Eenvoudige ruimteakoestsiche modellen

Simple room acoustic prediction methods

In the process of architectural design, prediction methods can help to access the acoustic quality before the building is constructed and to assess also so called non-diffuse or coupled rooms in terms of their acoustic quality.
Nowadays, the room acoustic simulations can be considered as an equivalent to the virtual measurement of the room impulse response, from which many acoustic parameters can be derived, and auralisation can be performed.

This lecture focuses on the explanation of the principles of ray-based algorithms used for room impulse response simulation. Advantages and disadvantages are discussed. A special attention is given to Image source method and ray-tracing method. Where the image source method (ISM) is a deterministic method, which starts from a configuration assuming a point source and a point receiver, which are present in the room of interest. The ISM is based on the law of reflection, where the reflected sound from the wall in the acoustical model can be understood as arriving from an image source. This image source can be geometrically constructed as a mirror image of the real source formed by the plane, e.g. wall, ceiling or any other plane in the model.
Ray-tracing methods used in acoustics presume, just like the ISM, that the sound waves can be simulated as rays. This assumption is valid, provided that the geometrical objects encountered by the waves have dimensions that are much larger than the wavelength. This correspondence thus depends on frequency. Strictly speaking, ray tracing cannot cope with diffraction effects at long wavelength and low frequencies, but by making use of multiple scattered ray generation for reflection events, diffraction can to some extent be mimicked and/or handled statistically.

Ray-tracing algorithms are noted for their good results for predicting room acoustical quantities, such as reverberation time T_{15}, T_{30} [s], early decay time *EDT* [s], sound pressure level L_p [dB], Clarity C_{50}, C_{80} [dB], Deutlichkeit D_{50} [%] and the STI value [%] and can be performed faster than e.g. BEM, but due to the approximations made with respect to diffraction and scattering, whose effect is especially noticeable in the early part of the impulse response, the approaches are sometimes combined in an optimized hybrid model.

Finally, a binaural room impulse response that is based on the so-called Head-Related Transfer Function (HRTF) necessary for realistic auralisation is discussed and examples of application of auralisation technique in science and architectural practice is shown.