Renovating the Royal Festival Hall

George Dodd

Refereed

Acoustics Research Centre, University of Auckland, g.dodd@auckland.ac.nz

Introduction

A recent IOA Acoustics Bulletin carried an article [1] (see reprint page 4) reporting opposing views about proposals for renovating the Royal Festival Hall (RFH).

This response to that article reflects on the debate about the renovation from the perspectives of personal association with the hall, experience with its pioneering electronic enhancement system, and research on music listeners' habits and preferences.

History

The RFH is the main (and oldest) component of London's South Bank Centre and, for acousticians, is notable as being the first major serious music venue to accept and use electro-acoustics[1] as part of its permanent fabric.

The original design for the RFH building dates from the late 1940's. The intention for the hall was that it would be London's 'flagship' Concert Hall (in its original meaning of an auditorium dedicated to symphonic performances primarily from the repertoires of the classical and romantic eras) and was built as part of the celebrations for the 1951 Festival of Britain. After its opening it was realised that the acoustical flavour of the hall was different from that of halls renowned for their sound, and it rapidly acquired the reputation of being lacking in "warmth" and somewhat "dry". The primary reason for this can be traced to the ceiling separating the auditorium from the lighting and services void above. The completed ceiling (reportedly significantly thinner than indicated on original plans) was so light that, working as a panel absorber, it provided efficient dissipation of low frequency sound. The effect of this is clearly seen on the reverberation times in the hall (see Fig. 2)

However, whilst it seems that all listeners could recognise the effect of the lower reverberance it is not the case that it was universally regarded as a defect. The RFH must be credited with helping to raise acousticians' consciousness to the fact that "classical" music lovers do not have homogeneous and unified preferences for hall acoustics.

40 years on this remains a largely unresearched area but a low reverberance – resulting in a high clarity of sound – is very much to some listeners' liking.

Rather than attempt to make an adjustment to the hall's reverberation by changing the structure or reducing the seating capacity it was decided to try a totally novel approach involving electro-acoustics. This led to the system which became known as Assisted Resonance.

This system was the brainchild of Peter Parkin (known to generations of students through his book Acoustics, Noise and Buildings) and was simply an elegant way of harnessing feedback "ringing" of amplification systems to cover a wide bandwidth. This was achieved by having many 'channels' tuned individually to a specific frequency (see Fig. 1) within the required bandwidth.

Parkin realised that the ringing of a P/A system is simply one frequency decaying with a long reverberation time and hence, if a sufficient number of frequencies could be reinforced in this way and suitably excited by the sound field in a hall, this would be heard as lengthening the hall's reverberation time.

The system (comprising about 100

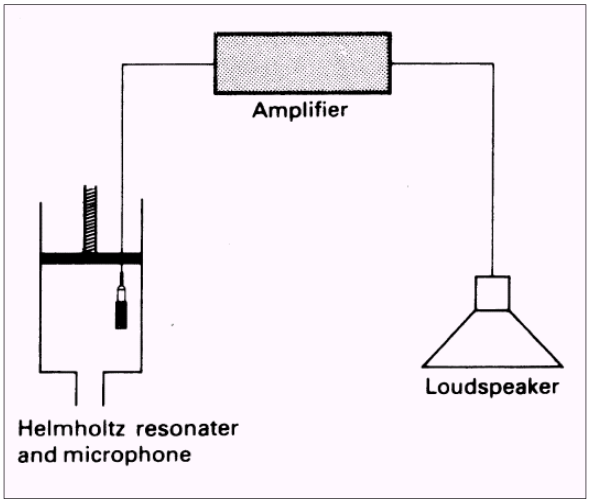

Figure 1: The simple equipment used in each Assisted Resonance channel showing how Parkin used a mechanical filter (Helmholtz Resonator) to select the frequency to be reverberated.

1. For contributing to the acoustics – as opposed to straight amplification for voice communication.

channels covering the low frequencies up to 350 Hz) was installed in 1964 and 1965 [2] but, because there were fears of a reaction from performers and concert-goers to the idea of loudspeakers being part of a live performance, this was carried out largely in secret.

This was possible because the installation was completely invisible to occupants in the hall, - its only connection with the hall sound field being through pre-existing holes in the suspended ceiling.

The system was gradually brought into service to avoid an abrupt change and it was a source of considerable satisfaction to Parkin and his team[2] that the hall management received a number of unsolicited enquiries and comments – especially from performers – remarking on an improvement to the acoustics.

Figure 2 shows the change in low frequency RT produced by the system.

Some commentators claimed that with the system fully operational the problem of lack of warmth had been overcome, and that the hall had become one of the best in the world. As Barron has put it "*for those with a musical background the ability to hear individual instruments and individual lines in the RFH can be a magical quality*" [4].

How optimum the average concert-goer found the listening conditions is difficult to judge but the acoustical conditions were sufficiently good to enable the RFH to become – based on the number of performances per year – the busiest concert hall in the world!

The AR system was in use for 30 years before the ageing equipment required it to be switched off permanently in the late 1990s.

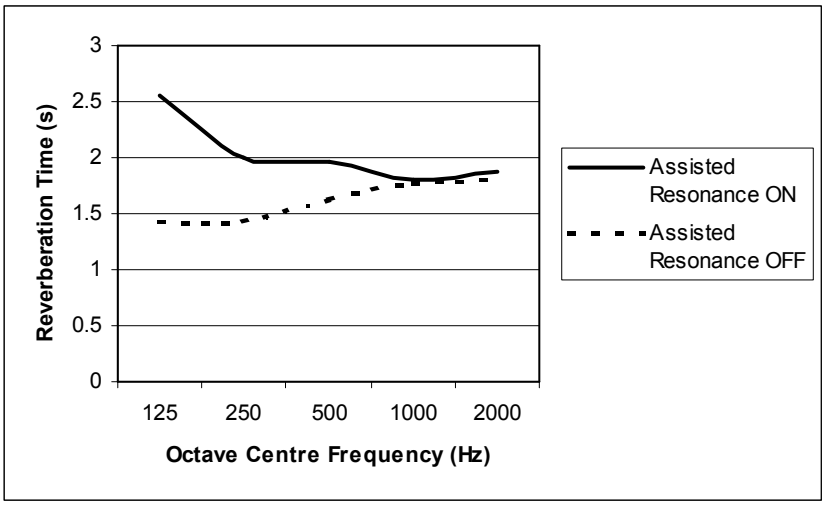

Figure 2: The effect of the Assisted Resonance system on the reverberation time in the Royal Festival Hall.

This return to the original lower reverberation, coupled with a general need for refurbishment, prompted planning for changes to the hall, which have kindled the present dissention.

Amongst the issues in contention is the proposal not to replace the AR system with a modern electro-acoustics system but to raise the RT by means of seating and ceiling changes.

This brings us to a need to clarify the difference between *active* and *passive* acoustics and a need to realise the implications for performance venues when choosing one or the other.

Active and Passive design

An electro-acoustical system involves at some stage the conversion of a sound signal into electrical energy and – after the required processing – transduction back into sound energy. This process of transduction and the need for an energy source to drive the system are what earn the description *active* for such systems.

Active systems are easy to vary (at the very least they can be turned on or off!) and so, in principle, they are the obvious way for providing acoustics which can be readily tuned to suit the whims of different performers or to make major changes for accommodating contrasting uses of a hall.

By contrast, *passive* systems operate by virtue of the inherent properties of materials placed in the path of sound (i.e. to reflect, scatter or absorb) and so, unless a hall is designed to enable major physical changes (e.g. to its volume or area of seating), a passive design will have fixed acoustics.

As humans continue to evolve and progress, we develop and adopt new technologies, and this is no less in the area of our artistic activities. Most clearly this can be seen in the history of the development of our musical instruments and, most recently, how performance aids have been pivotal in the emergence of new genres of 'music'.

So it must be seen as fully consistent with our humanity that in this age of electronics we explore and apply the potential of new electro-acoustical tools. It would surely be regarded as a crime against the creative instinct if, for example, we prohibited composers

2. The author worked on the system under the supervision of Parkin for his doctoral research. [3]

from experimenting with works which utilise a change of acoustics during their performance. Since this would require rapid changes we would only expect it to present as a practical proposition when using an active system. (Izenour [5] has designed auditoria which, by means of mechanical systems for changing the volume and seating capacity, permit major changes to the passive acoustics but in all cases these changes are major and lengthy undertakings.)

However, we must also be guided by a full appreciation of what underlies and motivates the choices made by listeners.

Listener Preferences and Choices

When designing (or renovating) a venue for public performances it is self evident that our efforts should be towards optimising the experience for listeners.

If, as the RFH exemplifies, the lifetime of the venue before renovation is likely to be of the order of 50 years then we need to anticipate the needs and preferences for at least 2 generations of listeners. However, a possible difficulty for us is that these needs and preferences must also be in the process of evolution.

We cannot know, for example, what the impact of new or as-yet-undreamed-of technologies for personal and home entertainment might be. We do not yet know the time scale for significant changes to our preferences, nor are we able to distinguish those features which are amenable to change by virtue of them being culturally determined from those which may be more resistant by virtue of being set by our physiology.

Some clear needs, however, have been identified from the results of a survey of listener behaviour and preferences [6]. Central to this survey were thought experiments which were designed to pinpoint the important characteristics of a live performance for listeners, and to uncover instinctive reactions to the use of electro-acoustics (specifically loudspeakers) in the context of conventional classical music performance. Two findings have relevance for the debate about acoustical design for the RFH.

First, it was found that listeners are sensitive to the "two–way" nature of communication at a live performance. This has implications for the type of active system which is most appropriate for a live performance venue.

We can distinguish two categories of system which have been labelled In–Line (IL) and Non–In–Line (NIL) respectively [7]. The NIL variety importantly preserve the "acoustical reciprocity" which characterises a passive space and hence maximises the sense for listeners of desirable two–way communication.

We may note that the original AR system in the RFH (and also the ill-fated wide-band multi-channel system in the Aotea Centre) was of this preferred type.

Second, it was found that where listeners have experience of, or even simply a concept of, works composed for a particular era when performance venues and the associated generation of instruments were all passive, then they overwhelmingly reject a change to using active elements for their live performance.

This has led to the idea of an **originality** criterion needing to be applied to design choices.

It should come as no surprise to find that a similar **originality** criterion is also evident when considering architectural matters.

Just as we have found that audiences are strongly influenced by the original intentions for musical works (hence wanting performances to keep faith with those intentions) we find architects being concerned that the **original** design intentions for the RFH are respected. For them this extends to ensuring that the visible details in the auditorium remain unchanged.

It is worth noting that preserving something because of a respect for originality is different from preserving something because of a dislike for change (i.e. mere conservatism) – even though the result is the same.

The proposed changes

Current plans to redevelop the hall include refurbishment of, and additions to, the building, and "transformation" of the auditorium.

The principal acoustic consultants advising on the auditorium are Kirkegaard and Associates. The intention is to return to passive acoustics, rather than using electronic enhancement, while maintaining the hall's exceptional clarity.

The reverberation time will be lengthened, by changing auditorium surfaces to make them more reflective and by increasing the volume of the hall through lifting and reshaping the ceiling. Adjustments will also be made to the stage and platform area to increase reflections on stage to support the performers.

A new canopy is planned, the seating is to be renovated, and variable acoustic elements such as retractable screens may be introduced.

These proposals appear to suggest retaining the primary goal for the RFH as a traditional Concert Hall. But a report in *The Independent* newspaper [8] states -"*a new acoustic screen .. due to be added over the stage .. will be flexible for the natural sound of classical music but also suitable for amplified music*"- and thus makes clear an intention to cater for a broad spectrum of performance.

The work is estimated to cost £70m and expected to be complete in time for a formal reopening in January 2007.

Specific issues raised

The opposition expressed in the Acoustics Bulletin article is both architectural and acoustical.

The architectural objections are really beyond the scope of this response although it has already been noted that respect for the originality of a creation is equally due to designers of architecture as to composers of music. Therefore we must sympathise with those wishing to retain the present form of the auditorium. However, there is not unanimity amongst architects.

The Twentieth Century Society describe the proposals as "*a brutal intervention*" amounting to "*architectural vandalism to Britain's greatest post-war building*" [9] whilst, on the other hand, English Heritage has given its support to the proposals.

Turning now to acoustical matters, it is clear that we cannot make a full assessment of the criticisms since we do not have details of how the brief for the refurbishment expresses the goal for the acoustics.

If the brief cites quantitative acoustic values the validity of the proposals is testable by established

acoustical theory and since it would be surprising to find a purely qualitative brief – or a least a brief which has not subsequently been translated into quantitative goals – we must conclude that the essence of the criticism is about what goals the brief sets or what the brief leaves open.

1. The major issue for us is the decision to return to passive acoustics after nearly 2 generations of audiences at the hall have accepted some active assistance.

   In view of the originality criterion discussed above, it seems required that we come down in support of this decision to go passive since the major intention for the venue is for it to be a classical Concert Hall.

   The character of the RFH (which is specifically valued by some [4]) has been established by the acoustics achieved with the assistance of AR and therefore it is appropriate to set those acoustics as the goal for the passive redesign. The IOA article indicates that players, soloists and conductors are strongly in favour of a completely passive hall.

2. One criticism is expressed as follows "it is not worth altering a space so radically just so it can fulfil one of its requirements", "the hall has always been used for the presentation of many different kinds of music and art forms".

   This clearly speaks in favour of providing variable acoustics. If we cannot accept dramatic physical changes to the hall then the possible passive variation (e.g. by deployable banners in the ceiling void) would be minor.

   The attractive alternative would seem to be to employ a NIL active system. However, since the current generation of systems – both IL and NIL – are only capable of adding reverberation and "reflections", the symphonic setting which is that requiring one of the longest RT's would necessarily involve the active system. The originality criterion, however, rules this out for the RFH.

   We can foresee that research might provide us with 'smart' materials whose absorption coefficients are readily varied (possibly actively!). At this point, active reduction of RT would be possible and not violate the originality criterion.

   If, and when, composers take advantage of active acoustics and write specifically for performance in spaces so equipped, then the originality criterion is not merely in support of active systems but demands their provision for those compositions!

3. "Enjoying a concert is not solely about an audio experience but is equally about enjoying a space visually".

   Apart, perhaps, from debating the exact balance between the contributions from audition and vision, this contention is probably not something that we would wish to contest. However, it is salutary for acousticians to be reminded that one of the areas still requiring research is the exact contribution that vision makes to the concert experience.

   There is a growing suspicion that the visual experience may have quite a strong influence on, or interaction with, the way a sound field is perceived. (France has been a leader in such experiments [e.g. 10] which include, for example, demonstrating how changing the distance seen to a source changes one's assessment of the acoustical distance).

   Thus we must expect that changes to the size, shape and colour of visible features of the RFH auditorium have the possibility of altering the experience of the acoustics of the hall even though objective measurements might demonstrate a successful reinstatement of the behaviour of the sound field!

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Conclusions

Criticisms of the planned renovations for the RFH have been reviewed focussing on the differences between passive and active acoustics. I have suggested that we need an additional "originality" criterion for assessing designs. This criterion, coming out of research on audience preferences, supports having solely

passive acoustics – such as is being proposed in the refurbishment plans.

This is as far as we can go in supporting the plans for the acoustics without access to details of the brief. It is argued that it is appropriate to set the acoustical goal for the hall as those conditions experienced with the Assisted Resonance system in operation.

The originality criterion could also be applied to architectural creativity and hence used to argue in favour of conserving the architecture of the hall (at least, its visible aspects) unchanged. The proposals for the renovations, however, do include some changes which will be visibly quite obvious. Discussion of this as an architectural issue is beyond the scope of this review but it is noted that the changes have the support of at least one authoritative architectural body.

Finally, we are beginning to recognise an interdependence of the visual and auditory dimensions of spaces but we lack even the most preliminary of criteria for assessing the influence of visible features on the experience of the acoustics of a space. This must add a degree of uncertainty about the outcome of the refurbishment for audiences.

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