

## Evaluation of microphone positions for music and speech recording by auralisation

Marcel-R. Babazadeh<sup>1</sup>, Ingolf Bork<sup>2</sup>

<sup>1</sup> *Erich-Thienhaus Institut der Hochschule für Musik Detmold*, Email: marcello\_baba@web.de

<sup>2</sup> *Physikalisch-Technische Bundesanstalt(PTB) Germany*, Email: ingolf.bork@ptb.de

### Introduction

Balancing the sound and positioning the microphones is an important point in the workflow of a Tonmeister. Taking into account the directional properties of the instruments and the microphones as well as the room acoustic environment and the aesthetics of the music, the Tonmeister decides which microphone position would suit his intention.

Auralisations and room acoustical measurements in two rooms at selected recording positions show the relation between perception of the audible differences and the measured room acoustical parameters due to ISO 3382. This offers more objective criteria to a Tonmeister for evaluating his work.

Room acoustical simulation allows more detailed analysis of the soundfield and with auralisation a comparison of real and virtual measurements can also be made audible.



**figure 1:** measurement setup in the Studio at position Ve 04

### Measurements

There were two different rooms for real measurements:

- **Neue Aula** der Hochschule für Musik, Detmold (concert hall: 4800 m<sup>3</sup>)
- **PTB- Studio** (recording studio: 400 m<sup>3</sup>).

At fifteen recording positions measurements were made. They differ in distance, vertical and horizontal angle viewed from the sound source. Besides an omnidirectional sound source (OMNI) a normal studio monitor (EMES) had been used for obtaining results that relate to instrumental directivity. A dummy head served as the sound receiver (figure 1). The signals consisted of dry and monaural recordings of music, speech and noise. All measurements and their evaluation were made with WinMLS ([www.winmls.com](http://www.winmls.com)).

### Room simulation

The simulations of the two rooms were made with CATT- Acoustics ([www.catt.se](http://www.catt.se)). With this program all positions of the sound sources and receivers as well as their properties could be modelled. The auralisations use the same audiomaterial.

### Evaluation

The sound characteristics of every recording position are well audible. To hear them properly, usage of headphones is crucial due to the fact that all recordings are of binaural nature. The musical gesture of the sound material has an important impact on the audibility of the character of specific positions. It has to be mentioned that the simulated auralisations also reproduce a detailed and realistic image of the acoustical environment.

**Increasing the distance** between sound source and the receiver affects mainly two things:

- the value of ITDG (Initial Time Delay Gap) and the related comb filtering
- the relation between direct and diffuse sound which corresponds to the reverberation distance

Comparing the different recording positions in the **horizontal plane** shows that the structure of the side wall plays an important role on sound colourations. This can be seen best in the values of *IACC*, *D50* and *C80*.

The variance of the *C80*-Values in the concert hall is much broader compared to those in the studio, which is connected to the different reverberation distance (figure 2, 3).

|           | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz |
|-----------|--------|--------|---------|---------|
| Studio    | 1,01 m | 1,11 m | 1,19 m  | 1,14 m  |
| Neue Aula | 2,83 m | 3,23 m | 3,53 m  | 3,60 m  |

figure 2: reverberation distances in both rooms

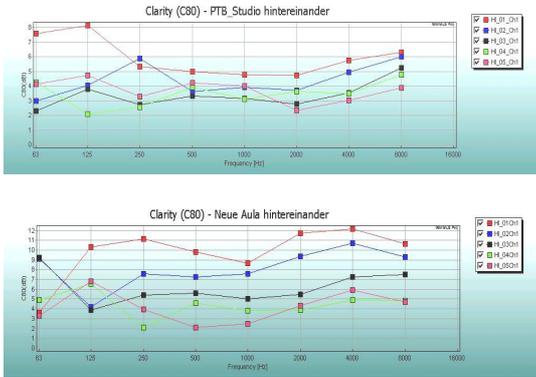


figure 3: WinMLS-measurements of C80-values in PTB-Studio and Neue Aula, growing distance

The pattern of the incoming early reflections has a big effect on the sound quality and is very sensitive to position changes. This phenomenon is very obvious at a certain position in the vertical plane, where two

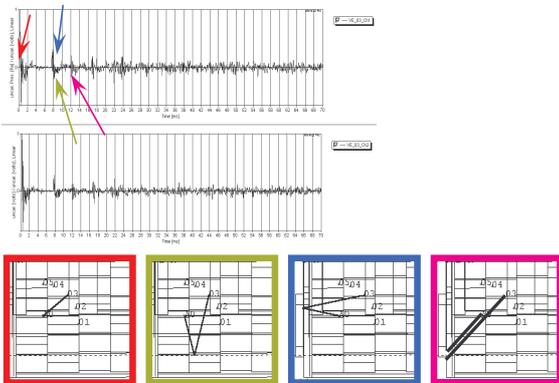


figure 4: binaural impulse response at Ve\_03 in PTB-Studio, simultaneous arrival of the floor reflection (green) and the rear wall reflection (blue)

reflections (one from the floor and the other from the rear wall) reach the receiver simultaneously.(figure 4).

The auralisations show a higher degree of spaciousness in this position which is represented in low *IACC*-values.

Generally the measured data fit quite well with the simulations, whereas the virtual calculations themselves offer more idealistic values.

The measurements allow making comparisons of the sound quality of recording positions. In most cases the measured parameters correlate to an audible perception, which is even more interesting due to the fact that the rooms are very different in shape and acoustical character.

There are parallels in the changing of tone colouration and the values of the parameters *C80* and *D50* at certain frequencies especially in the treble part of the spectrum. Subjective changing in the perception of spaciousness do show up in the *IACC*-values.

Having a lot of different sound material makes it possible to focus on specific acoustical phenomena which occur more clearly in a musical context. Especially examples like xylophone and trumpet serve well for judging spaciousness and envelopment.

### Conclusion

Room acoustical measurements are helpful on the way of finding accurate microphone positions for music recordings. For obtaining effective and comparable results using a computer and suitable software is inevitable. Then it is possible to modify the setup on-location. Room acoustical simulation only makes sense for rooms that are often used for music recordings because modelling of the virtual rooms takes relatively long time. The effect of acoustical modifications can be predicted and tested before severe changes have to be done in reality.

### Literature

[1] Marcel-R. Babazadeh: „Bewertung von Aufnahme-positionen mit Hilfe raumakustischer Parameter“, Diplomarbeit an der Hochschule für Musik Detmold (Fachbereich: Musikübertragung) 2004