political topic any longer, partly because things have improved, but also because we now have clean air as a current issue. So my Norwegian colleague has a project designing traffic noise screens that also integrate filters for clean air. So you can reduce the sound and simultaneously clean the air. It was immediately popular and the students liked it very much because of its social impact. In conclusion, most students like to do things that are currently relevant.

Comment: In general, students are interested in the more trendy parts of acoustics — electroacoustics, multimedia, and sound processing. In Spain we have few acousticians, although a diploma in

sound and image is in demand. There are many universities which offer these studies. But the study of noise control is not an attractive part of acoustics. For example, I teach mechanical engineers; and for mechanical engineers it is difficult to understand sound propagation laws because sound is invisible and without a mechanical system or mechanism. So acoustics is not attractive to students of mechanical engineering who think about building cars and motorcycles.

Comment: There are two reasons why we have many students in Stuttgart studying technical acoustics and machinery acoustics. The first is that this program differs from that of other Germany universities by its inclusion in the machine design faculty rather than the electrotechnical faculty. The second reason is that there is a lot of important industry in Stuttgart interested in graduates of high-quality courses in technical and machinery acoustics.

Question: Does that mean much of the research is sponsored by those industries?

Answer: Yes.

Demand for Engineering Courses Worldwide

Chair: May I summarize what seems to be the situation? First, with a few exceptions—Stuttgart, the courses in sound imaging in Italy, the demand for short courses—the demand for engineering and engineering-related courses in developed countries is decreasing. There are various reasons—I'm not a sociologist—I'm sure that sociologists are looking at this. But one can't help contrast this situation with the situation in developing countries where the demand for engineering and engineering-related courses is burgeoning, it's exploding. Nearly ten years ago I was a visiting professor at a middle-ranking Chinese university, Yangshan University. The only claim to fame of that particular university was that it was at one end of the Great Wall. Their engineering school had 8000 students. Now admittedly there are lots of students in China, but if you scoured the whole of the U.K., you'll not find 8000 engineering students. I believe that Prof. Caliskan who asked this question told me a short time ago that they had no problem getting engineering students in Turkey. So globally there seems to be a divide between the developing world and the developed world in terms of interest in engineering. Suppose that we wanted to have a series of targets for increasing the interest in noise control engineering or applied acoustics. One suggestion has been to exploit the interest in audio technology and media studies. Another is to have some distinctive aspects of the courses such as those available at Stuttgart. Or choose a hot topic into which one can introduce acoustics. I'm not sure you can do that in nanotechnology although I'm just starting research in sonic crystals. But one thing mentioned with regard to Norway was the energy issue. If there were a hot topic, energy is it because of the burgeoning demand throughout the world. Thermoacoustics and the noise implications of alternative technology should be good areas to pursue. Could we compile a list of things which could be a way to increase interest in acoustics and in noise control engineering?

Comment: It would be difficult to compile such a list, but such a list would be very valuable.

Comment: Although there is a huge demand for engineering in China, India, and other developing countries, one thing I've learned from the Chinese academics who visit the U.K. is that they like the western style of engineering courses as a model because typically these introduce project work and design work. The courses available in China tend to be much more academic and much less oriented towards practical problem solving.

Current Engineering Hot Topics

Chair: One other area that may inspire some comments from the panel is medical acoustics, a growing area of interest, and medical acoustics has noise control implications. Witness the current interest in noise in hospital wards, although I remember that there was interest in that area twenty years ago. But it's back in the headlines again, such as the noise made by magnetic resonance imaging equipment. This could be another way to interest people in acoustics and noise control.

Comment: What worked in our university is that we centralized all that we do in applying array technology, arrays like microphones, loudspeakers, and sound sources. I've been a guest professor at a German university where, after the fall of the Wall, the university expanded to 80,000 students. An institute for multimedia technology was established at the university with the only educational offering in Germany in that field. Students came from all over the country to become specialists in multimedia technology. This may not be the general approach, but the university offered something novel, something new, and something that can provide a career. This attracts a lot of students.

Mobility and European Scholar Projects

Comment: I agree that a program in acoustics and noise control can be an integral part of an engineering education. But it's difficult for each university to have experts in all the different topics in acoustics. So a scholar project in universities that work on specific problems in acoustics can help students as well as build joint ventures between universities.

Question: Does a scholar project offer any sort of learning packages?

Answer: Yes.

Question: So a student based in Italy could obtain learning packages from one

of the other universities and could stay in Italy and study these?

Answer: Yes. They can receive this education as well as information on the courses available throughout Europe.

Instruction on Product Design

Comment: Consider what our duty is in European universities. Our duty is to give lectures to students which should remain meaningful for the next ten to twenty years. What is necessary to ensure this? We must provide instruction on designing a high level of quality into our products to remain competitive on the world market.

Comment: Low-noise emission is an indicator of the high quality of a product. Training in acoustics then becomes important to increase the quality of various products. But it does not produce new products; it concerns improvement of existing products. This should be important but is not in line with today's demand for an ever-increasing number of mass-produced new products. In the Swedish universities we have a trend toward mass production of engineers. The effect is often that the administration favors courses that attract 75 students rather than courses that only attract 25 students.

Highlights of the discussion:

1.While the interest in industrial sciences and engineering among the younger persons in EU countries is decreasing, the number of applicants for engineering programs specializing in acoustics appears to holding steady.

2.There is a divide between the developed world where interest in engineering is decreasing and the developing world where the demand for engineering-related courses is burgeoning.

3.Engineering courses available in many Asian countries tend to be more academic and less oriented towards practical problem solving than the Western-style courses.

4.Courses in the design of low-noise products to prepare graduates to meet industry needs must be further developed.

5.How can interest among students in acoustics and noise control engineering be increased?

a.Exploit the interest in audio technology and multimedia studies.
b.Choose a hot topic such as energy into which one can introduce acoustics. Other such topics as thermoacoustics and the noise control implications in medical acoustics have current interest.
c.Use applications in array technology involving microphones, loudspeakers, and sound sources.
d.Combine noise control technology with other currently relevant issues such as clean air, as such subjects are popular because of their social impact.

1. Lindsay, R.B., Report to the National Science Foundation on conference on education in acoustics, J. Acoust. Soc. Am., 36, 2241-2243, 1964

An announcement of the availability of the Proceedings of the 9th International Congress on Noise as a Public Health Problem appears on the inside back cover of this issue. The congress was dedicated to the memory of the late Henning E. Von Gierke. Dr. Von Gierke was the third Chair of the International Commission on the Biological Effects of Noise, and had a major influence on many activities related to noise, especially noise standards and requirements. The tribute below was prepared by Kenneth M. Eldred and appears in the Congress Proceedings. — Ed.

Henning Edgar von Gierke

Henning E. Von Gierke

Henning was born in Karlsruhe, Germany on 22 May, 1917 into a family whose heritage includes medical doctors, scientists, lawyers, and artists. In 1936 he was required to serve in the German Army, sent to Spain on Hitler's orders, returned an officer only to be told he could no longer serve because he had a Jewish grandmother. In the late 1930s, he began studies of electrical engineering and acoustics at the Technical Universities in Karlsruhe and Munich, receiving a Diplom Ingenieur in 1943 and Doctor of Engineering in 1944 from the Technical University, Karlsruhe. There, for his thesis, he studied pure tone sound radiation from gas jets under Professor Herman Backhaus. His combined interest in human responses and their governing mechanical processes formed the basis of his four-decade professional career in studying the interaction between acoustic, mechanical energy and the human organism.

The outstanding results that he achieved in these four decades were due to a combination of several key qualities. He was a true teacher who, through his quick focused and deep probing questions stimulated his associates to think and to think logically. His scientific curiosity led to the development of several patented devices ant to the answers to many scientific questions. But the quality that brought success to many of his endeavors was his remarkable ability to quickly find the central core of a complex issue and then to energetically lead others. He was brought to the US by Operation Paperclip after the war where he was launched on a research career in biophysics at Wright Field in Dayton Ohio and then from 1956-88 he was the Director of the Biodynamics and Bioengineering Division at AMRL. There, he had many accomplishments, including developing the equal energy rule as the time intensity trade-off for Air Force hearing conservation regulation. Many years later he chaired the ISO working group which prepared and obtained consensus for the adoption of ISO 1999 which used the equal energy rule as the basis for determining occupational noise exposure and estimating its hearing impairment.

Henning has been a member of the Acoustical Society of America for over 50 years, a Fellow since 1956, and its President in 1979-80. He has been a leader in the development of the Society's Standards Program, chairing the S2 Committee on Bioacoustics, and serving as the first Standards Director. For many years he organized and led the US delegation to the ISO TC/43 Technical Committee on Noise, and for 30 years he chaired the ISO TC/108 Subcommittee on Human Exposure to Mechanical Shock and Vibration. He was past Chair of the NRC Committee on Hearing, Bioacoustics and Biomechanics, past Chair of the International Commission on Biological Effects of Noise, past Chair of the ANSI Acoustical Standards Management Board, and a member of INCE and the Aerospace Medical Association.. He was a fellow and past vice president of the Aerospace and Environmental Medicine Association, an elected member if the National Academy of Engineering, the International Academy of Aviation Medicine, and the International Academy of Astronautics. He received many awards, including the Meritorious Executive Rank Award (twice), the Department of Defense Distinguished Civilian Service Award, the Commander's Cross of the Order of Merit of Germany, the Rayleigh Medal from the United Kingdom Institute of Physics, the Lesser Award from the American Society of Mechanical Engineers, and both the Silver and Gold Medals from the Acoustical Society.

He is survived by his wife Honlo and his daughter Karin. His second daughter, Susi, died of multiple sclerosis in 2002.

Kenneth M. Eldred

INTER-NOISE 08 Report

Thirty nine countries were represented as 507 paid registrants, 163 students, and 163 accompanying persons attended INTER-NOISE 08, and made the congress an outstanding success. INTER-NOISE 08, the 2008 International Congress and Exposition on Noise Control Engineering was held on October 26-29, 2008 at the Shanghai International Convention Center in Shanghai, China. The theme of the meeting was *From Silence to Harmony*. Jing Tian of the Institute of Acoustics, Chinese Academy of Sciences served as president of the congress. The congress was hosted by the Acoustical Society of China and the Institute of Acoustics, Chinese Academy of Sciences. The International Institute of Noise Control Engineering (I-INCE) was the sponsor of INTER-NOISE 08.

Professor Jing Tian

Professor Wenqing Shen

Professor Mianheng Jiang

The opening session was held on Sunday, October 26 in the auditorium of the conference center. There was a musical performance by The Girls Folk Music Band of the Shanghai Rose Music Workshop. Jing Tian, congress president, welcomed the delegates, and introduced Wenqing Shen and Mianheng Jiang, distinguished members of the Chinese Academy of Sciences who also greeted the delegates. Professor Wenqing Shen is vice president of the National Natural Science Foundation of China and chairman of the Shanghai Association for Science and Technology. Professor Mianheng Jiang is vice president of the Chinese Academy of Sciences.

Dr. Steven Colburn presents the first distinguished lecture at INTER-NOISE 08

The first distinguished lecture was titled "Binaural hearing mechanisms," and was presented by Dr. Steven Colburn, a professor of biomedical engineering at Boston University, USA. The abstract of his presentation follows:

> The mechanisms of binaural hearing, both physiological and signal-processing mechanisms, are reviewed with an emphasis on the relationships between underlying mechanisms and functional benefits. The elements of the binaural hearing system start with peripheral processing of each acoustic input through narrowband filters, nonlinear rectification, and envelope extraction. Intermediate processing stages combines left and right information in each frequency band with short-time cross correlation to estimate interaural time delays and a mechanism for interaural intensity weighting. The central processing stages combine information across time and frequency to form perceptions of sources of sound in the acoustic environment. The perceptual abilities of human listeners are discussed in terms of these processing stages. These abilities include classic binaural abilities in sound-source localization and binaural masking level differences as well as improved speech intelligibility in multiple-source and reverberant environments and spatial release from informational masking.

Tor Kihlman summarizes the results from the Southampton workshop.

Tor Kihlman, past president of I-INCE, then presented some conclusions from a workshop held in Southampton, United Kingdom and hosted by the Institute of Sound and Vibration Research. The three-day workshop was organized under the auspices of the International Council of Academies of Engineering and Technological Sciences (CAETS) and featured assessments of transportation noise issues by European experts in the field. Professor Kihlman's presentation, "Transport noise in Europe—an approach to the global noise issue," was published in the December issue of this magazine. A reception for all delegates followed the opening ceremony.

The Girls Folk Music Band

Dr. Goran Pavic presents the second distinguished lecture at INTER-NOISE 08

The second distinguished lecture was held on Monday morning, October 27. The title was "Noise sources and virtual noise synthesis," and was presented by Dr. Goran Pavic, a professor at the National Institute of Applied Science in Lyon, France. The abstract of his presentation follows:

> The synthesis of the noise produced by an industrial product can he done by sub-structuring it into its basic components. A particular sub-structuring method, Noise Synthesis Technology (NST) offers such a possibility. It predicts the trends in the overall noise by combining data from the real source(s) with a simplified model of the main frame. The connectivity between the source(s) and the frame is ensured in NST by impedance coupling rules. The critical components are the noise sources which have to be characterized by measurements. The characterization techniques are not simple, but reveal a lot of useful information to the designer apart from providing the input data to the core NST. The simplified frame model has the advantage of being robust and easy to implement in the NST synthesis. The output of the synthesis is the noise level and the noise waveform for audible reproduction. The paper outlines the basics of the source characterization techniques and of the NST approach.

Then followed ten parallel sessions devoted to a variety of topics in noise control engineering. One special feature of Monday's program was a workshop titled "Asia-Pacific education in noise control engineering." Speakers from China, Japan, Korea, Hong Kong, and Australia presented their views of noise control engineering in their country, and a report was received from India. This was the third in a series of workshops on noise control engineering. The first was held in 2007 in the United States in conjunction with the NOISE-CON 07 conference, and the second was held in conjunction with the International Congress on Acoustics in Madrid, Spain in 2008. Material from the first workshop was published in the September, 2007 issue of this magazine, and the second is published in this issue. It is expected that material from the Shanghai congress will appear in the September 2009 issue of this magazine.

Dr. Jing Tian presents the third distinguished lecture at INTER-NOISE 08

The third distinguished lecture, presented on October 28 was titled "Microperforation for sound absorption and noise reduction," and was presented by Dr. Jing Tian, a professor at the Institute of Acoustics, Chinese Academy of Sciences and congress president. The abstract of his presentation follows:

> Microperforation is a special technology widely used in sound absorption and noise control. Microperated panels can serve as non-fibrous broadband sound absorptive materials, not only applied to general building acoustics and noise control engineering, but also to some extremely high temperature or high-speed flow situations. When backed with layers of cavities, the panel can give effective sound absorption in several octaves in the low-frequency range. In jet noise control, well-designed micropores at the outlet of an air or steam jet nozzle can greatly reduce the noise radiation in audible frequency range, by 20 to even 60 dB(A) generally. In this paper, the acoustical behavior of microperations in sound field or at the source is introduced. Main research progress in the sound absorption mechanism and its practical applications in noise control are reviewed and discussed. The physical concepts of turning the sound energy into turbulence, and shifting the sound energy from audible frequency range to ultrasound frequencies are very attractive and heuristic to the development of modern noise control technologies.

Again, ten parallel sessions followed the lecture.

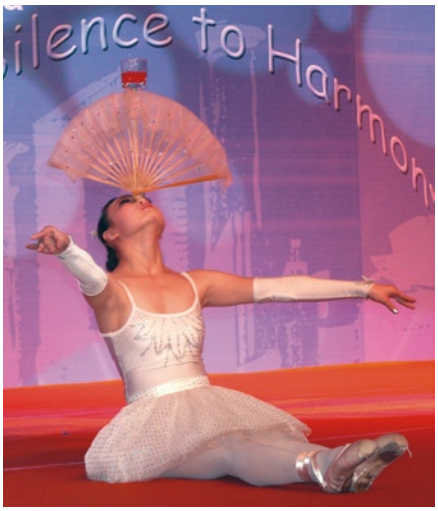
Dr. Murray Hodgson presents the fourth distinguished lecture at INTER-NOISE 08

The fourth distinguished lecture was titled ""Evaluation and control of acoustic environments in 'green' (sustainable) office buildings," and was presented on October 29 by Dr. Murray Hodgson, professor of acoustics in the School of Environmental Health and in the Department of Mechanical Engineering at the University of British Columbia, Canada. The abstract of his presentation follows:

> This paper discusses the increasing important issue of the acoustical design of "green" (sustainable) buildings. Many "green" buildings have unsatisfactory acoustical environments, according to their occupants. Work done at UBC to evaluate acoustical quality in "green" office buildings and improve it by engineering control measures is reviewed, The problem of "green" building acoustics is introduced and its importance discussed. Details of the acoustical evaluation of six "green" office buildings by occupant satisfaction surveys and acoustical measurements are presented, and their implications for the design of "green" buildings considered. A detailed study

of one naturally-ventilated "green" building is discussed. Pre-treatment surveys and measurement evaluation results are presented. It is concluded that inadequate noise isolation due to natural-ventilation openings is a big problem. The design and post-treatment evaluation of noise-control measures to improve the noise isolation in two situations is discussed. Finally, other "green" building acoustical issues are noted, and conclusions are drawn as to where future work should be directed.

The highlight of the social program was the congress banquet which was held in Shanghai Hall of the conference center. The food was excellent, and the entertainment was outstanding. Several photos from the banquet are shown here:



An outstanding equipment exposition was arranged for the congress. Thirty five exhibitors participated in the exposition:

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Asona Benelux BV

Brüel and Kjær

Beijing CA Acoustics Co., Ltd.

BSW Office China

BSWA Technology Co., Ltd.

Cirrus Research plc

Data Physics Co.

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ESI Group

Evonic Röhm GmbH

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PCB Piezotronics, Inc.

Pulsar Instruments plc

Quest Technologies, a 3M company

Richardson Metal Products (Shanghai) Ltd.

Rion Co., Ltd.

Saint-Gobain Insulation

Seti Media. Inc.

Shanghai Hanson Industrial Co., Ltd.

Shenzeh Newcon Environmental Construction Materials Co., Ltd.

Softnoise GmbH

SoundPlan

Svantek sp. Zo.o

The team that made INTER-NOISE 08 a success.

Trevor Nightengale, co-president of INTER-NOISE 09

Joseph Cuschieri, co-president of INTER-NOISE 09

After the final parallel sessions, the closing ceremony was held in Mandarin Hall in the congress center. Jian Tian summarized the congress and presented statistics as they were known at the time. Co-Presidents of INTER-NOISE 09, Trevor Nightengale (Canada) and Joseph Cuschieri (USA) presented an overview of INTER-NOISE 09 which will be held in Ottawa, Canada on August 23-26, 2009. Travel planning information for the congress appeared in the December issue of this magazine.

A farewell reception for all delegates was held immediately after the closing ceremony. The INTER-NOISE 08 organizing team then sat for a final photograph, and an extremely well-run congress ended.

The conference proceedings are on a CD-ROM which contains PDF files of the 636 papers presented at the congress. It is available for 50 Euros from Zhang Li at the Institute of Acoustics in China. The CD may be purchased with a credit card. Contact Zhang Li at zhangli@mail.ioa.ac.cn to obtain a credit card authorization form. The form should contain the detailed mailing address and telephone number. Fax to: +8610-62553842, and the CD will be sent.

Active 2009 OTTAWA, CANADA – 2009 August 20-22

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Philippe Micheau

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Jenni Vincent

General Information
info@internoise2009.com

INCE Business Office
9100 Purdue Road
Suite 200
Indianapolis, IN 46268
Tel: +1 317 735 4063
Fax: +1 317 280 8527
e-mail: ibo@inceusa.org

Readers of *Noise/News International* are cordially invited to participate in ACTIVE 2009, the 2009 International Symposium on Active Control of Sound and Vibration. The ACTIVE conferences provide a unique opportunity to exchange and share on up-to-date research and new directions in active control with international colleagues. They are held every 2 or 3 years at locations in North America, Europe, and in the Asia Pacific Region.

The past symposia are:

2006: Adelaide, Australia
2004: Williamsburgh, VA, USA
2002: Southampton, UK
1999: Ft. Lauderdale, FL, USA
1997: Budapest, Hungary
1995: Newport Beach, CA, USA

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Internet: http://www.internoise2009.com/active09/

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New Zealand ..... Centre for Sound Studies

Portugal ..... Laboratorio Nacional de Engenharia Civil, Lisboa

Sweden ..... Department of Applied Acoustics, Chalmers University of Technology, Gothenburg

USA ..... Graduate Program in Acoustics, The Pennsylvania State University, State College, Pennsylvania

Conference Calendar

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 page on the Internet, www.i-ince.org.

2009 August 23-26
INTER-NOISE 2009
The 2009 International Congress and Exposition on Noise Control Engineering
Ottawa, Canada
Contact:
Institute of Noise Control Engineering-USA
Jenni Vincent, Congress Coordinator INCE Business Office
7150 Winton Drive, Suite 300
Indianapolis, IN 46268, USA
Telephone: +1 317 735 4063
E-mail: ibo@inceusa.org
ACTIVE 09, the 2009 International Symposium on Active Control of Sound and Vibration will immediately precede INTER-NOISE 09.

2010 April 19-21
NOISE-CON 10
Baltimore, Maryland
Joint with the 159th meeting of the Acoustical Society of America.
Contact:
Institute of Noise Control Engineering-USA
Jenni Vincent, Congress Coordinator INCE Business Office
7150 Winton Drive, Suite 300
Indianapolis, IN 46268, USA
Telephone: +1 317 735 4063
E-mail: ibo@inceusa.org

2010 June 13-17
INTER-NOISE 10
Lisbon, Portugal
Contact: Portugese Acoustical Society
LNEC
Av. do Brasil 101
1700-066 Lisboa
Facsimile: +351 21 844 30-28
www.spacustica.pt/internoise2010/text/ivitation.html

2011 September 4-7
INTER-NOISE 11
Osaka, Japan
Contact: INCE/Japan
c/o Kobayasi Institute of Physical Research
3-20-41 Higashimotomachi, Kokubunji
Tokyo 185-0022
Facsimile: +81 42 327 3847
e-mail: office@ince-j.or.jp
home page: http://www.mmjp.or.jp/INCE-JAPAN

Directory of Noise Control Services

Information on listings in the Directory of Noise Control Services is available from the INCE/USA Business Office, 210 Marston, Iowa State University, Ames, IA 50011-2153; +1 515 294 6142; Fax: +1 515 294 3528; IBO@inceusa.org. The price is USD 400 for 4 insertions.

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Mark your calendar and plan to participate!

Inter-Noise 2009

Ottawa, Canada
23–26 August, 2009

Ottawa, Canada, will be the setting for the 38th International Congress and Exhibition of Noise Control Engineering (Inter-Noise 2009). The annual Congress opens 23 August with a special ceremony, lecture and reception, and continues through 26 August. Several plenary sessions and hundreds of papers on various aspects of noise control will be presented during the four-day event. A large vendor exposition will be held during the congress and the ACTIVE 09 Symposium will be held immediately before the congress.

The INCE/USA Page at the Atlas Bookstore

www.atlasbooks.com/marktplc/00726.htm

INTER-NOISE 06 Proceedings

This searchable CD-ROM contains the 662 papers presented at INTER-NOISE 06, the 2006 Congress and Exposition on Noise Control Engineering. This, the 35th in a series of international congresses on noise control engineering was held held in Honolulu,Hawaii, USA on December 3-6, 2006. The theme of the congress was "Engineering a Quieter World."

The technical topics covered at INTER-NOISE 06 included:

- Aircraft and Airport Noise Control
- Community Noise
- Fan noise and aeroacoustics
- Highway, automobile and heavy vehicle noise
- Machinery noise
- Noise policy
- Product noise emissions
- Sound quality.

The NOISE-CON 05 Proceedings Archive (1996-2005)

This searchable CD-ROM contains 198 papers presented at the joint NOISE-CON 05/ASA 150th meeting as well as 749 papers from the NOISE-CON conferences held in 1996, 1997, 1998, 2000, 2001, 2003, and 2004 as well as the papers from the Sound Quality Symposia held in 1998 and 2002. All papers are PDF files.

Several papers are taken from sessions organized by the Noise, Architectural Acoustics and Structural Acoustics Technical committees for this 150th ASA meeting. The three plenary lectures related to noise and its impact on the environment are included. Also included are papers in one or more organized sessions in the areas of aircraft noise, tire/pavement noise, and hospital noise.

Noise as a Public Health Problem

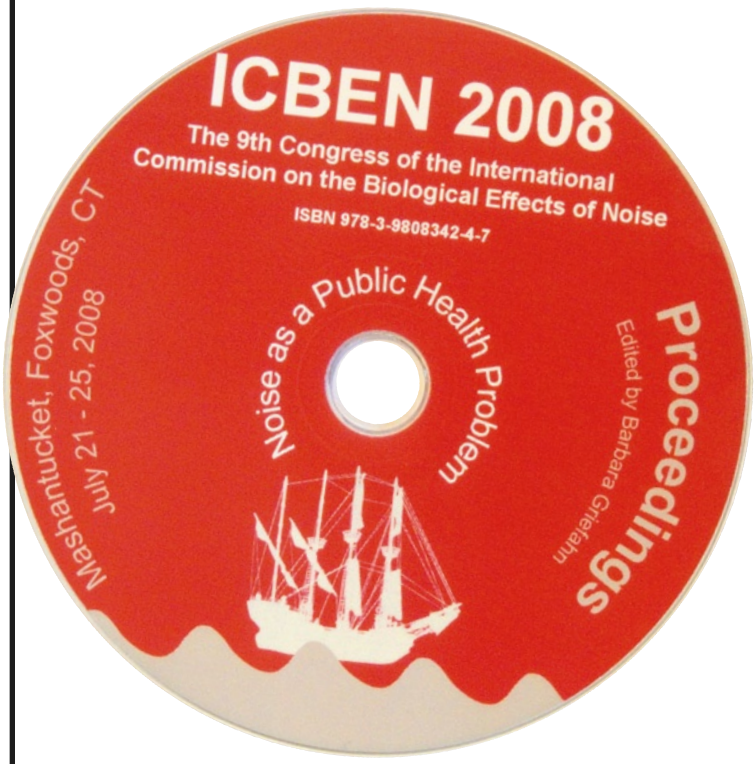
The Proceedings of ICBEN 08, the 9th Congress of the International Commission on the Biological Effects of Noise, are now available. The Congress was held on 2008 July 21-25 in Mashantucket, Connecticut, USA. In his keynote address, Adrian Davis, MRC Hearing and Communications Group, Manchester University, UK opened with:

Noise is a major public health challenge. It is major because noise is all pervasive in our societies at a level that it can seriously affect population health and quality of life throughout the lifecourse. It is a challenge because the noise sources are constantly changing as the pace of technology and change gathers globally. As some areas of the world legislate or change their strategies the issue is displaced or changed rather than lessons being learnt and applied globally. There is much that we know in terms of solutions in good practice that is reduced in effectiveness because it is not known widely or is not applied / seen as a priority. There are also huge gaps in our knowledge of current population exposure and effectiveness of new ways to combat noise e.g. in particularly challenged groups such as in military or in airline/airport industry.

Scientific papers were presented in ten areas:

- Noise-Induced Hearing Loss (38 papers)
- Noise and Communications (11 papers)
- Non-Auditory Effects of Noise (15 papers)
- Noise and Performance (18 papers)
- Effects of Noise on Sleep (16 papers)
- Community Response to Noise (27 papers)
- Noise and Animals (5 papers)
- Noise Policies: Regulations and Standards (14 papers)

The table of contents for the ICBEN 08 Proceedings may be downloaded free of charge from the Web address at the bottom of this page.



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NOISE-CON 08 CD-ROM

This searchable CD-ROM contains PDF files of the 161 papers presented at NOISE-CON 08, The 2008 National Conference and Exhibition on Noise Control Engineeering which was held in Dearborn, Michigan, USA on 2008 July 28-30. Also included are all of the papers presented at NOISE-CON 07 which was held in Reno, Nevada, USA in 2007 October. The CD-ROM also contains the proceedings of SQS 08, the 2008 Sound Quality Symposium.

This CD-ROM supplements the NOISE-CON 05 CD which contains all of the papers presented in NOISE-CON Proceedings beginning in 1996.

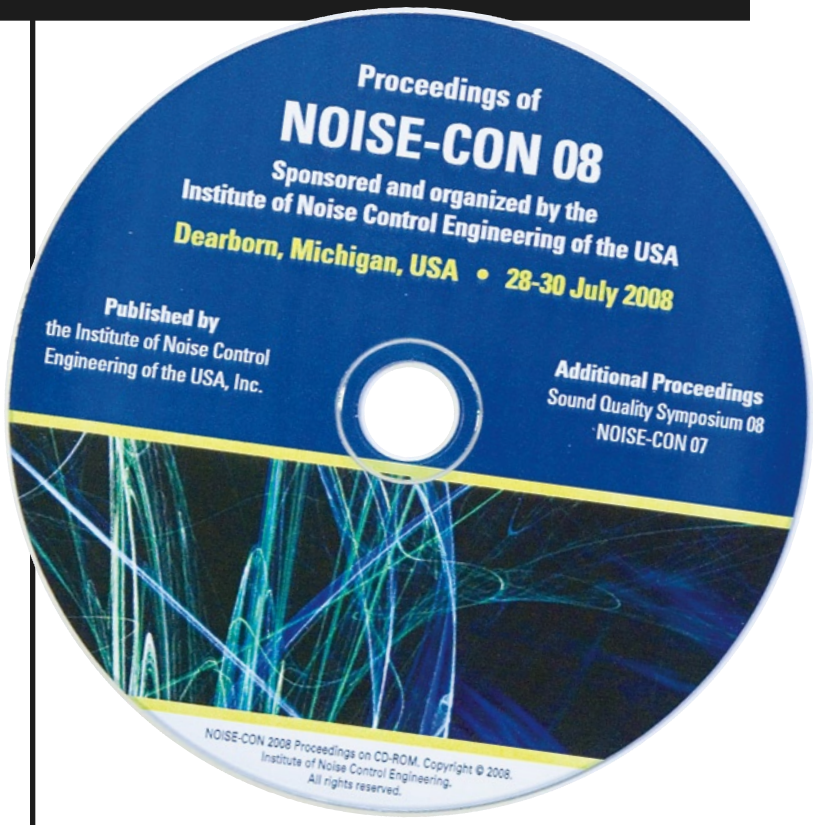
One feature of this year's NOISE-CON was that several papers addressed two emerging topics:

- Flow tones and instabilities as a NOISE-CON/ASME-NCAD joint session, for flow induced noise generation and transmission (6 papers),
- Hearing loss prevention in industry/bio-acoustics, particularly with possible application of auditory system simulation to noise control (7 papers)

Technical papers were presented in more than 40 technical sessions. There was emphasis on the subjects below;

- Vehicle Interior Noise (14 papers, co-organized with ASME-NCAD)
- Modeling and Measurement of Acoustic Material Properties and Design for Noise Performance (13 papers, co-organized with ASME-NCAD),
- Numerical Methods in Acoustics (12 papers, co-organized with ASME-NCAD),
- Information Technology Noise (11 papers)
- Aircraft interior Noise (11 papers)
- Experimental Techniques and instrumentation in Noise and Vibration (10 papers)

The tables of content of the NC08, NC 07, and SQS Proceedings may be downloaded free of charge from the Web address below.



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