

Listening test to test the effect of different parameters of binaural room impulse responses (BRIRs) on perceptual reverberation

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14 October, 2020

Purpose:

There are many parameters that influence room reverberation effects in binaural room impulse responses (BRIRs). In order to determine their effect on perceptual reverberation and find the effect thresholds, the listening test is come up with and performed.

Materials:

A staircase-method Graphical user interface (GUI) is designed through the Appdesigner in MATLAB.

Methods:

1. There will be three big groups of listening tests about reverberation effects of three rooms with different reverberation time (0.31s, 0.91s and 1.51s). Participants need to listen to and compare reference audio samples and test audio samples. When they feel the reference audio sample is same with the test audio sample, they need to response 'Yes', otherwise, they need to response 'No'. Each big group of listening test includes four small groups of listening tests with 1 reference audio and many test audios each:

- a) The reference audio and many test audios (less than 30) which are generated by convolving dry sound with BRIRs that are removed early reflections from late reverberation to direct sound direction for different periods of time.
- b) The reference audio and many test audios (less than 30) which are generated by convolving dry sound with BRIRs that are extended initial time delay gaps (ITDG) for different periods of time.
- c) The reference audio and many test audios (less than 30) which are generated by convolving dry sound with BRIRs that are removed early reflections from direct sound to late reverberation direction for different periods of time.
- d) The reference audio and many test audios (less than 30) which are generated by convolving dry sound with BRIRs that are removed late reverberation for different periods of time.

There are all 12 groups of tests and they are random.

2. The listening test adopts staircase method, so three predetermined conditions are set.

a) **Where to start the series.** According to the researcher's test and debugging, the first stimulus should be distinguished from the reference audios but they should not be far from the threshold-level. Therefore, the initial values of reversely removed early reflections are set as 50ms, the initial values of extended ITDG are set as 40ms, the initial values of forward removed early reflections are set as 35ms, and the initial values of removed late reverberation are set as 465ms, 780ms and 1250ms for BRIRs with 0.31s, 0.91s and 1.51s reverberation time respectively.

b) **How long the steps are.** For ITDG and early reflection test, the initial step is 5ms. When there occurs 3 'Yes' responses, the step is changed to 3ms, and when there occurs 5 'Yes' responses, the step is changed to 1ms. For late reverberation test, the initial step is 10ms. When there occurs 3 'Yes' responses, the step is changed to 5ms, and when there occurs 5 'Yes' responses, the step is changed to 3ms.

c) **When the trials should be stopped.** There are two stopped conditions. One is that there occurs 5 'Yes' responses and the trials continue to be conducted 10 times. The other is that the trials are conducted 30 times.

3. Save experimental results and summarize and analyze the collected data.

Data Interpretation:

Scatter plots will be plotted for these results, including modifying ITDG, forward early reflections, reverse early reflections and late reverberation at reverberation time about 0.31s, 0.91s and 1.51s respectively. The number of trials will be plotted on the X axis (abscissa) and the modified parameter values will be plotted on the Y axis (ordinate). The values of the parameters change relatively rapidly until they reach an asymptotic level or plateau, and then they hover around this level as long as the conditions unchanged, and then the average values of the plateaus can be calculated as the parameter thresholds affecting the perceptual reverberation.