

ROOM ACOUSTICS – MODELLING

Modelling Sound in Rooms

Eminent concert halls, ships and bridges were built in the past without modelling. However, failures that could have been avoided if a model had been built and tested were, and still are, common. The first room acoustics models used ultrasonic waves, water ripples, or light beams. Today, any laptop computer can generate the signals and process the sounds needed in a physical 1:20 scale model.

However, modern computers have the power to simulate the acoustics of a virtual model, and can even simulate sound that is hard to distinguish from the sound in the actual room when built. Modelling using computers is no longer an exotic form of art. It is used for offices, factory halls, classrooms, foyers, airport terminals, train stations and stadiums. It predicts the acoustics of new designs and evaluates planned improvements in existing buildings.

Computer Models

Wave equation models such as FEM (Finite Element Method) and BEM (Boundary Element Method) are very accurate at single frequencies. However, the number of modal frequencies in rooms restrict FEM and BEM to low frequencies and small spaces.

Image Source models are based on specular reflection and may be useful for simple shapes like a box, but with complex rooms like a concert hall the number of image sources becomes excessive.

Ray Tracing models were used for the first practical design of auditoriums. Sound rays are traced from a source point up to a high order of reflection. At a receiver surface an energy-reflectogram can be traced for estimating room acoustic parameters.

Hybrid models combine the best features of two or more methods. ODEON Room Acoustics

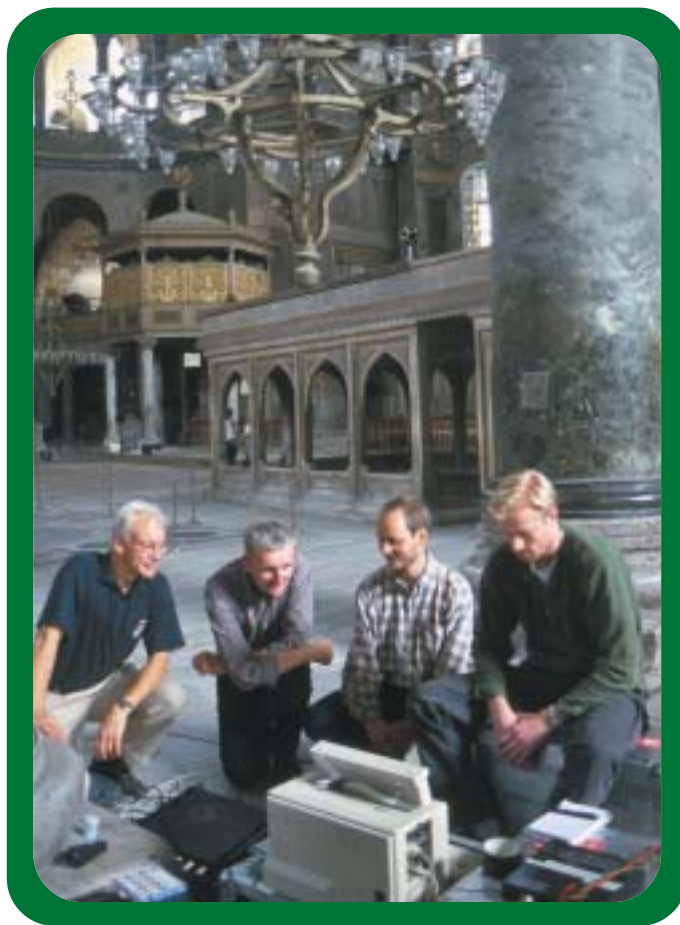
Software combines the Image Source method with Ray Tracing to optimise modelling accuracy and efficiency.

Building your Model

Often a 3D CAD model is available, and your computer can create the acoustics model geometry from an appropriate file (.dxf). But if you start from scratch, you define the geometry using a simple modelling language provided with the modelling software.

The model can be surprisingly simple and yet give reliable results. Details that are small compared to the wavelength of sound increase the calculation time and do not improve accuracy.

Once you have created the model geometry, you assign materials to all surfaces from the materials library supplied in the software, and place suitable sound sources and receivers in the room. Now is the time to verify your model, using the



tools provided in the software. You can quickly identify warped, duplicate, overlapping or missing surfaces, and check your surface materials.

Results

The actual simulation is often done in seconds, or minutes for more complex jobs. As a result, you get the reverberation time as well as sound levels, speech intelligibility and special concert or factory hall parameters. This can be for a single position, several positions, or mapped for an entire surface. Of course, the ultimate goal is to convince decision makers. With computer modelling you can show “what if” scenarios using impressive graphic displays and played back sound, CD recordings or live sound through the model.

Product Guide

A product that solves this application is ODEON Room Acoustics Modelling Software Types 7835, 7836 and 7837.