Introduction

Dynamic binaural synthesis has become a popular subject in research and it is often used to perform listening experiments in virtual acoustic environments. A software tool is presented that combines classic listening experiment paradigms with dynamic binaural rendering. The creation, presentation and the analysis of results are performed using Scale [1], a software tool for listening experiments. The rendering of the audio signals is performed with the SoundScape Renderer (SSR) [2].

Scale

Scale is a software tool that covers the full chain of setup, conduction and analysis of psychoacoustic experiments. It offers several testing procedures and the interaction between researcher or subjects and the software is done via a graphical user interface (GUI) and does not require any programming skills. Test setups or results can be easily ported from one instance of the program to another. Thus everything is portable and exchangeable between different computers and researchers. The first version of Scale was presented at the DAGA Conference in 2013 in Merano, Italy.

SSR

The SoundScape Renderer (SSR) [2] is a tool for real-time spatial audio reproduction, which includes several rendering methods. It is free open source software running on UNIX-based systems and using the JACK [3] audio framework. The SSR can be controlled either using a graphical user interface (GUI) or a TCP/IP network interface. Sound source positions and other attributes represented in a spatial audio scene, as shown in Figure 1, can be imported or exported using audio scene description files (.asd) [6].

Scale-SSR extension

Scale is designed for an easy and integrated workflow. The entire process of test generation and spatial audio scene setup is completely managed using Scale. Thus, listening experiments using dynamic binaural rendering can be created and performed with little effort and interacting with only one software.

As shown in Figure 2, Scale processes subject’s inputs and operates the SSR using its network interface via TCP/IP protocol while the test is performed. The SSR runs in the background generating stimuli with the combination of the incoming audio signal, the tracker data and the corresponding head related impulse response (HRIR) or binaural room impulse response (BRIR) set.

Test Creation

During test creation the researcher selects the dry source signals, the HRIR/BRIR sets, the tracker device and specific source parameters (i.e. position and volume). In a next step Scale automatically generates the audio scene description files for the SSR. Procedure-specific settings, the number of scenarios and instructions appearing during test performance are also configured in this module.
Implemented tests

The initial version of Scale included a selection of frequently used test procedures like simple or transformed staircase adaptive procedures, semantic differential, double blind triple-stimulus with hidden reference and rating tests. A description of the latter can be found in [1]. In the current version two additional procedures, MUSHRA and SAQI, are implemented.

MUSHRA

The aim of a multi-stimulus test with hidden reference and anchor (MUSHRA) test [4] is to rate global differences between several audio stimuli. All stimuli are presented in a single trial and have to be compared to a given reference. Each stimulus has a continuous scale (continuous quality scale) which goes from 0 (bad) to 100 (excellent), as shown in Figure 4. Reference and stimuli can be switched over instantly. The order of the stimuli is randomized and every trial has to include a hidden reference and an anchor.

SAQI

The spatial audio quality inventory (SAQI) test [5] has been specifically designed for the perceptual evaluation of virtual acoustic environments. In every trial a reference and a stimulus are presented together with 48 verbal descriptors of perceptual qualities that are assumed to be of practical relevance when comparing virtual auditory environments. Each descriptor comprises a rating scale with a pair of opposed adjectives in its scale ends.

Results analysis

The results can either be evaluated internally using Scale or exported to different file formats like text, excel and Matlab figure and dataset. The dataset format, which is defined in the scope of Matlab’s Statistics Toolbox, is the most straightforward approach to work with the results directly in Matlab. Furthermore, metadata and information about the subjects (i.e. age, sex or experience in listening tests) is included. As shown in Figure 5, different visualisation options (i.e. individual results, averages and confidence intervals) are available for internal evaluation.

Running environment

Three main components have to be installed in an OSX computer in order to use the presented solution:

- Matlab version R2014a or greater (needed to run Scale)
- SoundScape Renderer (SSR) version 0.4.2 or greater
- JACK Audio Connection (JACK) version 0.124.1 or greater

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References


