Integrated audio makes sound sense

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Noise pollution can be a major problem for station operators. Several court cases have been won recently by public pressure groups, forcing transport operators to seek fresh solutions.

Traditional station acoustic systems flood the platforms to ensure even levels of communication. The nature of sound means that for every metre it travels, its level drops by 3 dB. In normal conditions, this means that someone standing 5 m away from a speaker only hears 3% of the actual signal.

In some instances, however, sound can carry through the air much more efficiently. Windy conditions, bounce off station structures and phasing due to the position of the speakers all affect the way in which sound carries, creating very difficult modelling conditions for platform audio designers.

Traditionally, the station manager's audio control is limited to increasing or decreasing the volume. When people complain that they cannot hear the announcements, the staff will generally try to help by turning the volume up. This has the opposite effect, as the amount of energy being transmitted only compounds the problem.

Sound travels at 330 m/sec, meaning that two conventional directional speakers will interfere with each other when heard non-equidistantly. The effect of this, coupled with bouncing signals and acoustic reverberation, contributes to confused acoustic signals and a reduction in intelligibility.

Audio technology

Until now, audio in transport networks has been compromised by the limitations of speaker technology. The result is poor operational performance, safety risks, high integration costs and low intelligibility, as well as complaints of noise pollution and high power use. Installations may be damaged by vandalism, and the ingress of brake dust reduces performance.

Small vibrations from an actuator can excite an audio signal over a large surface area.

Feonic plc specialises in solid-state acoustic actuators, or 'drives', which can provide controlled audio where it is required — without noise pollution or overspill — by converting structures into high quality speakers. Pressure differentials generated when a train goes straight through a station, which have been known to rupture the thin diaphragm of a traditional speaker, do not affect a Feonic drive and nor does brake dust contamination.

Feonic technology uses a high power density 'smart material' at the heart of its audio drives. This enables wide bandwidth audio signals to be generated from tiny output vibrations when the drive is mounted to the rear of a suitably resonant surface. Distributing the signal over a large surface area means that consistent, equal and non-bouncing audio can be heard at high levels all around the driven surface.

The phenomenon of surface excitation is not new. Lower power Distributed Mode Loudspeakers have been available in the consumer market for some time, from companies such as NXT. DMLs do not emit sound from a single point source, but exhibit a flatter, even distribution across the entire surface. Feonic's high-power capability can convert a series of co-joined resonant panels into long lengths of acoustically-conductive surface.

As the DML has no apparent single acoustic source, and the energy is distributed through the whole surface area, the single strong signal that traditionally encourages reverberation, bounce and echo is avoided. As a result, DMLs generate a much clearer sound quality that is able to deliver intelligible information over a wider area (Fig 1). Vibration is very small, with maximum amplitudes of only 4 µm recorded at 300 Hz, and less than 1 µm at 500 Hz and above.

These amplitudes are as much as 1 000 times lower than vibrations from conventional speakers. Combined with careful design of the accoustic panels, this makes the likelihood of interference and damage to the surrounding infrastructure through vibrational fatigue significantly lower.

Suitable 'acoustic' materials include everyday building and construction materials commonly used in the transport industry, such as honeycomb reinforced steel (VE and powder coated), aluminium and glass. Platform screen doors, station media displays and platform partitioning all offer scope for integration with Feonic audio technology. Smaller structures made of acoustically co-joined panels can also be driven, generating a three-dimensional locus of signal specifically above, under or alongside locations where people congregate.

Design advantages

Unlike moving coil/magnet arrangements in conventional speakers, the power delivered by a solid state size-for-size Feonic device far exceeds existing loudspeaker capabilities without moving parts, fragile diaphragms or the need for maintenance or lubrication.

Feonic technology has a bandwidth response of 80 Hz to 20 kHz and sound pressure levels of 90 dB to 100 dB at low power levels (typically 8 W to 10 W). The drive design uses no combustible or potentially toxic materials, and laboratory testing has confirmed operational performance at temperatures up to 150°C. Both standard 4 Ω and 100 V transformer step-down are available, and the product's normal

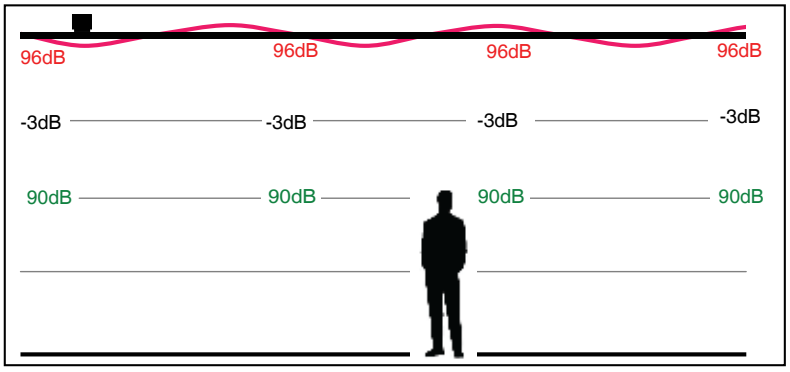

Fig 1. Distributed mode loudspeakers offer a clearer sound quality; this example shows the effect of two 10 W Feonic drives with a pitch greater than 12 m.

IP55 rating can be increased to IP65 or IP67 if required.

Current devices can be tested remotely, using ASL-approved integrated standard devices. Intelligent diagnostics are now under development to facilitate self testing of 'ping response' status.

Whispering windows

Originally established as a spin-off from Hull University, Feonic has developed high volume production lines for its drives. These have been used for a wide range of applications, including retail outlets, historic buildings, sports arenas and hotel rooms.

One product is known as the 'whispering window'. Feonic technology is particularly suitable for media panels where information or advertising screens are used behind glass panelling. Media panels normally contain provision for discrete audio which can convey real-time information and advertising messages to waiting passengers or passers-by.

Potential applications in the transport sector include surface and underground stations, transport hubs, concourses, walkways and tunnels, airport buildings or terminals. Indeed, the technology is appropriate for any large structure designed to operate mass transport services, where specific PA/VA information has to be transmitted intelligibly and clearly, with no overspill, pollution or loss of key information. Speech transmission index levels have been recorded as high as 0·75, even in difficult environments.

Visually-integrated panelling systems masquerading as signage systems or fascias can be designed to perform as highly intelligible, powerful DMLs. They are suitable for both audio reproduction and public address systems, and satisfy the EN60849 standard for acoustic quality in public places.

Fewer drives are required, compared to traditional speakers for the same area. This enables the designer to save on materials, installation costs and redundancy, and to use less power than similar flood systems. With careful control of the low frequency response settings, energy requirements are significantly reduced, as one Feonic device can replace up to seven cionventional loudspeakers.

Large scale testing of Feonic's acoustic panelling is underway, and trials on several metros in various countries are planned later this year.

Typical station public address relies on large numbers of speakers to flood the platforms with sound, which can result in noise pollution and poor audibility.