

STATE-OF-THE-ART IN AURALIZATION OF CONCERT HALL MODELS – WHAT IS STILL MISSING?

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1. AURALIZATION

Auralization is the process in which a 3-D model of a concert hall is made audible. The process includes the simulation of sound propagation in the 3-D model, from the sound source(s) to the listener. The auralization process needs proper anechoic stimulus signal(s), information about the directivities of sound sources, room acoustics modeling and a reliable 3-D sound reproduction technique. In this paper, we try to cover each of these subtask from the view point of authentic auralization of a concert hall model. By authentic auralization we mean the creation of a virtual auditory environment that is indistinguishable from a real auditory environment. After such quality level is achieved, the auralization can be used as a reliable tool in the design of concert halls. However, there are still many research problems that have to be solved before an authentic auralization is available for concert hall models.

1.1. Stimulus signals

The sound source in a concert hall is a symphony orchestra, not a single point source as often applied in concert hall acoustics studies. Therefore, for authentic auralization an anechoic recording of the whole orchestra is needed and hopefully so that each player or section is recorded individually. It is a tedious process to do such recordings, however, they have been done at least in DTU Denmark and TKK Finland. These recordings are discussed in the paper.

1.2. Directivity of sound sources

Each instrument has its own frequency dependent radiation pattern that should be taken into account in the auralization. Measured directivity data for all instruments has not yet been published, although some data

are available in the Internet. The need for such data is elaborated in this paper.

1.3. Room acoustics modeling

Room acoustics modeling has been studied over 40 years, but still no method has been presented that can handle the whole audible frequency range accurately. Ray-based methods are good and reliable for computing room acoustical parameters, except for very low frequencies, but not all of them are suitable for auralization. We discuss different methods from the point of view of auralization.

1.4. 3-D sound reproduction

In auralization the main point is to listen to the simulation results. For such listening a reliable 3-D sound reproduction method is needed. Traditionally, binaural auralization has been listened to with headphones. Recently multichannel reproduction methods have been extensively researched and they are also available for reliable 3-D sound reproduction. The most suitable methods for auralization are presented and discussed.

2. CONCLUSIONS

We will discuss the current state-of-the-art in auralization. In addition, we'll estimate how far we still are from the authentic auralization of the concert hall model. In other words, if we had good and reliable auralization, it could really be applied as a desing tool when designing new concert halls. Some demos and more information can be found at <http://auralization.tkk.fi>.