

The magazine of the
Institute of Sound and
Communications Engineers

Summer 2018

ISCE



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Comments on articles and letters are invited.

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Introduction from our President



Welcome to our Summer 2018 edition of the ISCE magazine.

My introduction unfortunately starts on a sad note. Many of you will have heard about the tragic passing of Brian Latham FlinstSCE. Brian was a long-time member of the Institute and was

also on our Council. Brian was very active in his work with the ISCE. There was recently a Memorial Service at Aylesbury Methodist Church, to celebrate Brian's life and many ISCE members, including myself, were present. Brian, while being passionate about our industry, was very much a family man and will be greatly missed by us all. You will also see in this edition, an article about Brian's work on the sound systems for the recent Royal Wedding.

The Institute was present at the recent FIREX exhibition in London. Colleen, Ros and myself were pleased to see many of our supporting members exhibiting; Baldwin Boxall Communications, SigNET (AC) Ltd, DNH Worldwide, Vox Ignis, TOA Corporation and ASL. The exhibition was well attended and it was good to catch up and talk with many fellow ISCE members.

We will also be exhibiting at PLASA London at Olympia on 16–18 September, so we hope to meet many of you there.



For members that use an iPhone and/ or iPad – there is a new app called 'Wild Apricot for Members'. Wild Apricot is the

host and provider of our new membership database. The app allows you to see all the members who have opted in to a public view directory. You can phone or message them by email directly on your phone, using the app. You are also able to see and register for any events that the Institute is providing. You simply log in using your existing unique user name and password that you would have used to renew your membership and view the directory on a PC etc. Please click on the **App Store link** to download. (Wild Apricot plan to introduce an Android version soon.) Many of you are yet to make your profile public and we urge you to do this.

Over the next few months, you will start to see the ISCE Logo re-branding on our stationery – in the styles introduced on our new website. The new website is also enjoying quite high visitor browsing and unique clicks. The highest interest being from the 20–34 age group. This is definitely a positive move to enhance the profile of ISCE going forward.

Once again, Ros has put together some really interesting articles and features, provided by our members, which I hope you will enjoy and find informative.

I hope that you enjoy the 'long hot summer' and I look forward to meeting up at a future ISCE event or exhibition participation. ♦

Phil Price FlinstSCE



We welcome your contributions to the magazine with editorial and advertising.

Please send news or articles to **Ros**

Events Diary

14–18 September 2018

IBC
Amsterdam, Netherlands

16–18 September 2018

PLASA 2018
London, UK

26 September 2018

ISCE Electrical Safety for Sound Engineers
London, UK

17–19 October 2018

AES
145th, New York, USA

7 November 2018

Production Futures
Wakefield, UK

5–8 February 2019

ISE
Amsterdam, Netherlands

5 March 2019

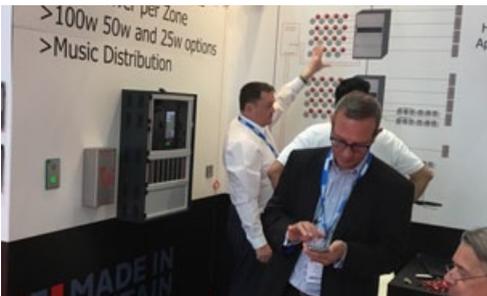
ISCEx AGM and Networking Dinner
Coombe Abbey, Nr Coventry, UK

6 March 2019

ISCEx Exhibition and Seminar Day
Coombe Abbey, Nr Coventry, UK

FIREX · 19–21 June 2018

We were delighted to see so many visitors and members at Firex this week at ExCel, London. It was also great to see a number of our supporting members on their own stands.



Assistive listening technology is changing but new systems have yet to come of age

By Richard Dungan *MInstSCE*



Hearing loops have been the dominant form of assistive listening technology for those with hearing loss for the past 80 years. With the growth of digital technologies new systems are being developed that could come to challenge induction

loops but, argues Richard Dungan, Head of Electronic Design at Contacta, they are yet to reach maturity.

Hearing loops were becoming ubiquitous when my career in electronic design began in the 1970s. This was the time when behind-the-ear hearing aids were being introduced and the NHS started prescribing them to patients.

In the last 40 years hearing aid and hearing loop technology has developed considerably. Digital signal processors mean loop systems now offer much better sound quality while digital hearing aids give users an improved listening experience.

The beauty of the induction loop and Telecoil system is that it is universal. Users can take their NHS-issued hearing aid, or one from a high street audiologist, and travel anywhere in the UK or indeed, the world, and know that if there is a loop installed their hearing aid will be compatible.

This hasn't come about by accident - it's a testament to the industry that manufacturers and academics work together on the British Standards Committee and the International Electrotechnical Commission to set standards on performance and universality.

The development of disparate new technologies is a challenge for these bodies; how to bring them together to offer the best experience to the user.

Bluetooth, streamers, smartphones and wearables currently offer benefits to people with hearing loss. Apps which act as an amplifier through ear buds for example are a low cost and efficient way of transferring sound to the listener. 'In-ear computers' can cancel out background noise, connect to devices through Bluetooth or amplify sound all with just a tap. Some of these can even be programmed with the user's hearing profile to give them a personalised experience.

'Personal' is a key term as they have less to offer in a communal listening environment such as the theatre where you can't place your smartphone in the footlights and pop in your ear buds.

One other concern is that some of these are off-the-shelf options that potentially cut out the audiologist and the advice they offer. Not only does hearing loss need to be responded to by a professional, it can be an indicator of additional health concerns such as cognitive decline.

These technological developments have yet to mature sufficiently to offer benefits widely, although this will come. But the pace of change will be relatively slow.

In the UK, the current hearing aid and loop system is ubiquitous and 85% of the two million aids worn by people with hearing loss are issued by the NHS. The purchasing cycle in the health service is currently five years which has an influence on the pace at which new products are introduced. ▶

It will be some years yet before the hearing impaired will see a wholesale change in the way sound is enhanced for them. There is no doubt digital technology will ultimately give them a better listening experience – just not yet.

Richard Dungan is the Head of Electronic Design for Contacta Systems Ltd and a member of the ISCE. He sits on the BSI standards committee for hearing loops which sets standards for their development and use in the UK.

He is also on a committee of the International Electrotechnical Commission, the world's leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

www.contacta.co.uk ♦

Hoare Lea chooses K-array Invisible audio for Wolfgang Buttress sustainable art installation



Kevin Luckhurst

Soho fashion outlet, Oliver Spencer, relies on K-array Lyzards hidden amongst flowers for in-store immersive experience

London, UK – May 2018... With a focus as much on sustainability as high-end fashion, Oliver Spencer is one of the UK's most distinctive men's clothing brands – a fact illustrated by the recent installation of a nature-themed immersive art exhibit within the chain's flagship Soho London store. Named Reverie, the exhibit is the work of world renowned artist Wolfgang Buttress, whose design incorporates wildflowers, and an intricate soundscape of countryside sounds delivered by an almost invisible K-array audio solution.

Founded in 2002, the Oliver Spencer brand already boasts a large online presence plus four stores in London with another in Toronto. The brand's commitment to sustainability runs deep, leading to

the connection with Buttress, an artist whose own connection to nature has become internationally celebrated.

The result is Reverie – a multi-sensory, immersive experience designed to highlight the importance of pollinators, lasting within the store for just one month. The installation comprises two facing wooden seats which are surrounded by living, bee friendly wildflowers. Mirrors adorn the ceiling, while a Haeckels-curated scent suggests flora and beeswax. The accompanying audio seems to emanate from the flowers themselves.

"We needed loudspeakers that we could place as discreetly as possible, but which would still deliver a very professional performance," explains Paulie Roche, Senior Audiovisual Engineer for Hoare Lea, the leading UK-based consultancy who designed ▶

and installed Reverie's audio solution. "The visual aspect is so important in Reverie, we needed something with an extremely small physical form." Having used K-array in the past, Roche visited the Italian brand's exclusive UK distributor, 2B Heard, and soon found the answer he was looking for. "Dave and Sam from 2B Heard were really helpful. They even let us set up a test system in our office so we could experiment. We probably listened to the whole range of K-array speakers, as it's impossible to copy and paste a design like this – we needed something unique, something extremely discreet," he explains. "That's the main reason that we decided to use the K-array Lyzard."

The completed solution now comprises 12 hard-to-find Lyzard-KZ12 ultra-miniature line array elements nestling amongst the fauna. Two Rumble KU44 subwoofers are installed under the seats for low-end augmentation. "There is a hum and rumble of bees in the low end, and then you have birds tweeting and crickets whizzing around your head at the high-end," enthuses Roche. "The Lyzard-KZ12s deal well with the high frequencies while the KU44s bring the low end from under the seats."

He continues: "If you sat down in one of those seats and saw a speaker you'd pinpoint where the sound was coming from, but a lot of people sit down and they can't do that because the speakers are invisible to them, so they start asking where the sound is coming from."

With Reverie now having opened, visitors to the Oliver Spencer store are experiencing it daily. "We are very proud of the install," Roche says. "Customers sit down and close their eyes – at the launch it was like musical chairs because everyone wanted to have a go. 2B heard have provided some unique loudspeakers from K-array that can fit into a unique place for a very unique project. We will certainly continue specifying them in the future."

2B Heard is a leading UK-based distributor of premium audio brands and is the sole authorised representative of K-array in the UK and Ireland. Led by respected industry figures Dave Wooster and Sam Nankivell, the company delivers exceptional service and support based on real world experience within the UK's entertainment technology, professional AV and home audio markets.

www.2b-heard.com ◆

Kevin Luckhurst



Audio-Technica partners with Luthman SMTTS AB for distribution in Sweden

Audio-Technica has announced the appointment of Luthman SMTTS AB as its new distributor in Sweden, with effect from 01 June 2018. Founded in 1990, Luthman is the largest distributor of MI/consumer and professional audio products in the Nordic region with more than 60 international brands – including Gibson, Apogee, AVID, RCF, H&K Audio, Focusrite and TC Electronic – in its extensive portfolio.

Pär Olsson, General Manager/COO, Luthman SMTTS AB said of the new agreement, “We are extremely proud to add Audio-Technica to our industry-leading portfolio of high profile brands. We have followed the company’s development for well over 20 years and have always been impressed with the quality and performance of its products, as well as the wide

range of solutions for all types of audio applications that Audio-Technica delivers. The brand will be a cornerstone in our operations from now on and we look forward to a long-lasting relationship.”

Dre Klaassen, Audio-Technica Export Sales Manager added, “We’re delighted to welcome Luthman to our network of distribution partners. The company’s wide experience and reputation is second-to-none and I look forward to working on some exciting projects together in the future.”

For more information, please visit www.eu.audio-technica.com ♦

EES Showhire produces International Bomber Command Centre opening ceremony



EES Showhire had a successful day on 12 April 2018 at what was one of our most prestigious contracts to date, the opening of the International Bomber Command Centre (IBCC) in Lincoln.

Although the cold weather and fog cancelled the pre-arranged flypast's and hampered preparations, it did not dampen the spirits of the 3,000+ audience which included over 300 war veterans and VIPS. Media coverage of the event was extensive with a live stream being broadcast on YouTube all over the world.

After winning the contract to provide production services for the event last November, we have worked closely with the Chief Executive of the IBCC Nicky Barr and the Musical Director for the event, Crauford Thomson. Our main task was to engineer the live sound and lighting on stage and provide the audio feed which was used by the BBC to broadcast online and in local news bulletins. However, our role was more extensive than just sound and lighting. We also

sourced the stage for the event, large format video screens, grandstands, generators and a temporary road infrastructure to manoeuvre large vehicles around the site and create car parking on an adjacent field.

Split into two parts, the event saw the official opening ceremony conducted by John Sergeant followed by an evening concert compered by Carol Vorderman. During the opening, the veterans were invited to cut the ribbon and take a piece home as a keepsake for their involvement. The memorial was built to remember and honour those who fought and died during their time in Bomber Command. To be part of this emotional tribute to them was a great honour for EES Showhire.

During the event people were given an insight into life under Bomber Command during the war by actors reciting scripts almost like diary entries. Many choirs performed, most notable of which may have been ▶

the Invictus Games Choir, along with solo artists singing songs from the era. Crauford Thomson also brought together a full orchestra to perform 'Strike Hard Strike Sure', a piece written specifically for the event. Speakers during the opening ceremony included Nicky Barr, The Rt Revd Christopher Lowson, Bishop Of Lincoln, Sir Peter Luff of the National Heritage Memorial Fund and Lord Howe, Minister of Defence in the House of Lords.

Because the event was of such great prestige, we needed to ensure the highest quality of audio and lighting. We used a range of microphones and techniques to get the sound right for the tasks we were given. It was cold, windy and damp which always makes outdoor music events difficult. Audio Technica overhead choir mics were used for the choirs and orchestra with spot mic'ing utilized on bass instruments to add to the richness of audio.

Condensor mic's were used for individual instruments and the piano whilst Shure wired and Audio Technica radio mics were used for presenters and singers. We also used an Allen and Heath digital mixer.

The lighting was delivered with a mixture of warm conventional par cans and LED programmable coloured lights against a large white backdrop. A Zero 88 lighting desk was used to programme and deliver the show.

Nicky Barr of the IBCC said "EES (Showhire) provided all the staging, pa, AV and generators for our opening ceremony. Despite dreadful weather and a complex and exhausting environment, they delivered everything exactly to brief and were a delight to work with. They produced flawless sound and lights all day and night and Andy and his team were extraordinarily good. I am indebted to them."

Carol White, Partner of EES Showhire said "The day saw all our planning of the last six months and the 20-hour days on site for the last week setting up for the event come to excellent fruition and we are just over the moon the opening ceremony was such a success. I'm very proud of my staff and pleased to have been a part of the opening."

www.ees-showhire.co.uk ♦



Faith in DAV



Direct Audio Visual (DAV) have stepped into a new area of expertise in order to help a Birmingham Muslim community realise their long-standing dream to create a mosque, evening school and sports centre.

After their AV contractor ceased trading through insolvency, the charity's trustees approached DAV to rescue the situation.

Having been most comfortable in retail, corporate and warehousing sectors, Pete Rutherford SenTechInstSCE, the owner of DAV, was nevertheless ready for the many challenges.

The Anjuman El Saifee mosque had been recently built, but the AV cabling had been designed and partially installed by the former contractor. This left DAV with the task of revealing hidden cabling within the beautifully crafted walls of the new and architecturally symmetrical mosque. With the minimum of disruption, the team were able to finish the layout and design a superior system using the fewest possible inconspicuous speakers.

The background noise at events, coupled with the acoustics of the room and the propensity of the Imams to move around the room while addressing the attendees, led to quite specific parameters. A balance had to be found in order to provide clear sound, loud enough to be heard over the worshippers without being unacceptably loud in the vicinity of the speakers. Reverberation, EQing and feedback all needed to be factored in.

The building had come into use when DAV became involved and the need to work in the building while it was unoccupied and in addition, complete the work within the desired timeframe, were hurdles ably overcome through thoughtful just-in-time equipment sourcing and sensitive communication with the client.

The system comprised a Pan Acoustics steerable array with a Powersoft Ottocanalii 4K4 amp and Audac loudspeakers fitted in the ceiling. Mipro microphones and an Atterotech Dante networked audio interface were installed. ▶

Pete Rutherford has further plans for optimising the system and dampening the ambient noise. He'll use ambient microphones out of phase with the main microphones and attempt to create a program file, which will allow that continual adjustment.

US based Visionary Solutions supplied encoders and decoders for the project. The components suited the video over IP and the fully structured cabling network and could support flexible placement.

The support on the opening night from Visionary Solutions was impressive. Just half an hour after a support request was logged, their tech support had dialled in and rectified the issues.

As a result of the success of their installation in this mosque and the client's delight, DAV are assisting the same charitable trust with other mosques and have also begun quoting for work in other places of worship.

Another organisation which has shown its faith in DAV is Carmel Group Ltd. Last month Carmel acquired 90% of the share capital of DAV, in order to complete the range of services they can offer clients. Pete Rutherford and his team are seen as key to continuing the success of Carmel Group and all look forward to a prosperous partnership. ♦

How to make the most of the Apprenticeship levy: investment of skills

Paul Sanders *MInstSCE* C-TEC Research and Development
Tracey Wood, Hopwood Hall College

Fellow ISCE members, I wanted to take the opportunity to raise awareness about recent changes to apprenticeships in England, and the introduction of the apprenticeship levy.

I am a massive beneficiary of the modern apprenticeship scheme and as such, I would encourage every business to consider apprentices as a route to filling the skills gap that technology related industries are facing.

It is important that employers are not just looking at their needs for staff today, but have one eye on what their needs maybe in the future. Please consider and gauge the required technical capability for your organisation to allow business as usual to be an uninterrupted process. This is not just a case of forecasting growth to estimate staff count, but having well-structured succession planning to help minimise the impact of losing decades of experience from a business when someone retires.

I am lucky enough that my training and development is still on-going and I am currently studying at the University of Bolton, working towards an MBA. One of the major benefits of the MBA has been the people I have met, and the knowledge and experience each person brings to discussion and debate is enlightening. I will now hand you over to one of my classmates, Tracey Wood of Hopwood Hall College. Tracey gave me a clear understanding of the changes and has kindly put together the following article to share with you a summary of the levy and how to make the most of it.

Apprenticeships and the Levy have been a significant talking point over recent months, and despite so many articles, seminars and workshops, many

businesses that are subject to the Levy are still unsure what it means for them or how to maximise on their investment. Even more confused in this market are the non-levy payers, small or medium-sized (SMEs) who employed more than 16.1 million workers in 2017, which made up 60% of all private sector employment.

Since April 2017 there has been much publicity around the introduction of the apprenticeship levy and new standards, what does it all mean for business?

Who has to pay the levy?

The levy applies to employers in England who have an annual pay bill above £3m.

How is the levy calculated?

The levy is 0.5 per cent of the annual pay bill.

All employers will receive a £15,000 annual allowance, to be offset against the bill.

The levy will be collected by HM Revenue and Customs monthly through Pay as You Earn (PAYE). It can then be accessed by employers through an online digital service account.

How do you access your levy?

Employers can use the online digital service to pay for apprenticeship training for apprentices that work for at least 50 per cent of their time in England, which will be limited up to certain maximum funding bands. When the apprentice training starts funds (in the form of vouchers) will be taken from the account.

To register visit www.gov.uk/guidance/manage-apprenticeship-funds ▶

What can the levy be spent on?

You can spend your Levy funds on apprentice training and assessment for either existing staff or new recruits as long as the training meets an approved standard or framework and the individual meets the apprentice eligibility criteria. They cannot be used on other associated costs such as apprentice wages, travel and subsidiary costs or the costs of setting up an apprenticeship programme.

Non levy payer?

If your business has a pay bill less than £3m it will not have to pay the Levy. In England, organisations will still be able to access government support for apprenticeships up to 90%/

New apprenticeship standards

The new apprenticeship standards, developed by employers for employers, now offer more role and sector relevant training. They deliver greater flexibility than the previous framework structure and support team members to develop suitable skills, knowledge and behaviour, helping them to perform their job roles to the highest possible standards.

Finding apprenticeship standards and sourcing apprenticeship providers has been made far easier visit www.instituteforapprenticeships.org/apprenticeship-standards/

Financial Incentives

To support the uptake of apprenticeships moving forward, a number of incentives have been put in place to support the transition to standards and to achieve employer buy-in. These include:

- An annual £15,000 allowance to offset the levy fee.
- 10% monthly top up to levy funds.
- £1000 per 16 to 18-year-old apprentice (and 19–24 year-olds with a local authority education, health and care plan).
- Employers of less than 50 people will not pay a contribution for apprentices aged 16–18 or those 19–24 who meet the special requirements. 100% of the cost will be supported by the government.

In addition, business no longer need to pay National Insurance contributions for apprentices under the age of 25.

Apprenticeships are changing into technical education schemes and routes into work play a vital role in both improving the country's employment record and developing the skills of our workforce, which in turn delivers economic value for all of us. Apprentices (either new staff or current staff) are “employees” that will help future-proof your business, improve your skills base, add diverse talent, deliver improved productivity, and bring new ideas and ways of working into the workplace. With new starters it is a chance to home grow your own talent who will embed your brand and company values.

Research has shown that a typical apprentice delivers productivity gains of over £10,000 per annum and, with the roll out of the government's apprenticeship reforms – employer-led, credible apprenticeship training. Large employers will essentially now have ring-fenced apprenticeship training funds so it makes sense that apprenticeships form a significant part of their talent management strategy - there is no better time to invest in apprenticeships.

About Hopwood Hall College

Hopwood Hall College is a recognised approved provider of Apprenticeships with 20 years' experience of delivering apprenticeships. We have specialist team to work with employers to understand their workforce development needs and to support them to upskill their workforce through recruitment and training of apprentices, new staff and existing staff.

www.hopwood.ac.uk ♦



Invitation

**to a Theatre Sound Open Day
at the Victoria Theatre, Halifax**

Hosted by NEXO and AC Audio, this Open Day is a chance to hear NEXO's new sound reinforcement technology in the fantastic 1500-seat classical auditorium at the Victoria Theatre. We will be presenting the new GEO M10 mid-size line array, alongside the compact GEO M6 array system which is permanently installed at the theatre, together with the acclaimed super-compact ID Series point-source cabinets which are a popular choice for under-balcony and stage fill in theatres around the world.

Wednesday 25 July

**The Victoria Theatre
Fountain Street
Halifax HX1 1BP**

**To attend, or request an agenda, please contact
Steve Eaton: steve.eaton@ac-et.com
or Gareth Collyer: Gareth.collyer@nexo.fr**

FIRPHASE

A new approach on linearity for RCF live loudspeakers

In this whitepaper, we will discuss the importance of excluding phase distortions in the sound reinforcement systems and how RCF made it possible with FIRPHASE processing, reaching near-sub frequency phase linearity without annoying time delays.

A brief history of phase perception

The Georg Ohm's acoustic law (1843) states that a musical sound is perceived by the ear as a set of a number of constituent pure harmonic tones. Later, Von Helmholtz agreed to the Ohm's law and deepened his future researches saying that aural perception depends only on the amplitude spectrum of a sound and is independent of the phase angles of the various complements contained in the spectrum. In 1841, August Seebeck, a scientist from Dresden University, was arguing with his experiments that the phase differences are clearly audible. The missing fundamental effect explain how a perceived pitch of a sound can be altered by phase differences of harmonics. The debate continued for twenty years in the scientific journal *Annalen der Physik und Chemie*. Seebeck then died young and his knowledge was forgotten until 1959, when Schroeder, in his work entitled *New results concerning monaural phase sensitivity* (1959), demonstrated the phenomenon. Schroeder states that Ohm's conclusion is invalid and it's only true in some particular cases. He postulates that, according to Schroeder's phase masking effect, by just modifying the individual phase components of two signals of identical envelopes, it is possible to produce strong varying pitch perception, eg, when playing melodies. Today we have several demonstrations who oppose the earlier belief that the human ear is phase-deaf, as the work of Lipshitz et al. in the *Journal of Audio Engineering Society* in 1982: "We have found that midrange phase distortion

can be heard not only on simple combinations of sinusoids, but also on many common acoustical signals." He pointed out that those problems exist but can be subtle and transducer designers can make an intelligent decision on the significance (not the existence) of phase effects. In another late AES conference in 1996, Johansen & Rubak stated that "the conclusion must be: we cannot allow the excess phase to be neglected, and we will have to get around the equalization task in another way." The perception of the phase spectrum has also been studied in relation to many topics, such as concert hall acoustics, pitch perception, vowel identification, masking, speech processing, and binaural rendering.

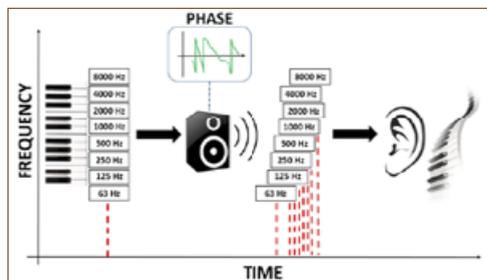


Fig 1 Visual example of the monaural phase distortions generated by a sound system that can be made of transducers, EQ, crossovers, and amplifiers

0° linear phase

Linear-Phase or constant group delay describe a characteristic of linear systems where all the spectral components of a signal travel through the system at the same speed. In a particular case, a linear phase system can be called 0°-phase: all spectral components of a signal arrive at the output at the same time. In a system with linear frequency response and 0° phase, the shape of the output signal is ideally an exact replica of the input signal, where the magnitude depends only on the gain of ▶

the system. Multi-way speaker cabinets and traditional IIR filter-based analog or digital crossovers are typical examples of non-linear phase systems with some amount of ‘time smearing’ due to the all pass nature of the summed electric or acoustic response. The goal of a loudspeaker designer is to deliver a “transparent” sound, where the loudspeaker is able to reproduce a sound most as possible close to the original, an important characteristic for voice-based applications. Any sound characterization such as equalizations or distortions should be made by, eg, the musician and sound engineer, giving them the freedom to present their own sound to the public. In classical music applications, the sound can be perfectly transduced without alterations.

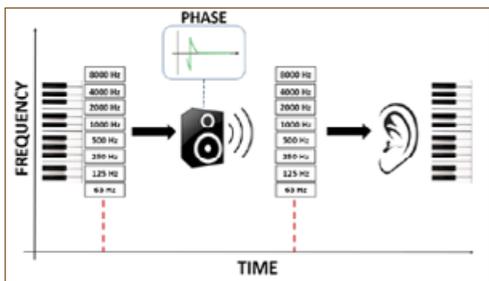


Fig 2 Visual example of an ideal linear system

The square wave problem

A 0°-phase loudspeaker delivers to the listener all the frequencies at the same time, without relative delays, with the result of a true reconstruction of the original sound. One of the most relevant and audible effects in the passage between “not-0°-phase” and “0°-phase” is the optimal reconstruction of the transients. Let us think of a snare, or a picked guitar string: a lot of energy and frequencies in a very small amount of time. If the frequencies of the kick or the pick arrive at the ear not packed but a bit distributed in time, the impulse loses energy, dynamic, detail. This could be understood by using a squared wave that is the sum of a fundamental sine wave and a number of its odd harmonic at higher frequencies. If the harmonics are delayed respect to the fundamental, the reconstruction fails.

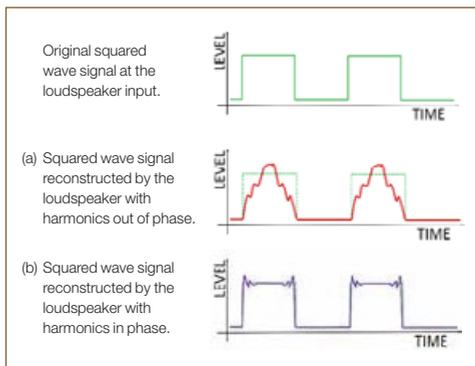


Table 1 Visual example of a square wave reconstruction from (a) a phase-distorted system and (b) a phase-coherent system

The loudspeaker is not only made of transducers but crossover and equalization filters act a fundamental role in the final result. Analog filters or digital IIR filters produce phase distortions around the frequency on which they act adding them to the ones already present in the transducers.

FIR filters for phase linearization

The modern DSPs permit a pre-compensation of these phase distortions in order to deliver a 0°-phase signal. The most useful and powerful way is the use of FIR filters (Finite Impulse Response filters). A FIR filter is nothing but a set of coefficients, representable as an impulse response (IR) in the time domain. The digital audio signal is filtered, hence modified, with the FIR by mean a mathematic operation called “convolution”. This kind of filters introduces a delay, the time necessary to the signal for passing all the length of the filter. Luckily, the time delay is equal for all the frequencies (no relatives delays between frequencies): in this particular case, they are named linear phase. A linear phase FIR filter can manipulate the amplitude equalization of a signal without distorting its phase, it can act as a bank of IIR filters without their side effects on signal phase. For example, FIR filters can be used for a crossover filter instead of common Low Pass and High Pass IIR filters, reaching very high slopes without modifies on the phase. ▶

Delay issues of FIR filters

Unfortunately, all that glitters is not gold: there is a cost to pay also for the use of FIR filters. The lowest frequency controlled by the filter (its resolution) is proportional to the length of the filter in terms of samples and hence to the latency that introduce in the DSP chain. As shown in the Table.2, the minimum length of a filter useful for managing all the audible frequencies introduces a delay of 21 ms (at 48 kHz of sampling frequency), delay not acceptable for live performances. The use of this kind of filters becomes a compromise between resolution and latency. Considering the price in terms of latency, FIR filters can be hence used for correcting a large part of phase deviations from 0° creating a sort of Dirac delta (all pass filter): an impulse that doesn't affect the amplitude spectrum of the signal but modifies the phase in order to temporally align the frequency components of the sound.

Number of taps	Sampling freq. 48 kHz		Sampling freq. 96 kHz	
	Resolution (Hz)	Delay (ms)	Resolution (Hz)	Delay (ms)
32	1500	0.33	3000	0.17
256	188	2.7	375	1.3
1024	47	11	94	5.3
2048	23	21	47	11
4096	12	43	23	21

Table 2 Delay introduced by FIR filters

The temporal alignment of the frequency components is clearly visible in terms of Impulse Response measurements. The phase alignment increases the dynamic of the signal reproduced by the loudspeaker, because the energy is concentrated around the same time and not distributed as in the case of absence of FIR filter. The design of the FIR filter for this specific purpose should start from an accurate measurement of the loudspeaker phase.

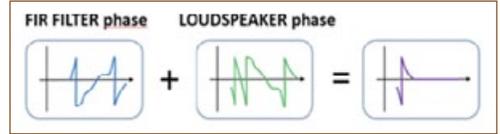
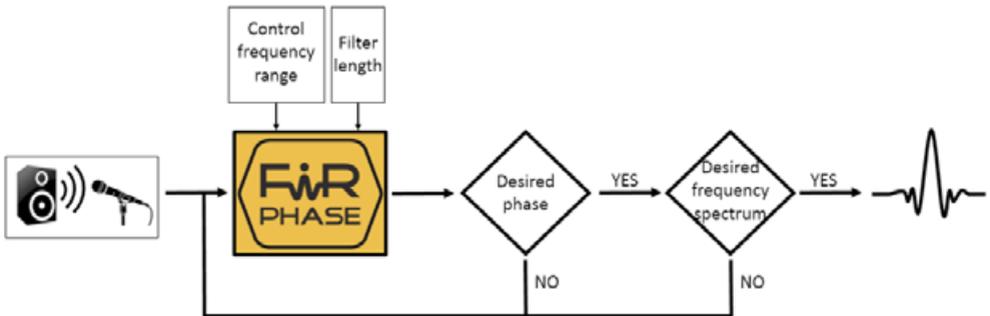


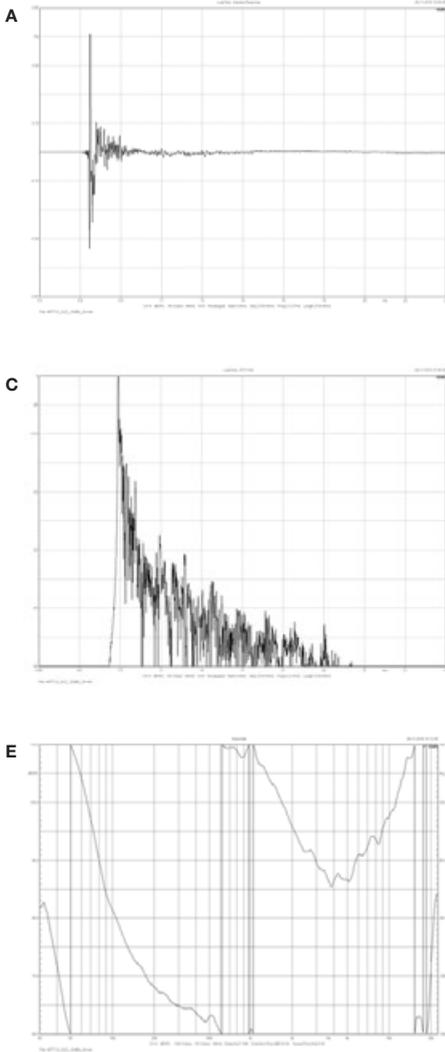
Fig 3 sum of the FIR filter phase with the loudspeaker phase

FiRPHASE

RCF FiRPHASE processing uses this measurement and try to invert the loudspeaker's phase without touching the amplitude equalization. The heart of the advanced technique used by FiRPHASE is a recursive method (Least Squares method) combined with a proprietary RCF algorithm that calculates the best FIR filter coefficients set in according to amplitude and phase constrains. The algorithm corrects phase and amplitude (if necessary) by taking into account the weak points of the transducers and the resonances or cancellations due to the cabinet of the loudspeaker. This technique permits to the designers a deep control of phase at mid-low frequency with relatively small filters, reaching a higher resolution than that one which theory suggests. ▶



Without FIR filter



With FIR filter

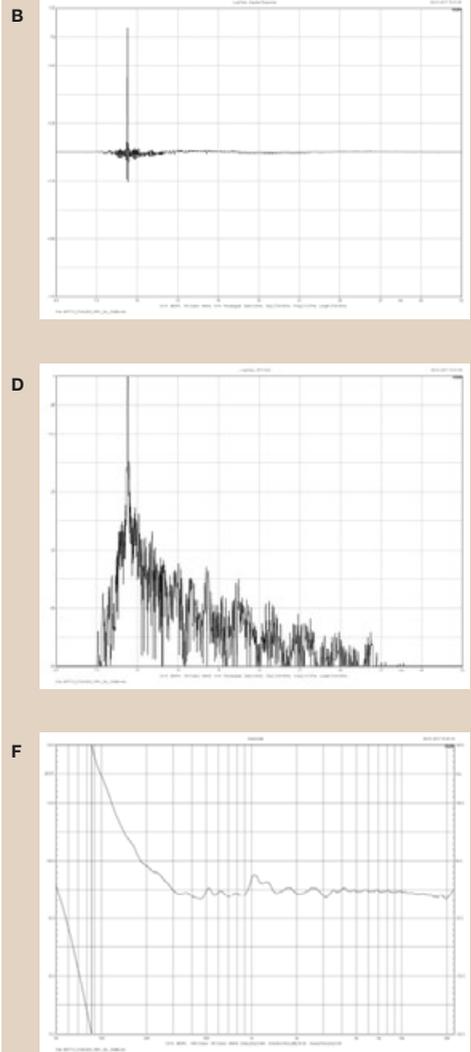


Fig 4
A – Impulse Response, no FIR; B – IR after FIR filtering;
C – Energy Time Curve plot, no FIR; D – ETC plot after FIR filtering;
E – Phase plot, no FIR; F – Phase plot after FIR filtering. ▶

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The Royal Wedding

19 May 2018

By **Brian Latham** *FInstSCE*



It was a great privilege for Electronic Audio Systems Ltd to be asked to provide the Public Address systems in Windsor for the Royal Wedding. I am sure that many other ISCE members were involved with their own local contracts, but I'm also convinced that ours had the largest audience of an estimated 120,000+ members of the public.

To be clear, our systems were installed in the streets of Windsor, the Long Walk and the surrounding Alexandra Gardens and Home Park. There were seventeen loudspeaker zones controlled from nine positions throughout the town and castle. All control positions were connected via microwave links and multicore audio & data cables. The audio signal of the chapel wedding service in was provided by the BBC as a clean feed. We distributed the service audio throughout the streets where the public could not see any of the large video screens; and at the thirteen large video screens we provided line arrays to

complement the pictures. All systems were powered by twin generators to provide continuous service.

It took just over three months to plan, sixteen days to install and three days to de-rig. We had thirty-four technicians (some working in two shifts) to operate the sound and communications systems. For those of you who like statistics, there were 18 digital audio mixers feeding 44 amplifiers powering over 221 loudspeaker cabinets. Just don't ask about the number of microwave links or the length of cable installed!

Our thanks go to two other ISCE supporting members, namely Delta Sound Inc who provided the majority of the equipment and NSR Communications Ltd who provided the PA to accompany one of the screens in Home Park.

www.electronicaudiosystems.co.uk ♦

The family have given their permission to publish this article, which was submitted before Brian's sudden passing.

St Bridget's Church, West Kirby

By Roy Kirkpatrick *MInstSCE*



St Bridget's Parish Church serves the small town of West Kirby, on the Dee estuary. The Church was founded by Christian Vikings from Ireland and has served the local community for more than a thousand years.

Looking to improve the performance of the installed sound system the Church contacted Kirkpatrick Sound Engineering, renowned church specialist supplier, to improve upon the installed sound system, made up of a collection of components added to over a number of years and fast becoming unreliable and unfit for purpose.

Roy Kirkpatrick, Director for Kirkpatrick Sound Engineering, comments, "we designed an outline proposal for the new sound system at St Bridget's Parish Church and offered to demonstrate the performance of the proposed solutions, with a number of different loudspeaker choices, to

allow church members to hear for themselves the differences between the proposed solutions".

Active Audio R100 one metre high column loudspeakers were chosen to provide audio coverage for the Church's Nave. The unique rigging system of the R100's allows them to be vertically mounted very closely to the wall on which they are fitted whilst the acoustic properties provide optimum coverage over a nominal range of twenty metres, which makes them perfect for use in church buildings.

Audac Kydo column loudspeakers were used to provide coverage in the choir and chapel areas, mounted horizontally and high up, within the eaves of the church roof to provide natural sounding coverage in these areas.

Energy-Star compliant Audac EPA amplifiers were installed to provide audio output to the Active Audio and Audac column loudspeakers. The amplifiers ▶



are convection cooled, offering almost silent operation, and in addition to their low power consumption in standby mode, were chosen for their clean, low-distortion acoustic properties.

In addition to fixed position installed microphones Kirkpatrick Sound Engineering also opted to provide a four-channel wireless microphone system, choosing the MiPRO ACT 7 system. For the fixed position microphones, Electrovoice Polar gooseneck microphones were used.

“We like the MiPRO Act 7 system, it provides truly natural sound, excellent coverage and professional performance and we chose to use the EV Polar goosenecks as they allow us to select the polar pickup pattern of the microphone, once installed, essentially allowing us to fine-tune the audio-acoustic properties of the system really easily”, comments Kirkpatrick.

The microphones are connected to a Shure automatic microphone mixer, with the output connected to the Church’s main mixer, an Allen & Heath ZED-14 compact audio mixer. An Apart PC1000R MK2 CD/SD/USB player, used to provide background music playback during services, completes the audio line-up of the newly installed sound system.

“This project has been achieved with the help and assistance of the technical support team at Commercial Audio Solutions who provided help with the system design and product demonstrations. The system installed at St Bridget, West Kirby, is one of a number of systems installed churches in the area, our aim is always to provide optimum solutions, within

available budgets, without compromising on audio quality and performance”, concludes Kirkpatrick.

Further information

Kirkpatrick Sound Engineering

Kirkpatrick sound engineering supply and install professional audio equipment and sound systems either from main agents or directly from the manufacturer, using experience and expertise to help customers source the best equipment for their needs.

Located in Knutsford, Cheshire the company is owned by Roy D. Kirkpatrick, MInstSCE who has been designing and installing sound systems for more than forty years.

www.kirkpatrick4sound.co.uk

Commercial Audio Solutions

From their base in the Peak District of Derbyshire, Commercial Audio distributes professional audio products to all corners of the UK and overseas, holding stock of many of the world’s most prestigious brands, including Bosch, Sennheiser, JBL, Yamaha, RCF and Audio Technica. With over 40 years experience our aim is to offer customers the very best possible service. From the smallest background music system to huge stadium venues, we can supply.

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Equipment list

2 x Active Audio R100 Column Loudspeaker ♦

ECO Design regulation

News of our industry's petition to save stage lighting

'Theatres will not go dark due to ECO design rules'

On 20 June 2018, the period of public consultation for the proposed ECO design regulation – that will affect lighting products of all types – expired. The EU DG Energy department has passed on a revised draft to the next stage of the legislative process. We expect to know its content within a few weeks as it progresses through the committee stages of the process of turning it into a law. Although much still remains to be known, the situation now is far more positive than many had feared and greatly improved since our public meetings earlier this year.

Our petitioning team made a clear case for exemptions for our industry – including for stage, studio, film and live event purposes – and we have received strong indications that the main arguments of the case have been accepted. There will be a list of exempted lamp base types that will include many of the specialised tungsten and discharge lamps we use. We can expect the list to be comprehensive, but we should also expect that a few types we have been

using will not be exempted if they are in use for other common non-entertainment purposes. There will be an exemption for colour-tunable light sources, but the details have not yet been provided.

The text of the regulation will be published publicly in November this year and is to be enacted in law in September 2020. More specific details will be available shortly, and these will be disseminated as soon as they are confirmed. There may be more work to do and more details to clarify but, until we see the revised draft, it would be prudent to remain calm and patient.

Adam Bennette (PLASA)

Christian Allabauer (OETHG)

Randell Greenlee (VPLT)

Silke Lalvani (PEARLE)

on behalf of the Professional Entertainment Lighting Products ECO design task group. ♦

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ISCE welcomes new supporting members

INFOIL Innovative foiling solutions

INFOIL

Employees at INFOIL have been producing induction foil since 2000, but also have an extensive knowledge of sheering, rolling and copper alloys going back to 1978. As there is a large percentage of the population that suffer with partial or full hearing loss it's important for us to be able to help make a difference to those people. We design and manufacture innovative products that we can bespoke to our customers needs (i.e.) Direct burial cable (DBC) which can be supplied in lengths from 100 meters up to 3000 meters, this enables the installers to lay the cable with no joins in it which enhances the quality and reliability of the hearing loop.

We're proud to say that we can bespoke a variety of copper foils to various designs, widths, lengths and thickness if required by the customer. Our products are presented on cardboard flanged reels which prevent damage to the copper foil and makes installation easier, these reels can be printed with your company logo if required.

As a company, we recognise the importance of being a member of the ISCE and also as reassurance to our customers. The extensive range of training courses, seminars, exhibitions and technical advice offered by the ISCE have proved invaluable to our company. We are a family owned and run company that pride ourselves on old fashioned values and customer satisfaction.

www.infoil.co.uk ♦

If you want to join a select group of companies who have chosen to encourage us in our efforts to improve technical standards and practices within the sound industry, contact Ros for an application form or go to www.isce.org.uk/membership/isce-supporting-members/



Application Solutions (Safety & Sound) Ltd

Founded in 1989 as an electronic design consultancy, ASL began its legacy in the voice alarm market with the design of technology-leading systems for London Underground in 1999. Now established as a key supplier for the UK transport industry, ASL has evolved to design and supply products for customers worldwide and now caters for many industries including stadiums, airports, hospitality, retail, healthcare, commercial buildings, nuclear, oil and gas, roads and tunnels.

ASL is pleased to announce it's supporting membership of ISCE. Neil Voce, head of business development at ASL said "ASL has long been an informal supporter of the Institute with many personal members amongst our staff and also through the ISCEx event.

Recognising the Institutes' continuing development for the good of our industry and the challenges we need to meet maintaining professionalism and continuing education in the sound engineering world, we have taken the decision to add our name to the many other great companies supporting the ISCE through a formal membership.

We look forward to contributing to the continued growth of the ISCE in the future".

www.asl-control.co.uk ♦

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Training update

We were pleased to offer our *Principles of networking* and *Advanced principles of networking* training course during April. Our thanks go to Leisuretec for hosting the training at their offices in Leighton Buzzard and to Mark Faulks MInstSCE for presenting the course.



In May, we ran our *Hearing loop systems – design & installation and measurement & certification* training course. Our thanks go to Audiologic for hosting the training at their offices in Harlow and to Peter Roe FInstSCE for presenting the course.



More information on our next scheduled training course, *Electrical Safety for Sound Engineers* to be held in London on 26 September, can be found [here](#). Look out for details of a new course coming soon, *Audio for AV Engineers*.



ISCE is a member of the CPD Certification Service and our training courses are CPD accredited. There are many benefits to Continuing Professional Development at all levels. From an individual, organisation or industry as a whole, CPD is essential to keep skills and knowledge up to date and helps you focus on how to become a more competent working professional.

Standards update

By Andrew Scott *FInstSCE*

EN 303 348

EN 303 348 has been re-written and now has the title: *Induction loop drivers up to 25 amps in the range 10 Hz to 9 kHz. It is currently being reviewed by ETSI.*

One of the legal issues is the need for published limits for out-of-band radiation and work is now taking place to include the definition and associated limits for generic inductive applications and inductive loop audio applications in Annexes 9 and 10 of ERC Recommendation 70-03.

This is likely to result in a legal physical limit on the size (longest side) of a single loop antenna of 1/50th of the shortest in-band wavelength (9 kHz \approx wavelength of 33310 m = 666 m).

EN 54-24

(Voice alarm) Loudspeakers

There has been no change since the last report. CEN TC72 WG23 has started to work on a standard for active loudspeakers, including large phased arrays but is waiting for publication of a new DIN standard on active loudspeakers, which will hopefully provide practical requirements and tests that will be acceptable to industry.

Meetings on this subject have been suspended for the time being.

EN 54-16

Voice alarm control and indicating equipment

CEN TC72 WG23 has set up a task group which has completed its review of the comments. Work is still taking place to tidy up the draft and to ensure that it is in line with proposed changes to EN 54-2 (Fire Alarm Control and Indicating Equipment).

At the time of writing, the eighth task group meeting is about to take place, after which it is hoped (again!) that there will be a draft for WG23 to review.

BS 5839-8 and BS 5839-9

The last meeting of BSI FSH/12/5 in May discussed the possibility of asking the BRE to develop an LPS standard for Emergency Voice Communication System components. The BRE has been approached regarding this and negotiations are in progress.

Disclaimer

This information is believed to be correct but it is not guaranteed and neither the ISCE nor its officers can accept any responsibility in respect of the contents or any events arising from use of the information contained within this article. ♦

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