Determining the area of the sweet spot in a surround loudspeaker setup for various microphone techniques

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Background

Several types of microphone techniques exist to record music performances for surround sound reproduction.
All the arrays are targeted to produce an accurate spatial impression at the sweet spot.

Does the microphone technique affect the size of the sweet spot, the area in which the spatial cues are reproduced with sufficient accuracy?

Hypothesis

Spaced microphone techniques lead to larger sweet spot areas than a coincidence microphone technique.

The microphone techniques

- Spaced Omnis
  - Polyhymnia Pentagon (Bach)
  - Decca Tree (Mozart)
- Optimized Cardiod Triangle - OCT
- Soundfield Ambisonics

a detailed description of the microphone arrays and the recording procedure can be found in [1] and [2]

The music

- J.S. Bach, Variation 13, Goldberg Variationen (BWV 988), [1]
- W.A. Mozart, maurische Trauermusik c-minor (KV 477), [2]

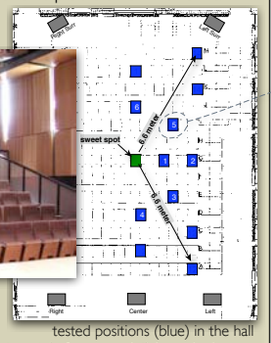
References

- [1] S. Kim et al. "An Examination of the Influence of Musical Selection on Listener Preferences for Multichannel Microphone Technique" In proceedings of the 28th international conference of AES, Pieta, Sweden, , 2006
- [2] ORF Surround Listening test, available at www.hauptmikrofon.de/orf.htm

Method

- Playback of the 5.0 recordings, using the speaker system in Tanna Schulich Hall
- Binaural recording of the wavefield using a B&K dummyhead at different positions in the hall

B&K dummyhead at the sweet spot



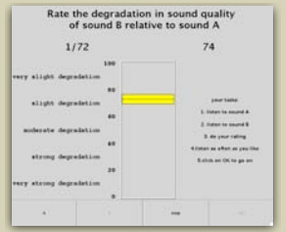
tested positions (blue) in the hall
the sweet spot (reference point) is marked green

Independent variables

2 musical excerpts
3 microphone techniques
13 listening positions in the hall

Listening experiment

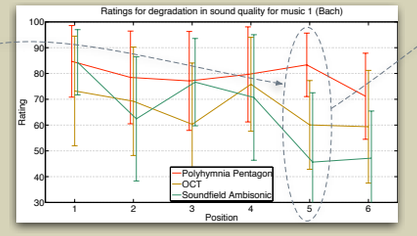
- 9 trained listeners (sound recording students) with normal hearing, aged between 22 and 35
- excerpts of the binaural recordings (each ca. 7 sec.) were presented by headphones
- pairwise comparison of the reference stimulus, (recorded at the sweet spot) with a stimulus recorded on another listening position
- each pair was presented twice

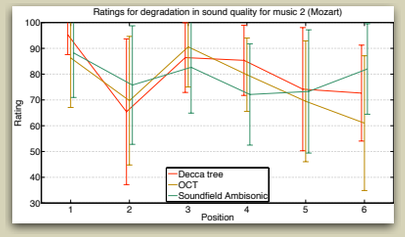


Interface for the listening test

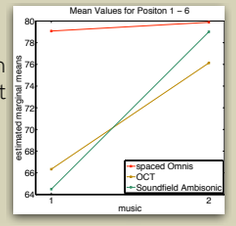
Results

- distance to the sweet spot is the most significant factor in degradation of listening quality ($p < .000$)
- significant effect caused by the microphone technique ($p < .001$) can be observed at position 1 - 6





There is an interaction between the musical excerpt and the recording technique

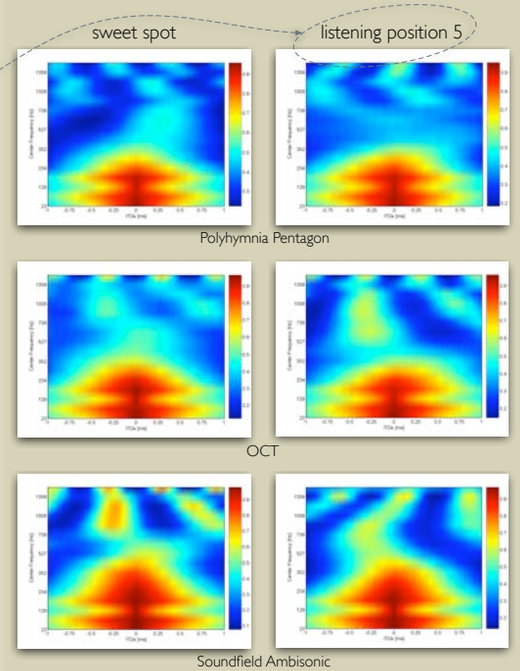


Conclusion

- the microphone technique influences the size of the sweet spot
- although these results are preliminary, the sweet spot tends to be increasable by using a spaced omni microphone technique

Binaural model

B&K dummyhead recordings, analyzed by a binaural model (here ITDs)



Future work

- repeat the binaural recording in other halls
- more subjects for the listening experiment
- find relations between the results of the listening experiment and the binaural model

Acknowledgments

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