Acoustics Bulletin

April 1987 Volume 12 Number 2

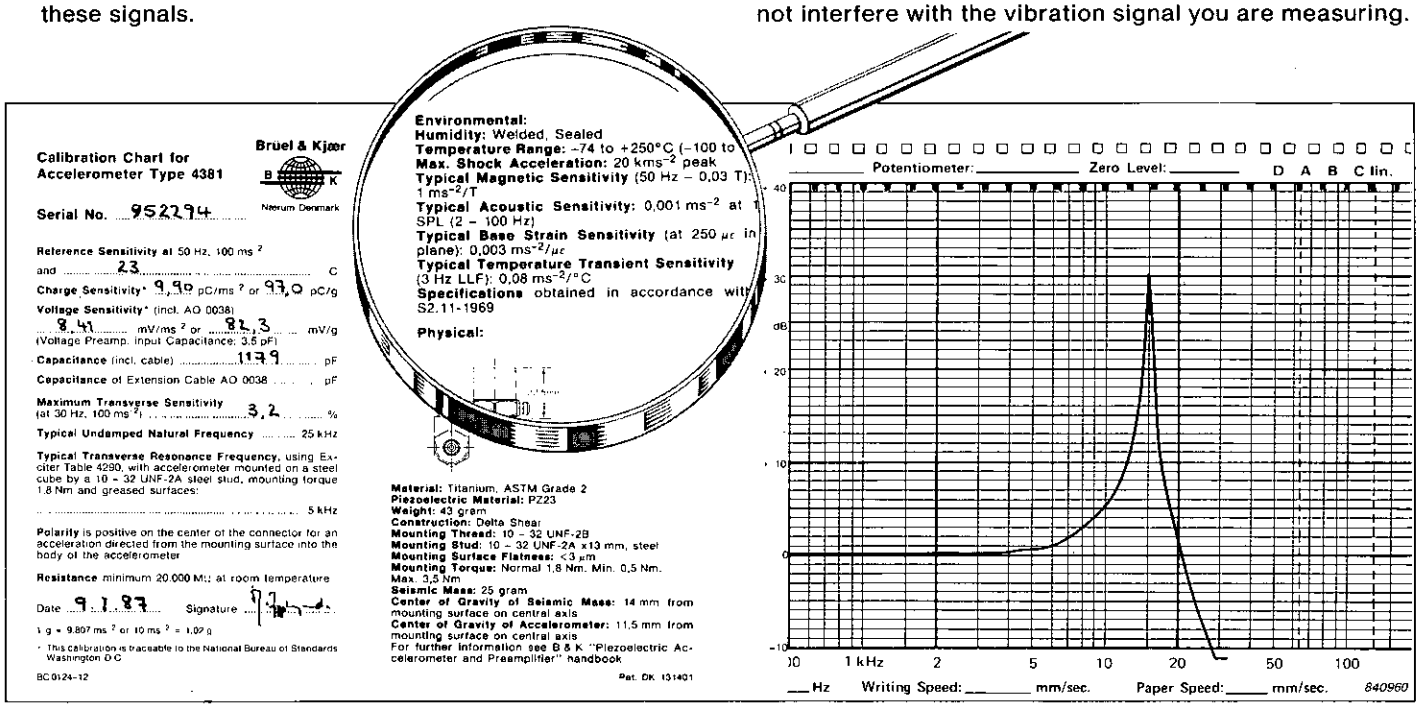
INSTITUTE OF ACOUSTICS

WHY NOT BUY THE BEST?

DELTA SHEAR® Piezoelectric Accelerometers

- ***Wide Frequency Range***
  Delta Shear® accelerometers have a working range from a **fraction of a Hz** up to many kHz. You can accurately measure vibration signals from machines running at very high speeds whilst retaining the low frequency components of these signals.

- ***Extremely Low Base Strain Sensitivity***
  Deformations under the base of an accelerometer can cause base strain effects which severely limit the reliability of your vibration measurements. Using Delta Shear® accelerometers **base strain effects are minimised** and do not interfere with the vibration signal you are measuring.



- ***Low Temperature Transient Sensitivity***
  Small fluctuations in the air temperature round an accelerometer are difficult to avoid in practical measurement situations. Delta Shear® accelerometers have significantly small sensitivity to these temperature transients and allow you to make **accurate low-level, low frequency** measurements.

- ***Wide Temperature Range***
  High temperatures are common where vibration measurements are made. The simple construction of Delta Shear® accelerometers, **using no glues**, allows you to make high temperature measurements and retain the long term performance of your accelerometer.

- ***Wide Dynamic Range***
  The unusually wide dynamic range of Delta Shear® accelerometers means that you can reliably measure both **shock** signals and **low amplitude** vibration signals.

- ***Long Term Stability***
  Delta Shear® accelerometers have integral **all-welded housings and connections**. Direct contact between components over a large surface area ensures the accelerometer characteristics remain stable. Your Delta Shear® accelerometer will give reliable results for many years.

- ***Individually Calibrated***
  Delta Shear® accelerometers are supplied with an individual calibration chart and, in most cases, a frequency response curve. Specifications are given according to the latest international standards, and the calibration is traceable to National Certification Bureaus. You know that your accelerometer has been thoroughly tested – we give you the results to prove it!

Write for our free 16 page colour brochure!

Brüel & Kjær

In the United Kingdom Bruel & Kjaer (UK) Ltd., 92 Uxbridge Road, Harrow, Middlesex HA3 6BZ
Telephone: 01-954 2366 Tlx: 934150 BK UK G Fax: 01-954 9504

Acoustics Bulletin

Editor:
J W Tyler

Associate Editors:
P M Nelson
A J Pretlove
J W Sargent
R W B Stephens

Advertising enquiries to:
Sydney Jary Ltd
28 Southway
Carshalton Beeches
Surrey SM5 4HW
Telephone: 01-642 5775

Contributions and letters to:
Editor, IOA Bulletin
Pooh Corner
Chalkhouse Green
Reading RG4 9AG

Books for review to:
A J Pretlove
Engineering Department
University of Reading
Whiteknights
Reading RG6 2AY

Published by:
The Institute of Acoustics
25 Chambers Street
Edinburgh EH1 1HU
Telephone: 031 225 2143

The views expressed in Acoustics Bulletin are not necessarily the official view of the Institute, nor do individual contributions reflect the opinions of the Editor.

Single copy £5.00

Annual subscription (4 issues) £18.00

ISSN: 0308-437X

April 1987 **Volume 12** **Number 2**

Contents **Page**

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 organization 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 (HonFIOA)

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) be a graduate in acoustics or a discipline approved by Council, or (b) be a technician in a branch of acoustics approved by Council, or (c) be engaged or interested in acoustics or a related discipline.

Student

Candidates for election to the class of Student shall have attained the age of 16 years and at the time of application be a bona-fide student in acoustics or in a related subject to which acoustics forms an integral part. 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.

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

Sandy Brown Associates
London

Brüel & Kjær (UK) Ltd
Harrow, Middlesex

Fokker BV
Schiphol-Oost, The Netherlands

Hann Tucker Associates
Woking, Surrey

LMS-DIFA Ltd
London

London Scientific Services
The County Hall, London

Loughborough Sound Images Ltd
Loughborough

Lucas CEL Instruments Ltd
Hitchin, Herts

Masscomp UK Ltd
Reading, Berks

Monitor Acoustic Control Ltd
Glasgow

Morison & Miller Engineering Ltd
Glasgow

Scientific Atlanta
Hitchin, Herts

President's Letter

Dear Fellow Member,

At the time of writing, the preparations for the AGM of the Institute are well under way. The annual report of the Council will show many signs of healthy development. It may be invidious to pick out some items to highlight in a letter of this kind — however, perhaps one may be permitted to indulge one's idiosyncrasies.

The membership of the Institute has now passed the 1400 mark.

The various meetings generated a significant overall surplus which is a healthy sign, and not only for the finances of the Institute. This was achieved by the commitment and the hard work of many colleagues. I would like to mention, in particular, Cathy Mackenzie and Roy Lawrence whose hard work contributed greatly to the success of the main meetings.

I believe that two other developments are well worth noting.

Firstly, the launching of the new Noise Council is a culmination of the efforts of colleagues in the Noise Council Committee of the IOA, as well as the other participating organizations. One can only hope at this stage that its influence will grow with its activities.

Secondly, the legitimization of the joint IOA/IOP Physical Acoustics Group is reaching its final stages. The Council of the IOA has approved its constitution and we are hopeful that the IOP will also do so in the near future.

Many will remember that this significant area of acoustics stopped being represented within IOA activities (except through the much valued personal efforts of indefatigable Dr R W B Stephens) when the Physical Acoustics Group of the Institute virtually disbanded itself some years ago. This welcome re-birth of the Group, albeit in a different guise, owes a great deal to the efforts of a small number of 'younger' physicists. I do hope that (with the support from our membership as well) this time it will flourish.

Yours sincerely

Orhan Berktay

Fluctuation Phenomena in Underwater Acoustics

Underwater Acoustics Group Conference held on 9 and 10 December 1986 at the Hotel Prince Regent, Weymouth

WEYMOUTH in December may not be the ideal venue for a conference, but the sun managed to shine for two days and this meeting, organized by the Underwater Acoustics Group and hosted by British Aerospace, proved to be both productive and enjoyable.

Although the topic might be regarded as one of the more esoteric areas of underwater acoustics, thirteen contributed papers were presented in addition to those of the four invited authors, and the quality and variety of this technical programme was able to attract over 120 delegates from ten different countries.

The meeting was opened by Dr B J Uscinski of Cambridge University with a keynote paper on the successes and failures of multiple scatter theory. He showed how expressions for the first four moments of the wave field in a random medium can now be derived theoretically using a number of approaches, and how random wave propagation can be simulated using numerical methods. It was noted, however, that the question of the frequency cross-correlation of intensity fluctuations has yet to be resolved, and that a theoretical derivation of the probability distributions of wave field fluctuations is still nowhere in sight. The random propagation theory theme was carried through the first two sessions, the first concentrating on analytical techniques and the second on numerical methods, with some interesting papers from RSRE, Malvern, showing how the use of power-law spectra to describe the medium can simplify the mathematics, and pointing out the fractal nature of such a medium.

The third session, slightly delayed by the late arrival of afternoon tea, was devoted to the effects of fluctuations on sonar performance, starting with an overview of the subject by R J Urick, of the Catholic University of America, who concluded that as all quantities that affect detection of a sonar target fluctuate the result is a log-normal distribution for the probability of detection — a distribution that is most convenient in practical calculations. The other paper in this session demonstrated that surface wave effects in shallow water introduce errors into the target range and depth predictions of a matched-field processing system.

Pictured at the conference are (left to right) Colin Schofield of BAe and Peter Dobbins, the Conference Chairman, with the four invited authors: Professor Anthony Hewish, Dr Barry Uscinski, Professor Terry Ewart and Bob Urick. (Photo: Dorset Evening Echo)

Institute of Acoustics

1987 FEES

A review of membership fees was completed last year and approved by Council. The new rates, which are eligible for tax relief at your marginal rate, were due in January.

Fellow	£45	Associate (Under 30 on 1/1/87)	£26
Member	£33	Student	£5
Associate (30 or over on 1/1/87)	£30	(Air-mail supplement	£15)

In previous years up to a third of the subscriptions have been outstanding after the first quarter. This places unnecessary cash-flow difficulties upon your Institute, entailing the short-term use of interest-bearing reserves and so directly contributing towards increased subscriptions in following years.

Early receipt of your fee would therefore be to everyone's advantage and help to make 1987 a more prosperous one for the Institute.

Dr G M Jackson
Hon Treasurer

This concluded the first day's work, but a report would be incomplete without mentioning the excellent conference dinner provided by the Hotel Prince Regent. We will say nothing about the 49 litres of house wine consumed by delegates, but simply note that the after dinner speech given by Prof. R G White, of ISVR, Southampton, was both interesting and amusing, and even managed to finish with a serious conclusion.

Delegates were brought round gently on the morning of the second day by an interesting review of scintillation techniques in radio astronomy by Prof A Hewish, 1974 Nobel Physics Prize-winner, of the Cavendish Laboratory, Cambridge. This session was entitled 'Contributions from Other Fields', and, although some of the theoretical papers from the first day might properly have been placed here, only the more obvious examples were included, these being two contributions on underwater laser propagation from the British Aerospace Sowerby Research Centre. The first dealt with applications, while the second described numerical modelling techniques, with an emphasis on the effects of bubbles.

Oceanographic and acoustical measurements were the subject of the final two sessions, and the keynote paper was given by Prof. T E Ewart of the University of Washington. Using data from the 1977 Mid-Ocean Acoustic Experiment, MATE, he demonstrated the complexity of the problem faced when trying to reconcile acoustic scattering theory with experiment, and made it clear that understanding the processes of acoustic scattering cannot proceed without a thorough understanding of the medium. It was also made clear that there was a need to conduct oceanic scattering experiments simultaneously with a complete space - time sampling of the environment.

This session wound up with a paper describing fine scale oceanographic measurements on the UK continental shelf — a neglected area — which appeared to support a model for the medium based on power-law spectra.

The first two papers of the final session described recent acoustic fluctuation experiments, and were concerned with the propagation of broadband signals. The third gave examples of amplitude fluctuations in signals with frequencies up to 13 kHz in the Marginal Ice Zone. This data had been collected for a different purpose so, unfortunately, little environmental information was available. The final paper presented results from an experiment designed to investigate the degradation of array gain of a 96 element array due to the effects signal fluctuations. Frequencies between 30 and 120 Hz were used over distances up to 2000 km and the worst case loss of gain was reported to be 6 dB.

The meeting was closed with a discussion session, set in motion by Dr D E Weston, of ARE Portland, with some interesting, but slightly artificial, examples of how difficult it is to differentiate between stochastic and deterministic processes if the underlying mechanism is not understood.

To sum up, a successful conference although, to paraphrase the concluding remarks of Dr B V Smith, Chairman of the Underwater Acoustics Group Committee, one never knows if such success is due to the quality of the papers and the eminence of the speakers, or the quantity of the food and the strength of the beer!□

Peter F Dobbins

Letter to the Editor

From Professor Peter Fellgett, FRS, University of Reading

Professor Charles Taylor in his excellent article on musical acoustics *(Acoustics Bulletin,* October 1986, pp 8—9) expresses optimism which I believe we are justified in sharing. Recent years have indeed seen from both sides increased understanding between physicists and musicians.

Professionally a physicist moves in a simple universe inasmuch as he tries to strip away the complexities of the sensible universe so as to reveal the fundamental laws which underlie it. Some extension or modification of the usual methods of physics is therefore required in musical acoustics, and it is true that at one time physicists were reluctant to modify their usual thinking in the necessary way. As always tends to happen, this does not apply to the greatest of them, particularly Lamb[1] and Lord Rayleigh.[2] Indeed much of my recent research has concerned matters that are already represented, at least implicitly, in the work of these authors.

Musicians by contrast live in a world of aesthetics and at one time tended to make statements that were physically nonsense. For example singers were wont to speak of sound in terms applicable only to a load of gravel. Fortunately musicians have become much more tolerant of physicists in recent years, so that there is now a positive contribution from both sides.

Music is essentially an interactive process, involving interaction between the performer and his instrument, between himself and what he hears, between him and the acoustic, and interaction with the audience. Cybernetics therefore forms a useful bridge between the physicist and musician.

A good example of this is reproduced sound. An electronics engineer tends to believe that good electrical design is sufficient, but this is not so because the ultimate arbiter is the human ear-brain. The history of audio is a history underestimating our ability to detect and dislike imperfections in reproduced sound. We have scarcely more than a toehold on understanding what the requirements of the ear really are and therefore for the foreseeable future it will be necessary to check the performance of the equipment by actual listening and subjective assessment.

Incidentally as an 'electronics man' I find no prestige in electronics as such. In my view its sole purpose is to come between the performer and the eventual listener as little as possible, either by not being there as at a live concert, or else being as perfect as is possible in the current state of the art. To me a liking for 'electronic sound' is as immature as the adolescent liking for loud motorcycle exhausts; grown-up engineers like machinery to be as quiet as possible. This is a personal view which I know will not be universally shared.

Finally Jenny Zarek's justified strictures on electronic tuners and their advocates do not apply to the best of either. Methods and equipments are known which do not remove the necessary element of musical judgement but do aid the occasional or emergency tuner who has not acquired the special aural perceptions of a professional keyboard tuner.[3]

An interesting lemma remains. In view of octave stretch, what actually happens during the playing of a piano concerto? Does the orchestra sharpen the upper registers, and if so are they aware of making the adjustment?

Peter Fellgett

References

1. H Lamb, 1910. *The Dynamical Theory of Sound,* Edward Arnold, London.

2. Rayleigh. J W Strutt, Baron Rayleigh, 1986. *The Theory of Sound,* Vol II, 2nd edn. Macmillan, London.

3. J Bedford 1972. *J IERE, 42* (9) 131—5.

Disorders of Speech Perception

A MEETING of the Speech Group was held at the Department of Phonetics and Linguistics, University College London on Friday 23 January 1987.

Given the wide ambit defined by the title of this meeting, it was interesting that the presentations fell neatly into three categories.

The afternoon opened with two papers relating to moderate hearing impairment. I R Summers described his attempts at simulating in normal listeners the impaired frequency selectivity found so commonly in the hearing impaired. Such simulations promise a clearer understanding of how degradation in various auditory abilities differentially affects the perception of speech. Taped demonstrations helped a great deal in allowing the audience to experience what the effects of such degradation might be. G H Saunders followed with an account of what might be considered very moderate impairments, indeed! — people who report great difficulties in understanding speech (especially in noise), but who seem to have more or less normal hearing by presently applied clinical criteria. In fact, it appears that such people do have slightly worse hearing than 'normal' listeners, but this does not completely account for their self-assessed disability, nor the actual disability they demonstrate in controlled tests.

Three papers dealing with various aspects of visual displays then followed. A M Dew described preliminary investigations of the possibility of using an automatic speech classification system being developed at Leeds University as the basis for a visual feedback device to be used in training speech production in the hearing impaired. The results were quite encouraging, especially as regards appropriately signalling the relative durations of various phonetic segments. Along related lines, C Bootle and J Smith demonstrated a real time visual display for speech therapy, based on a laryngograph, microcomputer and signal processing electronics. Voice fundamental frequency contours were displayed in green, with the possibility of making the width of the contour vary directly with overall speech intensity. The spectral shapes of voiceless sounds were indicated by a white pattern, mapped into the upper end of the fundamental frequency range so as to integrate the two elements into a cohesive display. On a rather different note, M Roberts talked about a cheap yet realistic way of synthesizing faces whose mouth and lip movements were appropriate for any given sentence. Unlike previous electronic faces for lipreading, this 'Max Headroom' clone (as MR says) has a tongue! Such displays may be helpful in two distinct domains: firstly, they may assist in the perception of synthetic speech, which is often only marginally intelligible; secondly, they are apt to be useful in controlled psychological investigations of lipreading skills, hopefully leading to better techniques of improving such skills in those who need them.

Finally, there were two papers dealing with the speech perceptual abilities of listeners who are so profoundly impaired they can no longer benefit from acoustical stimulation. These are totally deaf adult users of cochlear implants which evoke auditory sensations by direct electrical stimulation of the auditory nerve. G Ball first described some comparisons of two speech coding schemes for a single-channel extra-cochlear implant currently undergoing clinical trials at University College Hospital and the Royal National Institute for the Deaf. It appeared that for many patients, a simplification of the input signal to the voice pitch alone could be of equal or more aid to them than the full bandwidth speech signal. S Rosen followed with the results of a test of consonantal identification on one single-channel, and two multi-channel, systems. Although the multi-channel systems were superior (at least for some patients) in signalling place of articulation information that is contained in the dynamic spectral shape of a sound, they were often inferior in signalling voicing and manner of articulation, typically signalled by the temporal pattern of silence, periodic and aperiodic activity. Analytic studies like those both these speakers described are likely to lead to improvements in speech processing that will significantly benefit users of implants.

The meeting was well attended, and lively, with just over fifty participants, and many questions from the audience. Perhaps the most surprising feature of the day was that all the many, many pieces of audio-visual equipment (slide and over-head projectors, audio and video players, and three computers plus monitors and speech synthesizers) worked without a hitch! This is owed both to the careful preparations by the speakers, and also to David Smith of UCL who oversaw all the audio-visual arrangements. Thanks also to John Walliker, who skilfully moderated the proceedings, and Georgie Harland for organizing the tea.

Titles and abstracts of the papers presented at the Meeting are given on pages 7 and 8 of this Bulletin.□

Stuart Rosen

CSTI Appointments, 1987

Professor Sir Frederick Warner, FRS, F Eng has been appointed Chairman of The Council of Science and Technology Institutes (CSTI). Dr Anthony Roe, MA, CChem, FRSC has been appointed Executive Secretary.

The CSTI was established in 1969 by the five profesional institutes for Biology, Chemistry, Mathematics, Metallurgy, and Physics. It now represents fourteen bodies covering a wide range of scientific and technical disciplines.*

The aim of the CSTI is to promote the common interests of members and foster inter-disciplinary professional relationships. The CSTI communicates the views of its members to Government, Industry, and Research Councils among other bodies, and advises on the education and training of scientists and technologists.

Sir Frederick Warner has had a distinguished career in chemical engineering and is past President of the Institution of Chemical Engineers. Dr Roe was previously Director of Chemistry at Smith Kline and French. The office of the Executive Secretary will be at 30 Russell Square, London WC1B 5DT.

*Institute of Acoustics; Institute of Biology; Institute of Ceramics; Institution of Chemical Engineers; Royal Society of Chemistry; Association of Clinical Biochemists; Institute of Food Science and Technology; Institution of Geologists; Hospital Physicists' Association; Institute of Mathematics and its Applications; Institute of Metals; Royal College of Pathologists; Pharmaceutical Society of Great Britain; Institute of Physics.□

Proceedings of The Institute of Acoustics — Abstracts

Disorders of Speech Perception

Meeting of the Speech Group held at the Department of Phonetics and Linguistics, University College London on Friday 23 January 1987

Electronic simulation of impaired frequency resolution

I R Summers
Department of Physics, University of Exeter

The loss of frequency resolution which generally accompanies sensorineural hearing loss has been simulated by speech processing which broadens each frequency component in the speech input into a band of noise. Significant features in the spectrum thus become 'blurred'. The effective resolving bandwidth of the ear is broadened, corresponding to a convolution of the auditory filter frequency response with a noise band. A twelve-channel analogue system allows variation of this spectral 'blurring' with frequency.

Normally hearing subjects were asked to identify word lists using a range of processing conditions. As might be expected, results show that middle frequencies (315 Hz —2 kHz) are more susceptible to this processing than lower or higher frequencies, and that increases in effective resolving bandwidth of the order of the critical bandwidth or greater produce a significant reduction in scores (e.g. with output noise bands of width approximately 2 × critical bandwidth, whole word scores fell to 60 per cent, compared with 95 per cent without processing). Direct measurements are currently being made on the effective resolving bandwidth of normally hearing subjects listening via the processing system, for comparison with theoretical predictions.

A complete simulation of a particular hearing loss might be attempted by combining the circuitry described above with elements to simulate sensitivity loss, recruitment, etc. As well as allowing measurement of the effect of independent variation of these loss features (not generally possible when looking at real hearing losses), such a system would be a useful test bed for hearing aids.

Obscure auditory dysfunction in patients without 'abnormal' audiograms

G H Saunders and M P Haggard
MRC Institute of Hearing Research, University of Nottingham

A substantial percentage of ENT consultations are taken up by people with hearing that is essentially 'within normal limits', but who experience great subjective hearing disability and handicap. We have denoted them as suffering from Obscure Auditory Dysfunction (OAD). This study aims to characterize the group and to improve counselling available to them. This paper reports interim results in which OAD patients are compared with controls, matched for age, sex, socioeconomic group and noise-exposure history. In addition to a general audiological work-up and an in-depth interview, variables measured include: frequency resolution at 2 kHz, two disability measures (pseudo-free-field speech-in-noise test and an audiovisual test), personality traits and self reports of disability and handicap.

Results have shown that the high degree of subjective disability and handicap experienced by OAD patients can be partly accounted for by auditory variables with a physiological basis; that is, OADs do have slightly raised pure-tone thresholds. This decrease in sensitivity is reflected in poorer scores on the speech-in-noise and audiovisual tests. However, even when hearing levels are taken into account by an analysis of covariance OADs still have poorer scores on these two tests, albeit non-significantly ($p<0.15$). It seems that other factors, possibly perceptual cognitive or personality traits, as yet unmeasured, must also play a part in the OAD syndrome.

A possible application of Leeds University Phonetic Input System to give visual feedback to the deaf — an investigative study

A M Dew
Department of Linguistics and Phonetics, The University of Leeds

The speech of the pre-lingually deaf exhibits certain well known features. These include, amongst others: phonemic distortions and omissions, poor ability in moving from one articulatory target position to another, poor ability to group words into phrasal groups, and high fundamental frequency. The idea that the acoustic signal can be used to give visual feedback to assist in teaching some of the above aspects of speech to the deaf is not new and the results have been quite encouraging. A technique for automatically segmenting and labelling continuous stretches of spontaneous speech into broad phonetic classes has been developed at Leeds University. It is thought that this system could be developed for use with a microcomputer to give visual feedback to the hearing impaired. An optional fundamental frequency display and an intensity display could be incorporated so that several parameters of speech could be shown simultaneously. In order to understand more fully the requirements of the proposed system it is necessary to undertake various feasibility studies. This presentation assesses the capability of LUPINS to cope with the speech of three girls with normal hearing and three girls with varying degrees of hearing impairment.

A new visual display for speech therapy: first trials

Colin Bootle
Department of Phonetics and Linguistics, University College London

Jane Smith
Birkdale School for the Hearing Impaired

The rationale behind the development of a new interactive display for speech therapy will be discussed, followed by a presentation of initial exploratory trials of the display by a speech therapist working with pre-lingually profoundly deaf children. The display builds upon experience gained during the development of the Laryngograph (for extraction of fundamental frequency, Fx) and the Voiscope (for presentation of Fx in a manner suitable for speech therapy). Intonation patterns are normally developed during the babbling stage before the development of control of articulation. The control of vocal-fold vibration greatly affects the quality of voicing and intonation and thus the intelligibility of the speech. With a poor auditory feedback path, the child can neither perceive adequately the sounds to be imitated nor monitor his or her own production. A visual display based on fundamental frequency can give a supplementary feedback path to aid the therapy of this foundation upon which intelligible speech may be built. The new display extracts further information from the acoustic signal. The overall speech intensity is used to modulate the width of the intonation contour. This gives additional feedback for the control of breathing efficiency, stress and loudness. An important feature of the new display is the presentation of fricative quality. This is of particular importance in speech therapy after the initial foundations have been laid, and upon which the initial trials are based. The frequency scale has been mapped to correspond more closely to subjective perception rather than an analytic, physical scale. Thus fricative information is shown as being an integral part of the speech display, whilst keeping the display as clear and simple as possible for ease of interpretation.

Audio-visual speech synthesis with a BBC micro

D Storey and M Roberts
Department of Computer Studies, University of Technology, Loughborough

Interest in the provision of visual cues to facilitate speech understanding by the hearing impaired has stimulated the development and investigation of a variety of methods for computer-controlled synthesis of visible articulatory gestures. Efforts to date range, both computationally and graphically, from the relatively simple to the highly complex; yet none is entirely without limitation, either as regards visual sufficiency or cost effectiveness. This paper describes an embryonic system for audio-visual speech synthesis which has the merits of being computationally straightforward, cheap to implement and yet naturalistic in outcome. The rationale

leading to the development of the system, the techniques employed and its resultant capability are all easily demonstrated.

A comparison of two speech-processing schemes for single-channel cochlear implants: further results

Ginny Ball and Stuart Rosen
Department of Phonetics and Linguistics, University College London

This work is part of an ongoing study of patients implanted by the UCH/RNID group and tested by the authors at UCL. Patients were implanted with one of three single-channel extracochlear systems that present a frequency-equalized and amplitude-compressed whole speech signal to the patient. In addition to perceptual tests with the whole speech signal, patients are tested with a reduced signal produced by extracting and presenting only voice pitch information. The results of these tests will be presented and the merits of the two processing schemes will be compared.

Acknowledgements: This work was supported by the Medical Research Council.

The perception of consonants with single- and multi-channel cochlear implants

Stuart Rosen
Department of Phonetics and Linguistics, University College London

Although there is general agreement that cochlear implants can play an important role in the treatment of post-lingual totally-deafened adults, there is still much controversy about the relative merits of various systems. In an attempt to clarify some of the dimensions of this controversy, patients using a variety of cochlear implant devices were tested on their ability to identify a set of 12 consonants spoken intervocalically in a number of conditions. These included tests with and without lipreading, and auditory presentations which included either the entire speech signal, or only its fundamental component. Almost all patients improved their lipreading scores with use of their aid. Important differences were sometimes found in performances obtained from two different speakers, so comparisons across patients should be on the basis of *identical recordings*. All single-channel systems proved capable of transmitting information about the presence or absence of quasi-periodic excitation indicative of vocal fold vibration, and some users of some single-channel systems were also sensitive to the aperiodicity of fricative sounds. Thus, they were able to identify the phonetic features of voicing and manner of articulation on the basis of audition alone, often to a greater extent than users of multi-channel systems. However, only users of multi-channel systems showed a sensitivity to spectral features (whether dynamic or static) that allowed, without lipreading, a significant transmission of place of articulation information. Even so, some multi-channel users did as well with the voice pitch information alone as with the full speech signal. It therefore seems likely that no single system will prove to be ideal for all patients, and that both electrode configurations and speech processing schemes should be selected for each individual.

Acknowledgements: This work was supported by the Medical Research Council, and by a special travel grant from the Heinz and Anna Kroch Foundation.

Noise insulation package working well

(from BRE News, December 1986)

In the last ten years well over 30 000 dwellings have been fitted with the standard remedial package to protect them against traffic noise. A major survey by BRE shows that it usually provides a worthwhile reduction in noise inside the dwelling and that the great majority of residents think it is satisfactory.

As well as reducing traffic noise, the package has to prevent overheating in the home due to solar gain and to allow adequate ventilation. The package therefore comprises double windows, venetian blinds, a powered ventilator and a permanent vent. BRE measurements made in more than 150 living rooms at 27 noisy sites showed that this produced an average reduction in noise level of 34 dB(A). By comparison, 100 untreated single windows gave reductions between 25 and 29 dB(A).

In a survey of nearly 900 residents, a large majority (84%) thought the package was satisfactory overall, and liked the double windows and the venetian blinds. The ventilators were the least popular part, because of their size and the fact that they let in draughts, but even so over half thought they were satisfactory.

Reporting on these findings*, the researchers have made several proposals for improving the package. These include a tighter specification for the inner window to help with the problems found with opening the window for cleaning, provision of guidance to residents on how the package should be used, and means of reducing draughts. Guidance is also needed for installers to ensure good performance from the package.

*Journal of Sound and Vibration 1986, **109** (1) 1-18

Forthcoming Conferences

There will again be two Autumn Conferences this year, both at the Hydro Hotel, Windermere. **Roy Lawrence** is the Conference Organizer for

Live and Reproduced Sound
5 — 8 November

Stuart Bennett and the Industrial Noise Group are handling the technical organization for a conference on the general theme of

Industrial Noise
26 — 30 November

Acoustics '88

The 1988 Spring Conference will be held from 10 — 13 April at Queen's College Cambridge. The Technical Organizer is **Professor J E Ffowcs Williams.**

Enquiries relating to these and other IOA Conferences and Meetings should be addressed to the Institute's Secretariat at 25 Chambers Street, Edinburgh EH1 1HU.

ANC REPORT

SINCE our last report in the July 1986 Bulletin, the Association of Noise Consultants has continued to promote its activities as the representative body of (the majority of) independent acoustic consultants. The membership currently consists of twenty-five practices involved in the diverse aspects of commercial acoustic consultancy.

The perennial problem regarding our name and in particular our initials, still remains, though we have recently commissioned a graphic designer to re-vamp our 'logo', in an attempt to resolve this. In many ways the considerable, almost daily, publicity given to the African National Congress has meant that our Association is more easily remembered by clients, albeit for the wrong reasons!

The Association now has a member, David Fleming, who is on the BS4142 Review Committee. Discussions at Council meetings on this topic have produced a good degree of agreement about ways in which the Standard could be improved. It is a welcome opportunity to put forward those points of view held by people who have to use the Standard in practice. Our considerable experience in the way the Standard is interpreted by the judiciary, planning authorities, local authorities, etc., has left us well placed to comment upon it. From the present position of the Review it is, however, clear that many of the problems with the existing Standard will be overcome in the new document.

Other discussions have centred on the use of a 24 hour L_{eq} for the measurement of aircraft flyover noise around airports, in place of the present NNI procedure.

There was general agreement at the Council meeting that there was a good case in principle for changing to an L_{eq} based rating method (eg., ease of measurement, conformity with other types of noise measurement, correlation with subjective reaction, and so on), but there were some reservations. In particular it was felt that there should be a distinction between daytime and night-time movements, for which the L_{eq} (24-hour) alone would not be adequate. Further research might be required to quantify this distinction, but there was a consensus that whilst L_{eq} would be appropriate for the daytime, some control of maximum levels would be necessary for the night-time period. Other factors raised during the discussion included the need to secure public credibility for any new methodology, for clear definitions of relevant measurement periods and for a published calculation procedure/database.

The Chairman of the Association has written to the Department of Transport expressing our views.

At our most recent meeting in February 1987, a preliminary discussion was held in respect of the 'Draft Code of Practice on Sound Levels in Discotheques' (1986) which is published under the auspices of the Noise Advisory Council. Our members have all frequently been involved with noise nuisance from such establishments and a number of members specialize in the design of such clubs. The preliminary discussion group was, however, surprised at the broad brush approach of 'Draft Code' and discussions as to the practical implementation of many of the proposals is to continue. Following the completion of the deliberations, we shall make our representations to the Noise Council.

Since our last report, the Channel Tunnel project has come to the fore. The Tunnel is one of the most exciting and interesting civil engineering projects for many years. The Fixed Link not only is a 50 km long twin bored rail tunnel and service tunnel connecting major terminals on either side of the English Channel, but also includes facilities to handle road and rail freight and provide the necessary ventilation of the Tunnel. A project of this size naturally has many facets requiring the expertise of an acoustic consultant. Naturally members of the Association have been involved with a number of specific areas.

The work of the acoustic consultant requires initially extensive environmental noise studies of existing conditions, and accurate prediction of the impact of all the new facilities and integration of necessary required noise control measures into the final design. A number of our members have been extensively involved with such studies and predictions, culminating in the future presentation of expert testimony to the House of Lords Select Committee hearings.

NEW ELECTIONS

The following elections to corporate and non-corporate Membership of the IOA have recently been approved by Council.

Fellow

R B W Heng	D J Meares	B R Wood

Member

J A S Angus	D Fox	H Kenyon	B M Shield
C F Beards	R J Groves	M A Kenyon	M S Siblock
M C Cattley	B G Hatton	D W Kilpatrick	M J White
P L Cousins	P Jackson	K Y R Kwan	Y G Yohanis
B Cranfield	J A Jephcott	S Reantragoon	S J Young
L B Cronin	P M Joplin		

Associate

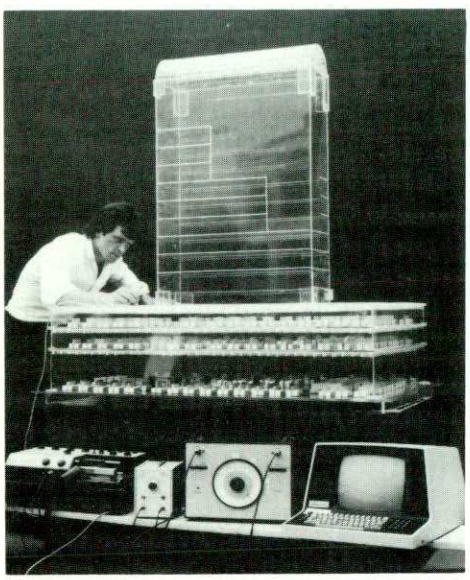
E Adamczyk	J L Jarvie	W S Lun	K W T To
K Y Au	D M R Johnston	D J Miller	K Y To
C J Au Yeung	P K Kwan	R Muir	H C E Tsang
Y N Au Yeung	W Y Kwok	P S Nagra	Y W A Tsang
L H Burt	C W Lam	J Saviar	T F Tsui
C W Chu	S F Lam	G Simpson	B G Watkins
R M Cole	P K Lau	S S Siu	A F Weaver
V J Davies	S M Lee	S T Smith	M D Wheatley
N J Fowler	W T Lee	M A Stewart	F M Wong
C P Gray	S Leung	K H Tam	I C Wong
J M Greenough	W T Li	C W Tang	W-M Wong
R E Hammond	K H Liu	M C Tang	S F Wu
H Jackson	A Lockwood	S S Tang	C H Yau
W K James	I R Lones-Greaves	H Taylor	K-L P Yeung

Student

D Maundrill	R Subramanian	S M T Wray

On a lighter note, two of our members seem to be deluged with studies of dog noise nuisance. It appears that our canine friends are upsetting neighbours of boarding kennels, Guide Dogs for the Blind training centres and other such premises. Since no unit or method of rating the annoyance of barking dogs exists to our knowledge, one wag (no pun intended) at a recent meeting suggested a suitable unit would be the dBA(RK) unit!

The recent completion of the new Lloyds of London Building in the City has meant that one of our members who was the consultant on acoustic matters is now able to release details of the work. The unique design of the glass



The atrium/Underwriting Room. 1:50 scale model undergoing tests with the equipment shown in the foreground

atrium and galleries forming the new Underwriting Room, gave special acoustic problems not normally found in more conventional buildings.

Take a space with the same volume as the Albert Hall, fill it full of people noisily trying to communicate, and what are the acoustic conditions likely to be? The brief from the client to our member was simply that the ambience of the new Room was to be no worse than existing Rooms, and preferably better. As the acoustic performance was not amenable to prediction by calculation, the consultants constructed a 1:50 scale Perspex model of the area, complete with simulated finishes and underwriting boxes.

With highly specialized equipment operating at ultrasonic frequencies (fifty times audio frequency), measurements were made in the model. These were to predict the acoustic performance of the space and design the acoustic treatment required. Subsequent tests carried out in the completed building have shown good correlation with the model measurements and confirmed that the predictions made, and measurements taken, to control reverberation and diffusion within the space, have been effective.

Two of our members have been retained for projects involving Her Majesty The Queen.

The opening of the new Clore Gallery, part of the Tate Gallery, is to be conducted by Her Majesty; our consultant member does not, however, expect to be presented.

A new PA system has been designed and installed for St George's Chapel, Windsor Castle, which also enjoys the Royal patronage on many occasions. Given the subjective qualities of noise, the consultants concerned in both projects are relieved that the Sovereign's displeasure no longer results in a long or short holiday at the Tower of London.□

Alan Saunders

Two new volumes of Conference Proceedings

The Audio Engineering Society, an international organization devoted exclusively to professional audio technology, has published two collections of original manuscripts, authored by leading audio professionals, in bound form. These are: *The Proceedings of the AES 3rd International Conference: Present and Future of Digital Audio, Tokyo, Japan, 1985, June 20-21,* and *The Proceedings of the AES 4th International Conference: Stereo Audio Technology for Television and Video, Rosemont, Illinois, 1986, May 15-18.*

Orders for these publications may be placed with AES British section, Lent Rise Road, Burnham, Slough, SL1 7NY. Tel: Burnham (062-86) 63725. Prices — single copies including postage: member £20.00; non-member £30.00, plus packing and postage £2.00 for single item, £1 for each additional item on same order.□

NON-INSTITUTE MEETINGS

1987

8 May. *Noise in Welding.* Copenhagen. Sponsor: International Institute of Welding. Contact: Marvin Kennebeck, American Council of the International Institute of Welding, 550 NW Lejeune Road, Miami, FL 33126, USA.

26 May. *Developments in instrumentation and computation in acoustics.* Contact: F J Mak, Society of Chemical Industry.

6—9 July. *Ultrasonics International '87.* London. Contact: Marija Vukovojac, Ultrasonics International '87, Butterworth Scientific Ltd., PO Box 63, Westbury House, Bury Street, Guildford, Surrey GU2 5BH.

8—10 July. *NOISE-CON '87.* Pennsylvania. Contact: Conference Secretariat, Noise-Con '87, the Graduate Program in Acoustics, Applied Science Building, University Park, PA 16802, USA.

24—28 August. *11th International Symposium on nonlinear acoustics.* USSR.

13—18 September. *4th European Conference on Non-destructive Testing.* London. Contact: Conference Associates NDT, 27A Medway Street, Westminster, London SW1P 2BD.

15—17 September. INTER-NOISE '87. Beijing, China. Contact: INTER-NOISE '87 Secretariat, 5 Zongguancun Street, PO Box 2712, Beijing, China.

22—25 September. *New Materials and Their Applications.* Coventry. Conference and Exhibition. Contact: Meetings Officer, The Institute of Physics, 47 Belgrave Square, London, SW1X 8QX.

1988

9—10 April. *Physics in Medical Ultrasound.* Durham. Contact: Dr K Martin, Regional Medical Physics Department, Newcastle General Hospital, Newcastle upon Tyne, NE4 6BE.

21—25 August. *Noise '88, The 5th International Congress on Noise as a Public Health Problem.* Stockholm. Contact: RESO Congress Service, 5-113 92 Stockholm, Sweden.

30 August—1 September. *INTER-NOISE '88.* Avignon, France.

BRANCH AND GROUP NEWS

North West Branch

November Evening Meeting

The meeting was held at the splendid Bruel & Kjær Office in Manchester. Dr Peter Thorne of the Institute of Oceanographic Sciences gave an excellent talk on the use of Acoustics in Sediment Transport Research. He described the development of several of the more interesting techniques used over the years, and discussed many of the problems involved. There is considerable interest in this work from a wide range of industrial and government organizations; in particular the commercial mining sector, the fishing industry and the Department of the Environment who license dredging operations. Peter Thorne has been developing a novel acoustic technique for monitoring sediment transport. The method involves measuring the noise generated by collisions between particles of mobile material. Analysis of the acoustic signals obtained from laboratory experiments and sea trials has shown that it is possible to monitor the bedload transport of coarse sediment. The technique has been used to develop an understanding of the relationship between sediment movement and turbulent flow conditions and can provide continuous estimates of sediment transport rates. Peter concluded with slides illustrating the measurement rig used during sea trials.

Following the talk we were treated to an excellent open sandwich buffet with Danish lager. My warmest thanks to Barbara Mothersole and Bruel and Kjær for once again looking after the NW branch so well.

February Evening Meeting and AGM

This meeting was rescheduled from January due to bad weather; my apologies to those who braved the weather — we did try and contact you.

The AGM was well attended by students of Salford University; this seems to be a new and welcome aspect of our meetings. The Chairman and committee remain unchanged apart from the departure of Sue Riddler who will be missed. Mike Ankers gave his Chairman's report summing up the year and keeping us up to date with what has been happening in the IOA council. Following the AGM we were treated to a talk by Dr Raf Orlowski of Salford University, on Recent Developments in Auditorium Acoustics and 'The Centre of the Future'. He considered the development of concert hall design over the last thirty years, illustrating the marked change in concert hall acoustics by considering the design changes made from the Royal Festival Hall to the Philharmonic in Berlin and finally to the most recent halls in New Zealand and the USA. Raf discussed the revolutionary design of the Orange County Hall in the USA, and his involvement with the testing of the acoustic scale model and the final subjective assessments of the completed hall. This hall embodies the developments made in the last 30 years and provides a truly multipurpose auditorium. He said that it was essential to implement acoustic research to provide the best environment for the listener. Following the talk members were invited to view the new acoustic test facilities at Salford. Finally discussions continued in a local pub near the University.□

Chris Waites

Letter from the Vice-President Groups and Branches

I have just finished writing my report for Council covering the activities of Groups and Branches during the year 1986. Despite problems, some of which have been mentioned in these pages, I am reasonably optimistic about the future for Groups and most Branches.

The main problems are twofold:

1. The distances members have to travel to attend Branch meetings.

2. The time committee members have to spend on IOA business.

Item 1 is going to remain a problem for ever. There just aren't enough potential members throughout the British Isles to warrant more branches covering smaller areas. It is quite apparent that those branches centred in an area where there is a strong local interest in acoustics are the ones with a reliable core of members who turn up to most meetings.

The Scottish branch recently adopted a policy of holding only two meetings per year, and concentrating their efforts on making them of such good quality that members will be encouraged to make the effort to attend. I wish them well and shall look forward to seeing the results of their policy; if successful it could be applied elsewhere.

Item 2 should really consider the 'lack' of time committee members have for IOA business. Everybody appears to be running to stand still these days and spare time is a luxury of the past. However there are some rewards to be had for the effort spent helping your local branch but perhaps a little encouragement from the membership would help. One Branch Chairman recently wrote to me and said 'If there had been even one phone call to ask why the Branch was not active, it would have made some difference to my attitude — but with my present workload it is difficult to find the enthusiasm to push the branch back into activity.' I have no intention of revealing the name of that Chairman but if you think it was yours why not give him a call! Why not give your branch chairman a call anyway and let him know you are around and interested in what is going on locally in your chosen profession.□

Geoff Kerry

Results of RNID Survey on Induction Loop Systems in London Theatres

The Royal National Institute for the Deaf (RNID) published in January the results of a survey on the effectiveness of special equipment, known as induction loop systems, installed in London theatres for the benefit of hearing aid users. The report shows that more than two-thirds of the loops assessed failed to provide any benefit and that theatre staff were often unaware when a loop system was not working. It also reveals that three-quarters of the theatres failed to indicate to patrons the presence of the loop systems.

The RNID expressed concern at the results of the survey, which they feared might be reflected in theatres in other parts of the country, and in churches, railway stations and public halls where loops had been installed.

The RNID called for stricter adherence to performance standards set out in BS 6083, Part 4, for the organization of routine maintenance, better training for those responsible for installation and maintenance, and clear indication to the public where the loop system is installed.□

New Products

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

Frequency Analysis and short-term Leq Modules

Two new modules have been produced by B & K for their modular Precision Sound Level Meter type 2231.

The new BZ7103 Frequency Analysis module maintains the function of the 2231 as an Integrating Sound Level Meter but also enables it to record automatic Serial Frequency Analyses by means of the 1/3 and 1/1 Octave Filter Set Type 1625.

When the 2231 is connected to a printer by means of its interface module, the set-up is used to maximum advantage and all parameters and measurement data are conveniently available in the form of hard-copy printouts. The printouts have variable headings and are recorded digitally and graphically in both full and short form.

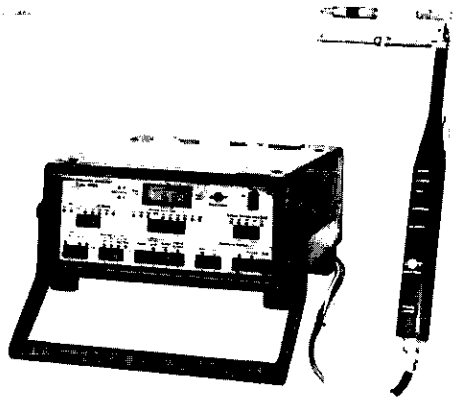
The start and stop frequencies are selectable. To optimize the total measurement time, the set-up measures the Leq in each frequency band over a length of time which depends on the filter bandwidth. It is also possible to preset the number and average up to 999 frequency analyses made at the same or different points.

In addition, the maximum and minimum RMS levels as well as maximum peak level and the overload duration can also be measured for each frequency band.

The new BZ7106 Short-Term Leq module is specifically designed for the measurement and recording of Short-Term Leq over consecutive user-defined periods of time, and by using its interface module the 2231 can be made to provide 64 different digital output formats for data loggers or other recording or storage systems without any loss of measurement time.

Portable Sound Intensity Analyser

The Sound Intensity Analyser Type 4433 from B & K is a portable, battery operated serial analyser designed to measure sound pressure level, particle velocity level and sound intensity in 1/1 octave bands with centre frequencies from 63 Hz to 8 kHz. Linear and exponential averaging are available with



The Sound Intensity Analyser Type 4433

selectable averaging times. Measurements may be controlled from the front panel, from a remote control unit or via the IEEE488 Interface Bus.

Automatic filter scanning, A weighting, digital output of each measurement result and adjustment for ambient conditions (temperature and pressure) can be controlled from the front panel of the 4433. For sound power measurements the area over which measurements are taken can be entered and the sound power displayed directly.

Hand-arm Vibration Measurement

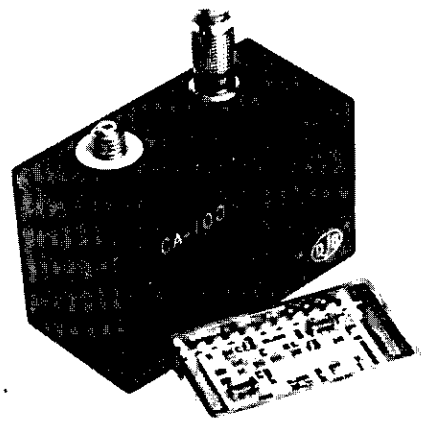
The B & K Hand-Arm Transducer set Type 4392 does away with the necessity for mounting accelerometers directly on the tool handle. The main components of the set are a hand adaptor, handle adaptor and an accelerometer. The metal adaptors transmit vibration from the tool handle and operator's hand to one or more accelerometers mounted on the adaptors, without interfering with the operator's grip.

Further information on the above products can be obtained from Bruel & Kjær (UK) Ltd, 92 Uxbridge Road, Harrow, Middlesex HA3 6BZ. Tel: 01 954 2366.

Miniature Charge Amplifier Type CA-100

D J Birchall Ltd have announced the addition of the CA-100 miniature charge amplifier to their range of products. The internal hybrid circuit based upon their 04 Series charge amplifiers is mounted within a dual-in-line package and housed in an aluminium case measuring 30 x 45 x 23 mm. The charge amplifier is normalized for accelerometers using a miniature pre-set potentiometer, through a screwdriver hole. The amplifier gain is adjusted by selecting appropriate pins on the DIL Package. The output bias voltage can be adjusted by means of a single resistor on the printed circuit board.

Further details from D J Birchall Ltd, 102 Bath Road, Cheltenham, Glos. GL53 7JX. Tel: 0242 518588.



The miniature Charge Amplifier CA-100

Basic on the Real Time Analyser Type 830

The Norwegian Electronics' Real Time Analyser type 830 can be equipped with an internal Basic Interpreter option. This Basic is called NE-BASIC and allows the RTA 830 to operate as if an external computer was connected. Special measurement tasks can therefore be easily accomplished by the operator. Programs can be stored and loaded from the analyser's internal floppy disk.

Further details from Gracey & Associates, High Street, Chelveston, Northants NN9 6AS. Tel: 0933 624212.

Octave Filters for the CEL-493

CEL Instruments have produced an octave band filter set, the CEL-278, for use with their CEL-493 Precision Integrating Sound Level Meter. The filter set covers the range 16 Hz to 16 kHz and meets the requirements of BS, IEC and ANSI standards.

The price of the CEL-278 is £550. Further details from Lucas CEL In-

struments Ltd, 35 Bury Mead Road, Hitchin, Herts SG5 1RT. Tel: 0462 52731.

Personal Noise Monitoring Service

The Consultancy Division of Industrial and Marine Acoustics announce a Personal Noise Monitoring Service. It makes available the Metrosonics db 301 Noise Exposure Data Logger in standard or intrinsically safe form for on-site measurements.

The db 301 data loggers are dispatched by post, and the local Safety Officer supervises the local details of the survey, where an employee wears the miniature data logger through his or her working day. Data from these units are transferred to the dt 390 Data Collector, which has the capacity for a full week's worth of data. When full of data, these units are returned to Industrial and Marine Acoustics for computer processing. Full graphic printouts of the time history of the noise exposure, the overall Leq and Noise Dose, and (if required) the professional comments of Industrial and Marine Acoustics' consultant are returned within a week — providing the required records in quality presentation at a fraction of the cost of a low cost noise dosimeter.

For more information, please contact David Marsh on 0723 364495. Industrial & Marine Acoustics Ltd, P.O. Box 8, Newcastle under Lyme, Staffs ST5 2TR.

Dual Programmable Charge Amplifier Module

The DPCA is a high accuracy programmable dual charge amplifier that may be fitted to either the Signal Conditioning (SICOS) or Signal Conditioning and Data Acquisition (SCADAS) mainframes.

The modularity and flexibility of these mainframes allow any signal conditioning or measuring requirement to be met from standard programmable modules. The DPCA converts electrostatic signals from conventional piezoelectric transducers into proportional voltage signals. DPCA modules employ state of the art low-noise i.c. operational amplifiers in proven charge amplifier circuits.

For further details contact LMS-DIFA Ltd, Prospect House, 2 Prince Georges Road, London SW19 2PT. Tel: 01 648 2595.□

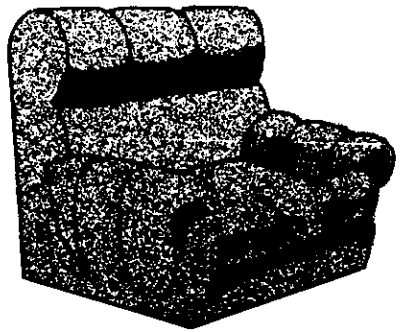
Material for the July issue of Acoustics Bulletin should reach J W Tyler at Pooh Corner, Chalkhouse Green, Reading, Berks RG4 9AG, no later than Friday 22 May.

It appears that there has been some misunderstanding over the advertisement on page 17 of the Bulletin for January 1987.

Please note that the *whole* of page 17 comprised the Cirrus Research Ltd advertisement. The lower half was **NOT** Bulletin editorial.

We apologise for any confusion caused by this layout and would ask that any correspondence concerning the contents of page 17 be addressed to the company concerned.

Professional Career Opportunities



The Easy Way to look for your new job from the comfort of your own armchair. Our well qualified consultants will carefully match your requirements against appropriate vacancies.

We have many clients seeking Engineers and Technicians at all levels and we are particularly interested in hearing from you if you have experience in the following:-

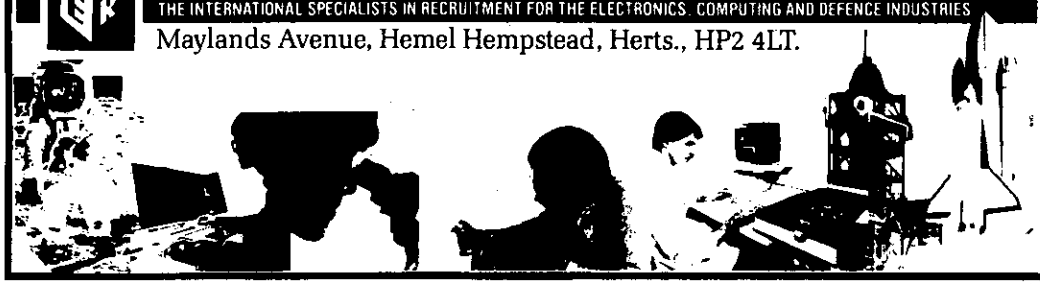
- **Signal Processing**
- **Technical Sales**
- **Project Management**
- **Acoustics**
- **Mathematics**
- **Real Time Software**

Your next step is to complete and return the attached coupon or telephone **Gordon Short** on 0442 47311 or one of our duty consultants on 0442 212650 during evenings or weekends.

Executive Recruitment Services

THE INTERNATIONAL SPECIALISTS IN RECRUITMENT FOR THE ELECTRONICS, COMPUTING AND DEFENCE INDUSTRIES

Maylands Avenue, Hemel Hempstead, Herts., HP2 4LT.



NAME.....(Mr/Miss/Mrs)

ADDRESS.....

.....

POST CODE .....

TEL NO:.....

QUALIFICATIONS AGE.....

☐ NONE ☐ CG/HNC ☐ DEGREE ☐ OTHER

SALARY

☐ 0-£6000 ☐ £6-10000 ☐ £10-15000 ☐ £15000+

JOB .....AB

Institute of Acoustics Meetings

1987			
5 May	SG	Applications of Speech Technology	London
13 May	SB	Subjective Effects of Mixed Noises (C G Rice)	Southampton
26 May	M	Developments in Instrumentation and Computation in Acoustics	London
29 May		Noise Induced Hearing Loss. BSA Meeting in association with IOA	London
September	PAG	Current Research Review Meeting, visit and AGM	
15 September	M	Outdoor Sound Propagation	Open University
October		Noise in the 90s. IOA/IEH Meeting, European Year of the Environment	Birmingham
5—8 November	M	Live and Reproduced Sound	Windermere
26—30 November	M	Autumn Conference	Windermere
1988			
10—13 April	**M**	**Spring Conference — Acoustics '88**	**Cambridge**
Aug/Sept	**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
LEM = London Evening Meeting

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:

Institute of Acoustics
25 Chambers Street
Edinburgh EH1 1HU
Tel: 031-225 2143

Christchurch Printing Company Ltd., 19 Woodside Road, Bournemouth BH5 2BA