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contents

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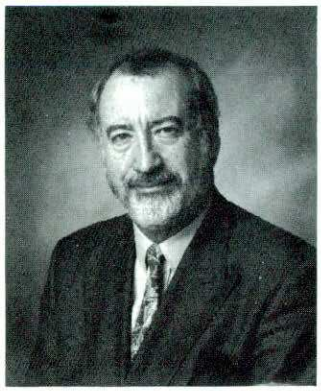

Dear Fellow Member

In an earlier President's letter I mentioned my objective of improving links with other national acoustical societies and you will be aware of the designation of Professor Mark Tatham as Vice-President for International Liaison. As a practical example of our efforts towards such closer liaison we recently invited over Professor Jens Blauert, Chairman of the Board of EAA and Dr Manell Zakharia, Managing Director of EAA. For convenience the meeting, which also involved Ian Campbell as President-Elect, took place at the Hilton Hotel, Stansted Airport, which, on a grey Saturday afternoon in February, had the atmosphere of a European No-man's land. Our visitors wanted to know more about the way the Institute is organised and we compared notes. Most of the discussion concerned ways in which the IOA could play a more active role in the EAA, and in particular whether we would more actively support the journal Acustica • Acta Acustica. Members of the French and German societies, and others, receive the journal free with their society subscription, but the IOA have opted out of this on financial grounds. We discussed how, in the short to medium-term we might increase the circulation of the existing journal in the UK, whilst also increasing the distribution of our Bulletin to other societies. We are also trying to find ways of improving the flow of news material to EAA. Mark Tatham is to begin a regular column in the Bulletin with news from the EAA. It may be that we will gradually work towards a new journal which blends the academic-type papers in Acustica • Acta Acustica with the more general newsy material of the kind which appears in Acoustics Bulletin. In the meantime IOA members should note that they do have the option of ordering two issues of the journal on free trial from the publishers, Hirzel-Verlag in Germany. (Fax 00 49 711 2582 290).

Sincerely yours

Bernard Berry

Bernard Berry

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THE EC GREEN PAPER ON FUTURE NOISE POLICY – A NEED FOR CHANGE?

Colin Grimwood MIOA & Matthew Ling MIOA

Introduction

A need for changes in the overall approach to national and European noise abatement policy is discussed in an EC Green Paper [1] issued during November 1996. This article discusses the Green Paper and looks at the impact it could have on UK noise abatement measures.

The Green Paper would be better titled *Future Environmental Noise Policy* as its brief excludes consideration of workplace noise exposure and noise in dwellings. It does, however, seek to give noise abatement a higher priority and to promote discussion on all areas of environmental noise policy with a clearly stated desire to see a harmonisation of assessment and measurement methods across the Member States.

For over 25 years EC noise 'policy' has essentially consisted of legislation fixing maximum sound levels for vehicles, aeroplanes and machines with a single market aim. However, the Green Paper notes that this has not led to significant improvements in exposure of people to environmental noise, particularly from road traffic. Concern is expressed on a number of issues:

- noise levels in 'black areas'* have been reduced but the number of people living in 'grey areas' has increased
- continued traffic growth coupled with urbanisation is resulting in a higher level of noise exposure
- leisure and tourism activities have created additional noise sources
- the spread of noise spatially (to affect rural and suburban areas) and over time

Additionally, there are problems associated with unifying assessment of noise exposure because of the different perception and acceptability of noise levels/exposure across the EU.

Environmental Impact of Noise

Section 2 of the Green Paper examines the impact of noise and relates it to eight general categories of noise sources; road, rail, air, industry, civil engineering, building site activities, recreational activities and outdoor equipment. The latter category includes gardening equipment. Many of these sources are already covered by existing UK legislation, codes of practice and BS or ISO standards.

Road traffic is singled out as the most important noise source, said to account for 90% of the EU exposure to levels greater than 65 dB(A) (80 million people), for whom a significant effect on human health can be expected. The grey category, where people are seriously annoyed, is said to affect 170 million EU citizens. It should be of no surprise therefore to expect recommendations to concentrate on this source.

Overall the trends which cause concern in the future are the predicted doubling of road freight by 2010, a forecast 180% increase in airline traffic and the development of high speed rail links.

Currently there is much interest across Europe in the polluter pays principle and the use of green taxes, but attaching a cost to noise exposure is a controversial procedure. Because of the difficulties a number of factors are identified in the Green Paper which may enable an economic assessment to be made:

- willingness to pay (for less noise exposure)
- change of market value of properties
- cost of abatement measures
- cost of avoidance or prevention
- cost of medical care and production losses

Cost estimates vary according to the method used but are typically found to be 0.2 – 2% of GDP. This annual cost to society (over 12 billion ECU) provides the EC with a significant argument for improved noise control measures.

Efficacy of Existing Policies in EU and Member States

Section 3 examines existing EC policies and the effectiveness of their implementation. These are summarised in Table 1.

What Levels Are Acceptable?

The Green Paper quotes OECD thresholds and WHO guideline values as the starting point for a discussion of acceptable levels in the EU, leading on to a restating of the night time L_{Aeq} targets contained in the Fifth Environmental Action Plan (to be achieved by the year 2000):

- to phase out exposure above 65 dB(A)
- reduction in proportion of population exposed to levels between 55 and 65 dB(A)
- exposure in quiet areas should not increase beyond 55 dB(A)
- a level of 85 dB(A) should never be exceeded

Most countries have already adopted legislation and guidance which broadly agrees with these figures eg PPG24 [2], and in fact criticism of these figures was made by some countries whose noise climates were already below target levels [3].

A New Noise Framework

The EC wishes to see member states working towards the common goal of a successful noise abatement policy. The EC suggests action in a number of generic areas to

**OECD, 1991, Fighting Noise in the 1990s, suggests that 'black areas' are those with daytime L_{Aeq} > 65 dB, and 'grey areas' have a daytime L_{Aeq} between 55–65 dB.*

Noise Source and relevant EC directives	*Developments*	*Comments*
Road transport 70/157 (as amended), 78/1015 (as amended)	8 dB(A) reduction for individual cars, 11 dB(A) reduction for individual heavy lorries	Resulting in only 1-2 dB(A) reduction in road traffic noise exposure because of increased traffic volume
Rail transport (no directives)	Proposed emission limits withdrawn in 1993	Legislation currently on an individual country basis
Air transport 80/51, 89/629, 92/14	Limit values introduced for take off and landing, noise certificated aircraft, phase out of chapter 2 aircraft by 2002	Improvements likely in short to medium term, concern over longer term deterioration
Construction plant & equipment, lawnmowers 79/113, 84/533, 84/534, 84/535, 84/536, 84/537, 84/538, 84/662, 86/594, 86/662	Approx. 1-5 dB(A) reduction from specified items; policy has a single market aim	No guarantee that current approach secures any environmental improvement; proposed new framework directive
Industrial noise 75/442 (as amended), 96/61	New area of EC activity	Control of some industrial noise emissions through a permit system

Table 1 Summary of EC Directives

achieve this:

- common noise exposure index to be used throughout Europe (L_{Aeq}) to enable comparability of noise data
- development of harmonised prediction methods for environmental noise sources
- development of harmonised measurement methods for environmental noise sources
- exchange of comparable information on noise exposure between member states, possibly collected and made available by the European Environment Agency (EEA)
- a framework for the assessment of environmental noise exposure
- provision of information on noise exposure to the public
- possible agreement on a limited number of minimum noise quality target values
- an obligation to take action to meet these target values

Achieving the Aims

At present it is unclear exactly how these aims will be achieved – after all this is a discussion paper – but we can draw some conclusions as to where effort may well be targeted.

Mapping to assess noise climate and noise exposure

The EC believes that noise mapping has the potential to be an effective and relatively inexpensive tool. Noise mapping combines noise level data with a conventional map, representing the noise levels as coloured bands or contours. This is not a new idea and bands have been suggested in ISO 1996 [4], but the real opportunity is to incorporate other data sources such as census information to assess population noise exposure. Noise data can be originated from model prediction or measurements.

Road transport noise reduction

A number of suggestions are given:

- reduction of tyre/road noise
- active promotion and funding of low noise surfaces
- use of vehicle taxation
- in-use noise testing of vehicles
- revision of test procedures (eg ISO R362) to make them more realistic
- consideration of new emission limit values
- support of relevant research

Railway noise reduction

Concern here surrounds the problems associated with high speed rail and freight transport. Apart from the joint bodies representing these sectors suggesting noise emission limits, the green paper highlights a combination of:

- economic instruments (eg track charges related to emission levels)
- agreements on targets for noise reduction and maintenance of equipment in use
- harmonised methods for assessment and prediction of railway noise

Aircraft

For aircraft noise a re-classification of aircraft types is suggested based upon actual operational noise rather than the current certification method. Greater stringency in emission values, the use of economic instruments and the role of land use planning are also discussed.

Outdoor machinery

The emphasis here is on a proposed directive for 1997 which will include noise limit values for some equipment and introduce noise labelling of machinery as diverse as construction plant, garden equipment and equipment used on refuse collection vehicles. This is seen as part of

the drive to improve eco-labelling of products. The OECD have reported that such an approach may create a market for low noise products.

General Actions

The final section of the green paper is concerned with those activities which promote exchange of ideas, technology and experience across the EU.

Some examples such as the LIFE programme to improve and inform land use development and planning already involve UK local authorities, whilst others such as the Telematics Applications Programme have been used to improve environmental information systems. It is expected that increased use will be made of these sorts of programmes to enhance noise reduction activities in the EU.

This possibility of financial support from the EC may be of interest to local authorities who are considering a more pro-active approach to environmental noise policy.

Concluding Remarks

This is the first attempt by the EC to significantly influence environmental noise policy across Europe. The EC also seem a little unclear as to whether they should initiate a greater involvement in this area of environmental activity. For example, compare this quote from the executive summary of the Green Paper: *The local nature of noise problems does not mean that all action is best taken at local level* with *The local impact of noise means that proposing and implementing solutions are essentially local responsibilities* taken from section 4.1.

As professionals working on a daily basis with noise problems we are all too aware of the influence and effects that noise exposure has upon local communities. We should welcome the opportunity to contribute to the debate and at long last give noise policy the attention it deserves.

The EC is seeking comments on the Green Paper by 31 March 1997. Observations should be submitted to: *The European Commission, Directorate General for Environment, Nuclear Safety and Civil Protection, 'Green Paper on Future Noise Policy', Rue de la Loi/Wetstraat 200, B-1049 Brussels, Belgium.*

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ACTIVE NOISE ATTENUATION IN DUCTS, INDOOR AIR QUALITY AND ENERGY CONSERVATION

Geoff Leventhall FIOA & Steve Wise

Introduction

Noise control engineers should be aware of the wider implications of the techniques which they employ and, in this connection, issues of indoor air quality (IAQ) and energy conservation have recently drawn attention to the traditional use of fibrous noise control materials in duct systems. This paper considers these issues and shows how active attenuation is a non-fibrous, low resistance alternative method for low frequency noise control in ducts. The frequency range of active control is increased by using multiple active systems.

Indoor Air Quality

Concerns related to the use of fibrous material in ducts include

- migration of fibres in the air stream
- growth of micro-organisms following contamination of the fibrous material

The migration of fibres is controlled by coatings, but may be a problem in old and imperfect installations which are approaching disintegration. A greater potential problem is the interaction of deposits of moisture and dirt in the fibres, so providing a breeding ground for micro-organisms. This is most likely to occur by condensation out of humid external air, but may also result from humidifiers installed too close to fibrous linings. Following these concerns, fibrous materials have been excluded from HVAC systems in some regions of the USA, particularly in schools and Government buildings.

Manufacturers of fibrous duct material have improved their products, to prevent migration of fibres and limit microbiological growth, by using coatings and chemical additives, which ease cleaning and reduce contamination [1].

Coatings may affect the high frequency attenuation, although this is not normally a problem since, in order to operate at low frequencies, the absorbing material used in most silencers provides more high frequency attenuation than is required. In practice, it is often the lower octave bands which determine the acoustical performance of a system.

Energy Conservation

A fan converts electrical energy to energy of the air flow in order to drive the air through the duct system and eject it with sufficient velocity to distribute correctly within the ventilated space. There is a rise in pressure across the fan. Resistance within the duct system results in use of energy to drive against this resistance, resulting in a pressure loss in the air stream. A number of components in the duct contribute to pressure loss, of which the passive baffle silencer is normally the greatest single component, possibly ten times the pressure loss of a square bend in the duct [2]. The silencer pressure loss depends on its dimensions and the flow rate.

The following data is taken from a commercial catalogue for a standard 'low pressure drop' silencer of 600 mm by 750 mm cross section and 2100 mm long [3].

Air flow m^3/s	3.4	4.7	5.8	7.5	9.2	11.9
Pressure loss Pa	30	69	90	149	229	376

Table 1 Silencer Pressure Loss

The dynamic insertion loss (dB) of this silencer under these conditions is

Frequency	63	125	250	500	1k	2k	4k	8k
Insertion loss	7	9	16	27	38	47	27	19

The total pressure loss in a ducted system, including the silencer, might be 1000 – 1500 Pa, but there are uncertainties, since poor installation may produce air flow conditions in the silencer which increase its pressure loss above that given in Table 1 [3].

The energy used to drive air against a pressure loss, ΔP is given by [4]

$$W = \Delta PQ/\eta \text{ watts}$$

where ΔP is the pressure loss (Pa), Q is the flow rate (m^3/s) and η is the fan efficiency.

Thus, from Table 1, the power used to drive 9.2 m^3/s of air through the silencer with efficiency of 0.70 is W = 3 kW. In some circumstances this energy loss might amount to 25% of the total fan power.

As a fan operates by increasing the pressure of the

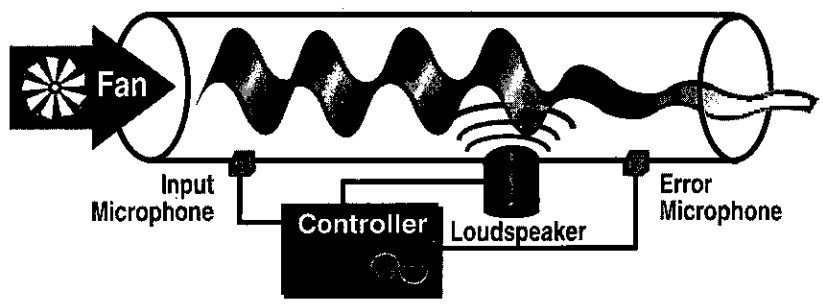


Fig. 1. Basic active attenuation system in a duct

air, the resulting compression leads to a temperature rise. The rise is given by 0.000812°C per Pascal of total fan pressure [4]. Clearly, the element of fan pressure which is used to overcome the silencer pressure loss produces an avoidable temperature increase. For typical fan efficiencies, the rise is about 1.2°C for each kilopascal of fan total pressure [4]. A pressure loss of 229 Pa leads to an increase of 0.27°C. Whilst this is a small increase, it adds to the load in a cooling cycle and causes further use of energy, depending on how much of the heat is dissipated in the duct prior to the cooling coils. If a silencer was available with negligible pressure loss there would be energy savings in HVAC systems. Active attenuation silencers fulfil this role. The electrical energy required to drive active silencers is 20 – 30 watts, which might be only 1 or 2% of the energy saved.

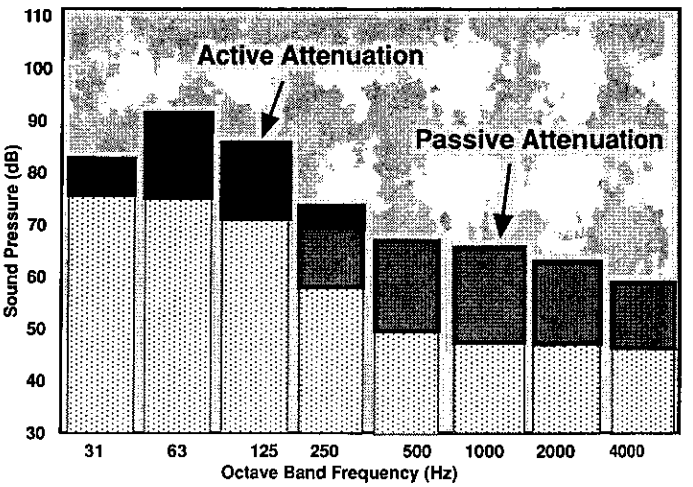


Fig. 2. Active and passive attenuation in a hybrid attenuator

Principles of Active Attenuation

An active attenuation system in a duct is illustrated in Figure 1. There are four components – the signal microphone, the digital controller, the loudspeaker and the error microphone. During operation the controller first measures the transfer functions between inputs/outputs of loudspeaker and signal microphone, between signal microphone and error microphone and between loudspeaker and error microphone. These transfer functions, which completely describe the physical system, are modelled into digital filters so that the controller contains a digital model of the physical system between the microphones. The model is continuously updated during operation (on-line adaptation).

It is possible to combine active and passive elements in a hybrid system. In this the active part controls the low frequency noise whilst the passive part controls high frequencies.

A typical octave band attenuation is given in Figure 2, which shows the active and passive attenuations separately. However, if a system is required without any fibrous material, only the active part of the attenuation will be achieved. Consequently, the duct system must be designed to control higher frequency noise in some other way. This starts with the fan selection and continues through the duct design. Most duct elements have frequency dependent attenuation, increasing with frequency, whilst passive silencers which are designed for effective low frequency attenuation often give considerably more than is required at the higher frequencies. Careful design leads to a situation in which low frequency noise is the major component of unlined systems and this noise is controlled by active attenuation.

Extending the Range of Active Systems

A single input single output (SISO) duct attenuator system assumes uniform pressure distribution across a duct and operates on the plane wave duct mode (0,0), which is uniform across the duct and can be detected and cancelled by transducers at any position on the duct. Figure 3 illustrates lower duct modes, whilst Table 2 shows their cut-on frequencies for a 600 mm x 750 mm duct.

Freq.	227	284	363	453	535	567	610	680	726
Mode	(0,1)	(1,0)	(1,1)	(0,2)	(1,2)	(2,0)	(1,2)	(0,3)	(2,2)

Table 2. Duct mode cut-on frequencies.

In a simple system, which makes use of the physical properties of the duct modes, the (0,0) and (1,0) mode may be separated by sum and difference outputs from two microphones. These are positioned on the nodal plane for the (0,2) mode, in order to exclude this mode, and the required

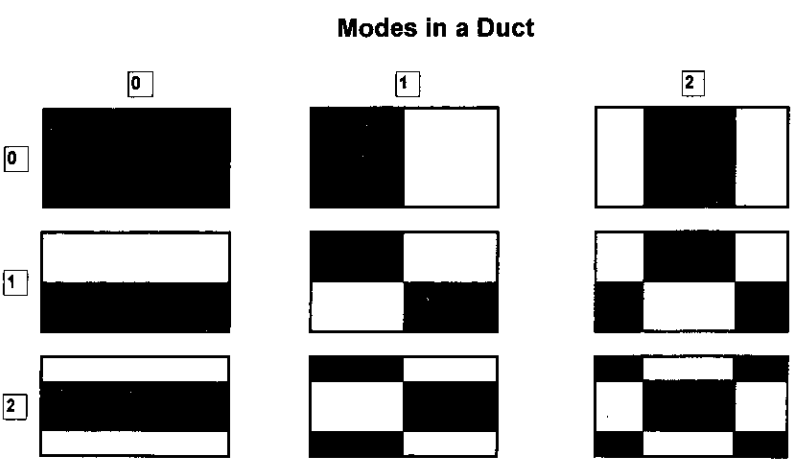
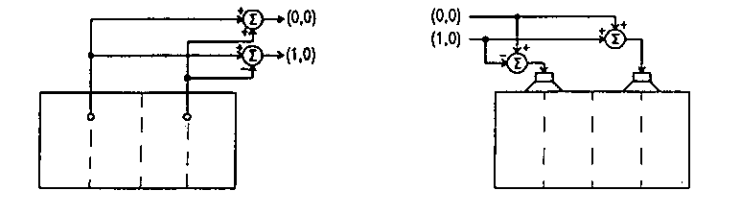


Fig. 3. Illustration of modes in a rectangular duct

cancelling signals are generated as in Figure 4 [5]. This system increases the range of operation above that achieved by a single system.

It is now possible to use more complex multiple duct systems (MIMO, multiple input, multiple output) to attenuate up to several times the frequency previously possible with SISO systems (single input, single output).

The general solution requires a control system with a sufficient number of independent inputs to give an exclusive definition of the primary sound field. This is followed by multichannel processing and independent outputs to uniquely synthesize the cancelling sound field [6]. Current developments in signal processing and computational power are gradually bringing MIMO systems within the reach of general HVAC applications. As these developments progress the use of fibrous attenuators may be reduced, thus responding to the continuing emphases on indoor air quality and energy conservation.



Sensor arrangement and decoupling network to separate the first two modes

Source arrangement and combining network to control the first two modes

Fig. 4. Duct system to control the (0,1) mode

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STADIA DESIGN – SOUND, NOISE AND ACOUSTICS

Jim Griffiths MIOA

Introduction

Since Lord Justice Taylor's report on the Hillsborough stadium disaster and the increased demand to attend many sporting events in comfort and safety, there have been numerous proposals to build state-of-the-art stadia in the UK and overseas. Indeed, the attendance at Premier League football matches has increased by around 13% over the past few years and many clubs have been modernising their existing grounds with some relocating to new purpose built facilities. Along with all the traditional structural, architectural, mechanical and electrical engineering services there is a need for an acoustic consultant to advise the design team on the inter-related sound, noise and acoustic issues which can have fundamental effects on the final design and venue use.

The Acoustics Group of Symonds Travers Morgan has been and is currently working on a number of stadium projects which have required a significant acoustic input at various stages of the design and operation. Two notable projects include the Millennium Stadium, Cardiff Arms Park and the Hong Kong Stadium. The Millennium Stadium is currently being designed by Lobb Partnership, whilst the Hong Kong Stadium was completed in 1994 and has generated significant media coverage over environment noise issues. Both projects are described in this article to outline the various aspects that need to be addressed when dealing with stadium projects.

Millennium Stadium, Cardiff Arms Park

The Millennium Stadium is to be built on the existing National Stadium of Wales site with a completion date of May 1999. The Stadium is to have a capacity of approximately 75,000 spectators with a retractable roof, the first of its kind in the UK.

Symonds Travers Morgan was appointed initially by Cardiff County Council to carry out an environmental noise impact study of the proposal and more recently we have been appointed by the M&E consultants Hoare Lea and Partners to progress the design of the various acoustic aspects.

For environmental noise impact assessments of stadia, the following noise sources need to be considered:

- Construction and demolition
- The events (eg pop concerts)
- The audience
- The public address system
- Mechanical and electrical plant
- Transportation noise

Before progressing the study it is important to obtain a detailed client brief covering all the aforementioned aspects. For example, the client for the Millennium Stadium wanted the venue to have an increased use for pop concerts over that currently permitted (typically two music events per year). For concert activity, we have recommended the use of the Noise Council's Code of Practice for Environmental Noise Control at Concerts. For up to twelve events per year (likely to be suitable for this new venue) the code recommends the music noise ($L_{Aeq,15min}$) not exceeding the background noise (L_{A90}) by more than 15 dB(A) up to 2300 hours. The local authority are seeking to limit the music noise to an increase of 10 dB(A). This is currently under discussion and is being considered by the design team as a desirable design limit with a maximum trigger limit not exceeding the Noise Council guideline. Clearly, in order to assess this and other noise sources, a detailed background noise survey was carried out at various residential and commercial properties surrounding the venue.

Predicting noise levels at a receptor from operational noise sources such as concerts, the audience and public address systems have been developed from data received at other venues such as Wembley Stadium. Concert noise source levels were taken to be 100 dB(A) at 40 metres from the stage (HSE Research Report 35/1991), whereas audience $L_{Aeq,\ 15min}$ levels at 5 metres have been recorded to be between 88 and 95 dB(A) with L_{Amax} levels ranging from 90 to 105 dB(A). The public address system source levels were derived from the system achieving a sound level of 95 dB(A) at the audience, which is likely to provide sufficient direct sound when considering the intelligibility of a sound system with respect to reverberant sound and ambient crowd noise. From the noise source strength of each activity receptor sound levels can be predicted by accounting for directivity, distance and intervening barriers. A model has been developed which has been validated with the current noise levels generated by concerts, audiences etc from the existing stadium.

With the new stadium being enclosed on all sides as compared with the existing venue which has a low uncovered stand to the East, the predicted noise levels are generally lower than these currently experienced irrespective of whether the roof is closed. Reductions of the order of 15 dB(A) are predicted at properties to the East from all three noise sources. Clearly, the detailed design (building fabric, flanking paths) will have a significant bearing on the sound reduction properties of the stadium as discussed later in relation to the acoustic designs element of our commission.

At the planning stage, it is difficult to be precise about the location and type of plant to be used. A performance specification approach has therefore been adopted giving source noise levels at 1 metre that should not be

exceeded as predicted to meet the advice given in BS4142: 1990. The stadium has been divided into zones, and source noise levels varying from 65 dB(A) to 82 dB (A) have been specified for various locations around the perimeter, depending on the proximity of nearby residential premises. The transportation impact is likely to be small as minimal parking has been made available on the site and there are no significant changes to the present road and rail networks.

Clearly, a significant potential impact, albeit of a temporary nature, is that of construction and demolition noise. A separate report has been produced predicting noise levels in accordance with BS5228 for various construction scenarios. As a starting point, the following guidelines (Table 1) have been recommended (which are under discussion with the local authority) in conjunction with a working code of practice which will assist in negotiating Section 61 agreements under the Control of Pollution Act.

Time (T)	0700–1900	1900–2200	2200–0700
$L_{Aeq,T}$	75	65	55

Table 1

The assessment has identified a number of impacts, in particular with respect to the first stage of the works which involves piling to construct a retaining wall on the banks of the River Taff. To assess this impact in more detail, four days of test piling have been completed and detailed noise and vibration measurements have been made. From these tests, an engineering solution coupled with local screening and hours of operation have been recommended to minimise the noise impact. Vibration levels from the piling recorded at sensitive receptors were below the criteria being recommended by BS7385 and BS6472.

Our latest appointment with Hoare Lea and Partners dealing with the acoustic design of the venue has investigated most of these aspects in further detail as well as considering other design parameters. These include:

- Sound system engineering
- Environmental acoustics and envelope sound insulation
- Internal acoustics and sound insulation between internal areas.
- Bowl acoustics
- Mechanical and electrical plant noise

The sound system is currently at the tendering and evaluation stages and has been specified to meet all the relevant standards (BS5839, BS7443, BS5588, BS7827). Furthermore, the system has been developed on the basis of a digitally controlled system in order to afford maximum flexibility for the various types of events proposed at the stadium. The designs are similar to those we adopted for Wembley Stadium, which was a digital control and matrix system using fibre optics at the heart of the communication network. As well as performing the normal safety and event-related announcements, the system has been used by all artistes performing at Wembley to supplement their main sound system. This is a unique feature, and is an option that is proposed for the Millennium sound system as it has advantages in terms of both enhanced sound quality in the bowl as well as reducing noise transmission outside the venue.

In terms of the environmental acoustics the effect of the building design has been investigated against the criteria discussed earlier. The effect of the retractable roof has been evaluated as has the sound insulation properties of various building fabrics, in particular in terms of the roof construction. With the proposed roof detailed (perforated inner aluminium sheet, mineral fibre, 2 layers of fermacell board, thermal insulation and an aluminium outer sheet) for the fixed and retractable elements of the roof, the Noise Council guidelines are likely to be met for most concert events held until 2300 hours (some variations are apparent dependent on stage orientation). With the present designs, other events such as boxing may also be held later into the night with minimal environmental impact providing the roof is fully closed. Discussions are taking place in respect of the flanking transmission via open vomitories and large ventilation fans/ducts which have the potential of significantly reducing the overall sound insulation. This area of concern is being carefully considered by the design team.

The basic acoustical requirements for the various rooms proposed in the stadium have been designed primarily with respect to their function. Acoustic spaces include multi-purpose function rooms, television and radio broadcast suites, executive boxes, plant and equipment rooms, general administration and event-related rooms. Where practicable optimum Reverberation Times have been specified in relation to the size of the room and its intended use. Advice on space planning has been given such that noisy rooms (plant rooms etc) are not located close to acoustically sensitive spaces. Minimum sound insulation properties of 40 dB ($D_{nT,w}$) for general Function Suites to 50 dB ($D_{nT,w}$) for Presentation Suites and 60 dB ($D_{nT,w}$) for Broadcasting Suites have been rec-

Photomontage of the Millenium Stadium, Cardiff

Computer control of Wembley Stadium's sound system during a Rolling Stones concert

ommended with the general guidance on flanking transmission etc.

The bowl design is another area requiring careful consideration with respect to acoustics. The design of acceptable acoustics is important in order for the various types of events to be enhanced by achieving good sound clarity for the audience. This aspect is directly linked to the electro-acoustic element of the sound system design so as to ensure a high direct to reverberant ratio thus assisting in providing good speech intelligibility from announcements.

Clearly the internal acoustics are governed primarily by the size, building fabric and shape of the stadium and are indeed variable in nature when considering the effect of the retractable roof. Traditionally Reverberation Times have been used to assess the internal acoustic environment, but in large spaces, other aspects such as long delayed reflections and local reverberance need to be carefully examined. At present, acoustic treatment is incorporated within the underside of the majority of the fixed and retractable roof. Further treatment is being recommended to the underside of the middle tier seating and other soft areas which although having little effect on the overall Reverberation Times, would improve the 'local' sound quality. An acoustic analysis of the stadium has been completed using EASE software with Reverberation Times ranging from 10, 4.5 and 3 s at low, mid and high frequencies respectively, with the roof closed, to 7, 4 and 3 s with the roof open. Other acoustic parameters are currently being evaluated along with the development of the stadium design.

The aspect of noise from mechanical and electrical plant is being investigated as mentioned earlier for the environment impact stage and when the details of the plant become available. The effect of internal noise from ventilation systems is also being considered with reference to the ventilation system design meeting acceptable internal NR values for each given room function.

Clearly it is hoped that the recommendations with respect to acoustics are fully implemented at the construction stage to avoid potential operational problems as highlighted at the Hong Kong Stadium.

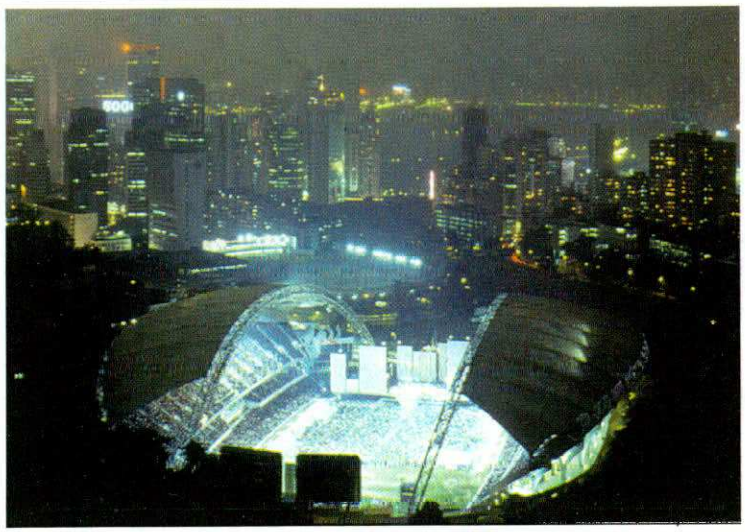
Hong Kong Stadium

The need for the services of an acoustic consultant from an early stage of a stadium project and the need for their advice to be followed are demonstrated by our experiences in Hong Kong.

Our commissioning at the Hong Kong Stadium started several months prior to the opening of the stadium in March 1994. The stadium is located on Hong Kong island in So Kon Po and lies at the bottom of a valley with high rise residential dwellings on top of the surrounding high ground. The intervening area contains dense vegetation with several villages comprising temporary housing. Some of these dwellings are located very close to the venue (within 100 metres) as is a school to the north west and a hospital to the north east.

The stadium has won several architectural awards and, indeed, provides an impressive landmark, in particular at night during an event. The eastern and western sides of the stadium are covered by a Teflon coated roof which although visually impressive, provides very little sound attenuation. The stadium's operators planned to use the venue for a range of sporting events and concerts. However, our environmental assessment showed that at some of the high rise apartments noise levels from concerts would exceed the limit (65 $L_{Aeq,30mins}$) set by the Environmental Protection Department (EPD). High levels, far in excess of the EPD limits, would also be experienced at the temporary housing. These values were predicted after considering the use of stringent noise control techniques including the use of the stadium sound system with the concert system, the use of field delay towers, careful configuration of the concert system, the construction of a noise barrier, sound propagation tests and continuous noise monitoring and control to comply with the limits set by the sound tests.

As predicted, the noise levels from the first four concert events marking the opening of the stadium, exceeded the EPD limit at a number of properties even though the many stringent noise control methods were adopted. Several canto-pop concerts were then held over the following few months with generally lower external levels (mainly due to lower internal levels acceptable for this type of music) which were still exceeding the EPD limits. Given



Pop concert at the Hong Kong Stadium

these breaches, a Noise Abatement Notice was issued by the EPD detailing that all future events are to meet the prescribed limit. Although attempts were made to obtain an exemption for a set number of days, the 65 $L_{Aeq,30min}$ level remained intact and no further concerts were granted.

Further options were considered and detailed tests were carried out on concert systems designed to focus the sound inside the stadium using a number of high Q devices from the stage and distributed arrays. The stage was also located in a different location orientated away from the majority of the nearest residential premises. The tests showed that the EPD limit could be met at all properties although the seating capacity in the stadium needed to be reduced to just over half the full capacity.

Before agreeing to opt for this solution, a trial concert was staged to assess both whether the audience found the sound level and coverage acceptable and whether the EPD limit could be met in a 'live' situation. The social survey indicated that the majority of the audience were satisfied and indeed the music noise met the EPD limits. However, the noise from the crowd with the music exceeded the limit and a lengthy debate ensured as to whether crowd noise should be included in the assessment. Issuing the audience with gloves was one suggestion!

Having exhausted all acoustic options over a period of a year, the laws of physics with the current stadium design and local considerations has meant that the situation has yet to be resolved. This catalogue of events demonstrates yet again the importance of taking acoustic aspects into consideration, alongside all other engineering issues, at the earliest possible stage in the design process. The laws of physics can then be used for, rather than against, us.

Jim Griffiths MIOA is Director of Acoustics with Symonds Travers Morgan, Symonds House, Wood Street, East Grinstead, West Sussex. Symonds Travers Morgan is a member of the Association of Noise Consultants. ❖

THE INSTITUTE DIPLOMA EXAMINATION 1996

Dr J M Bowsher HonFIOA

The numbers of candidates gaining Merits, Passes or Fails in each Module are shown for each Centre in the Table of Results. The total number of candidates was 194 (curiously, the same number as last year) and the overall pass rate 84.4% (83.9% last year), including all projects. Candidates who were registered to undertake the investigative project this year but who did not submit their project report by the set date are shown in the table to have failed.

The administration proceeded reasonably smoothly this year; there were some very minor problems connected with the high number of examination centres used by Distance Learning candidates and with very late submission of marks from some centres. Once again, both I and Jeff Charles, the Deputy Chief Examiner, would like to thank Linda and Kate in the office for their hard work in processing all the correspondence from centres and for checking every script for arithmetical and other errors in marking. Special congratulations are due to Kate for working so efficiently so soon after the birth of her daughter. The written paper moderating session in August went smoothly, with no cases demanding difficult decisions.

In the 1996 Diploma, the first run of the new Syllabus, the General Principles of Acoustics Module was as usual assessed partly by course work. Laboratory reports and assignments set throughout the year were graded and contributed 20% of the total mark. The overall practical effect was to raise the mean mark on the paper by 1.75% and reduce the standard deviation of the marks from 21.3 to 12.4. Although the coursework formed a 'hurdle', no candidates failed the whole paper for this reason, though one had to 'scrape in under the wire'.

A feature of the 1996 results is the very good performances of the Distance Learning candidates overall, and of those from Colchester Institute in the GPA module. A matter of concern, though, was the lack of GPA questions from centres. Normally the paper is made up from suggestions by Tutors all over the country, but this year not one was forthcoming.

The Institute awards a Prize to the candidate who performs best in the examinations in any one year. The minimum criterion for the Prize is that the candidate should have obtained three merits in the written papers and at least passed in the project. This year, two candidates fulfilled this criterion, and one of them was quite outstandingly good. Thus, I had no hesitation in awarding the Prize to Ms Clare Wildfire and Specially Commending Mr Martin Longhurst.

New appeal procedures were instituted by the Education Committee in 1995. Conclusions should not be drawn from the very small number statistics which apply here, but the number of appeals this year was 4 (all relating to the Law and Administration paper); it was two last year.

	General Principles of Acoustics			Architectural and Building Acoustics			Law and Administration			Measurement			Noise Control Engineering			Sound Reproduction			Transportation Noise			Vibration Control			Project			Overall		
	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail
Bristol	0	1	1	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	2	0	7	3
Colchester	8	9	0	0	0	0	1	10	1	0	0	0	4	11	3	0	0	0	0	0	0	2	3	1	3	13	3	18	46	8
Derby	2	26	2	1	2	0	1	13	6	0	0	0	2	15	4	0	0	0	2	19	2	0	0	0	6	23	4	14	98	18
Heriot-Watt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Leeds	0	10	0	1	0	0	0	9	2	0	0	0	0	10	1	0	0	0	0	0	0	0	0	0	2	7	3	3	36	6
NESCOT	1	23	0	2	5	3	1	11	3	0	0	0	2	13	2	0	0	0	1	13	0	0	0	0	2	23	10	9	88	18
Newcastle	0	0	0	0	0	0	2	5	0	0	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0	7	0	6	15	0
Sheffield	0	4	0	1	2	1	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	1	2	1	3	11	3
South Bank	3	11	3	0	8	1	0	13	2	0	0	0	0	0	1	1	2	0	1	10	1	0	0	0	3	10	8	8	54	16
Ulster	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0
Distance Learning	3	22	3	2	5	4	0	10	4	2	4	0	4	17	4	0	0	0	0	11	1	1	3	0	7	16	8	19	88	24
Totals	17	106	9	7	24	9	5	74	18	2	4	0	17	73	16	1	2	0	4	53	4	3	6	1	24	104	40	80	446	97

Diploma in Acoustics and Noise Control
Grades awarded to 1996 candidates from each centre

1996 Diploma Pass List

Tutored Distance Learning
Aazem, J
Allen, L
Boughton, P W
Cassidy, P R
Collins, R
Ellis, L A
Henderson, A M
Hilton, J L
Jefferies, A J
Mason, P R
Parkinson, C M
Pennington, A
Richardson, T M
Schofield, J
Shutt, M W A
Simpson, P C
Smith, A H
Taylor, R A
Thomas, S J
Watts, G W
Wheeler, H C
White, A
Wildfire, C E

Bristol
Long, A
Powell, A

Colchester
Baker, S M
Barber, J
Bentley, C F
Blazer, D H
Bowles, A P
Carter, D J
Fosker, J A
Fox, S M
Gilbert, C G
Howes, G P
Longhurst, M J
Marshall, P A
McCrory, J F
O'Donnell, Y M
Sharp, P J
Thresh, Y

Derby
Adams, B
Blundell, L C
Callingham, A J
Cannon, A J
Croxford, M
Dodd, A P
Durrant, K M
Grocott, G S
Haynes, W E
Johnson, D C
Langley, E J
Macken, G
Moore, S J
Morgan, B C
Mumford, A E
Pulford, R J
Rathbone, I C
Richards, C G
Robinson, A C
Rooney, P D
Scott, N
Simmons, A J
Simpson, T R
Smith, C L
Thiara, J
Wilde, R J

Leeds
Bilton, D J
Butcher, A T
Collinson, E R
Cowell, H
Crowther, R
Oakley, S
Walker, J F
Wragg, Z A

NESCOT
Birkett, G P
Bland, J D
Carpenter, T C
Dawson, G M
Elliott, A C
Ellis, J P
Gibson, A R
Hunt, P S
Ingram, Z
Jefferson, K
Jones, S L
Leonard, P A
Lomax, J B G
Maidment, R J
McEvoy, R P
New, M T
Newman, S L
Peters, H M
Rangecroft, L A
Sagoo, H A
Scrivener, R M
Smith, A
Williams, J A
Wood, C R

Newcastle
Foster, E T
Gribben, D
Holman, D L
McClen, F M
Randles, T J
Rudman, E C
Shaw, S A

Sheffield
Gascoigne, C M
Gray, I T
Whitehouse, N

South Bank
Aitchison, M J
Andrews, G C
Darius, O E
Divall, K G
Dunne, S
Lord, R M
McCarthy, G A
Mutimer, K
Newman, J
O'Hare, H
Rougier, F M
Stokes, D J
Watson, P

Ulster
Martin, D
McLaughlin, D P
Nugent, C

Diploma in Acoustics and Noise Control

Tutored Distance Learning

This mode of study is primarily intended for students who have difficulty attending a conventional course. The tuition pattern involves the programmed distribution of written material and exercises supported by a schedule of tutorial contacts and laboratory work. In addition candidates have to complete an investigative project.

Face-to-face tutorial arrangements are normally based on regular meetings in small groups with an approved tutor. Because of the variable travelling distances involved, these are arranged at several centres.

Tutorial groups start their studies on various dates between April and October as and when a number of students in that geographical area obtain clearance from their employer. All groups prepare for the Institute examinations in the June of the following year.

The normal minimum requirement for admission to the Distance Learning Course is a degree in a science, engineering or construction-related subject or an Environmental Health Officer's Diploma.

Students electing to follow this method of teaching face the same examination and course work requirements for the award of the Diploma as those studying by the conventional route which is offered, subject to demand, at eight Accredited Centres in the UK.

The award of the Diploma immediately satisfies the requirements for election to the non-corporate grade of Associate Member of the Institute, conferring the use of the designatory letters AMIOA. It also satisfies the academic requirements for Corporate Membership of the Institute. Election to the grade of Member (MIOA) involves in addition the fulfilment of certain experience requirements which usually amount to three or more years spent in a responsible role in a position directly related to acoustics, vibration or noise control.

THE INSTITUTE'S NEW TEACHING LABORATORY

The Institute now has a teaching laboratory suitably equipped for the major part of the laboratory programme for the Institute's Diploma in Acoustics and Noise Control. It has been set up in an annexe building to the Institute's offices at 5 Holywell Hill that became unexpectedly available, using instruments donated by companies, particularly Brüel & Kjær UK, British Telecom and Symonds Group. Some equipment was also acquired by scouring the country for sales organisations offering outdated equipment but still perfectly usable for educational purposes.

The primary reason for establishing the new laboratory is to enable practical teaching to be given to students on the Tutored Distance Learning Diploma Programme on a flexible schedule that suits their various other committments. It has proved to be an excellent opportunity to offer these students exercises specifically designed to suit their particular requirements.

Starting on January 10th of this year, students in groups of up to ten, attended one of four intensive laboratory/tutorial courses held on succesive weekends, starting on the Friday evening and continuing to Sunday afternoon.

This experience will be complemented by a day spent at one of the research laboratories to use the special chambers.

This development is part of an on-going exercise to

increase the services offered to members. As an example a vibrating table carrying a chair and desk is under development, so that consultants and others can bring their clients to the laboratory to feel what a certain level of building vibration feels like.

Short courses that could beneficially include a practical element are currently under development. ❖

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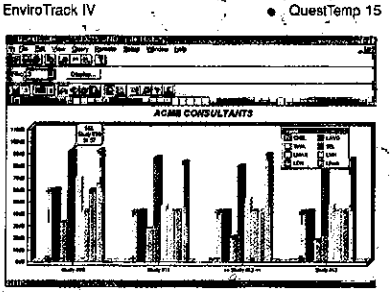

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ONE YEAR IN

Mike Heath

The new Engineering Council was formed on New Year's Day 1996, so the beginning of another new year is an appropriate time to review progress. And I believe there is much progress to report. We set out with a number of clear aims. They included a more effective promotion of the profession and also a raising of standards to stay world class.

On the promotional side, we were convinced that registered engineers wanted us to stimulate a greater appreciation of engineers and engineering. They wanted us to set about changing the national culture. It meant engaging the interest of the public to appreciate the tremendous achievements being made regularly by Britain's engineers. It also meant seeking Government and Whitehall recognition of the key contribution engineers make to the national economy, wealth creation and problem solving. This in turn would lead to attracting more of our bright young people into the profession.

On the regulatory side, it meant leaving much more of the mechanics of registration to licensed Institutions. It also meant a root and branch revision of the 'bible' on national registration as an engineer, known as 'Standards and Routes to Registration' or SARTOR. Like painting the Forth Bridge, this subsequently has to become a continuous process.

But you cannot effectively promote something on which there is not some basis of agreement and equally you cannot regulate a profession (in a non-statutory sense) unless the leaders of the profession are broadly content to be bound by such regulation. Public disagreements are seen by Government and public as evidence that the engineering profession has yet to be ranked with the other great professions in national esteem. We have in the past 'shot ourselves in the foot' in this way.

So we began with the basic premise at the heart of the unification process: that the Engineering Council would operate in partnership with the engineering Institutions. We have to remember that unification was preceded by fifteen years of at best non-cooperation and at worst antagonism between the Institutions and the Engineering Council, so partnership did not come naturally.

We have therefore worked hard at the mechanisms to make it a reality. First, we have had the Senate and the two Boards, BEP and BER. They include Senators elected by Institution Councils as well as directly by registrants. There are also six Senators nominated by the Privy Council to give the Government a stake in the process. A great deal of work has been put in to ensure that this mechanism works well. It may need further refinement but is now quite well established.

But although the Institution Council elected Senators may have the interests of their own Institutions at heart and can be lobbied and briefed by them, they do not, in any formal sense, represent them. They are not delegates. So the system of Senate and Boards is not in itself sufficient.

We therefore set up a system of what we called Institution Working Groups (IWGs) to address major issues. Their findings result in reports or papers to be taken by the Boards/Senate and later by Institution Councils where necessary. The IWG outcomes are not themselves inter-Institution agreements but make it more likely that proposals will subsequently find favour with Institution Councils.

Additionally, the 20/20 Vision Initiative has brought together the Institutions to contribute to the national debate in four key areas: communications, energy, environment and transport.

None of this replaces another vital mechanism which is the co-operation and personal contact between key members of staff of Institutions and the Council. I believe this has been genuinely transformed and now provides a platform on which we can move forward confidently. Much of the contact is informal but we now, for example, regularly see an Institution taking on the task of co-ordinating a profession-wide response to a Government consultation document. As a result of the co-ordinated response, the Government pays much greater attention to what is said.

Much of this is enabling and readers may be thinking that it is all talk. There has indeed been a lot of talk and not a little disagreement about the way ahead. I would argue, however, that the greatest weakness of the profession in the past has not been too much talk but too little. Communication is the weakest skill in most human beings and it is not one for which engineers are renowned. So we have to work harder at it.

But the first year has not been all talk. The profession has played a full part in the Government initiative 'Action for Engineering' and retained substantial responsibilities for implementation. We now find a ready audience in Government who have asked us to take the lead in setting up a national grouping of engineering bodies. We aim to play a larger part in the now well-established annual Science, Engineering and Technology (SET) Week. We are discussing a draft Memorandum of Understanding between the Government and the Council. We have also held discussions with all the major political parties.

Internally, we are well on the way to a resolution of the old duplication between the Council and the Institutions at regional level through the new PEIs. This has brought unification to the regions to mirror that in the centre although it will inevitably take some months to settle down. Much useful work has also been done on a new version of SARTOR. We should not underestimate the challenge of resolving the difficulties associated with this but they are certainly now better understood. And we have worked to make 'Engineering First' a better vehicle for communicating with registered engineers.

The Public Affairs staffs of the Council and Institutions now regularly meet and, instead of aiming only to promote their own organisations, now look to promote the profession in a wider sense. A Public Affairs Task Group of the BEP has been formed to enable Senators to advise directly on our strategy. On many occasions during the

CALL FOR PAPERS

1997 Institute AGM

and

One-day Meeting

The Management of Sound from Public Houses, Clubs and Other Indoor Venues

(Organised by the London Branch)

Tuesday 20 May 1997

Church House, Westminster, London

The control of noise from pop concerts has been generally addressed by the Noise Council's Code of Practice on Environmental Noise Control at Concerts. However, the succcessful management of sound from public houses, clubs and other indoor venues which are not covered by the Code, is still under debate. Mindful of the seemingly insatiable demand for amplified music at these types of venues, this one-day meeting has been arranged to explore a number of issues relevant to both environmental and occupational aspects

Papers are invited with both enforcement and operational perspectives, covering any of the following or other areas appropriate to this subject:

- Applicable criteria (including inaudibility)
- The design and realisation of sound insulation measures
- The design and use of sound level control devices
- Relevant legal judgements
- Problems specific to low frequency noise
- Successful (and less successful) noise control schemes

Intending contributors should send their abstract to the meeting organiser as soon as possible, but no later than 3 March 1997. Successful authors will be notified by 21 March and the papers to be presented will be published in .Volume 19 of the Proceedings of the Institute of Acoustics (1997). For this purpose, completed 8 page manuscripts must be submitted in camera-ready form, using the special paper provided, by 1 May 1997 at the very latest.

Meeting Organiser:

Jim Griffiths MIOA, Symonds Travers Morgan, Symonds House, Wood Street, East Grinstead, West Sussex RH19 1UU.
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JGRIFFIT@STMGROUP.MHS.COMPUSERVE.COM

CALL FOR PAPERS

1997 Autumn Conference

Codes of Practice

(their use and abuse in noise or vibration assessment)

27 – 30 November 1997

Hydro Hotel, Windermere

The 1997 Autumn Conference will be organised by the Environmental Noise Group of the Institute of Acoustics. Included in Codes of Practice will be standards which provide a basis for assessing certain types of environmental noise and vibration. Ideally we would like to examine at the conference every code that exists and try to examine:

- Whether it is used at all;
- How it is used;
- Does it need updating /re-writing?
- The question of formal adoption under Section 71 of the Control of Pollution Act 1974

If you have ever used, or even considered using, a code of practice in a noise or vibration assessment, you will be able to make a valued contribution to this conference. The sessions will be a mixture of formal presentations and workshops.

So, make a note of the dates in your diary now, and start thinking about what code of practice you will be speaking on.

Conference Programme Chairman:
Stephen Turner FIOA
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Manfred Heckl Memorial Meeting

Institut für Technische Akustik, Technische Universität Berlin

Friday 6 June 1997

(Organisers: Dr Maria A Heckl, Prof Michael Möser and Dr Joachim Scheuren)

A full one-day programme of technical contributions and tributes has been arranged. There is no fee for attending the meeting. For a full programme and accommodation information, please contact the Institute of Acoustics.

FIRST ANNOUNCEMENT

One-Day Meeting

IEC 1672

the new

International Standard for Sound Level Meters

(Organised by the IOA Measurement and Instrumentation Group)

Wednesday 25 June 1997

The Royal Society, London

The last twenty years have seen significant changes in the design and features of sound level meters. These changes have prompted the International Electrotechnical Commission to set up a Working Group, IEC/TC29/WG4, to prepare a new International Standard, IEC 1672, covering both integrating and non-integrating sound level meters. The Draft Standard should be circulated for public comment early in 1997, and this meeting has been arranged to discuss the specifications within the new Standard, and the implications for all users of sound level meters.

Topics to be discussed include:

Purpose and scope of the new Standard
Microphone requirements
Acoustical frequency responses and accuracies
Steady and transient measurement capabilities
Electromagnetic compatibility
Effects of environmental changes
Tests to show that meters meet the new Standard
The importance of measurement uncertainty during testing
The role of the sound calibrator
Implications and implementation time scales

Contributions have been invited from the following, many of whom are responsible for the content of the Standard:

Alan Marsh, Convenor of IEC/TC29.WG4,USA: Gaston Banget-Mossaz, LNE, France: Ole-Herman Bjor, Norsonic, Norway: Susan Dowson, National Physical Laboratory, UK: Peter Hedegaard, Brüel & Kjær Denmark: John Kuehn, Convenor of IEC/TC29. WG17, UK: Gunnar Rasmussen, GRAS Denmark: Richard Tyler, CEL Instruments, UK

Certificates of attendance for CPD purposes will be available to delegates.

Request for further information: IEC 1672

Please send me further information on the programme as it becomes available

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INSTITUTE DIARY 1997

20 FEB
London Branch 1/2 day Visit to BRE
Watford

24 FEB
Eastern Branch Evening Mtg Auditorium Design
Braintree

27 FEB
IOA Medals & Awards Engineering Division, Council
St Albans

28 FEB
IOA CPD Committee
St Albans

1/2 MAR
Acoustics for Sound System Engineers: Course
St Albans

3 MAR
Acoustics Bulletin Copy Date (March/April)

5 MAR
Midlands Branch Evening Mtg Timber in Acoustics
Birmingham

7 MAR
IOA CofC in W'place Noise Ass't Advisory Committee
St Albans

7 MAR
IOA Acoustics Bulletin Management Board
St Albans

18 MAR
Noise Impact Assessment Working Party
St Albans

19 MAR
London Branch Evening Mtg Noise and Environmental Health
St Albans

19 MAR
Eastern Branch Evening Mtg Live Entertainment Noise
Ipswich

24 MAR
Underwater Acoustics Group AGM
London

24-27 MAR
Joint IOA/IOP Physical Acoustics Group Conference
Leeds

7 APR
Building Acoustics Group Workshop
TBA

9 APR
IOA Environmental Noise Group Committee
St Albans

10 APR
Yorks & Humberside Branch Evening Mtg Computer-based Instrumentation
TBA

10 APR
IOA Diploma Board of Examiners
St Albans

11 APR
IOA I & M Group Committee
St Albans

16 APR
London Branch Evening Mtg Intelligibility/Safety
London

16 APR
Environmental Noise Group 1/2 day Workshop Entertainment Noise
Glasgow

19 APR
Eastern Branch Dinner
TBA

24 APR
IOA Publications, Meetings Committee
St Albans

1 MAY
North West Branch Joint Mtg with UKELA
TBA

1 MAY
IOA Membership, Education Committee
St Albans

1 MAY
Acoustics Bulletin Copy Date (May/June)

15 MAY
IOA Medals & Awards, Council
St Albans

16 MAY
IOA CofC in W'place Noise Exam
Accredited Centres

20 MAY
One-day Meeting: Sound from Pubs & Clubs etc and 1997 Institute AGM
London

22-24 MAY
Conference: Auditorium Design at the Millenium
Belfast

22 MAY
Eastern Branch Evening Mtg Natural Noise Control
TBA

6 JUN
IOA CofC in Env Noise M'ment exam
Accredited Centres

13 JUN
IOA CofC in W'place Noise Ass't Advisory Committee
St Albans

18 JUN
Midlands Branch Evening Mtg
TBA

19/20 JUN
IOA Diploma Exams
Accredited Centres

25 JUN
I & M Group One-day Mtg IEC 1672
London

1 JUL
Acoustics Bulletin Copy Date (July/August)

2 JUL
IOA Electroacoustics Group Mtg
London

10 JUL
IOA CofC in Environmental Noise M'ment Advisory Committee
St Albans

19/22 AUG
ISMA '97 International Symposium on Musical Acoustics
Edinburgh

2 SEP
Acoustics Bulletin Copy Date (September/October)

9 SEP
Midlands Branch Evening Mtg
TBA

18 SEP
IOA Publications, Meetings Committee
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25 SEP
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St Albans

2 OCT
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St Albans

10 OCT
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Accredited Centres

23-26 OCT
Conference: Reproduced Sound 13
Windermere

31 OCT
IOA CofC in Env Noise M'ment exam
Accredited Centres

1 NOV
Acoustics Bulletin Copy Date (Nov/December)

7 NOV
IOA CofC in W'place Noise Ass't Advisory Committee
St Albans

12 NOV
Midlands Branch Evening Mtg
TBA

13 NOV
IOA Publications, Meetings Committee
St Albans

27-30 NOV
Autumn Conference: Codes of Practice
Windermere

4 DEC
IOA Membership, Education Committee
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5 DEC
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11 DEC
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past twelve months, when engineering has been brought to the attention of the public, the unseen hand of Institutions and Council has been behind it. That will increasingly be the case.

The Council, helped in most cases by Institutions, has played a direct promotional role in running the Young Engineer for Britain Competition, the national Environment Award for Engineers, the Neighbourhood Engineers scheme and the Women Into Science and Engineering (WISE) campaign. The Council and a number of Institutions now have an important presence on the Internet. Potentially more important, however, have been our growing links with the media and other organisations with an interest in engineering. We are all putting our shoulder behind the Year of Engineering Success which we trust is going to be an outstanding success.

This year, among many other initiatives, we will see important development work on SARTOR heading towards completion. We will also see a major drive to communicate more effectively with industry. I see these as our next key priorities. There is a great deal of work still to be done. By itself, the Engineering Council would have neither the resources nor the credibility to carry it out. In partnership with the engineering Institutions, however, and given the enthusiastic and willing support of registered engineers throughout the nation, we will surely be able to make 1997 a landmark year in the history of the engineering profession in Britain.

Mike Heath is Director General of the Engineering Council ❖

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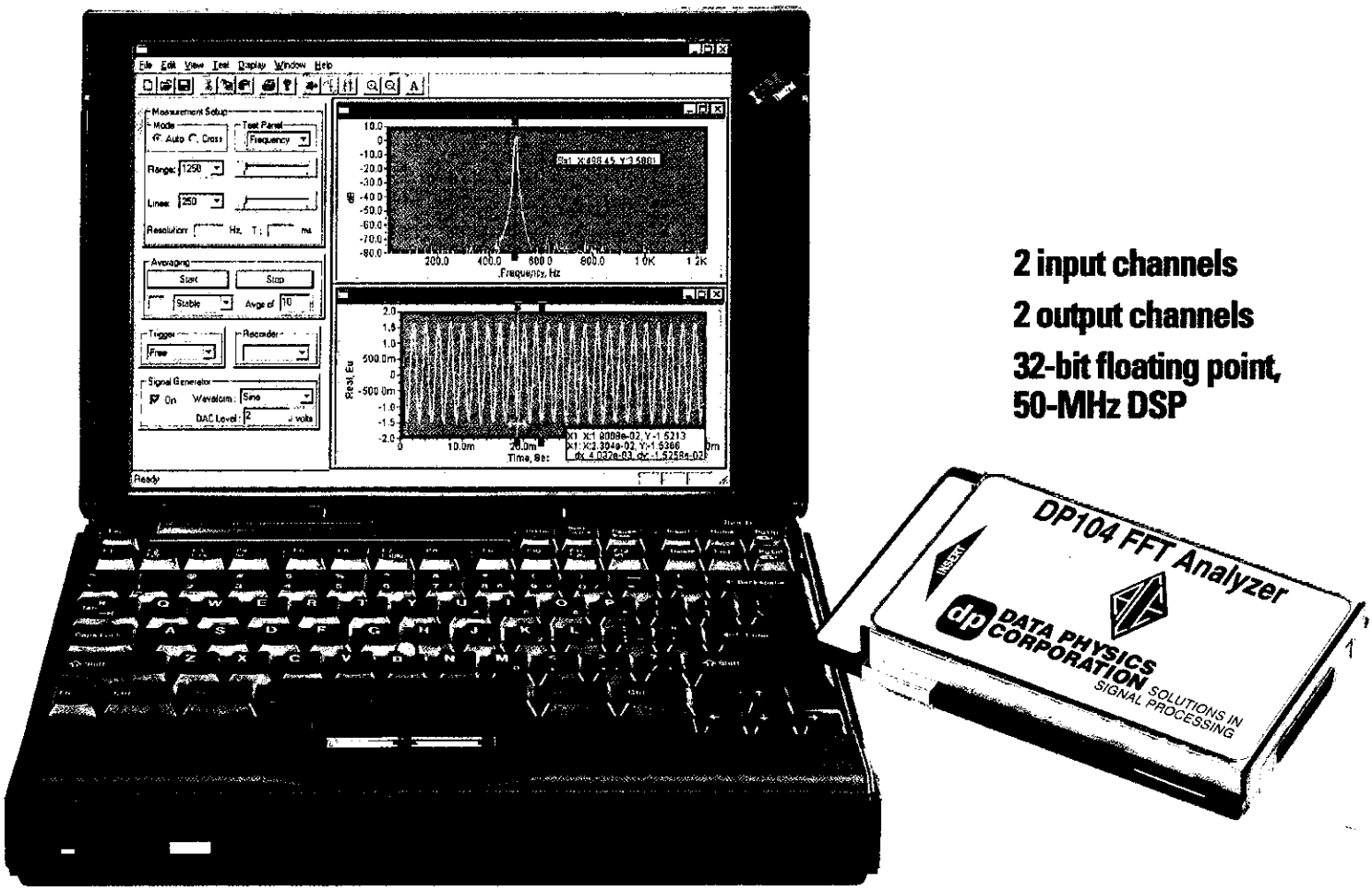

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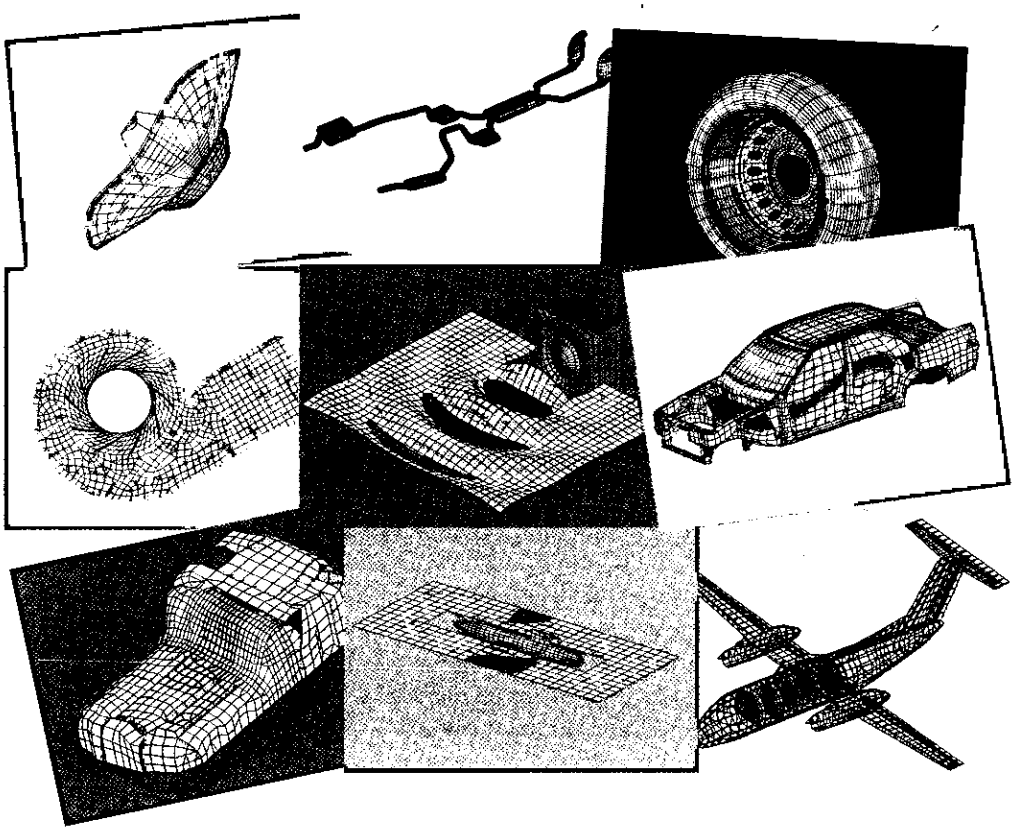

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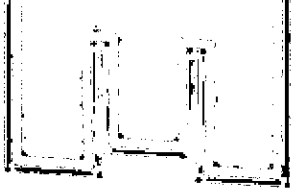

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SPEECH & HEARING, 1996 AUTUMN CONFERENCE

Hydro Hotel, Windermere, 21 – 24 November 1996

The 1996 Autumn Conference on 'Speech and Hearing' was held at the Hydro Hotel, Windermere from 21 – 24 November. Since the Speech Group was formed in 1976 this is the twelfth occasion at which a session or a whole meeting has been devoted to speech topics at an IOA Conference, and the seventh time at Windermere.

The conference followed the now established pattern of oral and poster sessions but this time each oral session began with an invited speaker giving a 30 minute keynote lecture on the latest developments in his field. This innovation was judged to be a success.

The first session on Auditory Scene Analysis was chaired by Bill Ainsworth and began with a keynote lecture by Martin Cooke from Sheffield University on 'Auditory organisation and speech perception: inseparable processes?'. This was followed by 'Expanded signal representations for auditory scene analysis' by Georg Meyer (Keele University) and 'A blackboard model of auditory organisation' by Daryl Godsmark and Guy Brown (Sheffield University). The session concluded with 'A sound separation system for the hearing impaired' by Philip Denbigh from Sussex University which included a convincing demonstration.

After coffee nine posters on Speech Synthesis and Perception were presented: 'Recurrent networks for English text-to-phoneme conversion' by R I Damper and M J Adamson (Southampton University), 'Improving text-to-speech naturalness', by M Tatham (Essex University) and E Lewis (Bristol University), 'Natural voice output in interactive information systems', K Morton and M Tatham (Essex University), 'A parallel formant synthesis approach to speech coding', by D F Marston, C I Parris, G D Tattersall and D Y-K Wong (Ensigma Ltd), 'The identification of gender from synthetic speech' by S P Whiteside and J Goodall (Sheffield University), 'Perceptual tolerance of the shape of formant transitions', by W A Ainsworth (Keele University), 'The influence of speaker normalisation on vowel identification in natural speech', by S K Boegli and A J Watkins (Reading University), 'A blackboard model of auditory organisation II: timbral similarity', by D Godsmark and G J Brown (Sheffield University), and 'Phase interpolation methods for pitch and time-scale modification of voiced speech', M P Pollard, B M G Cheetham, C C Goodyear (Liverpool University) and M D Edgington (BT Laboratories).

Following the usual substantial lunch Steve Cox chaired a session on Speaker and Language Identification. The keynote lecture was given by Mike Carey (Ensigma Ltd) on 'Speaker verification'.

The biggest application area for speaker identification is in the field of security systems: where an individual's identity is verified according to the patterns of his speech. To avoid the problems of imposters with tape recorders, the text has to be changed for each verification which makes the problem different to just matching the spectral content of the signal. For telephone quality speech and with up to 10s of signal, current systems seem to have error rates of about 5% misses and 5% false alarms among a test set of 40 speakers. Mike spoke about the favoured technique of Gaussian modelling which uses the distribution characteristics of short time spectral properties of the signal. Typically the frequency distribution of any single parameter is modelled by a mixture of Gaussian density functions; amazingly up to 1000 mixtures are used! Clearly uncontrolled changes in the signal quality affect the performance of such systems and Mark Pawlewski (BT) showed how different types of channel normalisation improved the performance of his system. Eluned Parris and Harvey Lloyd Thomas (Ensigma) spoke of a related problem: how to identify in which language a piece of speech is spoken. This has applications for the automation of international telephone services – to direct a speaker automatically to an operator of the appropriate language for example. When questioned why people weren't asked to speak the name of their language, Mrs Parris replied 'but what language would you ask them in?'

Papers in a related session on speech analysis and processing demonstrated a wide range of techniques of modern mathematical signal processing (higher order spectra, Bayesian noise models, Hilbert transforms) combined with the methods of experimental phonetics: including electropalatography (detection of tongue contact with the palate using an electrical plate), magnetic resonance imaging (MRI) of the vocal tract and inverse filtering of the larynx vibration signal from the radiated sound. The advanced techniques tend to show small enhancements for say fundamental frequency analysis or formant analysis, but on the whole tend to confirm that the conventional methods work pretty well.

So much effort has been put into exploring algorithms for speech signal analysis that it gets harder to find methods that give dramatic improvements. Residual problems are often due to the inadequacy of our model of the speech signal in the first place. To gauge alternative approaches effectively it is also necessary to have some standardised material and implementations of standard algorithms. Eric Mousset (Keele) started on this path with a comparison between a number of pitch detection algorithms on an emerging standard corpus of reference data. An interesting novelty was shown by G Cawley (UEA) whereby a vector quantisation (VQ) codebook is re-assigned and reordered to minimise the spectral distortion caused by transmission errors of the binary VQ codes. Christine Shadle (Southampton) displayed some beautiful MRI images of fricative production; the imaged

articulation of the tongue position had clear differences depending on the quality of the surrounding vowel. This so-called coarticulatory phenomenon was visible even though the fricative had to be held for several seconds to get the picture. The hope is to get enough detail from the picture to make a volumetric analysis of the articulated tract.

On Saturday morning in the session on Speech Recognition chaired by Laurie Moye, Martin Russell (DRA Malvern), in a lucid keynote talk, highlighted the dramatic drop in performance when state-of the-art recognisers are applied to natural, informal speech rather than read speech. He argued persuasively that what is missing is an ability to 'model the underlying mechanisms, rather than the surface manifestations', to make it possible to adapt to new speaking conditions. However, it is necessary to formulate such models by extensions of the established statistical recognition framework, based on Hidden Markov Models, rather than begin afresh.

There were several reports with this theme. Wiewiorka and Brookes (Imperial) presented a study of 'Exponential HMMs', in which 'the output distribution parameters follow negative exponential paths within each state. This is one way of addressing the limitation of conventional HMMs that successive observations associated with the same state are assumed to be uncorrelated. Wendy Holmes and Martin Russell have been working for some time on a related approach to the same problem. In their 'segmental HMMs', the observations in each state are associated with a trajectory rather than taken independently. Ben Milner (BT) introduced a scheme for associating temporal information into HMM state distribution modelling based on Cepstral-Time Matrices. He generalised this idea to experiment with several temporal transforms on a time-matrix of cepstral coefficients. All these studies show modest improvements in recognition rate, albeit only in some conditions and only on small-scale problems. They also demonstrate that extensions of HMM theory are not easy to accomplish without sacrificing some of the mathematical robustness of the technique.

In other oral presentations, John and Wendy Holmes demonstrated modest improvements in digit recognition by adding formant frequencies to the observation vector. The formant information was extracted in a novel way, by emulating human expertise in this task. The idea is to find the closest match of the data for a frame in a representative set of spectra for which the expert has provided formant labels. Steve Cox (UEA) presented a technique for recogniser assessment which uses the performance of human listeners as a reference standard. By how much do you have to degrade the speech until human performance matches that of a recogniser? The preferred speech distortion method is time-frequency modulation. In contrast, Catherine Brown (DRA) reported encouraging results from a study in which speech recognition was used in pronunciation learning by children.

In the poster session, Simon Downey (BT) presented work on recognition in noise, based on adapting speech models to the noisy environment. He showed that adaptation based on Wiener filtering dramatically improves the match between HMM state distributions trained on clean speech and distributions for noisy speech. In the only paper concerned with language modelling rather than acoustic modelling, Ian Gransden (DRA and Forum) reported on the use of long-context language models in re-scoring word lattices.

Flesch and Brookes (Imperial) tackle speaker adaptation by optimising their filter bank to an individual speaker. The optimisation is based on minimising the errors in a phoneme classification task. Suwastio et al (Plymouth) use HMMs to distinguish between the same word spoken as an adjective a noun or a verb (eg pErfect, peRFEct, perfECt). This works well, but how it might be extended outside the words in the corpus used is unclear. The paper is also remarkable for its results section, which includes more than 250 numbers and no graphs. Bill McKee (Plymouth) is developing an HMM adaptation technique he calls 'Optimal Feasible HMMs', which he claims can be 'globally-optimal with respect to the training data'.

Sunday morning began with a session on Phonetics and Aids for the Handicapped comprising the following posters: 'Speech intelligibility in classrooms' by R Craik, D J Mackenzie and S Airey (Heriot-Watt University), 'Visualising trajectories in phonetic space with self-learning maps', by A Hatzis, P D Green and S Howard (Sheffield University), 'WINDMILL – the use of a parsing algorithm to produce predictions for disabled people' by M E J Wood and E Lewis (Bristol University), 'An acoustic study of phonation in apraxia', by S P Whiteside and R Varley (Sheffield University), 'Analysing alternative pro-

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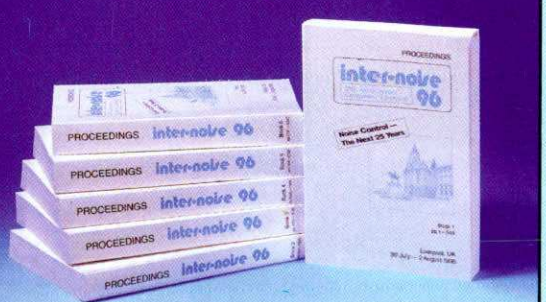

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nunciations to improve dictionary baseforms (or why people are not ideal sources for recording a speech database)', by S Downey (BT Laboratories), 'Investigating syntax-prosody relationships with the PROSICE corpus' by M Huckvale and A C Fang (University College London), 'Who needs phoneticians? Phoneme transcription for speech recognition vocabularies' by C Cheepen (Surrey University), N M Fraser and B Salmon (Vocalis Ltd), 'Singing pitch errors in children aged 7 to 11' by J A S Angus and D M Howard (York University), 'Managing inequality in dialogue: phonological signalling in interviews' by J Monaghan (Hertfordshire University) and C Cheepen (Surrey University) and 'Articulatory phonology, task dynamics and computational adequacy' by M Tatham (Essex University).

The keynote lecture of the Sunday morning session on Telephone Applications, chaired by Mark Tatham, was given by Denis Johnston from BT Labs. Its title was 'From phonemes to 'phones: applying speech recognition to telephone networks'. First he gave us some facts about the telephone, explained its structure and how it works. The main problem concerning both speech and telephone is a high level of variability, in the case of the telephone caused by a large number of different lines and coding systems. Non-linearities and distortions are either due to the telephone set itself, if, eg a carbon microphone is used, or due to the telephone link (network) which is responsible for the echo effects, acoustic leakage, analogue-to-digital conversion and signal compression. Moving from an analogue to a digital network reduced the error rate for speech recognition by 50%, but the talker still needs to speak clearly and correctly. Also using shorter telephone lines improves the results.

Johnston described some applications which make use of speech recognition over the telephone network in this country, such as the speaker-dependent ones: a speech controlled adventure game 'Penny Green' (1985) or repertory dialling using cellular phones fitted in a car (1986) and the speaker-independent ones: CallMinder – an answering machine in the network currently used by 600,000 customers (1994) or Brimstone – telephone enquiry system (1996). Telephone-based applications can find further use in such areas as operator assistance, spoken e-mail, repertory dialling, information services. Johnston concluded saying that telephone-based speech recognition was starting to become more and more widespread.

The following talk in this session was given by Peter Nowell from the DRA and was entitled 'Non-word based topic spotting: experiments on Switchboard'. Nowell started by explaining the word-based approach to topic spotting. First of all the training material has to be transcribed orthographically. Non-word based topic spotting differs from the word-based one in that the training material has to be transcribed phonemically and key-sequences of phones rather than keywords are selected in the analysis. The non-word based approach has the advantage of being easy to adapt, language-independent and needing no pronunciation dictionary. On the other hand, it requires phonemic transcriptions

Sunday morning and the snow arrived

and is sensitive to sub-word features.

Experiments were done using the Switchboard corpus which contains unscripted conversational speech of telephone bandwidth and quality, recorded from multiple speakers, through multiple channels and on multiple topics. In each experiment one topic was selected as 'wanted'. The results were disappointing. In his conclusion Nowell stressed that minimum error rate selection worked better for non-word topic spotting and that there was still room for improvement.

The following talk was given by P Sivakumaran from the University of Hertfordshire. Its title was 'Investigation into the performance of automatic speaker verification in telephony'. He started by pointing out two important factors in practical speaker verification. One has to do with spectral distortion due to the communication channel and the other with speech variability due to anomalous events. In order to deal with the first problem, cepstral mean normalisation or delta cepstral parameters can be used which aim to discard channel-related information. As far as anomalous events are concerned, these can range from channel and environmental to uncharacteristic speech sounds from a speaker. Their effect can be reduced if normalisation of verification results is used. That means that instead of the absolute values a ratio of the score for the target model (proposed speaker) to scores for other considered models (mean cohort score) is used.

The final presentation of the session and the whole conference was given by David Attwater from BT Labs. It was entitled 'Large vocabulary access to corporate directories'. The subject of the talk was Brimstone, a voice-driven directory enquiry system intended for use by BT employees and based on a subset of the BT internal telephone directory. It consists of 5000 entries, 3000 surnames and 900 first names. It is capable of dealing with homophones and synonyms, both spoken and fluently spelt speech, and it possesses a flexible architecture.

This short description was followed by a demo in which Attwater dialled the number of the service and made an enquiry. First he was asked to say the surname and spell it. Then the first name was requested, which only happens in the case of multiple entries with the same surname. The name was repeated and the user was asked for confirmation. Using a text-to-speech system the numbers were given of all people listed with the same name. Finally, the user was asked if he wanted to hear the numbers again and if he was intending to make a new enquiry.

After this demo Attwater described the system in more detail. The following dialogue issues are taken into account: user knowledge – different users respond to prompted items with varying accuracy; predictability – some items can be expressed in a number of ways; accuracy – speech recognition performance varies for different vocabulary types; data-characteristics – sub-dialogues are used to obtain less-known information; and disambiguation of similar entries by confirmation to the user. The architecture of the system consists of a dialogue manager, a speech platform, an application database and information management. The last one is separated from the dialogue manager and capable of maintaining multiple hypotheses, modelling each track and relationship in the vocabulary. The vocabulary model makes a distinction between concepts (multiple pronunciations and spelling) and vocabulary (many items referring to one concept as presented in the database).

In his conclusion Attwater stressed that large vocabulary systems are feasible. The fundamental limits are due to recognition accuracy and the quality of speech synthesis, but also both the dialogue manager and the information management have to be designed with special care.

Many people commented on the excellence of the meeting. It was marred for many however by their journey home. During the last session the snow fell steadily and by afternoon the roads out of Windermere were blocked with unmoving traffic. A combination of this, a fire in the channel tunnel and a French transport strike caused one delegate to take 24 hours to return home to Paris!

For those who were unable to attend the conference the abstracts of the papers can be found on the web at http://ioa essex ac uk/ioa/groups/speech html.

I am grateful to Mark Huckvale, Phil Green and Dorota Iskra for their notes on the Friday afternoon, Saturday and Sunday sessions respectively.

Bill Ainsworth FIOA

NUMERICAL/ANALYTICAL METHODS FOR FLUID STRUCTURE INTERACTION PROBLEMS

Strelley Hall, Nottingham, 16 – 17 December 1996

Introduction

This was the first Institute of Acoustics conference devoted entirely to numerical/analytical methods for fluid-structure interaction problems. Some previous Underwater Acoustics Group conferences have included material on this topic within the context of an application area. The aim of this meeting was to bring together researchers/designers using numerical methods in different fields. There were many contributions from academic establishments, industry and research agencies. There were authors from UK, USA, Denmark and Russia. The conference was held at Strelley Hall, the headquarters of PAFEC Ltd. This building is a delightful setting, having much history and character and served both as venue for lectures and the conference banquet.

Welcome and A B Wood Medal Lecture

After a welcome from Richard Henshell, the Chairman of PAFEC Ltd, the 1995 A B Wood Medal was presented to Nicholas Makris by Bernard Berry, the President of the Institute of Acoustics. Bernard's speech revealed that Nicholas has done much original research, is an eminent acoustician and a worthy recipient of the medal. The associated presentation used statistical arguments to show that a logarithmic measure of intensity is sensible in ocean acoustics, where there are fluctuations which can be described by circular complex Guassian random statistics. An outline of the technical programme follows.

Sonar Applications

David Hardie from DRA Winfrith presented a useful overview of computational techniques, including finite elements, boundary elements, wave envelope elements and hybrid approaches, and a brief description of some common types of transducer.

This was followed by Amanda Gallaher from the same establishment who spoke on modelling a diamond shaped array of ring transducers. Some insight into the difficulties of array design was gained by the audience because it seemed that the performance would be improved by moving the array elements closer than is physically possible! The animated contours gave greater understanding of the complex interaction effects between array elements.

A presentation by Trevor Francis of Birmingham University compared results from PHOEBE, Trevor's FE/BE analysis program, some computational results supplied by Patrick Macey of PAFEC Ltd and experimental results supplied by John Oswin of BAeSEMA, for a flextensional transducer. The agreement between computed results was very good, to the relief of both analysts. There was also good correlation with experiment.

A substructuring technique for finite element models of sonar transducers was described by Chih-lyeli Chen, Birmingham University. This gives computational savings for models with many identical elements. The accuracy of the technique was demonstrated by comparing with a full FE model and with experiment.

Acoustic Boundary Elements

FE and BE methods were reviewed by Colin McCulloch from LMS UK. Techniques for producing a simplified fluid mesh, from an initially existing fine structural model were described. Some of the geometries used to illustrate the methods were complex, coming from an automotive context where the technique is more widely used.

Results for a coupled FE/BE analysis were then described in a paper by Steven Newhouse of Imperial College. He suggested that often a finer discretization is required for the structural mesh than for the fluid mesh. A strategy for performing vibroacoustic analysis on a multiprocessor computer was outlined.

Patrick Macey of PAFEC Ltd described a strategy for efficiently analysing submerged axisymmetric shells with internal 3D structure, using a combination of Fourier and 3D elements. Various strategies for efficiently solving the resulting equations were discussed.

Submerged Structures/Periodic Systems

Brighton University's Paul Harris offered the unofficial title 'how to sink a submarine with a bubble'. A video was shown of some small scale bubble motion. A simplified theoretical model was described, assuming the bubble

The presentation of the 1995 A B Wood Medal

The Conference Banquet

remains spherical and stationary. Results can be computed very much more rapidly than in a full boundary element method. Interest in this talk was further heightened when it was pointed out that the theory might have application in the brewery industry! Mike Blakemore of SAIC Ltd then discussed methods for analysing submarine sonar self noise. Standard statistical energy analysis methods neglect coherence effects, hence the statistical power flow method was proposed.

Jiang Zhang of Bath University described a combined FE/BE method for predicting the response of a one-dimensional periodically stiffened, fluid-loaded plate excited by a line force, using the spatial Fourier transform method. Comparison was made with analytical results.

Scattering/Propagation

Victor Humphry of Bath University considered scattering by elastic cubes. Computational results from a combined FE/BE model were compared with experimental results supplied by Peter Thorne of the Proudman Oceanographic Laboratory and Shaobo Sun of the Technical University of Denmark. Good agreement was obtained. It was shown that the backscatter depends significantly on the orientation of the cube.

The transmission line matrix method was described by Simon Pomeroy of Loughborough University. This technique can be used to solve transient problems and a recent refinement permits the precise placement of object boundaries.

A new mathematical/physical model for scattering by a fish's swimbladder was described by Christopher Feuillade from the Naval Research Laboratory, USA. This model has been used to explain experimentally observed properties of Atlantic cod.

Social Programme

In the evening at the end of the first day a coach took delegates to the centre of Nottingham for a pre-arranged ghost tour of the historical city centre which ended up deep in the cave/cellars of Ye Olde Salutation public house. Highlights of the walk included the tale of Mortimer's cavern and the origins of celery growing in Britain. On returning to Strelley Hall there was a mulled wine reception followed by the conference banquet. Some informal entertainment was provided by a group of three musicians, Amanda Gallaher, David Hardie and Patrick Macey. The mediaeval music was played on wooden recorders, but also included some singing by Amanda and playing of the crumhorn, bass rackett and cornamuse. The evening was completed by a tour of the dungeons of Strelley Hall with a final late night ghost story. At lunch time on the second day many of the delegates looked round All Saints Church which dates back to the fourteenth centary and has an unusual tomb, of Samson de Strelley, in front of the altar.

Conclusion

The conference organiser believes that computational tools for fluid-structure interaction will become increasingly important in the future, as the cost effectiveness compared with experimental approaches improves. Hopefully the Underwater Acoustics Group will hold a second conference on this theme in the future.

Thanks are due to all involved in what was generally agreed as being an informative and very enjoyable event.

Patrick Macey ❖

The Strolling Players

Hansard

10 December 1996
Noise Barriers
Sir John Stanley: To ask the Secretary of State for Transport, pursuant to his answer of 29 November, Official Report, column 417, if highway authorities are empowered to fund the construction of noise barriers on existing motorways and trunk roads built (a) before and (b) after 17 October 1969.
Mr Watts [holding answer 9 December 1996]: Yes. Section 282 of the Highways Act 1980 empowers highway authorities to fund noise barriers on motorways and trunk roads built before and after 17 October 1969. The use of this power is discretionary, and there is no obligation on highway authorities to fund the construction of noise barriers.

11 December 1996
Aircraft Noise Limits
Mr Chidgey: To ask the Secretary of State for Transport what steps he will take to enforce the noise limits due to be imposed at Heathrow, Gatwick and Stansted from 1 January 1997.
Mr Bowis: On 6 December, the High Court ordered a stay on the introduction of the daytime noise limit of 94 dBA Lmax and the night-time noise limit of 87 dBA Lmax at Heathrow, Gatwick and Stansted airports until the determination of an application by the International Air Transport Association for judicial review of the decision announced by my noble Friend on 28 August. The decision to improve monitoring efficiency by resiting some of the existing monitors and adding new monitors and other matters in the announcement of 28 August are unaffected.

13 January 1997
Motorway Noise
Mr William O'Brien: To ask the Secretary of State for Transport what proposals he has to reduce noise from increased traffic levels on existing motorways affecting domestic properties; and if he will make a statement.
Mr Watts: Tighter noise emission standards for new vehicles were introduced on 1 October 1996. In addition, when renewing the surface of a road the Highways Agency considers the materials and technology available. Some of the surfacing products now available generate significantly less tyre noise than older surfaces, and they can be used where they are no more expensive in whole-life cost terms than conventional surface treatment.

15 January 1997
ENVIRONMENT
Noise Act 1996
Mr Harry Greenway: To ask the Secretary of State for the Environment which local authorities have indicated that they (a) will and (b) will not implement the Noise Act 1996 on 1 April 1997; how much expenditure will be incurred or saved in each case; and if he will make a statement.
Mr Clappison: This information is not available centrally. However, my Department is commissioning research to establish the level and type of noise complaints service provided by local authorities in October 1996 and to track development of these services, including take-up of the new night noise offence in the Noise Act 1996.

28 January 1997
Airports and Aerodromes (Noise)
Mr Jim Cunningham (Coventry, South-East): I beg to move,
'That leave be given to bring in a Bill to control the level of aircraft noise at airports and aerodromes; and for connected purposes'.
This is a modest Bill which responds to concerns about noise levels expressed by those who live near airports. It cannot be a substitute for Government regulations, which many hon Members have pressed the Government to introduce. The Bill is about research.
Governments across Europe are concerned about the effects of noise pollution. Aircraft landings and take-offs cause the greatest amount of noise – and at some airports there are landings every two to three minutes. The impact of aircraft engine emissions on the environment and on health should not be underestimated. Many residents complain of ill health, which they attribute to living near an airport or under a flight path. The disturbance to residents caused by night-time flying is well documented. Night-time flying is one of the most obvious causes of noise pollution – many hon Members receive regular correspondence on that subject – and can cause a great deal of disturbance and inconvenience to sleeping residents.
This Bill enables the Civil Aviation Authority to carry out research into, first, the use of hushkits; and, secondly, technology, including aircraft computers and so on. As well as examining ways of making hushkits more effective, it is important to conduct research into alternative forms of noise reduction.
In order to enable older aircraft to meet the chapter 2 standards, it was necessary to fit them with engine mufflers known as hushkits. They are relatively inexpensive, but they do not reduce the level of chemical emissions from aircraft engines. There is also a growing feeling in aviation that hushkits will not, by themselves, produce a satisfactory reduction in noise pollution.
Many aircraft that are currently classed as chapter 2 will be upgraded to chapter 3 by fitting them with hushkits. Unfortunately, many of the hushkits will provide only the bare minimum of noise reduction that is required in order to satisfy chapter 3 rules, while some of the new generation of aircraft are so far inside the restrictions that it almost makes a mockery of those rules.
Luton airport is currently developing a new computer system for aircraft that will enable pilots to monitor the level and direction of an aircraft's noise emissions, and allow them to alter the flight path so as to reduce the impact on residential areas.
Some companies replace old engines with modern ones which not only reduce noise pollution more effectively,

but cut the amount of chemicals emitted. However, the fitting of new engines is more costly, and many companies prefer to use the cheaper hushkits. There is a significant difference between the level of emissions produced by planes that simply have hushkits fitted, and planes that have new engines. That has been acknowledged by the Civil Aviation Authority and the Department of Transport.
The Bill has two aims: first, to raise the basic level of chapter 3 standards, and secondly, to encourage new research to be carried out by the CAA and the Department of Transport into ways of reducing noise pollution.
It must be stressed that the Bill is a short-term measure only, designed to alleviate some of the problems that residents living near Britain's small airports face day and night from older aircraft with poor noise pollution controls. It is not and should not be a substitute for a Government Bill to deal with the problems of noise pollution around all Britain's airports....
Mr Jim Cunningham accordingly presented a Bill to control the level of aircraft noise at airports and aerodromes; and for connected purposes: And the same was read the First time; and ordered to be read a Second time upon Friday 28 February, and to be printed.

Extracts provided by Rupert Taylor FIOA

BSI News

New and Revised British Standards

Hearing aids
BS 6083: Part 7: 1996. Methods for measurement of electroacoustical characteristics of hearing aids with automatic gain control circuits. (also numbered as BS EN 60118–2:1996). Supersedes BS 6083: Part 2: 1984.
Sound system equipment.
BS 6840: Part 7: 1996. Specifies the characteristics and methods of measurement and includes a classification and code for marking headphones, headsets, earphones and earsets for use on, or in, the human ear. (also numbered as BS EN 60268–7: 1996). No current standard is superseded.

BS EN Publications

The following are British Standard implementations of the English language versions of European Standards (ENís)
BS EN ISO 11200: 1996 Acoustics – Noise emitted by machinery and equipment – Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions. No current standard is superseded.
BS EN ISO 3746: 1996 Acoustics – Determination of sound power levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane. Supersedes BS 4196: Part: 6: 1981.
BS EN ISO 11201: – Acoustics – noise emitted by machinery and equipment – Measurement of emission sound power levels at a work station and at other specified positions – Engineering method in an essentially free field over a reflecting plane. No current standard is superseded.
BS EN ISO 11202: 1996 Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Survey method in-situ. No current standard is superseded.
BS EN ISO 11203: 1996 Acoustics – Noise emitted by machinery and equipment – Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level. No current standard is superseded.
BS EN ISO 11204: 1996 Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Method requiring environmental corrections. No current standard is superseded.
BS EN ISO 11546: – Acoustics – Determination of sound insulation performances of enclosures
BS EN ISO 11546 – 1:1996 Measurements under laboratory conditions (for declaration purposes)
Applicable to a total enclosure only and not to the individual panels from which the enclosure is made. No current standard is superseded.
BS EN ISO 11546 – 2: 1996 Measurements in-situ (for acceptance and verification purposes)
Applicable to a total enclosure only and not to the individual panels from which the enclosure is made. No current standard is superseded.

Drafts for public comment

(for information only as the deadlines for comment are passed by the time Acoustic Bulletin goes to press)
96/210023 DC Revision of IEC 849 Sound systems for emergency services. (IEC 100C/32/CDV)
96/210024 DC Revision of IEC 268–16 Sound systems equipment – Part 16: The objective rating of speech intelligibility (IEC 100C/33/CDV)
96/712140 DC Acoustics – Noise test code for fastener driving tools – Engineering method.
96/106677 DC BS 5228 Noise and vibration control on construction and open sites – Part 5: Code of practice for noise and vibration control applicable to surface mineral extraction (except coal) sites.

96/211067 DC Revision of IEC 268-3 Sound system equipment - Part 3: Amplifiers (IEC/100C/40/CD)
96/563601 DC BS ISO 362 Acoustics - Measurement of noise emitted by accelerating road vehicles - Engineering method (Revision of ISO 362:1994) (ISO/DIS 1680)
96/563602 DC BS ISO 1680 Acoustics - Test code for the measurement of airborne noise emitted by rotating electrical machinery (Revision of ISO 1680:1986) (ISO/DIS 1680)
96/713503 DC EN ISO 13753 Mechanical vibration and shock - Hand-arm vibration - Method for measuring the vibration transmissibility of resilient materials when loaded by the hand-arm system.
96/714930 DC ISO 10816-4 Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts - Part 4: Gas turbine driven sets excluding aircraft derivatives (ISO/DIS 10816-4)
96/714931 DC ISO 10326-2 Mechanical vibration - Laboratory method for evaluating vehicle seat vibration - Part 2: Application to railway vehicles (ISO/DIS 10326-2)
96/714995 DC ISO 10056 Mechanical vibration - Measurement and analysis of vibration to which passengers and crew are exposed in railway vehicles (ISO/DIS 10056)

CENELEC Publications

EN 60268-5: August 1996 (IEC 268-5: 1989+ A1: 1993) Sound system equipment - Part 5: Loudspeakers (Supersedes HD 483.5 S2: 1994) Amendment A2: August 1996 to EN 60268-5: 1996 (IEC 268-5: 1989/A2: 1996)

EN ISO'S

The following International standards have been adopted as EN's. These documents have been approved by CEN/CENELEC.
EN ISO 9614-2:1996 (ISO 9614-2: 1996) Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning.
EN ISO 389-2:1996 (ISO 389-2: 1994) Acoustics - Reference zero for the calibration of audiometric equipment - Part 2: Reference equivalent threshold sound pressure levels for pure tones and insert earphones.
EN ISO 3743-2: 1996 (ISO 3743-2: 1994) Acoustics - Determination of sound power levels of noise sources using sound pressure - Engineering methods for small, movable sources in reverberant fields - Part 2: Methods for special reverberation test rooms.

ISO Standards

ISO 5131: 1996 (Edition 2) Acoustics - Tractors and machinery for agriculture and forestry - Measurement of noise at the operator position - Survey method. (will be implemented as BS ISO 5131: 1996)
ISO 96111: 1996 Acoustics - Characterisation of sources of structure-borne sound with respect to sound radiation from connected structures - Measurement of velocity at the contact points of machinery when resiliently mounted. (will be implemented as BS ISO 9611: 1996)
ISO 11690: - Acoustics - Recommended practice for the design of low-noise workplaces containing machinery
ISO 11690-1: 1996 Noise control strategies. (will be implemented as BS EN ISO 11690-1)
ISO 11690-2: 1996 Noise control measures. (will be implemented as BS EN ISO 11690-2)

Draft International Standards

96/712508 ISO/DIS 13261-1 Sound power rating of air-conditioning and air-source heat pump equipment - Part 1: Non-ducted outdoor equipment.
96/712509 ISO/DIS 13261-2 Sound power rating of air-conditioning and air-source heat pump equipment - Part 2: Non-ducted indoor equipment.

British Standard Implementations

BS ISO 6798: 1995 Reciprocating internal combustion engines - Measurement of emitted airborne noise - Engineering method and survey method. Specifies methods for measuring the sound pressure levels on a measurement surface enveloping a source, and for calculating the sound power level produced by the source. No current standard is superseded.
BS ISO 5131: 1996 Acoustics - Tractors and machinery for agriculture and forestry - Measurement of noise at the operator position - Survey method. The test procedures specified are survey methods as defined in ISO 2204. No current standard is superseded.
BS ISO 9611: 1996 Acoustics - Characterisation of

sources of structure-borne sound with respect to sound radiation from connected structures – Measurement of velocity at the contact points of machinery when resiliently mounted. No current standard is superseded.

European new work started

EN ISO 14163 Acoustics – Guidelines for noise control by silencers

EN ISO 3741 Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms. (Revision of ISO 3741: 1988)

This information, provided by John W Tyler FIOA, was announced in the September to December 1996 issues of BSI News.

Book Reviews

Engineering Noise Control (Second Edition)
D A Bies and C H Hansen
E & F N Spon 1996 615pp
ISBN 0-419-20430-X £35.00

Active Control of Noise and Vibration
C H Hansen and S D Snyder
E & F N Spon 1997 1267pp
ISBN 0-419-13390-1 £195.00

Here are two offerings from Colin H Hansen (with co-authors) published by Spon. They have arrived on my desk at the same time and the subject matter is closely related so I am taking the opportunity to review the two books together.

Engineering Noise Control

This is the second edition of a book originally published by Unwin Hyman in 1988. I was glad to have acquired the first edition shortly after its publication, for in my opinion it is one of the best text books on this subject that I have seen and read. The second edition lives up to the high standards of the first edition thought it is clear that much of the material has been rearranged. There are also new sections on intensity measurement and a short chapter on active noise control. In addition many of the references to standards have been updated. The book also succumbs to modern audit jargon by declaring a set of LEARNING OBJECTIVES at the start of every chapter. There is an impression of a lot more theory in the new edition and perhaps I am not so keen on this as it probably detracts from practical applications – the first edition balanced theory and practice perfectly.

Right at the beginning of the new edition is a good general survey of what is important in defining a strategy for solving a noise problem – this was an unfortunate omission from the first edition. However, because strategy is central to noise control, the section is too short (8 pages) and insufficiently specific. For example, many people will want to know exactly what approach they can take to measurements designed to rank the strength of various sources within a machine. The book gives no guidance here and in other similar cases and I believe a whole chapter on noise control strategy would have been a worthwhile addition.

For the information of our readers the book contains the following material: Fundamentals, the Human Ear, Instrumentation, Criteria, Sources and Outdoor Propagation, Sound Power, Sound in enclosed spaces (Room Acoustics), Enclosures and Barriers, Mufflers, Vibration Control, Sound Power Data (from a variety of real sources), Active Noise Control and Techniques for SPL Estimation.

The quality of presentation and publishing is better than satisfactory though I regret that the paper quality is not as good as the really excellent first edition. Overall this is a valuable book and very good value at the price. I can recommend it with enthusiasm.

Active Control of Noise and Vibration

This is a veritable tome of 1267 pages and is certainly a specialist text with a coverage of active control which is both wide and deep. The authors attempt to take a unified approach to active control of both noise and vibration. This is commendable because the two subjects are so intimately connected with each other. In order to flourish in this field you will need to have a deep understanding of theoretical and practical acoustics (don't forget the Green's functions), structural dynamics in all its modal complexities, instrumentation and transducers, control theory at an advanced level, digital electronics,

patent law (it seems) and, I suppose, mathematics. This is a tall order for most of us ordinary mortals and yet many people must be researching in this area. The book attempts to cover most of these subjects and this accounts for its length. I am certain that if you have the stamina you will find something interesting here and it must also be a golden opportunity for most of us to learn something new too. It is not, however, a textbook; more a state-of-the-art account of the subject.

A broad outline of the coverage is as follows: Fundamentals of Acoustics and Vibration (not sure I would call Green's function a fundamental), Spectral Analysis, Modal Analysis, Modern Control review, Feed Forward Control System Design, Active Control of Noise in Ducts, Active Control of Free Field Radiation, Active Control of Enclosed Sound Fields, Feed Forward Control of Vibration in Plates and Beams, Feedback Control of Flexible Structures in terms of Modes, Vibration Isolation, Electronic Implementation Issues (in short), Sound Sources and Sensors, Vibration Sources and Sensors, and an Appendix on linear algebra.

Inevitably the book must bear comparison with Nelson and Elliott's book on Active Control of Sound, published four years ago by Academic Press. The coverage of the book and its appendix is remarkably similar to that of the older book though at greater length because of the inclusion of active control of vibration. Incidentally, Nelson and Elliott are also fond of Green's functions and one is led to the conclusion that they must be rather central to the matter. It is worth noting that Nelson and Elliott's very similar book currently costs £70.00 (or £24.95 in soft covers).

Reading carefully through selected short parts of the book, the treatment is attractive and meticulous and accurate. Thus, this book also appears to be a good buy, particularly in this case for the specialist in the field. Whether you can pay such a high price may, of course, be another matter.

A J Pretlove FIOA ❖

New Products

INDEX DATA SYSTEMS

nVision System

IDS have announced the release of version 4.01 of their nVision system which features a whole host of improvements for Microsoft Windows 95.

The new Base system includes file translators for Binary import, ASCII import, Larson Davis LD2800, LD2900 and LD3200, Windows sound card driver with calibration, Ono Sokki CF-4200, CF-5200, CF-6400 and DS-9100, NCSA HDF, SDF, UFF, Hi-Techniques, Nicolet, TEAC Quick Vu, Sony PC Scan, .WAV files, Brüel & Kjær 2123/2133 and 214n, Intensity, Famos, nCode, Optim MEGADAC and LMS Cada-X (including workstation interface software).

Also included in the package are data presentation modules such as Editor, Digital Segment Display, Matrix (frequency domain) Graph, Note Facility, Automatic Data Sequencer, Signal (time domain) Graph, Polar, Plot, Map, Contour, View and Waterfalls.

The Base package also includes basic DSP functions, and is completely upgradeable to work with the more advanced IDS tools such as the Data Processing Toolbox, the DSP Toolbox, Acoustic Intensity, Kalman Filtering, Order Tracking, Passby, Sound Quality Metrics and specialist tools for Automotive and Rotating Machinery applications. Version 4.01 is available now on floppy disk, and Version 4.10, available during March 1997, will ship on CD-Rom together with a significant amount of additional background material and a large library of example data.Upgrades are available to existing users of earlier versions.

To obtain a free white paper and demo system, or any other information, contact your local IDS representative, or call IDS UK directly, Tel: 01723 361528, Fax: 01723 501864, e-mail IDSL@MSN.COM. Index Data Systems Limited, Holtby House, 11 Alexandra Park, Scarborough, North Yorkshire YO12 5JN.

DIAGNOSTIC INSTRUMENTS

LineCHECK™

Diagnostic Instruments have produced an instrument which makes it possible to determine product/component quality based on noise and vibration signatures. The new LineCHECK™ product range from Diagnostic Instruments removes the subjectivity from inspection testing to give an objective assessment of product quality.

LineCHECK™ has been used to detect component defects such as cracks, inclusions, dimensional tolerance, test electric motor and bearing quality, provide in-car noise detection/quality assessment and gearbox whine verification.

The instrument's range of applications are vast, and extend to any production line that tests either self-excited (motors, pumps, compressors etc) or non-self excited (linkages, glass vials etc) products.

LineCHECK™ is the result of a two year research programme by Diagnostic Instruments. Using powerful frequency analysis and expert

diagnosis techniques, the instrument monitors complex noise and vibration signals, providing a simple green/amber/red indication of product quality to line operators. LineCHECK™ can be interfaced with a production line and automated to reject defective products/components. 'Level' and 'frequency' alarms can easily be set-up to monitor areas of spectral interest, while 'event trigger' enable users (and automation) to co-ordinate data capture with specific events. Data can be automatically tagged, enabling easy identification and retrieval at a latter date. A 'trend' facility allows off-line analysis of captured data, which can be stored on PCMCIA memory cards. This facility can be used to produce historical trends and statistical analysis, which can be exported into popular software packages for report generation.

Two functionally identical versions of the instrument are available, LineCHECK™ and LineCHECKlite™. LineCHECK™, with its industrial enclosure, is well suited to use on a production line. The unit can be secured to a wall, and a protective door prevents accidental damage to the unit's control panel. LineCHECKlite™ is a fully hand-portable rugged instrument which can be used as a roving test unit across different production lines. Manufacturers of high volume products, where inspection costs become an issue, will benefit from using Line-CHECK™.

Testing in noisy environments generally requires expensive and inconvenient sound booths, which interrupt the production process. LineCHECK™ can be implemented into a production process and configured to complete measurements while ignoring background/unwanted noise, focusing only on the areas of spectral interest.

For further information contact Anne McSherry, Sales Administrator, Diagnostic Instruments, 2 Michaelson Square, Kirkton Campus, Livingston, EH54 7DP. Tel: 01506 470011 Fax: 01506 470012.
EMail anne@diaginst.co.uk.

INDUSTRIAL ACOUSTICS COMPANY

Updated Hearing Test Booth

Industrial Acoustics Company (IAC) of Winchester, Hants has further improved the design of its 250 Series Mini Sound Shelteraudiometric testing booth to keep pace with the needs of occupational health specialists in manufacturing industry. Since the introduction of the Noise at Work Regulations, companies have shown a growing interest in monitoring their employees' hearing to obtain accurate information about the effects of exposure to noise on the workforce. This has created a surge in demand for in-house hearing testing facilities to enable employers to regularly check employees thought to be at risk.

The need to update the design of the booth has arisen because several large industrial users have recently asked IAC to incorporate a number of modifications to suit their own particular requirements. IAC has decided to take the best of these design changes and include them as

standard features in every booth now being sold. To improve patient comfort, the 250 Sound Shelter now has a more efficient ventilation system and a cooler, 30 watt lamp internally. The ventilation system is also quieter and conforms to the ISO 6189 standard. An additional power point has been added for an audiometer and a strong bench seat has been fitted inside the booth.

IAC has seen sales of its hearing testing booth almost double in the last three years; in Britain alone there are said to be over 2000 of its booths in use. IAC believes that an additional reason for the sharp rise in demand is the recent spate of higher compensation awards being to paid to workers whose hearing has been damaged at work.

For information: Simon White (PR), Nomis Communications Tel/Fax: 01344 761070 or Ian Rich, Manager, Medical Division Industrial Acoustics Company Tel: 01962 873000 Fax: 01962 873111

IAC is a Sponsor Member of the Institute

News

LMS INTERNATIONAL

Operational Management Changes

LMS International is in the forefront of computer-aided dynamic analysis, develops total solutions for testing, modeling and prediction of acoustic and dynamic behaviour and the structural integrity and durability of mechanical structures.

The LMS Group had a successful year in 1996, expanding from a work force of 240 to nearly 340 people. During that year LMS Difa Instruments was acquired.

SYSNOISE, software for acoustic prediction, is a product of LMS Numerical Technologies based in Leuven in Belgium.

LMS International has wholly owned subsidiaries in Paris, Stuttgart, Milan, Birmingham, Tokyo, Seoul, New York, Detroit and Los Angeles.

On 1 January 1997, Hans Wynedale, formerly Managing Director of LMS Numerical Technologies took up a post as Chief Operating Officer, which carries responsibility for day-to-day operational management and implementation of business plans of the various LMS divisions and international sales operations.

Dr Vandeurzen will continue to chair the LMS Board of Directors and will remain as CEO with a responsibility for long-term strategy and corporate development. Dr Leuridan, as Vice-President and Chief Technical Officer will cover the company's technological direction.

Mr Wynedale will remain Managing Director of LMS Numerical Technologies and the day-to-day management of that company will be the shared responsibility of Jean-Louis Migeot, previously Director for Projects and Support and Pierre Guisset who was previously Director of Product Development.

Items for inclusion in this section should be sent to John Sargent MIOA, Oak Tree House, 26 Stratford Way, Watford WD1 3DJ. ❖

Non-Institute Meetings

March 3–6, 1997: DAGA 97, German Acoustical Society Meeting, Kiel
Contact: Tagungsbüro DAGA97; Foschungsanstalt der Bundeswehr für Wasserschall und Geophysik; Klausdorfer Weg 2-24; D-24148, Kiel, Germany. Tel: +49 431 7204 -281; Fax: +49 431 7204 –150; e-mail: daga97@fwg.ki.eunet.de;http://daniels.techfak.uni-kiel.de/daga97

March 17–19, 1997: Spring Meeting, Acoustical Society of Japan, Tokyo
Contact: Acoustical Society of Japan, Ikeda Building, 2-7-7 Yoyogi, Shibuya-ku, Tokyo, 151 Japan. Fax: +81 3 3379 1456

March 24–28, 1997: 2nd Ultrasonics Symposium (part of International Science and Technology Conference), Havana, Cuba
Contact: Carmen Alvarez, Calle 15 No 551 e/C y D, CP 10400, Ciudad de La Habana, Cuba; Fax: +53 733 3373; e-mail: cimaf@ redacc.cu

April 2–4, 1997: International Symposium on Simulation, Visualization and Auralization for Acoustic Research and Education, Kobe
Contact: Symposium Secretariat, Environmental Acoustics Lab, Faculty of Engineering, Kobe University, Rokko, Nada, Kobe, 657 Japan. Fax: +81 78 881 25 08, e-mail: asva97@ icluna.kobe-u.ac.jp

April 13–16, 1997: 23rd International Symposium on Acoustical Imaging, Boston, MA
Contact: S Lees, Bioengineering Dept, Forthys Dental Center, 140 Fenway, Boston, MA, USA. Fax: +1 617 262 4021; e-mail: slees@forthys.org

April 14–18, 1997: 4th French Congress on Acoustics, Marseilles
Contact: Secretariat CFA, 4; 31 chemin Joseph Aiguier, F-13402 Marseilles Cédex 20, France. Tel: +33 91 16 40 68; Fax: +33 91 22 82 48; e-mail: cfa4@lma.cnrs-mrs.fr; http://alphalma.cnrs- mrs.fr/cfa4.html

April 21–24, 1997: International Conference on Acoustics, Speech, and Signal Processing - ICASSP 97, Munich
Contact: H Fastl, Lehrstuhl für Mensch-Maschine-Kommunikation, Technical University of Munich, 80290 München, Germany. Tel: +49 89 2892 -8540; Fax: +49 89 2892 -8535; e-mail: fas@mmk.e-technik.tu.muenchen. de

April 21-25, 1997: International Conference on Shallow Water Acoustics, Beijing
Contact: SWAC '97 Secretariat; c/o Institute of Acoustics, PO Box 71, Beijing, 100080; China. Fax: +(86-10) 6256 -9079 (Beiing): + (1-404) 894 - 7790 (Atlanta); e-mail.: xwf@canna.ioa.ac.cn (Beijing); swac97@gatech.edu(Atlanta)

May 12–16, 1997: 13th FASE Symposium on Hydroacoustics and Ultrasonics, Gdynia, Jurata
Contact: Prof. Eugeniusz Kozaczka, Akademia Marynarki Wojennej, ul. Smidowicza 71, P1-81-919 Gdynia, Poland; Fax: +48 58 25 48 46; e-mail: amw@beta.nask.gda.pl

May 21–23, 1997: 25th Congress of the Italian Acoustic Association, Perugia
Contact: F Asdrubali, Scientific Sectretariat 25th AIA Congress, Instituto di Energetica, Faculta di Ingegneria, Via G. Duranti 1-A/4, 06125 Perugia, Italy. Tel: +39 75 58 52 695; Fax: +39 75 58 52 696

June 3–5, 1997: 8th International Meeting on Low Frequency Noise and Vibration, Gothenburg
Contact: Multi-Science Publishing Co Ltd, 107 High Street, Brentwood, Essex CM14 4RX, UK. Tel: +44 1277 224 632; Fax: +44 1277 223 453

June 3–6, 1997: 7ème Colloque de Visuallsation et de traitement d 'images en mecanique desuides Saint-Louis
Contact: I.S.L.; Service AOR; Madame HENGY; B.P. 34; 68301 SAINT LOUIS CEDEX; Tel.: 03 89 69 51 36 Fax: 03 89 69 53 35

June 5–7, 1997: Conference on ICP and Inner Ear Pressure, Bath
Contact: British Society of Audiology, 80 Brighton Road, Reading RG6 1PS, UK; Fax: +44 1734 351 915; e-mail: mpsar@ bath.ac.uk

June 15–20, 1997: 8th International Symposium on Nondestructive Characterization of Materials, Boulder, CO
Contact: Debbie Harris, The Johns Hopkins University, Center for NDE, 102 Maryland Hall, 3400 N. Charles Street, Baltimore, MD 21218, USA; Fax.: +1 410 516 7249; e-mail: cnde@jhuvms.hcfjhu.edu

June 16–18, 1997: NOISE-CON97, State College, PA
Contact: INCE, P.O. Box 320, Arlington Branch, Poughkeepsie, NY 12603, USA; Fax.: +1914 463 0201

June 16–20, 1997: 133th Meeting of the Acoustical Society of America, State College, PA
Contact: S. Hayek, Active Vibration Control Laboratory, Pennsylvania State University, 227 Hammond Building, University Park, PA 16802-1401, USA; Fax: +1 814 863 7967; e-mail: sihesm@engr.psu.edu

June 18–20, 1997: Larynx 97 Marseille
Contat: Laboratoire Parole et Langage Université de Provence; 29, Avenue Robert Schuman; 13261- AIX EN PROVENCE; Fax .: (33) 04 42 59 50 986; E-mail: larynx97@1pl.univ-aix.fr

June 18–21, 1997: 3rd European Conference on Audiology, Prague
Contact: Paediatric Otolaryngologic Clinic, Faculty Hospital Motol, V. Uvalu 84, 15018 Prague 5, Czech Republic; Fax.: +42 2 2443 2620

June 24–27, 1997: 1st European Conference on Signal Analysis and Prediction, Prague
Contact: ESCAP Secretariat, Institute of Chemical Technology, Tecknicka 5, 166 28 Praha 6, Czech Republic; e-mail: escap@vscht.cz; WWW: http://www.vscht.cz/escap97/

June 25–27, 1997: 12th Symposium on Echocardiology and 9th Meeting of the International Cardiac Doppler Society, Rotterdam
Contact: L.M.C. Congress and Business Services, P.O.Box 593, NL-3700 AN Zeist, The Netherlands; Fax.: +31 343 533 357

June 25–27, 1997: 5th International Congress of the International Society of Applied Psycholinguistics, Porto
Contact: Maria da Graca Pinto, Universidade do Porto, Faculdad de Letras, Via Panoramica, s/n, PT-4150 Porto, Portugal; Fax.: +351 2 610 1990

July 2–4, 1997: Ultrasonics International 97, Delft
Contact: W. Sachse, Dept. of Theoretical and Applied Mechanics, Cornell University, Ithaca, NY14853, USA;Fax.: +1 6072559179; e-mail: sachse@msc. cornell.edu

July, 14–17, 1997: 6th International Conference on Recent Advances in Structural Dynamics, Southampton
Contact: N. Ferguson, ISVR, University of Southampton, Southampton SO17 1BJ, UK; Fax.: +44 1703 593 033; e-mail: mzs@isvr.soton.ac.uk

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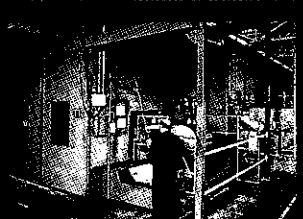

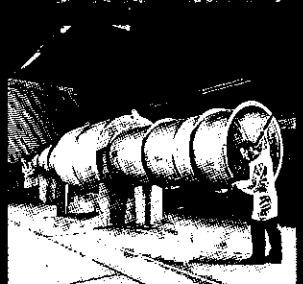

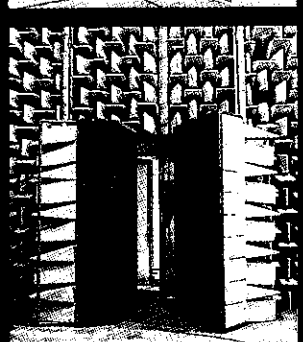

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