Session 1aAA

Architectural Acoustics: Computer Modeling of Room Acoustics I

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Chair's Introduction—10:55

Invited Papers

11:00

1aAA1. A transparency model and its applications for simulation of reflector arrays and sound transmission. Claus Lynge Christensen and Jens Holger Rindel (Odeon A/S, Oersted-DTU, Bldg. 352, 2800 Lyngby, Denmark)

The paper describes a new method for simulating the frequency-dependent reflection and transmission of reflector arrays, and the frequency-dependent airborne sound insulation between rooms by means of a room acoustic computer model. The method makes use of a transparency method in the ray-tracing process. In the first step of the calculation the rays hitting the relevant surfaces may either be reflected or transmitted, using a probability of 50%. In the next step the impulse responses in the receiver positions are calculated using a frequency-dependent correction to account for the reflected or transmitted energy. The method applied for the reflector array is based on a theoretical model that takes into account the dimensions of the reflecting surface, path lengths, and angle of incidence. The transmission calculation is based on the users' data for the frequency-dependent transmission loss of the partition, and this is useful for the auralization of sound transmission through different building constructions. The acoustic properties like volume, reverberation time, and the area of the transmitting surfaces are included in the simulation.

11:20

1aAA2. Numerical determination of scattering coefficients of wall surfaces for geometrical room acoustic simulation. Tetsuya Sakuma, Yoshiyuki Kosaka, and Yuki Tachioka (Grad. School of Frontier Sci., Univ. of Tokyo, 5-1-5 Kashiwanoha, Kashiwa-shi, Chiba 277-8563, Japan, sakuma@k.u-tokyo.ac.jp)

There exist a dozen geometrical room acoustic simulation programs which include scattering coefficients of wall surfaces to generate more realistic sound energy reflection. In the light of this utilization, a measurement method of the random-incidence scattering coefficient has been recently standardized by ISO 17497-1, while a numerical technique with BEM is developed to determine the scattering coefficient. First, one case study is done to investigate the behavior of scattering performance of periodical surfaces with sinusoid, triangles and rectangles, with changing the height of surface roughness. As a result, it is seen that the height-to-period ratio of about 30% maximizes the scattering coefficient in the range of middle and high frequency. Second, another case study of geometrical room acoustic simulation is done for a rectangular room composed of uneven reflective walls and absorptive ceiling and floor. Geometrical simulation is performed on a variety of conditions with changing the scattering coefficient, and the reverberation times simulated are compared with those given by wave-based simulation at every octave bands. From the correspondence in reverberation time, the scattering coefficients of the walls are estimated, and its frequency characteristics are compared with those given by the former numerical determination.

11:40

1aAA3. Edge diffraction in computer modeling of room acoustics. U. Peter Svensson (Acoust. Group, Dept. of Electron. and Telecommunications, Norwegian Univ. of Sci. and Technol., NO-7491 Trondheim, Norway, svensson@iet.ntnu.no) and Paul T. Calamia (Rensselaer Polytechnic Inst., Troy, NY)

Computer modeling in room acoustics is typically based on geometrical acoustics techniques. Limitations with such methods include, among other things, a lack of diffraction modeling, which primarily leads to inaccuracies at low frequencies. The inclusion of diffraction modeling is quite straightforward for first-order diffraction, which can be combined with specular reflections of any order. One impractical aspect, however, is that the number of diffraction components can be extremely high, and grows faster (with the reflection order) than the number of specular reflections does. At the same time, the importance, or magnitude, of the diffraction components will differ over an immense range. This variation can be exploited by estimating the importance of each diffraction contribution by the magnitude of its onset, and skipping the remainder of the calculations for those that are deemed too weak. This will be demonstrated for some typical geometrical cases including a set of overhead reflectors, an orchestra pit, and a convex hall shape for which diffraction is less critical. Results indicate that "diffraction culling" can provide a significant reduction in computation time with only small effects on the overall responses for the tested geometries. [This research has been supported by the Research Council of Norway].