

Masterarbeit

Perception of a Room's Timbre

The way a room influences the frequency balance of sounds is crucial for spaces whose main purpose is music performance, recording or reproduction. Among all parameters relating to timbre and tonal colour, a practical, single-number value – Bass Ratio [1] - was first introduced and commonly adopted. This relates to the variation of reverberation time across the spectrum, and it is often used by room acoustical planners when designing concert halls and music spaces. Some halls, however, are perceived as lacking energy in the low end regardless of high reverberation times in the low frequencies, which lead to the newly proposed parameter 'Bass Index' [2]. This is based on the difference in strength, rather than reverberation time, across the frequency spectrum. In order to assess the perception of a room's timbre, it is of interest to evaluate how changes in Bass Ratio and Bass Index magnitude are perceived via the identification of their Difference Limen, still unknown to date, as well as their effect on perceived 'Brilliance'. [7] A Difference Limen for broadband reverberation time of approximately 5% of the base value has been found and confirmed by several studies [4-6] and is currently included in room acoustics standard ISO 3382 [3]; a frequency-dependent value is yet to be found. Moreover, a correlation between Bass Ratio and Bass Index with RAQI factor 'Brilliance' shall be investigated. A listening test is to be designed, in which participants are asked to evaluate changes in anechoic orchestra recordings convolved with simulated room impulse responses with varying degrees of absorption across the frequency spectrum.

Literature

- [1] Beranek, L. L. (1992). Music, acoustics, and architecture. *Bulletin of the American Academy of Arts and Sciences*, 45(8), 25-46.
- [2] Beranek, L. (2011). The sound strength parameter G and its importance in evaluating and planning the acoustics of halls for music. *The Journal of the Acoustical Society of America*, 129(5), 3020-3026.
- [3] ISO 3382-1:2009 Acoustics - Measurement of room acoustics parameters - Part 1: Performance spaces.
- [4] Niaounakis, T. I., & Davies, W. J. (2002). Perception of reverberation time in small listening rooms. *Journal of the Audio Engineering Society*, 50(5), 343-350.
- [5] Seraphim, H. P. (1958). Untersuchungen über die Unterschiedsschwelle exponentiellen Abklingens von Rauschbandimpulsen. *Acta Acustica united with Acustica*, 8(4), 280-284.
- [6] Tsolias, A., & Davies, W. J. (2014). Difference limen for reverberation time in auditoria.
- [7] Weinzierl, S., Lepa, S., & Ackermann, D. (2018). A measuring instrument for the auditory perception of rooms: The Room Acoustical Quality Inventory (RAQI). *The Journal of the Acoustical Society of America*, 144(3), 1245-1257.

Requirements

Basic knowledge of psychoacoustics, audio signal processing, ray tracing simulations and statistics.

Supervision

Emanuele Porcinai, EN 107, emanuele.porcinai@tu-berlin.de
Prof. Dr. Stefan Weinzierl, EN 322, stefan.weinzierl@tu-berlin.de