Using Auralisation as a Tool for Subjective Evaluation

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Introduction

It is still a challenge to quantitatively describe the quality of impressions from acoustical phenomena. Mainly concert halls and larger auditoriums has been investigated and discussed so far, thus there are already a number of parameters that one can measure physically or calculate using models and have fairly good correlation with certain aspects of acoustical impression ([1], [2]).

There are, however, several aspects that conventional parameters do not describe, yet have a strong influence on subjective judgement. On the other hand there is the need to research calculation and modelling methods that allow one to design smaller rooms reliably, since well-known approaches developed for concert halls often fail.

Seeking Objective Parameters that Correspond the Subjective Side

Acoustical research in this field may be divided into two groups in general:

- In series of rooms having different shapes, layout and acoustical properties but having the same functionality, a series of selected programs are performed or played back. A group of carefully selected listeners is asked to quantitatively judge different aspects of the performance, in this way the subjective impression is described.

  At the same time, acoustical measurement are carried out in these spaces that result physically measurable parameters. Finally, correlations between physical parameter values and subjectively defined values are searched for.

- Different acoustical phenomena are reproduced by artificial means under laboratory circumstances. On may inspect then these phenomena independently from each other. Of course, a group of trained listeners is needed again. Acoustical phenomena are finally described by physical values and compared to the subjective scores.

In both cases the method is rather time consuming and expensive.

Auralisation as a Tool

Computer aided modelling provides a more flexible tool for the practising acoustician compared to earlier methods, while general aspects of the behaviour of a room or hall can be inspected with sufficient reliability. Tendencies of conventional room acoustical parameter value changes tracked and calculated ([3], [4]) with the limitations of the available methods in the mind, of course.

Auralisation is another step toward the investigation of subjective quality (or quality changes). This way non-existing acoustical situations or modifications can be evaluated subjectively, experienced by hearing.

We have to emphasise however, that current auralisation methods are not capable to provide the same impression one may experience in real rooms, since there are many aspects that simplifications of auralisation calculation methods obscure. Certainly great efforts are made in advances in auralisation technology will allow much higher accuracy in the near future.

Apart from the above, auralisation is still a useful tool in tracking tendencies and in helping clients, partners and other designers to understand the need of certain acoustical solutions.

Current Experiments

The aim of our current experiments is to test auralisation for the investigation of room acoustical phenomena and their relationships to conventional room acoustical parameters. Advantages of this approach:

- non-existing acoustical situations and tendencies can be investigated;
- novel room acoustical parameters can be developed that characterise recognised coherences.

During our experiments we have applied different auralisation methods (ORTF stereo microphone and 2D HRTF binaural simulation) to see the degree of accuracy needed.

In the current experiment series the application of diffusely reflecting surfaces are being investigated. In general, it is hard to characterise the degree of diffusity needed for small rooms that are fairly damped. Technical or listening rooms for music recording or broadcasting have typically these features.

A tested experimental set-up is shown in Figure 1. The room size is 5×4×3 m, there is a window, and a mixing console in the geometry. The source is a 2-channel monitor loudspeaker system. Surfaces had the same absorption coefficient except for the mixing console and the window. Diffuse coefficient were changed from 0.1 to 0.9 on the side walls and the back wall, other surfaces were purely specular reflecting.

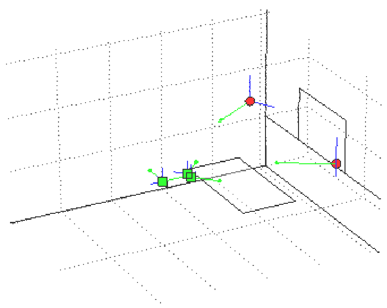

Figure 1: Experimental room configuration: geometry, 2-channel stereo monitor system, and receivers.

Results

Simulation results were investigated by using room acoustical parameters (reverberation time, early-to-late energy ration, lateral energy ratio and IACC) and also by using auralisation.

Based on the auralised simulations all subjects reported, that diffusing surfaces were more preferred on the back walls than on the side walls.

Room acoustical parameters followed this preference:

- reverberation times have shown a slight decrease when the applying diffusely reflecting surfaces on the side walls,
- early-to-late energy ratio values decreased, while lateral energy ratios increased significantly when diffuse surfaces were on the back walls only,
- IACC and centre time values did not show any coherence with changing the circumstances.

Summary

Auralisation as a method for investigations greatly facilitate the study of acoustical phenomena that are otherwise circuitous or expensive to consequently measure, describe or interpret in situ. Our experiments clearly show, that auralisation methods can be used to reveal correlations between room acoustical parameters and subjective preference.

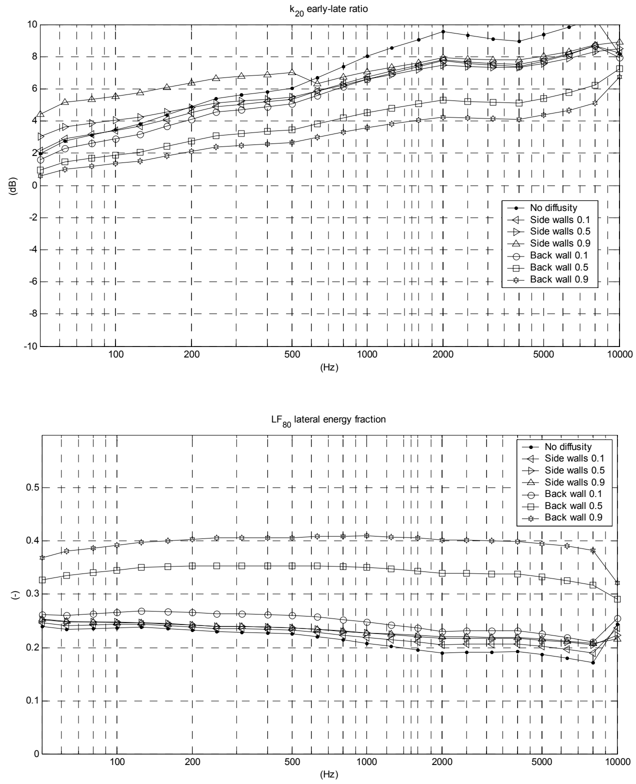

Figure 2: Simulated room acoustical parameter values (early-to-late energy ratio and lateral energy ratio) for the different configurations.

References

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