

Proceedings of The Institute of Acoustics

Comparison between objective and subjective criteria for auditoria

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Most objective criteria are evaluated from the pulse-response ("echogram") at a place in a room. They regard mean slopes of the sound pressure level (for instance the classical reverberation time), comparison of the reverberant energy with the direct sound or of the "early" energy and the total. A factor analysis of the criteria most in use today shows that they cover two factors only [1] and [2].

On the other hand subjective comparisons of two-channel tape-records, made with dummy-heads and reproduced either by earphones (Berlin [3]) or by loudspeakers with special pulse-compensations (Göttingen [4]) and also evaluated by factor analysis [5], made evident that there are at least three subjective aspects which decide the acoustic quality of an auditorium. Furthermore they proved that the aspects are weighted differently by at least two groups of different taste. This holds especially for the impression of the "strength of sound" [6] which is correlated to the stationary sound pressure level at a given power level ("strength-index"), whereas the qualities of definition and timbre seem to be weighted equally by all observers.

How far the content of lateral reflections has to be also regarded as a very important aspect and how far this aspect may be described objectively by the cross correlation between the pressures in both ears is still under discussion [2], [7].

References

1. Lehmann, P. DAGA-Tagung Stuttgart 1972, 162
2. Gottlob, D. Dissertation, Göttingen 1973
3. Wilkens, H. Dissertation, Berlin 1975, *Acustica* 38 (1977) 10
4. Damaske, P. and Mellert, V. *Acustica* 22 (1969/70) 153
5. Siebrasse, K.F. Dissertation, Göttingen 1973
6. Lehmann, P. Dissertation, Berlin 1976
7. All these problems are also discussed in Cremer-Müller, Grundlagen der Raumakustik, Band I, Stuttgart 1978.

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T Reverberation time (-5 ... -35 dB)

T_A Anfangs-Nachhallzeit (0 ... -20 dB)

T_I Initial reverberation time (0 ... -15 dB)

T_E Early decay time (EDT) (0 ... -10 dB)

$$\lambda(L) \quad \text{Liveness - degree} = \int_{\Delta t}^{\infty} p^2 dt / \int_0^{\Delta t} p^2 dt$$

H = 10 lg λ dB Liveness - index

$$\gamma \quad \text{Strength - degree} = \int_0^{\infty} p^2(x) dt / \int_0^{\Delta t} p^2(s) dt \quad (4\pi s^2 = 1m^2)$$

G Strength - index = 10 lg γ dB

t_i Initial time delay gap

Δt_l (= 50 ms) Limit of perceptibility

$$v(D) \quad \text{Definition - degree} = \int_0^{50ms} p^2 dt / \int_0^{\infty} p^2 dt$$

$\frac{1-v}{v}$ = ratio of "reverberant" to early energy

R(M) = 10 lg $\frac{1-v}{v}$ dB Reverberation Index

$$t_s \quad \text{center time} = \int_0^{\infty} t p^2 dt / \int_0^{\infty} p^2 dt$$

$$K_O^{50} = \frac{\overline{p_l p_r}^{50ms}}{\bar{p}_l \bar{p}_r} \quad \text{short time cross correlation coefficient}$$

$$|K(\tau)|_{\max} = \left| \frac{\int_0^{t_i} \bar{p}_l(t) \bar{p}_r(t+\tau) dt}{\sqrt{\int_0^{t_i} \bar{p}_l^2 dt \cdot \int_0^{t_i} \bar{p}_r^2 dt}} \right|_{\max} \quad \tau < 1ms$$