

# Perceived Quality in Surround Sound Systems

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The increased use of sound systems comprising more than two channels has given a vast number of possibilities for producers, editors and consumers to create and/or alter the sound image finally reproduced at the consumer's end of the chain. It is empirically and experimentally known that this sound image is able to give the listener an improved feeling of presence and more directional cues. It is agreed upon by researchers that one of the important properties of a multichannel sound system is the spatial impression created by the system, i.e. how the system deals with the three-dimensional characteristics of the sound sources and their environment.

Several attempts have been made to assess different aspects of a sound system's performance. These could roughly be divided into two categories: 'objective' and 'subjective', where objective assessment often is related to parameters measurable by some (electrical) instrument, whereas subjective assessment is used for describing methods where human subjects are used for detecting and quantifying some properties of interest.

In order to assess the spatial quality of a sound system it is important to know the dimensions of this conception. If an 'objective' instrument for measuring spatial quality is constructed, it has to be correlated to human perception to ensure the instrument's validity. The problem is to find the perceived dimensions of spatial sound and to scale them. Since human perception is the scope of the behavioural sciences, those research methods must be considered.

This paper reports on the results of a four-year project aimed at finding a method for evaluation of spatial quality. At first, some new ideas on scale development are presented and examples of derived scales are given [1]. The scale development employs methods never previously encountered in audio research, e.g. the Repertory Grid Technique and Verbal Protocol Analysis. These were used in an early experiment, which objective was to indicate whether a common set of factors for expressing the spatial features of reproduced sound existed and, if so, to find the factors. The approach used was to collect verbal data from a group of subjects and then analyse if a reduction of the data yielded meaningful information in the form of verbal attributes [2, 3]. The experiment elicited information from subjects by letting them use their own vocabulary to describe the characteristics of a number of reproduced sound stimuli. The descriptions were then collected in a structured way and subsequently graded by the subjects. The analysis indicated both the existence of such attributes and that these may be similarly interpreted by a group of listeners.

Secondly, results from two different scale validation experiments, involving experienced listeners, are given [4, 5]. In summary, the experiments comprised multichannel recordings, which were played to a number of subjects individually. The subjects graded the stimuli on a number of attributes extracted in the earlier experiment. The grades then were subjected to different multivariate statistical analyses in order to test for significant differences between the stimuli. The results show that a panel of listeners can make statistically significant judgements of spatial quality. Furthermore, it is noted that listeners differentiate between the ability to judge certain properties of an environment and the sensation of actually being present in the environment.

Finally, these results are compared with work by other authors, where both similarities as well as new observations are reported [6].

## References

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- 5 Berg, J. and Rumsey, F. (2002) Validity of selected spatial attributes in the evaluation of 5-channel microphone techniques. Presented at *AES 112<sup>th</sup> Convention, Munich*. Preprint 5593.
- 6 Berg, J. (2002) *Systematic Evaluation of Perceived Spatial Quality in Surround Sound Systems*. Doctoral thesis. Luleå University of Technology.