



Acoustics Bulletin

October 1987

Volume 12

Number 4

INSTITUTE OF ACOUSTICS

3-D VIBRATION PLOTTING SIMPLIFIED

The Brüel & Kjær program WT 9121 creates three-dimensional plots of instantaneous spectra, Autospectra, Cross Spectra and frequency response functions. The measurements are made with a Brüel & Kjær Dual Channel Signal Analyzer Type 2032 or 2034 and transferred to a desk-top computer. Hard copy is obtained using a graphics printer or plotter. This instrument set-up provides a sophisticated and easy-to-use 3-D plot system.

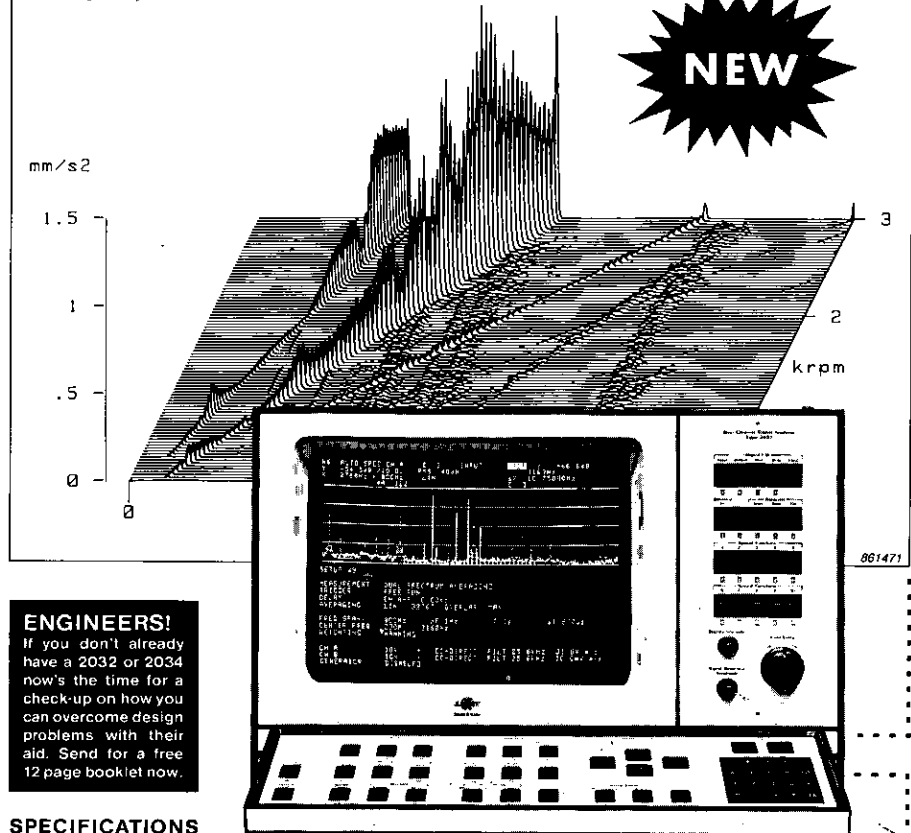
The principle applications for the program are the analysis of non-stationary signals found in the fields of machine vibration monitoring and troubleshooting, and in engineering development.

The fast rate of spectrum transfer (see Specifications for full details) ensures fast and accurate analyses while minimizing data loss. Spectrum acquisition from the analyzers can be made at regular time intervals, as a function of trigger count or machine speed, or through manual control.

Numerous facilities are incorporated for analyzing the 3-D display and for obtaining hard copy in a variety of formats to suit different application requirements.

The program has been designed so that it can also be used with data recorded on tape, e.g. using the Portable Tape Recorder Type 7007.

3-D plot from a run down test on a steam turbine.



ENGINEERS!
If you don't already have a 2032 or 2034 now's the time for a check-up on how you can overcome design problems with their aid. Send for a free 12 page booklet now.

SPECIFICATIONS

MEASUREMENT TRANSFER MODES (INPUT PROGRAM):

TIME: At user-defined time intervals
T-COUNT: After a user-defined number of trigger pulses

SPEC-MAX: As a function of machine speed by tracking the maximum value in the spectra. User-defined machine speed measurement range

TRC-PEAK: As a function of machine speed by tracking any peak in the spectra. User-defined machine speed measurement range

MANUAL: Under manual control
LEVEL: As a function of machine speed using the DC level from Frequency Multiplier Type 5859. User-defined machine speed measurement range

MEASUREMENT TRANSFER RATE:

Fast Routine (using fixed time interval or trigger DC component): See table
Slow Routine: See table

Compression Factor: Facilitates the analysis of tape recorded data. Allows recorded data to be played back at different speeds

TYPES OF MEASURED DATA

Functions: Autospectra, Cross Spectra, Instantaneous Spectra, Enhanced Spectra (using synchronous time averaging), Frequency Response Functions. Baseband or Zoom

Formats: Real, imaginary, magnitude or phase

3-D DISPLAY FORMATS:

3-D plot, with or without skew. Reversible z-axis. User-selectable x-axis display range within measurement range. Selectable upper

INPUT MODE	MIN. SPECTRUM TRANSFER TIME (ms)	
	Type 2032	Type 2034
TIME	fast	50
	slow	400
T-COUNT	880	1100
SPEC MAX	1100	3000
TRC PEAK	1100	3000
LEVEL	fast	230
	slow	1580
		840
		1600

T01242GB0

and lower y-axis limits. Lin or log. y-axis as selected on the analyzer

POSTPROCESSING DISPLAY FORMATS:

Single frequency, single spectrum, cut through 3-D plot (with set harmonic mode and peak adjust facility), Campbell diagram, total RMS of 3-D plot, maximum at all frequencies in 3-D plot.

UNITS:

User-defined x-axis and z-axis units. User defined y-axis units only with lin. y-axis

DATA STORAGE:

All measurements may be stored on data disk (disk type determined by the computer configuration) and recalled for later analysis. File names (9 characters) and labels (100 characters) are user definable

HARD COPY:

Hard copy available through an HP-GL plotter (e.g. Graphics Plotter Type 2319) or an HP compatible printer (e.g. Graphics Printer Type 2313). User defined header text for single frequency, single spectrum, cut, and total RMS plots

TYPICAL 3-D PLOT SYSTEM:

Dual Channel Signal Analyzer...Type 2032 or 2034
3-D Plot Program..... WT 9121
HP series 300 computer (with Display Compatibility Interface)
Photoelectric ProbeMM 0024
Frequency Multiplier Type 5859
Adaptor for analyzer trigger input plug..... WB 1001
Graphics Plotter..... Type 2319

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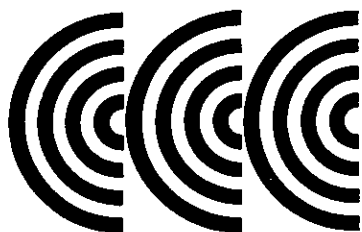
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The Institute of Acoustics was formed in 1974 by the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society and is now the largest organisation in the United Kingdom concerned with acoustics. The present membership is in excess of one thousand and since the beginning of 1977 it is a fully professional Institute.

The Institute has representation in practically all the major research, educational, planning and industrial establishments covering all aspects of acoustics including aerodynamic noise, environmental acoustics, architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics and vibration.

Membership of the Institute of Acoustics

Membership of the Institute is generally open to all individuals concerned with the study or application of acoustics. There are two main categories of membership, Corporate and Non-corporate. Corporate membership (Honorary Fellow, Fellow, Member) confers the right to attend and vote at all Institute General Meetings and to stand for election to Council; it also confers recognition of high professional standing. A brief outline of the various membership grades is given below.

Honorary Fellow (Hon FIOA)

Honorary Fellowship of the Institute is conferred by Council on distinguished persons intimately connected with acoustics whom it specially desires to honour.

Fellow (FIOA)

Candidates for election to Fellow shall normally have attained the age of 35 years, have had at least seven years of responsible work in acoustics or its application, and have made a significant contribution to the science or profession of acoustics.

Member (MIOA)

Candidates for election to Member shall normally have attained the age of 25 years, must either (a) have obtained a degree or diploma acceptable to Council and have had experience of at least three years of responsible work in acoustics, or (b) possess an equivalent knowledge of acoustics and cognate subjects, have had experience for not less than seven years of responsible work in acoustics or its application, and must have been a Non-corporate member

of the Institute in the class of Associate for not less than three years.

Associate

Candidates for election to the class of Associate shall have attained the age of 18 years and (a) have received a general education approved by Council, and (b) be engaged or interested in acoustics or a related discipline.

Student

Candidates for election to the class of Student shall normally have attained the age of 16 years and at the time of application be bona-fide students in acoustics or in a related subject of which acoustics forms an integral part; they should also (a) have received a good general education, or (b) pass a satisfactory preliminary examination. Normally a student shall cease to be a Student at the end of the year in which he attains the age of 25 years or after five years in the class of Student, whichever is the earlier.

Sponsor

Sponsor membership is open to firms, organizations or persons having an interest in acoustics, whose support can advance the aims and objects of the Institute.

Full details and membership application form are available from: The Secretary

Institute of Acoustics
25 Chambers Street
Edinburgh EH1 1HU

Sponsor Members

Admiralty Research Establishment
Portland, Dorset

Brüel & Kjær (UK) Ltd
Hounslow, Middlesex

Sandy Brown Associates
London

Burgess Manning Ltd
Ware, Herts

Lucas CEL Instruments Ltd
Hitchin, Herts

dB Instrumentation Ltd
Aldershot

Fokker B V
Schiphol-Oost, The Netherlands

GenRad Ltd
Maidenhead, Berks

Greater London Council
The County Hall, London

Hann Tucker Associates
Woking, Surrey

Isophon Ltd
Gillingham, Kent

Masscomp UK Ltd
Reading

Moniton Technic Ltd
Basingstoke, Hants

Monitor Acoustic Control Ltd
Glasgow

Morison & Miller Engineering Ltd
Glasgow

Scientific Atlanta
Hitchin, Herts

Stancold Acoustics
Bristol



President's Letter

Institute of Acoustics

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AIRO, Hemel Hempstead

Dear Fellow Member,

At the time of writing your President does not have a lot to say! For some reason the 'silly season' appears to get sillier with the passage of years.

Nevertheless we have another year of interesting IOA activities ahead. I for one am looking forward to at least some of the conferences. I do hope that a significant number of members will participate in these activities, then it makes all the hard work put in by the conference organizers seem worth while.

For example should we not support the European Year of the Environment and attend 'Noise in the Nineties' organized by your Meetings Committee; and what about the conferences held in the beautiful surroundings of the Lake District - 'Reproduced Sound' and the Autumn Conference on Industrial Noise. These are just three of the many opportunities that have been provided by your hard working organizers, to meet your fellow acousticians in stimulating surroundings. Make a new season's resolution to attend at least one event.

Yours sincerely,

Osman Berktaý

*Is this the best information that
can be offered to the membership!*

ACOUSTICS INDEX 1987-1988

It may interest members to know something of the unusual background to the publication of Acoustics Index 1987-88 which took place in May of this year

The story began some 18 months previous to the date of publication when the author of this article discerned a place within the existing framework of the Institute's activities for a broad spectrum reference text on all matters acoustical. As a sometime Hon. Treasurer of the Institute, the author was well aware that the year-to-year financial well-being of the Institute derives from surpluses generated by various activities to augment the income from membership fees. Its dependence for financial comfort on a small number of essentially haphazard sources of income places the Institute alongside many other learned societies of similar size and recently some useful surpluses have been produced by such activities as meetings, publications and education. In March of last year some revenue items for 1986 seemed destined to fall below the budgeted figures and the possibility of deriving a useful revenue from the publication of a members' reference manual added further impetus to the initial groundwork. In the event it transpired that the surplus income from meetings, particularly from the two November Windermere conferences, confounded expectations and thus the Institute's accounts for that year were transformed to a degree that would not be repeated often in future. However, the question of finance to cover the publication of a reference manual inevitably opened the issue of attracting supporting income from advertising; interestingly, soundings among members suggested that far from detracting from the possible quality of the intended product, the inclusion of advertising material, particularly if it were to contain useful technical information, could indeed enhance the final publication.

Various overall strategies and design proposals for the *Index* were put together during the many iterative stages of its development. Each prospective format was tested as far as possible against a number of conditions set down by the author. Firstly, it was laid down that the entire publication should be of sufficient standard in utility and presentation as to reflect well on the name of the Institute. Secondly, as an important point about its utility, the publication should allow recipients to add material from their own sources, an idea that pointed to the notion of an expandable

resource. Thirdly, any advertising material should come from an invitation worded in a manner that protected the Institute's independence. Finally, the entire exercise should be financially viable.

Considerations such as those above favoured a format centred upon a good quality A4 ring-binder. A full version of the *Index* was planned to contain separate reference and commercial sections with the first of these carrying a wide variety of reference literature, taken, with permission where appropriate, from a number of sources. The commercial section was perceived primarily as a device for filing, in a semi-permanent form, the sort of descriptive literature that might be distributed by relevant companies in their normal mailings; this literature, it was hoped, would mainly contain technical product information in a form useful to the practising acoustician. The fact that a very high proportion of literature distributed in this way is reputedly immediately assigned to the waste basket was taken as a reason for assuming that the proposed arrangement would appeal to the cautious guardians of advertising revenue.

At this point in the design process it became clear that the emerging publication would also be of value to a variety of professional categories whose members, whilst not primarily acousticians, encounter the subject and methods of acoustics in some degree, perhaps peripherally to their mainstream interests. The environmental health and architectural fraternities came readily to mind; it was concluded for this reason that the publication would be enriched if it sought to improve or extend awareness of when, how and with what potential benefit the *Index* reader should reach for the services of a professional acoustician. Accordingly the reference section was modified through the introduction of relevant tutorial material, directed primarily at those without, or perhaps presently receiving, training in the subject. A developing sensitivity to the requirements of potential advertisers suggested that a widespread free distribution of a reduced version containing only the commercial section and a small sample of the reference section to members of the Institute and also to known key personnel outside it would

prove to be a strong attraction. Recipients of this version would be receiving a useful commodity carrying the name and image of the Institute to a wider audience which would at the same time give them tangible encouragement to purchase the matching reference section to complete the manual. The choice of a ring binder increased the potential attraction of the product as it opened up the possibility of regular updating issues carrying additional material.

It was recognized from the start that the financial equation of the scheme contained some particularly uncertain items. Nevertheless the general approach was considered to be broadly satisfactory, when reasonable allowance was made for the likely range of these uncertainties. For the purposes of calculation, the initial distribution was assumed to include all members of the Institute, every Chief Environmental Health Officer and Chief Architect or equivalent in the public sector throughout the United Kingdom and Northern Ireland together with some 500 selected addresses covering large and industrial architectural offices, government agencies and consulting engineers. This accounted for some 3,300 copies of a probable print-run of 4,000 and even an optimistic guess at the income from the recipients ordering the reference section pointed to the need to attract a good level of advertising income. The author took the view that, given clear exposition, the concept and organization of the commercial section, taken with the nature of the guaranteed audience, would eventually prove irresistible to those actively seeking a vehicle to advertise their products or services. Despite the worrying uncertainties the overall formula was deemed workable.

Towards the end of 1986, and with the prior approval of Council, invitations to participate in the commercial section were distributed to some 800 companies, organizations and individuals at addresses gleaned from a wide variety of sources that implied some involvement with acoustics or noise control.

In the event, the response was somewhat below the author's most cautious estimate. The author's view of the pulling power of the concept underlying the commercial section was, it seems, not immediately shared by potential advertisers. Even though the cost of entering advertising was comparable to the figure quoted by agencies for simply posting out a similar number of copies of a company's own literature, the matter of cost was frequently raised.

The immediate outcome of this untutored foray into the realities of the

advertising world was that the author was unable to give Council, at its February 1987 meeting, an assurance that the project would be immediately financially viable. Council perfectly correctly decided that in the absence of such an assurance the Institute was not in a position to support this enterprise directly. However, the author was sufficiently convinced of the role and value of the embryo publication both to acoustics as a subject and to the Institute in particular, that Council gave permission for the enterprise to proceed, subject to the author making independent financial arrangements.

The collection and preparation of material for both sections was put in hand; the uncertainties in the cost equation meant that production expenses had to be contained without compromising effectiveness and quality. One necessary economy was that the entire publication was typeset by the author himself in the Institute office using Macintosh technology combined with laser printing facilities.

The reference section grew to over 300 pages, mainly as the result of a generous licensing agreement with James Ramsey of Ramsey Consulting, Wisconsin, USA which allowed the reproduction of a classified listing of over 2,800 references in acoustics and noise control which he had recently published in the USA. The tutorial element of the reference section took the form of 11 review articles commissioned from respected authors within the Institute and the part of the reference section selected for inclusion, by way of sample, in the reduced version comprised those pages of chapter 1 which detailed aspects of the Institute's organization. In total, the reference section derived from the author's perception of the essential information a typical practising acoustician, or indeed any other professional working on the fringes of the subject, might wish to find in one location.

For reasons of cost, the printing and print-finishing, collation, packaging and posting, were undertaken on Merseyside. High grade materials, including heavy-weight gloss paper were used throughout as a means of ensuring the quality of the finished product.

With regard to revenue from this venture, the price of the reference section was set at £30 for members and £48 for all other recipients of the reduced version. The complete publication would be available for purchase by libraries and other organizations at an inclusive price of £55.

The importance of maintaining up-to-date information was recognized and

the recipients of each version are to receive appropriate up-dating packages without further cost in Autumn 1987 and Spring and Autumn 1988.

In this way some 3,300 copies of the reduced version were duly produced and despatched during May and June of this year, using sources such as address lists purchased from the Royal Institute of British Architects. Institute of Acoustics members whose stated professional interests included underwater acoustics or speech were only sent their member's copy upon request. The full version, which weighs about 4 kilograms, was sent to those who had pre-ordered it.

It is perhaps early to draw general conclusions about the wider acceptability of the final product, but the picture so far suggests the *Index* has struck a favourable note in terms of both concept and realization. Advertisers have taken the trouble to contact Edinburgh to report early successes. The one negative reaction that has surfaced sufficiently frequently from the membership to justify mention, is a disappointment with the number and range of companies that have taken advertising space in the first issue. The author finds encouragement in this, as it confirms the impression that recipients are actually using the publication and that some at least are looking forward to having additional informative advertising literature included; this, one might suppose, bodes well for additional support coming forward for the three updating issues. Ironically, perhaps, the most favourable comments have come from advertising agents retained by some of the relevant companies; their profession, it seems, conducts an endless quest for the means of keeping their clients' literature on the desk and out of the waste basket.

The publication, production, marketing and distribution of this book has been a formidable undertaking for a small institution to be involved with. It is unlikely the author would have taken the project through to fruition if he had paused to envisage a pile of boxed reference manuals of sky-scraper dimensions – and all that implies. The same is true had he appreciated the hard and persistent work involved in securing advertising. More pertinently, perhaps, the informal reactions received at Edinburgh make it clear that the *Index* has achieved at least some of its objectives by extending awareness of the subject of acoustics and of the existence of the Institute outside its normal bounds. Indirect benefits available to the Institute from the whole exercise include the identification of corners of the UK acoustics world that have unfortunately

Editorial

What! an editorial – whatever is the *Bulletin* coming to? Honest, dear readers, I won't do this too often but I am moved by the need to emphasize the fact that without your contributions the *Bulletin* would hardly exist.

We need the reports of Branch and Group secretaries – I know we get some and thank you for those but we don't get them all regularly.

Now about technical articles. I know you are all very busy but the *Bulletin* does need articles on all aspects of acoustics and its applications to provide a balanced and interesting journal. For example, in January we shall be featuring the subject of Vehicle Noise Control, with articles on legislation, power train noise, tyre design and noise, the QHV90 project, and quiet vehicle development and testing. This should have been featured in the present issue but some of the articles have been delayed.

What we now need to do is build a supply of technical articles to provide material for future issues so that we avoid the hand to mouth existence we suffer at present.

So it is up to you, the readers, to take up your pens and give us the benefit of your expertise and experience.

Marjorie and I just do the editing and preparation – it is up to you all to provide the copy.

John W Tyler
Editor

been left untouched by the Institute.

The publication exhibits, perhaps, the good and bad points to be expected of a product that was emphatically not designed by a committee; it should be viewed as one member's perception of something that would prove valuable and acceptable and likely to give an upward twist to the wider image of the Institute and the subject of acoustics.

The latest picture, on going to press, is that the all-important additional advertising revenue appears to be coming forward in some measure for the updating issues from organizations and individuals who had been, for whatever reason, initially hesitant. Sales of the reference section have been at an encouraging level, although suggestions of means for stimulating further sales and also for raising advertising income, compatible with maintaining the good name of the Institute, are actively sought.

R Lawrence

Acoustics at Building Design Partnership

D W Templeton

to end

This article should have a proper place in this issue in FULL PAGE, 24pt Title

Diploma in Acoustics and Noise Control 1987

Titles of Diploma Projects

should be clearly differentiated

Building Design Partnership is a multi-discipline design practice of about 1200 staff, and still growing fast. The mainstream skills are architect, engineers (civil, structural, mechanical, public health and electrical engineers), landscape architect and interior design. Specialist skills include CAD, energy, electronic systems, and acoustics. The practice recently celebrated its Silver Jubilee.

BDP Acoustics was formed in 1981 as an association with Professor Peter Lord, with whom BDP had worked for many years. The link with his Department of Applied Acoustics made available considerable expertise, equipment for examination of noise problems on site and new laboratory facilities for component testing. The form of consultancy provided has frequently been from inception to final commissioning of a building, covering site noise, surveys, representation at public inquiries, advice on basic planning and service concepts, detailed design consideration of building elements, performance specification on ventilation and sound systems, supervision and commissioning.

We work with the parent practice of BDP on major projects. A current example is the Folkestone Terminal of the Channel Tunnel. Careful planning, roadside barriers and mounds will protect three local villages. Computer programmes check the cost effectiveness of particular screen configurations, shielding predicted high vehicle flow rates.

Office and dealing room centres are thick on the ground, but the most prolific building type is shopping centres. One centre in East Kilbride poses the challenging pot pourri of ice rink in shopping malls, overlooked by a library. The library has some very special 47 dB SRI double glazing. The ice rink will be made even 'deader' than BDP London's rinks at Lee Valley, Chelmsford and, potentially, Slough. Another leisure client is American Multi Cinemas: following the commercial success of The Point, Milton Keynes, with its 1200-seater social centre, fast food halls, bars, terraces, foyers and 'ten plex' cinema, AMC are going ahead with more than ten 8- or 10-screen centres throughout the UK.

Granada TV has commissioned a series of projects from BDP Manchester; including rebuilding Coronation

Bristol Polytechnic

Environmental impact of quarry blasting
Is the modern motorcycle noisier than the modern car?
The design and performance of a silent vacuum supply for a player piano
The evaluation and control of noise from clay pigeon shoots
Investigation of sound insulation in a new built tenement and identification of the flanking transmission paths
An investigation into the noise and vibration problems associated with the installation of personal lifts for disabled persons on the party walls of residential dwellings
Noise and vibration study of a factory relocation development
Assessment of future noise environment around Locking Castle development area

Colchester Institute

Properties of various materials when used as secondary vibration isolators
Clay pigeon shooting - noise assessment
Noise from an extract ventilation unit
Traffic noise assessment and the road surface as a component
Design and performance of a combined silencing system for a single cylinder diesel engine
Acoustic treatment of high pressure axial flow fans in series
Aircraft noise at Cambridge
Swimming pool acoustics
Design of fans for low vibration applications
Rail freight traffic noise on Ipswich to Felixstowe line
Pneumatic breakers - practical and legislative noise control
Fan noise from a grain storage unit and construction of an attenuator
Noise from a 2000 tonne onion store
Engine test bed noise and its attenuation
Noise criteria and control of microlight aircraft

Cornwall College

Using the Epson Hx 20 Microcomputer as a back-up for noise measurement in the field
The noise from powerboats
The control of noise emission from an externally sited refrigeration plant

Derbyshire College

The natural frequencies and damping ratios of a short railway rail
Design of noise control package for food processing machines
Noise and vibration produced by blasting at a new mine site
Control of industrial noise in the heavy plant fabrication shop
Noise from road heading machines
Diesel locomotive silencer design and noise measurement
Attenuated performance of in-duct fan noise for different splitters
Production and implementation of a hearing conservation policy
Landscape and parks maintenance: noise and vibration aspects of tools
A device to control amplified sound
Railway noise and housing development
The prediction of sound outdoors
Reduction of noise in Mark 3 sleeping cars

Heriot-Watt University

The sound insulation of a timber joist floor
Noise levels of refuse collection vehicles
Occupational noise exposure - municipal incinerator
An acoustical assessment of Motherwell Civic Centre
The stiffness of porous materials
Noise levels inside a slaughterhouse

Leeds Polytechnic

Investigation of party wall insulation
Use of the microcomputer in acoustics
Protection of hearing at work
Evaluation of noise from a clay pigeon shoot
The problem of speech communication and reverberation times in open plan offices

Liverpool Polytechnic

The effectiveness of sound insulation works at a house in Stockport
The effects of atmospheric variables on the propagation of sound over increasing distance
An investigation into the noise exposure of light aircraft flying instructors
An investigation into the effects of cuttings and embankments on railway noise
An investigation of the levels of vibration produced during power driving and its effect on buildings and people
Improving a lecture hall's acoustic performance
The use of a single dB(A) level difference to characterize the effectiveness of a glazing system
Subjective assessment of sound levels from car stereos and their effect on hearing loss

North East Surrey College of Technology

Investigation into noise levels associated with the use of a Kenting drilling rig 26 at Aldingbourne Rise near Bognor Regis
The effects of noise from a new road on the working environment in a nearby office building
Implications of road traffic and railway noise (including vibration) on a proposed housing development site
Investigation into the sound insulation properties of a floor between two conversion flats
Investigation into the noise problems of Broadoak village hall
Investigation into the sound levels recorded from a water cooling tower compared with prediction methods
Investigation into noise from model aircraft flying at Barton's Point, Isle of Sheppey, Kent
Project to investigate the relationship between motorcycle silencer design and frequency attenuation
Consideration of noise caused by the use of a bottle bank
Investigation of low level noise originating from a boiler room sited beneath a residential property
Assessment of airborne sound insulation in a recent housing development
Investigation into the airborne sound insulation properties of a party-wall timber-stud partition
Comparison of the measured and predicted positions of the 70 dB(A) L10 (18 h contour), and future shifts in position of this contour across a site earmarked for housing development
Noise problems in an open-plan office
A study of the proposed Channel Tunnel rail traffic 1987
Acoustic assessment of the Band Practice room of the Household Cavalry Regiment
Investigation into the sound insulation properties of an office partition
Examination of aspects of motorway noise, with particular reference to the M25 and the Ashted/L Leatherhead Gap
An answer to a typical noise problem from roof mounted plant causing environmental problems to nearby residences
Assessment of the comparative noise rating of window types
To further reduce noise emitted by noisy vacuum pump inside enclosure
Investigation of window sound insulation around Heathrow Airport
Assessment of noise produced from a commercial laundry situated in a residential area
Acoustic assessment of the Broadbridge Heath Free Church
Investigation into the noise levels and possible risk of hearing damage to workforce at a factory

Sheffield City Polytechnic

Assessment of a hearing conservation programme in a steel company
Noise nuisance caused by barking dogs
The use of sound exposure level (SEL) in the measurement and prediction of railway noise
Study of the sound transmission between two flats, before and after the installation of sound insulating material
Survey of noise dose levels (LEQ) received by refuse vehicle drivers
Assessment of the impact of vibration on a community from a light rail transit system
Assessment of environmental noise levels following the introduction of a light rail transit system
Assessment of noise levels during quarry blasting
Dance studios – a cause for complaint?
Investigation into an alleged noise nuisance from a village hall
Prediction of peak particle velocity on a residential structure from quarry blasting
Sound insulation of party walls in dwellings
A hearing conservation plan for Doncaster Abattoir
Calculation and measurement of sound pressure levels in a reverberant area
Investigation into the causes and effects of exposure to noise of meat inspectors in a pig slaughterhouse

Tottenham College

Inadequate sound insulation in flat conversions: a case study and legal implications
The acoustics of Sadlers Wells Theatre
Investigation into noise problems at Hertfordshire BTR Ltd, Dunstable
An investigation into levels of gravel extraction noise on surrounding residential property
A study to compare the 1967 BS4142 with the revised 1987 version
Studies of noise exposure levels experienced by clay pigeon shooters
Sound insulation in converted dwellings – a practical guide
Noise implications of the proposed redevelopment of Hartlands Road Fareham
An investigation into noise emitted from plant commonly available for hire to both public and trade
A field investigation into railway noise propagation
The suitability of Westminster City Council Chamber as an auditorium
Acoustic test and design report on the Broadcasting House London
An investigation of noise nuisance and sound insulation
An investigation of road traffic noise levels at a residential development in Harlow

Street (some of those attending the Spring IOA Conference last year in Salford may recall the walkaround!), conversion of a listed building for indoor sets, and a new production building (this held a full size Chamber of the House of Commons at the time of the conference visit). The latest project is to set up a 'Studio Tours' Centre based on Hollywood precedents. You go in a party of 30 and 'experience' different film-making techniques. High performance sliding doors/walls will hide the surprise of a steam train hurtling towards you on a hydraulic ram from the hushed demonstration of sound dubbing in the stop-off point before. Fires break out in Baker Street as you pass in your tram. You can see a circus in a new auditorium, built at arm's length from copious steam trains (the Greater Manchester Museum of Science and Industry is next door neighbour to Granada and BDP are involved in multi-million building works there also – including several auditoria). Another major conversion scheme is the BDP London proposals for the Institution of Civil Engineers, Westminster. This fine Edwardian building will have improved halls for conference venue use.

Half our work has been for outside architects. We have worked with local authority clients at the Albert Hall, Bolton, rebuilt as a chamber concert hall for 700 audience, and a multi-purpose hall for 1500 at Carlisle. Private architects are happy to work with us, although sometimes suspicious of the scale of BDP, its success and depth of design market penetration. We are nearing completion of a 550-seater recital hall in Worcester (architect Buttress Fuller Partnership) and our second private-sector school music building, with larger recital spaces, rehearsal rooms and small practice rooms.

A major commercial consultancy is on a new printing building for the *Daily Mail*, an investment potentially exceeding £100 million (architects Watkins Gray International). The challenge here is to adequately contain the noise of presses, by high performance building fabric to protect local residents. Control rooms and noise havens are double glazed, or separated by 11 mm multilaminate interlayer 'Pyrostop'. A 96-hour site noise survey in Surrey Docks was somewhat longer than our normal attendance.

Other architects with whom we have worked include Jeremy Dixon/BDP, Troughton McAslan, Byron Clark Partnership, and Frank Shaw and Partners. The latter have involved us in a large teaching hospital development in Sheffield.

contd on page 8

Meeting Report

Developments in Instrumentation and Computation in Acoustics

26 May
Society of Chemical Industry

This one-day meeting of the Institute was held on Tuesday, 26 May at the Society of Chemical Industry in London. Only 35 or so delegates attended this meeting, which was a disappointment in view of the topic and the venue. It is always difficult to determine precise reasons why attendance at a particular meeting is poor. In this case the fact that about a quarter of those attending were late registrants would seem to suggest that holding it on the day after an English bank holiday had something to do with it. It merely serves to illustrate just how many things have to be considered by the organizers of the meetings programme. It will go into the store of experience and will (it is hoped) be avoided in the future.

The bad news for those people who did not make the effort to attend is that they missed an extremely good meeting! The majority of the papers considered instrumentation for measuring and logging noise levels in some form or other but the variety of the solutions to deal with slightly different situations was fascinating. The meeting started with the exceptions to the measurement rule. The curtain-raiser was a paper on 'A New Microcomputer System for the Assessment and Development of Singing Ability' which was presented by David Howard of University College London and demonstrated an interesting but, to most of us I am sure, unexpected application of microcomputer technology in the wider field of acoustics. Computers are good for performing calculations and presenting the results graphically and Stuart Bennett and Alan Maneylaws of British Coal had taken advantage of this in the development of their software for predicting machinery noise in the coal industry environment, although the same technique could be applied to many situations.

All the noise monitoring and measuring papers were interesting and I apologise in advance to those authors to whose papers I do not draw particular attention in this necessarily brief report. Ralph Weston of RAF Halton highlighted many of the problems that face people who are trying to monitor noise levels in the great outdoors. He also reminded us of how almost all environmental noise monitoring was performed in those distant days before the L_{eq} meter arrived and then went on to describe the design of the 'Semi-

permanent Noise Monitoring System' that the RAF has commissioned. He then somehow managed to arrange a practical demonstration of the noise levels produced by a low flying military aircraft during the lunch period which followed his paper.

Lunch was a particular high point in the day's proceedings if not the whole year. For those of us who can barely remember what the word 'summer' is supposed to mean, the day was a beautiful early summer's day with warm sunshine and a cool breeze. To make the most of this unusual condition the lunch was served in the paved courtyard with a fountain playing and it made the return to the lecture theatre all the more difficult. En route there was also a small exhibition of the instrumentation that was the subject of many of the papers. This provided another admirable reason for delegates to dawdle on the way.

The friendly rivalry between the various systems being described can best be highlighted by drawing attention to the juxtaposition of two papers in the middle of the afternoon. Dudley Wallis of Cirrus Research Ltd extolled the virtues of storing all the raw data in the Sound Level Meter and then using a computer to retrieve it and process it in a variety of ways at a later date, while Martin Armstrong of Bruel & Kjaer (UK) Ltd put forward the opposing

viewpoint, advocating the use of a clever meter that could provide almost any form of data reduction on the spot. For me, Martin's paper will be particularly remembered for his definition of the historical time frame of Sound Level Meters – BC being Before Computers and AD After Digitization! Not all of the computers discussed were the desktop varieties that are now found in homes and offices. Martin Lester and Julian Morgan of Liverpool Polytechnic presented two papers that were related to 'Multi-Channel Data Acquisition and Processing for Intensity Analysis'. The machine that they were using for their processing was a significantly more sophisticated piece of equipment. I hope that this brief review will encourage many people to order copies of the Proceedings so that they can see just what they missed in the full programme of eleven papers.

I would like to thank all those people who contributed to the success of the day by giving papers, bringing equipment to the exhibition or just attending as a delegate. I hope they found it worth while. The Society of Chemical Industry are to be congratulated on the surroundings and services that they provided for this meeting and finally thanks should go to the meeting organizer, Fred Mak, who put so much effort into the organization. It was a tragedy that in the event he had to go to work and could not attend the meeting, but it was a tribute to his organization that the day ran so smoothly in his absence.

Robert Hill

Acoustics at Building Design Partnership (continued)

The pressure of work load has not prevented us writing on acoustics, which also serves as a showcase to some of our projects. *Detailing for Acoustics* (Lord/Templeton) is in its second edition and *The Architecture of Sound* (Lord/Templeton) came out in September 1986. This includes 34 case studies of auditoria world-wide. *Acoustic Design* (Templeton/Saunders) is a primer. All three are published by The Architectural Press Limited.

As a wholly-owned subsidiary of BDP, we are of modest scale (four in-house, with seven of Peter Lord's Department providing complementary technical back-up). With rising external noise levels, greater client expectation, and increased use of air conditioning plant within buildings, the market for acoustic consultancy in the building industry appears to be wider than ever.

NATLAS Accredits AIRO

Following a detailed assessment of its operating and technical procedures, the Hemel Hempstead based firm AIRO (Acoustical Investigation and Research Organization Ltd) has been accredited as a NATLAS laboratory listed under registration number 0483. The accreditation encompasses measurements of sound insulation and sound absorption to British and International Standards, together with field measurements of noise levels from lawnmowers and generating plant under the EEC Article 100 Directives.

Technical Articles

The editorial board would welcome offers of technical articles on Acoustics and related subjects likely to be of general interest. Please contact the Editor, John Tyler, at the address on page 1.

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Meeting Report Speech Group — No, not a Speech Group Meeting

(The First Franco-Britannic Meeting on Speech, Plestin-les-Grèves, Lannion, France, June 3-5, 1987 Font etc as left hand page ←)

In September 1986 a meeting of the Groupe de la Communication Parlée of the Société Française d'Acoustique was held which was attended also by some members of the IOA Speech Group. During that meeting, it was suggested that the forging of international links between speech communities should perhaps be carried beyond the stage of informal contacts and collaborations involving isolated groups and individuals, though these were still both useful and productive. The Chairmen of the British and French Speech Groups agreed to hold a Franco-Britannic Meeting on Speech at Lannion in June 1987 with the initial objectives of 'establishing a first contact between two neighbouring scientific communities, reviewing the range of leading work being done by each, and discussing common research aims'. It was agreed that the first meeting should be a relatively small and informal one, to which the French and British Speech Groups would each invite about twenty-five workers active in speech research, representing as wide a range of interests and backgrounds as possible. As many as possible of the major centres of speech research in each country should be represented.

The Speech Group committee issued invitations early in the year after some difficult and unlooked for decisions. The organization of the meeting and arrangement of local facilities and transportation in Brittany was undertaken by our French colleagues and hosts with the generous support of the Centre National d'Etudes des Télécommunications (CNET) at Lannion. As a result, twenty-four British scientists, together with their French counterparts, duly arrived at the Kerallic Domain by the morning of 3 June. The accommodation blocks, conference facilities and restaurant of the meeting venue were centred around a château on a wooded cliff above the sea at Plestin-les-Grèves.

Old friendships were renewed, and new ones quickly formed during a morning visit to CNET to see the work and organization of CNET and the way in which speech research is fostered in French governmental and academic institutions. Demonstrations of current CNET research projects in speech synthesis and recognition had also been arranged.

The meeting proper began in the

afternoon of 3 June and continued the following morning with brief, five-minute presentations concerning the organization, facilities, current work and future aims of each of the major laboratories and groups represented at the meeting (nearly thirty in all), assisted by printed surveys which the French organizers had prepared and issued prior to the meeting. The surveys were presented in two parts. The first was a list of laboratories, summarizing their names and addresses, the number of scientists working in them, their broad areas of interest and the major equipment, essentially computing machinery, which they used. The second was a list of speech scientists, summarizing their names and addresses, the principal activities of their laboratories, the individual research pursuits of the scientists and their future objectives. These directories, of less than one A4 sheet per entry, are regularly compiled by the Groupe de la Communication Parlée of the Société Française d'Acoustique. They proved to be so useful and informative that the committee of the Speech Group is currently considering emulating the French example and undertaking a similar exercise in Britain. No doubt Speech Group members will be hearing more soon about this first positive outcome from the Franco-Britannic Meeting.

The second stage of the meeting began in the afternoon of 4 June and continued on the following morning. Four discussion topics were selected to explore the future of speech research, each chaired by two leading British and two leading French scientists and lasting about two hours. During the first part of each session, discussion papers were presented, and opened to general discussion in the latter part of the session. The first session was devoted to 'Phonetics' and among the issues discussed was the future of phonetics and its role in automatic speech synthesis and recognition. The second session, on 'Synthesis and Evaluation', considered how synthesis could be improved, what its applications were and how its quality could be evaluated. There was much discussion about synthesis by rule, the nature of those rules and how to build suitable knowledge bases into synthesis systems; and the problems of prosodic effects and inter-speaker variability. However,

the popular notion that good automatic speech synthesis is yet a 'solved' problem, still less that the human articulatory system has yielded up all its secrets, was firmly disposed of! The third discussion topic was that of 'Recognition and Evaluation', similar questions being asked about recognition to those about synthesis. The core problem of pattern-matching raised examinations of connectionist models and parallel processing techniques. Speech perception studies also were felt by some participants to have a role to play in elucidating successful mechanisms of speech recognition. The final discussion session, 'Technology and Market', debated the relatively slow development of speech technology. There was one claim that there would be an enormous market for a recognizer that could reliably distinguish the word 'yes' from the word 'no'. It is not clear whether our French colleagues have a similar problem! In parallel with the discussion sessions, demonstrations by a number of laboratories represented at the meeting were offered for viewing. They included speech recognition systems and a video-disc based system for lip-reading training and assessment. A comprehensive range of published reports was also displayed and made available to participants.

The discussion sessions, complemented by the convivial meals, proved to be a most useful catalyst and amply fulfilled the hopes of the organizers. The interchange and discussion of information and ideas continued long after the end of the formal sessions. It rapidly became clear that the scope for international co-operation was founded on much stronger common ground than had been previously apparent to any but a few groups of speech researchers.

However, the final session in the afternoon of 5 June, a review and evaluation of the meeting itself, showed that much more had been achieved. Four important developments emerged to seal its success, all of which are now being carried forward. Firstly, the arrangements for the interchange of electronic mail between participants were clarified and encouraged. Secondly, it was agreed in principle that the British Speech Group and the Groupe de la Communication Parlée should interchange information by appending material transmitted across the Channel to informal newsletters issued to their memberships. The French already publish a newsletter regularly, and the Speech Group committee is therefore considering a similar publication. Thirdly, the committee of the Speech Group has approved a proposal that the Chair-

men of the British and French Speech Groups should explore the possibility of establishing a European Speech Association. This is being handled by a working party led by René Carré, and it is hoped that a further announcement will have been made at the European Conference on Speech Technology in Edinburgh in September 1987. The fourth outcome of the meeting was the decision to hold a second Franco-Britannic Meeting on Speech at the University of Sussex in 1988, oriented more towards technical issues. The intention will be to invite papers in specific fields of speech research, so that larger numbers of speech workers spanning a wider spectrum of activities can benefit from the Franco-Britannic associations that were so successfully formed at the first meeting.

Judging by the success of the first meeting, there are excellent prospects for future Franco-Britannic co-operation. As one participant said, it was a very good meeting 'extremely full of entente cordiale'. For that, the participants are indebted to the Groupe de la Communication Parlée of the Société Française d'Acoustique, to CNET, and, especially, to Christian Benoit, Jacqueline Vaissière and Claire Issler, who invested so much time and effort in the venture.

List of participants

British

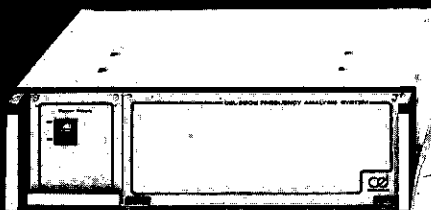
E Abbernon, A Fourcin, V Hazan and M Huckvale (Dept. of Phonetics and Linguistics, University College London); W Ainsworth (Dept. of Communication and Neurosciences, University of Keele); P Alderson (IBM UK Scientific Centre, Winchester); M Brooke (School of Mathematical Sciences, University of Bath); C Darwin and S Isard (Experimental Psychology Unit, University of Sussex); F Fallside (Engineering Dept. University of Cambridge); H Fuller (NPL, Teddington); S Hiller and J Laver (Centre for Speech Technology Research, University of Edinburgh); J Holmes (Uxbridge); R. Moore (RSRE, Malvern); R Patterson (MRC Applied Psychology Unit, Cambridge); D Pearce (GEC Research Ltd, Wembley); J Peckham (Logica Cambridge Ltd); C Scully (Dept. of Linguistics and Phonetics, University of Leeds); C Shadle (Dept. of Electronics, University of Southampton); A Simons (Dept. of Computer Science, University of Sheffield); M. Tatham (Advanced Speech Technology Laboratory, University of Essex); M Taylor (Smiths Industries, Cheltenham); and I Watson (Phonetics Laboratory, University of Oxford).

French

C Abry and L-J Boë (ICP, Institut de Phonétique, Grenoble); C Benoit, M Cartier, R Descout, S Maeda, C Sorin and J Vaissière (Centre National d'Etudes des Télécommunications, Lannion); G Boulakia and I Guillemin (Institut Ling., Université de Paris VII, Paris); J Caelen, R Carré and B Guerin (ICP, Laboratoire de la Communication Parlée, Grenoble); N Carbonell and J-P Haton (Centre de Recherche en Informatique de Nancy, Equipe RF-IA, Nancy); G Chollet and J-P Tubach (Ecole Nat. Sup. des Télécommunications, Paris); M Eskenazi and J-S Lienard (LIMSI-CNRS, Orsay); G Alcouffe (Société Crouzet Valence); J-P Lefevre (Société OROS, Meylan); A Marschal and M Rossi (Institut de Phonétique, Aix-en-Provence); H Meloni (GIA, Marseilles); B Merialdo (Centre Scientifique, IBM France, Paris); G Perennou (Cybernétique des Entreprises, Reconnaissance des Formes et Intelligence Artificielle, Toulouse); J Potage (Société Thomson, Gennevilliers).

N Michael Brooke ✓

CEL 8000 REAL TIME FREQUENCY ANALYSIS SYSTEM



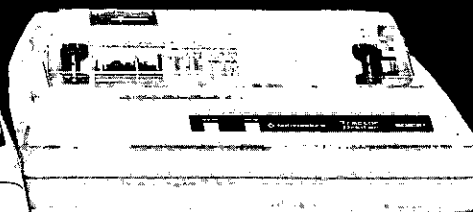
CEL-8010, 8020 features

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- Calculation of Transfer Functions from measured or manually entered spectra



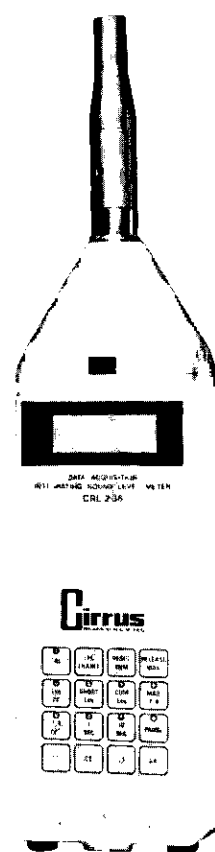
Lucas CEL Instruments Ltd
35/37 Bury Mead Road,
Hitchin, Herts, SG5 1RT
Tel: Hitchin (0462) 52731
Telex: 826615 CEL G



CRL 2.36 Data Logging Leq Meter CIRRUS RESEARCH – THE QUIET ACHIEVERS

Features:

- 114,000 Separate Leq stored
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“OUT-BOX PROCESSING – A MEASUREMENT REVOLUTION?”

The CRL 2.36 is the world's first 16 bit short Leq meter. Up to 114,000 separate Leq values can be stored in the internal memory in 1/8th 1 or 10 second periods. The data in the CRL 2.36 cannot be accidentally destroyed and at any time later can be downloaded to an external computer for measurement.

The dynamic range is 120dB and no controls need be used during acquisition. Thus the only vital task at acquisition time, is to have the meter in the correct place. Even calibration is automatic; all you do is put on a sound source and press a button!

The data is kept in unchanged integrated form on the floppy disk and as many copies as required can be made, to be re-played on any compatible computer. Thus

raw data copies can be archived or even sent to the other side of the world.

During the measurement phase, ANY index or statistic of the noise level can be calculated, assuming peak is not involved. The software provided with the CRL 2.36 will calculate the Leq between ANY two periods; measure ANY Ln between ANY times inside the file. There is no limit how often you can have a printout, from the basic period, which can be 1/8th second, up to the full 114,000 short Leq periods, which can be well over a full week. All the decisions on “What to measure” are left until this measurement phase. No decisions have to be taken at acquisition time.

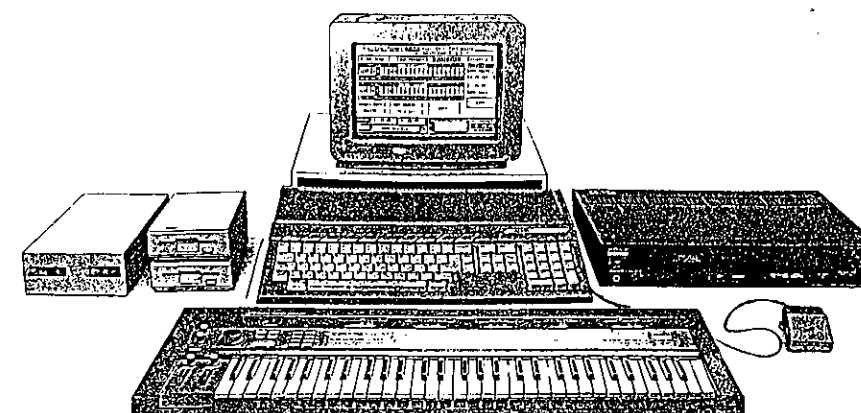
This separation of acquisition and measurement, opens up new

possibilities for acousticians. Not only can more data be obtained than with an older generation community noise analyser, but the analysis is a scale order quicker. As the power of current desktop computers is so much greater than even the very best “in-box” processing Leq meters, calculations which would have been impossible in commercial consultancy become routine. If, for example, an authority decides to ask for 1 minute Leq's instead of 15 minutes, it is no problem with the Cirrus software. 4 key-strokes and it will be done! With other systems, no matter how sophisticated, it would be impossible. With “in-box” processing Leq meters, the original time scale is fixed at acquisition. With “out-box” processing everything is fixed on replay.

CIRRUS RESEARCH – PUTTING COMPUTERS TO WORK IN ACOUSTICS

Cirrus Research Ltd, Acoustic House, Bridlington Road, Hunmanby, North Yorks. Tel: 0723 891655

COMPOSERS' DESKTOP PROJECT



The Composers Desktop Project (CDP) is an initiative to bring extremely powerful music-computing facilities within the grasp of the average musician or college department for the first time.

Using cheap but powerful domestic computing and digital hi-fi equipment, the project is adapting sophisticated computer music tools developed at such international research centres as Bell Laboratories, The Computer Audio Research Laboratory (UCSD, California) and IRCAM over the last 20 years to run on a low cost digital music workstation in your own home.

Apart from handling conventional musical (MIDI) data it will be able to completely restructure recorded sounds or synthesize new sounds in any conceivable way, with 16-bit professional audio precision.

The project will use the ATARI-ST microcomputer, and the SONY PCM Digital Recorder as part of a compact digital sound studio and sound-processing laboratory. The recent adoption of international standards for both music programming languages ('C' and 'Lisp') and musical data-representation ('MIDI') means that universal music computer software, developed on main-frame computers, can be transferred onto this compact system, and powerful new musical tools can be developed.

Despite the power of the system, however, the hardware for one stand-alone work-station will cost only about the same as a new upright piano.

Origins of the project

The Composers Desktop Project is not a commercial organization. It was established by a group of Yorkshire-based musicians concerned with the lack of major computing facilities for composers and musical researchers in the UK. Until the present time anyone in Britain with a serious interest in this rapidly expanding field has had to travel to

Boulez' IRCAM centre in Paris, or to various research institutes in the USA.

The recent development of cheap 16-bit personal microcomputers, with very large memory capacity, and the gradual standardization of approach in music computing, both in research and commercial spheres, have made it possible to contemplate adapting the powerful tools developed at the major international centres to run on a low cost personal system, accessible to all. This is precisely what the CDP is doing.

Furthermore, as these new tools are in software (rather than fixed in hardware), the musical environment they generate is completely open-ended, allowing a musician to design electronic 'instruments', sound processing 'devices', or composing tools according to his or her requirements, with none of the restrictions imposed by commercial hardware design. Ultimately we can envisage that such a sophisticated technologically-based music environment will become as accessible to the twentieth century musician as a piano would have been in the nineteenth century.

A network for co-operation

Equally importantly, the Composers Desktop Project is helping to initiate a radically new approach to co-operation in the field of music/technology through the establishment of a computer communications network over the telephone lines, which will enable individual musicians, schools and colleges to communicate with each other and with centres of research.

This solves a major dilemma for musicians working in this field. On the one hand they are faced with commercially packaged software which although often very good, is inflexible, and certainly not open to being modified or rewritten by the musicians themselves, to suit their own particular needs.

On the other hand, the competition

to use the public-domain facilities at the world's major research institutes is so intense that even for internationally-established composers there is a two year waiting-list! Similarly the limited studio facilities in University Departments in the UK cannot cope with the demands placed on them by former students wishing to continue making technologically-based music.

The CDP's network concept and its cheap hardware, will allow musicians and music software developers all over the UK to co-operate with one another in the development of the tools that musicians really need. This development is seen as so important that a number of research institutions and individuals outside the UK have already expressed an interest in participating in the project.

What the future holds

Ironically, the development of such decentralized resources is beginning to be favoured by the big international institutions themselves. Composers lucky enough to be invited to these centres will in future be able to develop their ideas in detail in their own home, before going on to the centre to put the finishing touches to their work, thus considerably reducing the pressure on the centres' own resources.

There are also plans afoot to establish software research projects based around the system, at the University of Keele, and also at the University of York, which has already co-operated in the development of a hardware interface for the music workstation.

Andrew Bentley
Thomas Endrich

Richard Orton
Trevor Wishart

ACCENT SYSTEMS – Acoustic and Environmental Technology

Enterprise Oil plc, having recently acquired ICI Acoustics, have re-launched the company as ACCENT SYSTEMS – Acoustic and Environmental Technology.

Accent Systems is a leading specialist in the design and manufacture of advanced products for noise and environmental control, their engineering design and contract management teams being capable of handling the most complex projects. The company's solutions are helping to meet noise control criteria, provide employers with means to meet environmental regulations and make workplaces safer and more pleasant for operators.

Proceedings of The Institute of Acoustics – Abstracts

Outdoor Sound Propagation

One-day meeting at the Society of Chemical Industry, London, on 14 September 1987

Measurement of the Reflection Coefficient of a Material with Ill-defined Surface

Yasushi Miki
Institute of Interdisciplinary Research, Faculty of Engineering, The University of Tokyo, Japan

A new method for measuring the reflection coefficient is proposed. In this method the distance between a material and an observation point is estimated from the minimum phase property that the sound reflection system may have, and the direct measurement of the distance is not needed. Therefore, this method is applicable to the case that the surface of a material is not well-defined, such as grassland. The case of non-minimum phase is also discussed.

Impulse Measurement of Ground Impedance

A J Cramond and C G Don
Chisholm Institute of Technology, Australia

The main features of an impulse technique for determining soil impedance from the shape change to an acoustic pulse will be summarized. A comparison will be made of measurements obtained over a variety of soil types and with different coverage. This will highlight some of the advantages and disadvantages of the pulse technique. Finally, the effect of adding moisture to the soil will be described. This gives rise to narrow peaks in the impedance at one or more frequencies, which have not yet been adequately explained by models involving a layered ground. A simple method of determining an effective flow resistivity of moist ground will be outlined.

EEC Lawnmower Certification and the Effect of Ground Absorption

Richard D Bines
Sound Research Laboratories Limited

Experience is presented on the results of development programmes for three major UK lawnmower manufacturers to produce quieter machines in order to meet the EEC Directive 84/538 on grass cutting machinery. The effects on the A weighted sound power levels of some 40 machines tested in accordance with the directive are used to illustrate the various contributions to the total noise generated by a machine. Tests were carried out within a Reverberation Chamber, in free field with a reflective surface and on different grass surfaces. The effect of these different surfaces is illustrated even though each location satisfied the site qualification procedure required by the Directive.

The proposed use of an artificial surface with a fixed absorption coefficient is discussed.

Ground Effect on Long Range Sound Propagation

Johann Wempen
University of Oldenburg, West Germany

The prediction of outdoor noise propagation requires the knowledge of the acoustic properties of the reflecting ground surfaces. The behaviour of outdoor grounds is examined at ranges from

20 m to 100 m. The dependence on grazing angle and source-receiver separation is considered to enable a correct extension to larger distances.

The transmission of sound along those surfaces can be described by the theory of sound propagation at grazing incidence. It predicts a low pass characteristic for realistic soil surfaces that may be described by their specific normal impedances.

The frequency dependent impedance for a variety of surfaces is deduced from measurements and an attempt is made to classify the surfaces in terms of characteristic behaviour of the impedances.

The Boundary Integral Equation Method in Outdoor Sound Propagation

S N Chandler-Wilde and D C Hothersall
University of Bradford

The boundary integral equation (BIE) method is restricted to the prediction of sound propagation in a homogeneous still atmosphere, but allows arbitrary boundary shape and surface impedance. A BIE, for propagation above an inhomogeneous impedance plane, is given, its numerical solution by a product integration method recalled, and recent results on the implementation and convergence of the numerical method are stated. The case of propagation from a line source over a parallel infinite barrier of finite thickness, situated on a homogeneous plane, is then discussed. A new BIE formulation for this problem is stated, which uses the numerical solution for the inhomogeneous impedance plane, and which can be shown to have a unique solution. A method of numerical treatment of this BIE is discussed, with reference to its accuracy and efficiency as a function of the wavelength. Comparison is made with analytical results and with model experiments. Numerical results, on the effect of different barrier configurations, are presented.

Propagation of Sound from Industrial Sites through Built-up Areas

Ing C A Nierop
M + P raadgevende ingenieurs B.V., Aalsmeer – Holland

Within the framework of the Dutch Noise Abatement Act rules were given to measure and calculate noise propagation in the vicinity of industrial plants. The 'Handleiding Meten en Rekenen Industrielawaai' (guide for measuring and calculating industrial noise) suggests technical procedures for this.

Not included in this guide is a method to calculate the excess damping due to buildings in residential areas. This excess damping is mainly due to screening and scattering.

At first a more qualitative method will be discussed, based on the results of a great number of measurements in the field. From this an average damping term has been determined for different types of buildings.

The damping term refers to the free field propagation as calculated from the Dutch propagation model (down-wind propagation). A more analytic method, based on a calculation model for

sound propagation in factories, is now being developed.

Sound Propagation in Three Environments, With and Without Snow

K Attenborough and H M Hess
The Open University, Milton Keynes, UK

J C Rogers and S M Lee
Michigan Technological University, Houghton, MI, USA

A series of outdoor sound propagation measurements has been conducted. Three environments were selected: pine forest, a deciduous wood, and bare ground. Measurements were conducted during the summer with annual foliage present and during the winter with snow present. Snow depths were variable. The controlled sound source, a loudspeaker located at a height of approximately 1.3 m, was driven by a white noise source and amplifier. Receiving points were established at several ranges, 12 m, 24 m, 48 m and 96 m. Two different receiver heights were used, 1.2 m and 2.5 m. Received signal power spectra were averaged at each of the receiving points using a two-channel spectrum analyser and then stored on magnetic disk for analysis. Several plots of sound attenuation with distance have been prepared for comparison of attenuation characteristics for the different experimental configurations.

Meteorological Effects on Sound Propagation in Forests

M J M Martens and W H T Huisman
Group of Eco-acoustics, Laboratory of Experimental Plant Ecology, Catholic University, Nijmegen, The Netherlands

Due to the typical thermodynamic properties of high-growing vegetation, the woodland microclimate differs systematically from the microclimate of an open terrain or a build-on area. Since sound propagation at ranges longer than 100 m is strongly influenced by temperature and wind gradients, the differences in microclimate have to be reflected in differences in sound transmission.

Model output and measurement results will be presented concerning the triangular relation between vegetation structure, micro-weather, and sound transmission.

With regard to noise abatement we will discuss whether and how vegetation may be used to manipulate the propagation of noise in the rural and the urban environment.

Development of a Robust closed form Integration Procedure for tracing Sound Rays through a Stratified Atmosphere

F Walkden and M West
University of Salford

Integration of the characteristic equations for three dimensional ray paths can be performed by using standard numerical procedures. However, for rays which return to the ground, the number of integration steps becomes prohibitively large. Assuming that the atmosphere can be divided

into thin strata, such that over each stratum the wind and sound speed behave in an approximately piecewise linear manner, the integrands can be manipulated so that integration using standard closed form procedures is feasible with this approach. The ray path computation is found to be significantly improved in terms of its speed and accuracy. The closed form procedure, however, is prone to breakdown due to sensitivity to small errors in the coefficients of the integrands under certain conditions. The development of a computer program for tracing the rays which overcomes these sensitivity problems is described.

The use of the three-dimensional ray paths in a procedure for calculation of enhancement factors on the ground is discussed.

Application of Creeping Wave Theory to an Acoustic Impulse

A J Cramond and C G Don
Chisholm Institute of Technology, Australia

The theory of sound penetration of the refractive shadow boundary by creeping waves is outlined and the predictions compared with experimental impulse propagation results. Initial discrepancies in both pulse shapes and amplitudes were attributed to the restrictive approximations in the

theory. Removal of some of these approximations has resulted in a significant improvement, although the theory overpredicts the attenuation well inside the shadow zone. The effect of changing the ground impedance on both the theoretical and experimental impulses will also be discussed.

The Dependence of Outdoor Sound Propagation on Temporally Varying Meteorological Conditions

Dennis W Thomson
Department of Meteorology,
The Pennsylvania State University, USA

Diurnal and weather dependent variations in atmospheric temperature, humidity and wind profiles are of enormous importance in determining both the spatial and temporal characteristics of sound propagated outdoors over distances ranging from a few hundred metres to tens of kilometres. Depending upon local weather conditions and topography, atmospheric sound channels may be persistent, but temporally changing, features for selected source-receiver compass bearings. The diurnal variability of frequency dependent atmospheric absorption coefficients strongly depends upon both weather and surface micro-meteorological conditions. Sound refraction depends critically upon constantly changing ambient temperature and velocity profiles.

Using a combination of measurements and models, we demonstrate in this paper the incredible sensitivity of propagated sound to the structure of and processes occurring in the atmosphere's surface and planetary boundary layers. In particular, the spatial distribution and temporal variations of propagated sound as a function of frequency are shown for a variety of both typical and 'extreme' weather conditions.

Noise Control Foundation Conference Proceedings Available

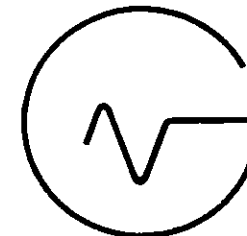
High Technology for Noise Control was the theme of Noise-CON 87, the 1987 National Conference on Noise Control Engineering. The Proceedings contain 126 papers on a wide variety of topics including: noise emitted by gears, valves and steam tubes, axial and centrifugal fan noise control, drill noise, chain saw noise, combustion noise, noise barriers, highway noise, sound absorptive materials, and sound intensity techniques; 800 pages in all. Cost is \$60.00; overseas orders must be paid in US Funds, through a US bank or a correspondent bank in the US, and \$18 per book should be added if shipment overseas is to be by air.

Post to: Noise Control Foundation, PO Box 2469 Arlington Branch, Poughkeepsie, NY 12603, USA.

Also available are the Noise-CON Proceedings for the odd-numbered years 1973 to 1985, and most of the Inter-Noise Conference Proceedings for each year from 1972 onwards. Titles and prices may be obtained from the Noise Control Foundation at the above address.

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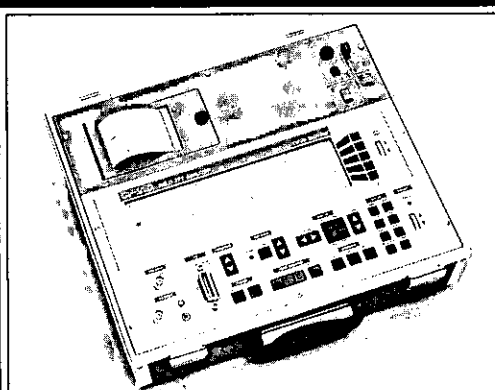


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INSTRUMENTS

This is very inconsistent in structure / Groups THEN BRANCHES?

BRANCH AND GROUP NEWS

North West Branch

Evening Meeting,
State of The Art Hi-Fi

In June the branch met at Salford University to hear some of the most expensive State of The Art Hi-Fi available. Jim Kerfoot of Sound Decision Ltd acted as host for the evening and introduced Peter and Guy from Audio by Design Ltd who had driven up from Brighton for this demonstration. Peter described the philosophy and design of the equipment which comprised a turntable, arm and hand-made cartridge. Amplification was provided by an Audio Innovations prototype preamplifier feeding two class A valve power amplifiers and, finally, Snell type C speakers; the total package, including good quality cables and connectors, costing around £10,000.

Peter played several tracks of music of mainly 1950 to 1960 recordings from his extensive record collection. There followed lively discussion on the sound quality of analogue versus digital recording and reproduction. It was a pity that there was not a similar quality digitally based system to put this to the test in a back-to-back comparison. Mike Ankers thanked our guests for providing us with an entertaining and stimulating evening and the branch adjourned to a local pub where discussions continued long into the night.

Chris Waites

London Branch

Twenty-eight people attended the fourth meeting of the Branch held on 17 June to hear Brian Hemsworth present a most interesting review of the work being carried out by British Rail's Acoustics Group into the generation and control of rolling noise.

Many attempts have been made in the past to produce quiet wheels, with results varying from very disappointing to various degrees of improvement. Before any real progress can be made in this area it is important to understand the mechanism of noise generation from a rolling train. Work was carried out on BR Inter-City trains to assess the accuracy of a theoretical model developed by Remington in the United States for predicting the effectiveness of rolling stock design in reducing the problem; if the predictions were good, this would provide a far more cost-effective tool than building test models which had been largely done hitherto. The work was undertaken at stretches along the

London-Edinburgh line with accelerometers placed on various parts of the track and wheels. The noise generated was monitored at various distances from the track and also on the train. The work confirmed that the main cause of railway noise was that generated from the wheel-to-rail interface, and this was largely due to surface roughness caused by corrugations on the wheel and track, the former being due to the effect of tread brakes.

It was found that the model broke down when equating the amplitudes measured to track roughness and train speed.

For this particular study, the rail was found to be the main radiator of noise up to about 1.25 kHz with the wheel becoming increasingly more prominent above 1 kHz. The result of this work is that the method used for the last ten to fifteen years is still employed, i.e. compare a new design against anything running which is very close to it, as a first approximation, although work on the use of predictive tools is still being pursued.

Since this meeting, Remington has published two papers on a revised model and a vibration study (see JASA, 8, (6), pp 1805-32).

John Wade

Letter from the Vice-President Groups and Branches

I was pleased to see that the last issue of the *Bulletin* carried a good number of reports from Groups and Branches reflecting the generally healthy state of the Institute in those areas. I was particularly pleased to see that the London Branch had revived the evening meeting series. There are many members within the London catchment area and with a well planned programme I hope the efforts of John Simson and his committee are rewarded with good attendances. Members from the outback planning to hit town should check their latest *Bulletin* to see if an 'evening meeting' is on; they will be most welcome.

Now that the Industrial Noise Group has a committee and, I understand, a programme of future events nearly finalized, I can stop bullying Stuart Bennett and turn my attention to other groups. Both Speech and Underwater Groups have well planned programmes, as does the Physical Acoustics Group. The latter should have held its first AGM by the time you read this. The

Physical Acoustics Group

Ultrasonic Studies of Bone - Report of a one-day meeting at the University of Hull, 20 May 1987

On 20 May 1987 the Physical Acoustics group of the Institute of Physics and the Institute of Acoustics sponsored the first meeting devoted to the use of ultrasound for the study of bones. One of the most serious problems for the NHS at the present time is the very high demand for orthopaedic beds from post-menopausal women suffering from osteoporosis. Osteoporotic weakening of the bone leads to fractures of either the hip, the wrist or the spine in twenty-five per cent of the female population.

At present the existing techniques for diagnosing and studying osteoporosis nearly all rely on the use of ionizing radiation. It is difficult to envisage that they could be used either as a screening device for the whole population or for repeated measurements on a particular patient. In addition these approaches have accuracies and repeatabilities that could, with benefit, be improved.

In an attempt to sidestep these problems a technique was developed some three years ago to use ultrasound to measure the density and structure of the bone. The bone that disappears in the elderly woman is the inner, spongy cancellous bone which is particularly prevalent in the neck of the femur (hip), the vertebral bodies (spine) and the

contd on page 16

Building Acoustics Group? well, is it a group or several individuals? Have they got a programme planned? Watch this space for exciting news in the near future!

A number of Group and Branch treasurers have raised queries in the past about their accounts at head office and in particular about the difficulty in obtaining up to the minute information about the balances. I have raised this matter with the Institute Treasurer and with our secretary, Cathy Mackenzie, and there was some discussion at the last council meeting on this topic. Everybody agrees that the situation has to be improved but there are problems in introducing a unified scheme that would satisfy not only G & B treasurers and the auditors but also the VAT man. We are pursuing the matter and I hope I shall be able to report satisfactory progress by the end of the year. In the meantime any treasurers requiring financial details should contact Geoff Jackson directly.

Geoff Kerry

radius and ulna in the wrist. An easily accessible site of the cancellous bone is in the os-calcis, or heel bone, and this site was chosen for ultrasonic study. In particular it was found that the frequency of ultrasonic attenuation in the range from 0.2 to 1.0 MHz was particularly sensitive.

The appropriate index for the bone state was the rate of attenuation increase with increasing frequency (or broad band ultrasonic attenuation, BUA) and this index was found to be low for an osteoporosis sufferer and higher for a healthy cancellous bone. Since the initial development, prototype commercial equipment has been produced and has been used by many centres in the UK and abroad. It was the purpose of this meeting to bring together all the interested parties to review the developments made so far and to discuss the future relevance of the technique to the study of osteoporosis.

The meeting was divided into three sections. Firstly, what factors of the cortical and cancellous bone influence the measurements of BUA? Miss M McKelvie of Hull University described a series of experiments designed to study the interaction problem and outlined the necessary theoretical approaches required to describe fully the observed attenuation of ultrasound. This approach holds the promise of extracting more clearly defined information from the ultrasonic measurements, perhaps allowing an absolute measure of density as well as obtaining structural information on the cancellous bone, which is a complex composite material with filaments and plates of bone enclosing fat pores.

The second section allowed several groups to compare the measurement of the BUA index with alternative techniques such as single photon absorptiometry (SPA), dual photon absorptiometry (DPA), and quantitative computerized tomography (QCT). Dr Hames, Mr Pettley and co-workers of Southampton General Hospital compared BUA with SPA, Dr Hosie of the Western Infirmary, Glasgow, compared QCT with BUA, Dr Evans of the University Hospital of Wales, Cardiff, compared BUA with both SPA and QCT, while Dr Kanis and Dr Murray of the Hallamshire Hospital, Sheffield, reported on DPA, SPA and BUA measurements. In all cases the results were encouraging for the new technique.

The afternoon session was devoted to illustrations of the clinical relevance of the technique. Dr Jones and colleagues from Loughborough University described the relationship between BUA and total body density, highlighting the com-

parison by considering two different populations: firstly a group of highly active males and secondly a group of age-matched sedentary males. This was followed by a paper from Dr J W Fordham from Middlesbrough General Hospital describing the use of BUA to study rheumatoid arthritis with and without steroid treatment where there is evidence showing that the steroid treatment leads in some cases to bone loss.

Finally, the meeting heard the preliminary results of population studies being carried out by Mr R W Porter and colleagues at Doncaster Royal In-

firmary. He has undertaken the daunting task of measuring 2000 old ladies as a statistical base for the study of fracture incidence. This should allow the measurement of BUA to be assessed as a predictor of fracture. Most promising results were described. The meeting was rounded off with a paper from Dr C M Langton, one of the pioneers of the technique, in which he summarized the present situation and looked optimistically to the future. It would seem that ultrasound has found yet another medical application.

Stuart Palmer

Musical Acoustics Group

Group Visit

Visit to the Bentley Piano Company Ltd, Woodchester, Stroud, Gloucester on Monday 20 July 1987.

On a rather wet day in glorious July members, together with a spouse or two, gathered at the Bentley Piano Co Ltd factory, situated by a millstream at Woodchester. The event had been organized in her usual efficient way by Jennifer Zarek; your Editor knows Jennifer is efficient because he, being a member of the Group, was present and was immediately delegated to prepare the visit report!

When we were told in reception to expect an Angel to show us round we wondered if perhaps the musical instrument concerned was, after all, a harp. However, all became clear when Frank Angel, Factory Director and a very practical and down to earth gentleman, appeared to act as our guide. Frank had worked his way up to his present elevated position through all the departments in the firm and thus was in an incomparable position to convert us all into expert piano makers.

The Bentley Piano Co Ltd was founded in 1906 by the grandfather of David Grover, the present Chairman and Managing Director. As the founder's father and grandfather made Grover and Grover pianos and David Grover's father spent his life with the firm, David represents the fifth successive generation, so that Bentley pianos benefit from a family tradition extending back to 1830. The Bentley name now incorporates the following famous names: Rogers (established 1843), Hopkinson (1835), Gerh. Steinberg (Berlin 1908), Zender (1892), Rich. Lipp u Sohn (Stuttgart 1831) and Grover and Grover (1830).

The Group had a most interesting and instructive tour round the factory,

starting with the cabinet shop. Solid timber, moisture controlled, medium density fibre board and chipboard are all used in their optimum position to make a strong and dimensionally stable framework for the working parts. Your editor, being something of an amateur cabinet maker, was particularly impressed by the quality of the wood veneers and the way in which they were matched. The cabinets are finished in matt polyurethane or gloss polyester and both modern and traditional cabinet designs are produced.

We then progressed through the various component shops: iron frames, the same as those supplied to a famous West German maker; soundboards and bass bars made from fine grain European spruce; actions, keys and hammers made by Herrburger Brooks, the oldest action manufacturer in the world, established in 1810; first quality West German Röslau tin plated steel piano wire;



One finished product

we saw all these components and more being assembled into complete pianos and the instruments adjusted and tuned – what an understatement of the care and attention we saw given to each instrument. The tuner was blind but carried out his work with a dexterity and precision surely not matched by a sighted person.

When we finally emerged from the factory and were led back to the reception area we were thoroughly saturated

with the elements of piano technology and very impressed with the skill and workmanship displayed to us. A warm and genuine vote of thanks was given to Frank Angel and the party then made its way to the nearby inn where lunch was taken and a Group committee meeting held.

Another successful event of the IOA Musical Acoustics Group.

John W Tyler



Spruce soundboard in course of construction; Mr Frank Angel, Factory Director, on left



Calls for Papers



Noise and Vibration Control on Construction Sites

One-day Meeting in Central London on 17 February 1988, organized by the London Branch. Papers are invited on all aspects of this subject including the following: the use of predictive techniques for estimating acoustic impact, with case studies of performance of models used; techniques for controlling noise and vibration at source; shock wave measurements from piling operations and shot blasting; occupational exposure to noise and vibration; legal aspects of control – including case studies of the use of Section 60 and 61 procedures.

Abstracts (approximately 200 words) for contributions of 20 minutes' duration, to one of the Meeting organizers before 30 November 1987, please. Organizers: Steven Turner and Paul Freeborn, London Scientific Services, The County Hall, London SE1 7PB. Tel: 01-633 2121/2981.

Acoustics '88

Annual Spring Conference of the Institute of Acoustics at Queens' College, Cambridge, on 5-8 April, 1988.

Contributions are invited in any subject area of acoustics, including: active control; aerodynamic and thermo-acoustics; architectural acoustics; medical and non-destructive testing; musical acoustics; psycho-acoustics; random media; road and vehicle noise and vibration; underwater acoustics.

Abstracts of 200 words to be submitted to the Conference Organizer and Programme Committee Chairman, Professor J E Ffowcs Williams, at the Engineering Department, University of Cambridge, Trumpington Street, Cambridge CB2 1PZ. Telephone enquiries to the IOA Office, Edinburgh.

BRANCH AND GROUP NEWS (continued)

Southern Branch

Brian Parker (Acting Secretary) has sent in the Meeting list for 1987/88. This has been included with the IOA Meetings list on the Inside Cover, but more details are given below:

October 27 (4.30 pm), *Vibro-acoustics of the Ariane Launch Vehicle Programme*, Dr G Borello, CNES, France (in association with Southampton Branch of the Royal Aeronautical Society), at the Nuffield Theatre, University of Southampton; 26 November, *Some Demonstrations in Aural Perception*, Professor C A Taylor (Joint ISVR-IOA) at the University of Southampton; in December (date and venue to be announced), *Boiler and Combustion Noise*, Dr C Lorn, Marchwood Engineering Labs, CEBG; 12 January, 1988, *Pile Driving Vibration Problems* (Joint with ICE), at the Guildhall, Portsmouth; 24 February (1.30 pm), AGM and *Modern Developments in Noise Control Equipment*, D Percy, IAC, at the Guildhall, Portsmouth; in March, *Practical Acoustical Applications in Property Conversions*, also at the Guildhall, Portsmouth; 28 April, *Condition Monitoring*, R Stewart, at the University of Southampton; and on 18 May, *Building Services Noise* (Joint with CIBS) at the North East Surrey College of Technology.

East Midlands Branch

Mr J G Walker of ISVR, The University, Southampton, will give a talk on Thursday 12 November at Loughborough University in the Manzoni Building at 7.30 pm entitled *Railway Noise – when is it a Problem?* There have been studies of the effect of railway noise on communities alongside the line, over the past 20 years, but widely recognized acceptability criteria have not been developed. Criteria developed for other transportation sources have been applied to railway noise in some instances, but take no account of the apparent differential responses to noise from different sources. Available information will be considered and possible definitions of 'reasonable levels of railway noise exposure' suggested. The meeting will be preceded by the AGM at 7.15 pm.

NON-INSTITUTE MEETINGS

1987

- 26-29 October NSCA 54th Annual Conference (including a session on *Transportation Noise*), in the Hewison Hall, Brighton Centre. Details from: The National Society for Clean Air, 136 North Street, Brighton BN1 1RG. Tel: 0273 26313.
- 26-30 October ROSPA: five one-day courses: *Monitoring the Workplace Environment; Monitoring for Dusts, Fibres and Gases; Noise Measurement; Noise Control; Noise Management Programme*. Details from: ROSPA Occupational Training Centre, 22 Summer Road, Acocks Green, Birmingham B27 7UT. Tel: 021-706 8121.
- 29 October *Active Vibration Control*, Seminar at IMechE HQ, London. Enquiries to: The Engineering Sciences Division, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ. Tel: 01-222 7899.
- 30-31 October Seminar: *Training Graduate Physicists for Industry*. Portsmouth Management Centre. Contact: Meetings Officer, Institute of Physics, 47 Belgrave Square, London SW1X 8QX.
- 3-6 November Short course: *Control of Industrial Noise and Hearing Loss Protection*. Details from: Pat Stenhouse, Course Secretary, Centre for Extension Studies, University of Technology, Loughborough, Leics. LE11 3TU. Tel: 0509 222161.
- 12 and 13 November Annual Conference of the Australian Acoustical Society, *Acoustics in the Eighties*, University of Tasmania, Hobart, Tasmania.
- 16-20 November Meeting of the Acoustical Society of America, Miami, Florida.
- 8-10 December British Medical Ultrasound Society, *19th Annual Scientific Meeting and Commercial Exhibition*, at the Conference Centre, Brighton. Contact: Mrs L Blench, BMUS, 36 Portland Place, London W1N 3DG. Tel: 01-636 3714.

1988

- 20-25 January *Envirotech '88*: 3rd International Exhibition and Conference on Pollution Monitoring, Control and Industrial Safety, organized by the Chemtech Foundation – Environmental Management Centre. Details: Chemtech Secretariat, Taj Building, 3rd Floor, 210 Dr D N Road, Bombay 400 001. Tel: 2942944 (4 lines).
- 1-3 March *Urban Noise and Territorial Administration*: 3-day International Meeting, organized by the City of Modena, Italy. Contact: Prof. P Zaniol, PMP Settore Fisico Ambientale, USL n. 16, Via del Pozzo 71, 41100 Modena, Italy.
- 22-25 March OPTICS/ECOOSA '88 (in conjunction with Electro-optics and Laser Exhibition). Metropole Hotel/NEC, Birmingham.
- 29-30 March *Colour Information Technology and Visual Displays*, Second International Conference organized by the Institution of Electronic and Radio Engineers. Venue: The University of Surrey, Guildford. Contact: The Conference Secretariat, Institution of Electronic and Radio Engineers, 99 Gower Street, London WC1E 6AZ. Tel: 01-388 3071.
- 9-10 April *Physics in Medical Ultrasound*. Contact: Dr K. Martin, Regional Medical Physics Dept, Newcastle General Hospital, Newcastle upon Tyne NE4 6BE.
- 26-27 April *Stress Analysis and the Micro – '88*. Brunel University, Uxbridge, Middx.
- 5-9 June 19th International Congress of Audiology, Jerusalem, Israel: *Early Detection, Identification and Management of Deaf Infants*. For information contact: Secretariat, 19th International Congress of Audiology, PO Box 50006. Tel Aviv 61500.
- 15-17 June NAM-88, *Nordic Acoustical Meeting*, organized by the Acoustical Society of Finland and the Tampere University of Technology. Contact: Jukka Linjama, Acoustical Society of Finland, Metallimiehenkuja 8, SF-02159, Espoo, Finland.
- 20-22 June NOISE-CON 88, *National Conference on Noise Control Engineering*, on Purdue University campus, together with exhibition; theme: Noise Control Design: Methods and Practice. Contact: Conference Secretary, Ray W Herrick Laboratories, Purdue University, West Lafayette, IN 47907, USA.
- 5-7 July *Sixth British Conference on the Teaching of Vibration and Noise*. Contact: Mr P Round, Short Course Support Unit, Sheffield City Polytechnic, 43 Broomgrove Road, Sheffield S10 2NA.
- 21-25 August NOISE '88, *5th International Congress on Noise as a Public Health Problem*. Abstracts by January 15, short papers before May 1, 1988. Contact: Conference Secretariat, Noise '88, c/o Reso Congress Service, S-113 92 Stockholm, Sweden.
- 21-27 August I.U.R.A.M. Congress, Grenoble, France.
- 30 August – 1 September *Inter-Noise '88, 17th International Conference on Noise Control Engineering*, Avignon, France. Theme: The Sources of Noise. Contact: Secretariat, Inter-Noise '88, BP 23, F 60302 Senlis Cedex, France.
- 5-7 September *Noise Control '88*, Cracow, Poland.
- 5-8 September *Healthy Buildings '88*. CIB Conference organized by the Swedish Council for Building Research in collaboration with the National Institute of Environmental Medicine, with the co-sponsorship of the World Health Organization. Information from: The Swedish Council for Building Research, S:t Gorangsgatan 66, S-112 33 Stockholm, Sweden.
- 3-5 October I.E.E.E. Ultrasonic Symposium, USA.

Information relating to meetings of possible interest to readers should be with the Editor at the address on page 1 no later than four months before the date of the meeting.

Book Reviews

Acoustic Waves; Devices, Imaging and Analog Signal Processing

Gordon S Kino

Prentice-Hall International, 1987, 601 pp, £68.50.

This book is an advanced level text which presents selected topics in physical acoustics. It is a substantial text (601 pages) that is packed with information and much of the material presented is based on work first given in papers produced by the Stanford University research community. The author states that this particular collection of material was first developed as class notes for two graduate courses on 'The Theory of Acoustic Devices' and 'Analogue Signal Processing'.

The book is a collection of 'packets of information' and it is soon seen by the reader that the author has a real grasp of his subject and has included much information gained through many years of experience in the field. The result is a text which is a useful combination of topics that are given a treatment which unites theory with examples of applications to devices and systems. It is also a text that is complementary to the material to be found in other books on related topics.

The book consists of four large chapters with many subsections and ten appendices. A brief review of sound wave propagation is given at the start of Chapter 1. This is followed by a review of the piezoelectric properties of materials and there is extensive treatment of piezoelectric transducers, their equivalent circuits, backing and matching properties. The discussion of several realistic design examples is included. The result is that Section 1.4 provides the best treatment of piezoelectric transducers and their design that I have seen.

Chapter 2 (45 pages) looks at waves in isotropic media, and their equations of motion in solids and fluids as well as the interaction of these waves with plane interfaces. This is then followed by a review of acoustic wave guides, interdigital transducers and both normal mode and perturbation theory.

Wave propagation with finite sources is considered in Chapter 3 (158 pages). Anyone seeking an introduction to fundamental aspects of the wavefields from acoustic and ultrasonic transducers based on piezoelectric material will find this chapter invaluable as it gives con-

sideration of the basic piezoelectric transducer theory and analysis for the wavefields due to finite sources, plane piston transducers, focused transducers and pulsed excitation. When the treatment of single transducers is complete the various forms of lensless acoustic imaging are covered: basic imaging theory, Fresnel lenses and digital sampling, chirp focusing systems, tomography and acoustic holography are then all addressed.

Chapter 4 covers 210 pages and presents an extensive consideration of transversal filters; sections consider linear passive SAW devices, charge-transfer devices, matched filters; FM chirp filters and chirp transform processors, bandpass filters, convolvers, adaptive filters, acousto-optic filters. This chapter could stand on its own as a course text covering this group of topics.

Ten appendices, covering 58 pages, are then given. Appendix A provides a good summary of stress, strain and the reduced notation. A collection of acoustic parameters of common materials is given in Appendix B and this section alone will be enough to ensure that this book will become a commonly used reference text! The following eight appendices cover specific selected theoretical topics.

Problems have been included at the end of most sections, which will make the book of added value to the teacher of an advanced course who is looking for coursework problems! In addition there is a good subject index and extensive lists of references are included.

The readership of this book can be expected to include many members of the physical acoustics research community; those working on underwater acoustics, SAW electronics and NDT/NDE, but it should also have a much wider potential readership. It is a book to dip into to find a particular piece of theory or a review of a particular topic and should be considered for the shelves of anyone working in these fields. It should also be considered by students and lecturers on Electronic and Electrical Engineering MSc or BSc option courses which cover 'Filters' or 'Acoustic Devices'. Some may feel that the book could well have been more useful if it had been divided into two smaller volumes; this would have increased the potential readership among students,

but in my view *Acoustic waves* remains a valuable contribution to the literature for both students and research workers. Possibly the best recommendation I can give is that I had to recover my copy from one of my research students to enable me to complete this review! He has already decided that this book is going to be a useful textbook for his work.

Leonard J Bond
University College London

Sound insulation of partitions in Broadcasting Studio Centres

K E Randall, D J Meares and K A Rose
British Broadcasting Corporation,
October 1986, £30. UDC 534.833.522.

This A4 sized document discloses the airborne sound insulation achieved by various types of partition used by the BBC over a period of 15 years in their studio facilities. A brief introduction to the sections which present the results explains that the data have been selected from measurements where flanking transmission was generally not an obvious problem, though it is stressed that the results inherently include transmission by all paths between source and receive rooms. Results for 350 individual partitions are categorized into appropriate groups by form of construction and/or by performance according to the average sound insulation in 5 dB intervals. No attempt has been made to convert the measured level differences into Apparent Sound Reduction Index form, but the authors have noted the order of the receive room reverberation times which may be helpful for those wishing to apply the results to other circumstances. The descriptions accompanying the results provide the basic construction details and any matters of particular note such as deviations from the norm.

The tables of results give measured level differences in the conventional one-third octave bandwidths but often over the extended range of 50 Hz to 8000 Hz. For each construction group the average values are given for each frequency band as well as the averaged result across the frequency range for each individual partition. This average value is based on symmetry around the 500 Hz band, so that the averages

INCONSISTENT style

a.b.c

remain comparable for rank ordering purposes irrespective of the actual frequency range used in each measurement. The results are presented graphically as well as in tabular form. Not surprisingly perhaps, many of the results represent the better end of the sound insulation spectrum, with such as studio/studio partitions and control room windows, but there are some results showing the effects of various door configurations and outside broadcast vehicle enclosures.

This reviewer felt that the book could be enhanced by a few more explanatory drawings to clarify some of the descriptions and by an index together with page numbering to assist finding items of particular interest. Overall, however, it is felt that the document provides a very useful extension to the existing, and in fact somewhat limited, sound insulation database.

A J Jones
AIRO

NEW BOOKS

Industrial Noise and the new EEC Regulations

A recent EEC directive requires that, by 1990, all member states introduce specific legislation to protect their workers from the effects of noise. The new noise limits, measurement techniques, control procedures, and responsibilities specified in the directive are slightly different from the Codes of Practice already enforced in the UK under the Health and Safety at Work Act 1974.

A recent leaflet published by Thoroughbred Digital Systems Ltd. (of 28a Fins Road, Cambridge CB2 1LA) describes the main provisions of the directive and suggests how they are likely to be implemented in the UK, with particular emphasis on the new responsibilities of employers, workers, machinery manufacturers, and factory designers.

Balancing Transport and the Environment

A 32-page, full-colour booklet entitled 'Transport and the Environment' was published in May by the Department of Transport as a contribution to EYE.

At the booklet's launch, Transport Secretary John Moore said: 'European Year of the Environment comes at a time when all of us have become more aware of the ways in which advances in our society can affect the quality of our

lives. Advances in transport are no exception.'

He went on to say that we all want the best of all possible worlds. A society which is mobile, in which goods can be moved to market quickly and cheaply and in which people can travel. Equally we want to protect our landscape, wildlife, buildings and archaeological heritage.

'The Department does not just talk about the need to conserve our environment - it is spending money in ways to achieve that end,' he said. 'The tunnels on the M25 and the tunnel to be built under Saltash to remove intrusive through traffic are examples of this commitment.'

Grants, he explained, are available to move freight from heavy lorries to rail and inland waterways, and in addition the Department funds the research and monitoring of a whole range of transport-related pollution problems.

'In the European Year of the Environment,' he concluded, 'anyone who is still unaware of the Department's efforts to balance the needs of the environment with the requirements of transport should read this booklet.'

It is available free from the Department of Transport, AM and M, Unit 10,

Ashwyn Business Centre, Burgess Hill, West Sussex, RH15 8QY.

Reproduced from EYE News, No. 2, June 1987.

Applied Ergonomics Handbook, 2nd edn, edited by Ian R Galer. Published by Butterworths, £19.95.

This is an established text, now extensively revised and incorporating ten new chapters including design of displays, controls and workplaces, factors affecting the working environment including climate, noise, vibration, vision and lighting, with a final chapter containing a series of useful case studies. The editor, Dr Ian Galer, is a senior lecturer at the University of Technology, Loughborough. ISBN 0-408-00880-6.

IOA Diploma

Courses are starting this month at 12 colleges throughout the UK and Northern Ireland. Institute Distance Learning Scheme is now in operation. Further information Mrs B Ruthven, Diploma Registrar at the Institute office.

CALLS FOR PAPERS NON-INSTITUTE MEETINGS

Sixth British Conference on the Teaching of Vibration and Noise

Sheffield City Polytechnic, 5-7 July 1988

Papers are invited covering specialized topics including: Control of vibration and noise; Architectural acoustics; Vibration applications to robotics; Sound reproduction systems; Industrial applications; In-service training of specialists and non-specialists, and many more. Summaries of 500 words by 23 November 1987, to Mr P B Round, Short Course Support Unit, Sheffield City Polytechnic, 43 Broomgrove Road, Sheffield S10 2NA.

Noise '88

5th International Congress on Noise as a Public Health Problem.
21-25 August, 1988, at Folkets Hus Congress Hall, Stockholm, Sweden

To promote exchange of knowledge related to the biological effects of noise, among research scientists, governmental agencies, industrial workers and managers, building constructors and city-planners, and health and environmental protectionists. Subjects will include: Noise induced hearing loss, Noise and communication; Non-auditory physiological effects induced by noise; Influence of noise on performance and behaviour; Noise-disturbed sleep; Community response to noise; Noise and animals; Combined agents. Organizers: Noise '88, c/o Reso Congress Service, S-113 92 Stockholm Sweden.

(Maximum 500 words abstracts by January 15, 1988)

New Products

Submissions for inclusion in this section should be sent direct to J W Sargent, Building Research Establishment, Garston, Watford WD2 7JR.

CANAL – Computer Aided Noise Analysis and Logging

CANAL, developed by a new Cambridge company, Thoroughbred Digital Systems Ltd, is a combination of hardware and software which transforms an IBM PC, XT, AT or close compatible into a multi-channel noise analyser and logger. It combines the functions of a data capture and analysis instrument in the audio frequency range, a noise analyser and dual-channel FFT analyser. Installed in a portable PC, CANAL can be taken into the field to perform instantaneous analysis on site.

With the addition of suitable microphones, CANAL provides analysis to

IEC 651 (BS5969) grade 1 accuracy.

The CANAL (Computer Aided Noise Analysis and Logging) hardware consists of a four-channel data acquisition assembly which fits into two PC expansion slots. The assembly incorporates programmable gain amplifiers, analogue-to-digital converters and all the necessary anti-aliasing filters. The assembly utilizes one of the latest and fastest digital signal microprocessors, the ADSP-2100. This device provides decimation filtering in real time to allow variable rate sampling, and carries out all FFT and spectrum weighting calculations at very high speed.

CANAL is suitable for many applications, such as noise and vibration analysis and logging, acoustic signal analysis up to 20 kHz, audio frequency line monitoring and speech analysis. Further applications can be simply catered for by using specialized software modules.

Programmable Dual Filter PDF 3700

Difa's enhanced PDF 3700 dual filter offers optimum filter efficiency in today's computer- or manually-controlled measuring systems. It offers a choice of: flat-amplitude, no-ripple filter performance for general purpose applications; optimized linear phase response for specific applications that demand undistorted signals with minimal overshoot; superior and ultra-sharp roll-off characteristics for highest filter efficiency.

The PDF 3700 has the following features:

- a frequency range from 0.1 Hz to 102 kHz;
- 3700 discrete frequency steps;
- variable tuning;
- local and remote control of cut-off

frequency, gain, high/low pass;

- overload indication;
- ungrounded operation to eliminate ground loops;
- IEEE-488 interface;
- choice of five different characteristics: Butterworth filter with stop band attenuation more than 90 dB; elliptic filter with 80 dB/oct and 0.01 dB pass band ripple; ultra-sharp filter with 150 dB/oct and a maximum of 0.3 dB pass band ripple; ETD filter with phase distortion less than 0.5 degrees; pass band filter with 80 dB/oct high pass and low pass.

Further details from LMS-DIFA Ltd, Prospect House, 2 Prince Georges Road, London SW19 2PT. Tel: 01-648 2595.

All measured and calculated data can be displayed graphically (and plotted with a suitable plotter), or can be stored on disk for further analysis (as a text file or as a Lotus 1-2-3 spreadsheet) for professional presentation.

Further details from Thoroughbred Digital Systems Ltd, 28A Hills Road, Cambridge CB2 1LA. Tel: 0223 358155.

CEL-8000 Real-Time Spectrum Analyser Upgrades

A range of system upgrades is now available to CEL-8010 Real-Time Third Octave Analyser users. The CEL-8020 is a 16 microphone channel version with built-in random noise source and is ideally suitable for sound power measurements and acoustic testing of building materials.

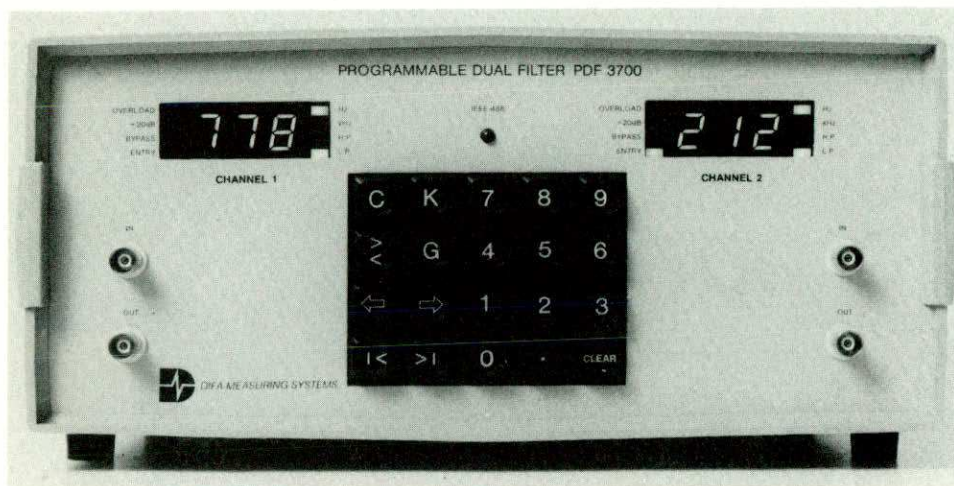
All users can take advantage of further software developments which enable up to 225 spectra to be acquired continuously at a maximum rate of 10 ms intervals and then stored to disk for subsequent recall and analysis. User selectable delays can be set to vary the spectrum acquisition rate. Once spectra have been stored on disk, then the BASIC Disk Recall program allows users to write their own software analysis routines for handling spectra stored on the 1 Megabyte floppy disk.

Further information is available from Lucas CEL Instruments Ltd, 35/37 Bury Mead Road, Hitchin, Herts, SG5 1RT. Tel: 0462 422411.

Waterfall Display Program for B & K FFT Analysers

Bruel & Kjaer (UK) Limited have announced a Waterfall Display Program for detailed analysis of non-stationary signals. The program is designed for use with their Dual Channel FFT Analysers Types 2032 and 2304. Applications of the software package Type WT9121 include machine run-ups and coast-downs, reciprocating machine analyses and order tracking on machines running at variable speeds.

The computing speed and the versatility of the IEEE interface of the analysers are fully utilized to give a fast spectrum transfer rate of up to 20 spectra per second. Spectra up to 800 lines can be transferred. A high degree of flexibility is also afforded. Spectra can be transferred at selected time



intervals, after a selected number of trigger counts, as a function of the operating speed of the machine under investigation, or under manual control. Similarly, a wide range of display options is provided. Measurements can be presented as 3-D plots of up to 100 spectra, as Campbell diagrams, as maximum value at each frequency, or as a plot of the total RMS level of all the spectra in the 3-D plot.

Harmonics single spectra and single frequencies can be studied in detail by selecting any slice of the display for viewing. To optimize viewing and analysis, 3-D plots may be skewed, the Z-axis reversed and the X-axis display range and the upper and lower Y-axis limits selected. Units are user definable for all three axes. For analyses of data recorded in the field with a tape recorder, the program incorporates a facility which allows recorded data to be played back at different speeds. Measurements can be stored on disk in user labelled files, and hard copies of any display measurement can be obtained by means of a plotter or printer.

Further information can be obtained from Bruel & Kjaer (UK) Ltd, 92 Uxbridge Road, Harrow, Middlesex HA3 6BZ. Tel: 01-954 2366.

NORSPRING – Rubber Springs

Northern Rubber's range of NORSPRING progressive rate springs has been substantially increased. Their range now includes over 60 types of spring which are capable of being modified with respect to hardness and deflection characteristics to suit individual requirements of loading, deflection and other operational parameters. Brochures and deflection curves for all types are available from The Northern Rubber Company Ltd, Victoria Works, Retford, Notts. DN22 6HH. Tel: 0777 706731.

State of The Art Digital Filter

The recently developed EF8 Universal Digital Filter is based on a design created by the UK's Medical Research Council Institute of Hearing, to simulate hearing responses, and offers filtering capabilities which cannot be achieved using purely conventional analogue technology.

The system allows the user to define frequency steps and attenuation levels across the whole of the filters dc to 30 kHz (audio) bandwidth. The EF8's modular construction means that it can be supplied as a single or dual channel

filter system, each containing full programmable sub-sections: anti-alias (pre-process) low pass analogue filter; universal digital; post-process low pass analogue filter. The EF8 is therefore able to offer up to 512 weighting coefficients for symmetrical responses, and programmable anti-alias and post-process filters, among many other features.

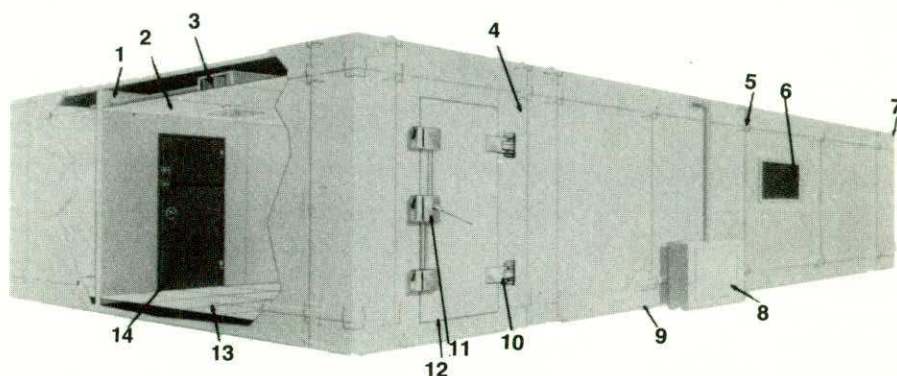
The EF8 came in for a special mention recently when Fern won the SCOT-BIC Innovation award. Applications for the EF8 are in audiology, physico-acoustics and speech-processing.

For further information please contact: Murdo J N Mackay, Fern Developments Ltd, 7 Springburn Place, College Milton North, East Kilbride G74 5NU, Glasgow. Tel: 03553 29464.

IAC Sentry Enclosures

From Industrial Acoustics Company comes news of a new product range designed to provide physical security for documents, computer tapes etc, and also to provide acoustic integrity to contain speech or radio transmission sounds and further radio frequency screening up to Tempest standards.

The capabilities of IAC Sentry RF/Acoustic Shielded Security Rooms are fully detailed in a new colour bulletin available from Industrial Acoustics Company Ltd, Walton House, Central Trading Estate, Staines, Middlesex TW18 4XB. Tel: 0784 56251.



Key: 1. Full height partitions provide high performance acoustic integrity, between divided areas; 2. Architectural acoustic ceiling for flush lighting, grilles etc; 3. Silenced and RF shielded AC/Vent System; 4. Panel joiner system clamped by bolts to ensure optimum RF shielding performance; 5. Cast joint covers to eliminate need to 'stuff' cracks to meet RF shielding requirements; 6. RF shielded vent inlet opening; 7. Fully welded, fabricated corners to prevent RF leaks; 8. Filter housing for power and communication lines; 9. Structure set on dielectric isolation and anti-vibration mounting system; 10. Trans-rotational hinges to enhance RF seal life and provide 180° door swing capacity; 11. Multi-point latching system ensures positive shielding; 12. Flush door with low threshold for easy access; 13. Raised access floor; 14. Acoustic door to vestibule can be supplied with sophisticated security locking.

New Acoustics Measurements Guide

Alan Fry, Technical Director of The Salex Group Ltd, presenting the first copy of the HEVAC 'Real Room Acoustics Test Procedure' to Richard Rooley, Partner, Donald Smith, Seymour and Rooley Consulting En-

gineers and current Chairman of BSRIA, at the 1987 HEVAC exhibition, together with Ron Baker, Director General, and Bob Wilkinson, Commercial Manager, of HEVAC. This new guide sets out the procedure for making meaningful acoustic measurements in real everyday rooms as opposed to the use of extensive acoustic laboratories.



SECRETARIAT NOTES

Professional Indemnity Insurance

At the request of several members we are exploring with brokers the possibility of a scheme that might possibly involve different scales for corporate and non-corporate members. Contact HQ if you have any views on this.

Typesetting

Facilities exist at the office for 300 dpi laserwriter typesetting (Macintosh technology) of books, descriptive literature, consultancy reports etc, to the standard seen in the Acoustics Index. Material could be submitted in handwritten or typed form or, preferably, on a disk prepared using Wordwise on a BBC micro (other formats and machines might be possible). Printing and binding also at reasonable cost. Contact Secretary.

Acoustics Index 1987-8

Members who have paid their 1987 membership fee and who believe they should have received a copy of either

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the shorter or (if they have paid £30 for the Reference Section) the full version, but have not yet done so, please contact the Secretary.

News of members

Mr R J Bowdler, Fellow, has left Sandy Brown Associates, and Mr C M Frier, Member, has left Monitor Acoustic Control. They have set up a partnership, called New Acoustics, operating from Glasgow.

Information on the whereabouts of the following please: P M Allen, N J Bourne, S R Braund, J M Davies, E K K Lau, S S Li, M Squirrel, R P Williamson, M F Y Wong (all Associates); K A Bishop, M J Davies, J Lincoln, A Syrett, C Xydeas (all Members).

Diploma

David Hughes, Member, has retired from Staffordshire Polytechnic. The future of the Diploma course there is uncertain.

PRESIDENT-ELECT

At the last meeting of the Institute Council it was agreed that Mike Ankers MIOA, will be elected President of the Institute of Acoustics for the years 1990/1992.

Mike has been an energetic and effective Chairman of the Meetings Committee for some years as well as being Vice-President; the Institute can look forward with confidence to the start of the next decade.

News of members

Dr M E Delany, Fellow, presently Head of Acoustics at NPL, leaves this month to take up an appointment as Rector of the Parishes of Copythorne and Minstead in the Diocese of Winchester.

Seminar

Active Vibration Control seminar, organized by the Institution of Mechanical Engineers, Engineering Sciences Division, 29 October. Programmes available from IQA office.

ACOUSTICS INDEX 1987-88

Orders being taken now for advertising space in the Spring 1988 updating issue. Contact IOA office.

OBITUARY

Arthur H Benade

Arthur H Benade, professor emeritus in physics at Case Western Reserve University, died on 4 August 1987 aged 62. He took early retirement last year because of illness but, in spite of his cancer, he continued to work from his home, writing papers and receiving visitors from many parts of the world, until just two weeks before his death.

Art Benade was known throughout the world for his work on tone production in musical instruments, especially the clarinet on which he was a very able performer. He was born in Chicago, spent much of his early life with his parents in India, but returned to the USA for university studies at St Louis. His early work was on cosmic rays and later on low-energy atomic and nuclear physics.

He gradually devoted more and more of his time to musical instruments and acoustics, became a vice-president of the Acoustical Society of America and, in 1984, received its silver medal for his

achievements. Among his many other affiliations he was a past president of the Catgut Acoustical Society, Chairman of the Technical Committee on Musical Acoustics of the ASA, associate editor of JASA, and a member of the scientific advisory committee of IRCAM.

He was a tremendous enthusiast; I had the pleasure of spending a couple of days in his home about fifteen years ago and learned more about wind instruments in that short time than I could have gleaned from months of reading. His interests were very wide and I remember especially some very moving conversations about civil rights.

His two books, *Horns, Strings and Harmony* (1960) and *Fundamentals of Musical Acoustics* (1976) will be a lasting memorial and he will be remembered with gratitude by countless students, researchers, instrument makers and musicians throughout the world.

Charles Taylor

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BDP Acoustics is a subsidiary of the multi discipline design practice Building Design Partnership which has offices nationwide. Based in BDP's Manchester office, but with a strong workload bias to London, we provide specialist consultancy both for BDP and external clients over a wide range of challenging and prestigious projects.

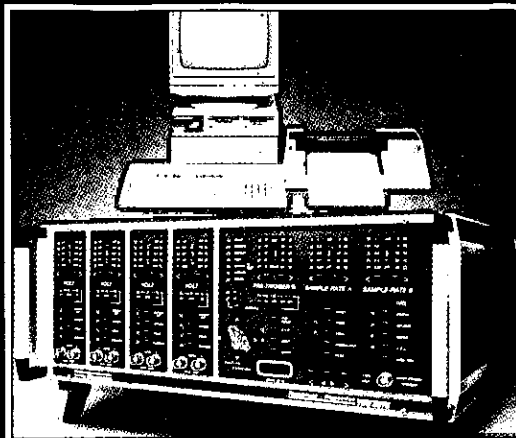
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Candidates should hold an engineering degree, and be able to demonstrate relevant experience in client-based projects, together with the ability to communicate effectively at all levels.

Applications from engineers working in industrial noise control, environmental noise, architectural acoustics or building services design would be particularly welcome.

An attractive remuneration package is offered, which normally includes a company car and profit-related bonus.

Written applications accompanied by detailed CV's should be forwarded to:

**AV Technology Limited,
Avtech House, Birdhall Lane, Cheadle Heath,
Stockport, Cheshire SK3 0XU.
For the attention of I F Bennett,
or K A Worthington.**

Hann Tucker Associates

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Hann Tucker Associates is a leading independent acoustic consultancy practice which is actively engaged in multi-million pound commercial office and multi-function development schemes, both new build and refurbishment/fitting out.

We wish to recruit acoustic design engineers with the skills and enthusiasm to take leading roles in these projects and advance to senior positions within the Practice.

Applications are invited from Corporate Members of the Institute of Acoustics, or engineers having qualifications leading to Corporate Membership.

Salaries are negotiable and will fully reflect the capability and potential of the successful applicants. Benefits include a company car and entry into a profit-related bonus scheme after a probationary period.

Please send a full CV in confidence to:

**Mr J E Ledgerwood
Hann Tucker Associates, 80-82 Maybury Road,
WOKING, Surrey GU21 5JH**



Institute of Acoustics baw! Meetings

1987

27 October	SB	Vibro-acoustics of the Ariane Launch Vehicle	Southampton
Autumn	PAG	Acoustic Microscopes and their Applications	
5-8 November	M	Reproduced Sound 3. Third Annual Conference	Windermere
12 November	EMB	Railway Noise - When is it a Problem?	Loughborough
18 November	LB	Noise Generation	County Hall, London
26 November	SB	Demonstrations in Aural Perception	Southampton
26-29 November	ING/M	Autumn Conference - Industrial Noise	Windermere
December	SB	Boiler and Combustion Noise	To be announced
7 December	M	Vibration Isolation of Heavy Structures	London
9 December	LB	The Work of the NSCA Noise Committee	County Hall, London
17-18 December	UAG	Underwater Communication and Position Fixing	Norwich

1988

12 January	SB	Pile Driving Vibration Problems	Portsmouth
20 January	LB	Sound Control for Homes	County Hall, London
3 February	M	European Year of the Environment, <i>Noise in the Nineties?</i> IOA/IEH Meeting	Birmingham
17 February	LB/M	Noise and Vibration Control on Construction Sites (one-day Seminar)	County Hall, London
24 February	SB	Modern Developments in Noise Control Equipment (and AGM)	Portsmouth
March	SB	Practical Acoustical Applications in Property Conversions	Portsmouth
1 March	PAG	Digital Signal Processing and Display Techniques for Ultrasonics	London
16 March	LB	Noise Control by the Airfields Environment Federation Trust	County Hall, London
5-8 April	M	Spring Conference - Acoustics '88	Cambridge
20 April	LB	Low Frequency Noise	County Hall, London
27 April	SB	Inaudibility in the Assessment of Noise Nuisance	To be decided
28 April	SB	Condition Monitoring	Southampton
18 May	LB	Visit to British Aerospace	Hatfield
18 May	SB	Building Services Noise	N E Surrey College of Technology
15 June	LB	The Problem of Marine Vibration	County Hall, London
22-26 August	M	7th FASE Symposium: Speech '88	Edinburgh

Key

M = Meetings Committee Programme
BAG = Building Acoustics Group
ING = Industrial Noise Group
MAG = Musical Acoustics Group
PAG = Physical Acoustics Group
SG = Speech Group
UAG = Underwater Acoustics Group
LB = London Branch

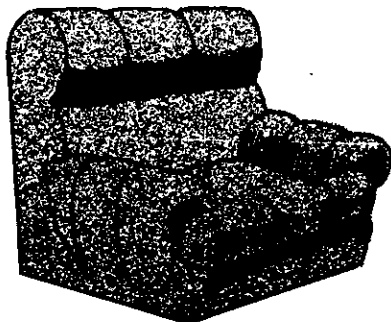
EMB = East Midlands Branch
NEB = North East Branch
NWB = North West Branch
SB = Southern Branch
ScB = Scottish Branch
SWB = South West Branch
YHB = Yorkshire and Humberside Branch

Further details from:

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