Visualizing Acoustic Surface Properties Using Colours

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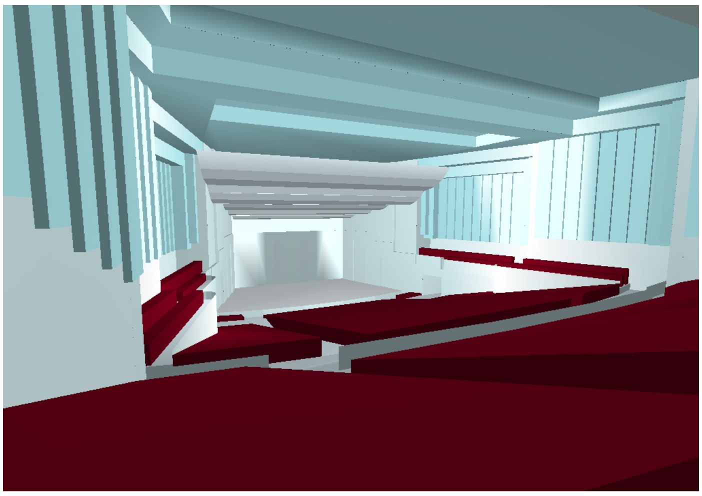
The OpenGL rendering engine, which comes with the Windows operating system, offers an efficient way of visualizing geometries. With an appropriate translation from acoustic absorption properties into visual colours it is also a powerful way to visualize acoustic absorption.

Absorption Coefficients

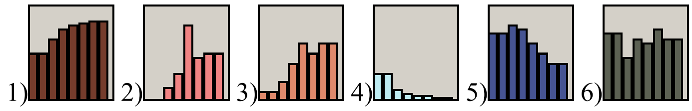
In room acoustic programs such as ODEON, absorption coefficients, one for each frequency band, are assigned to each surface. In OpenGL™, it is possible to assign the surface colours in terms of a **Red**, a **Green** and a **Blue** intensity (the human eye is capable to distinguish three different frequency bands of *light* because of different tap-cells in the eye, which are sensitive to each frequency range). To convert the acoustic absorption coefficients into a visual **RGB** intensity, an average absorption coefficient is calculated for the **lower**, the **middle** and the **upper** frequency bands of the acoustic material. These average absorption coefficients are then converted into acoustic reflectance ($r = 1 - \alpha$), which are used for the specification of the colour intensities, an intensity for each of the colours **Red**, **Green** and **Blue** of the surfaces in the visual OpenGL representation.



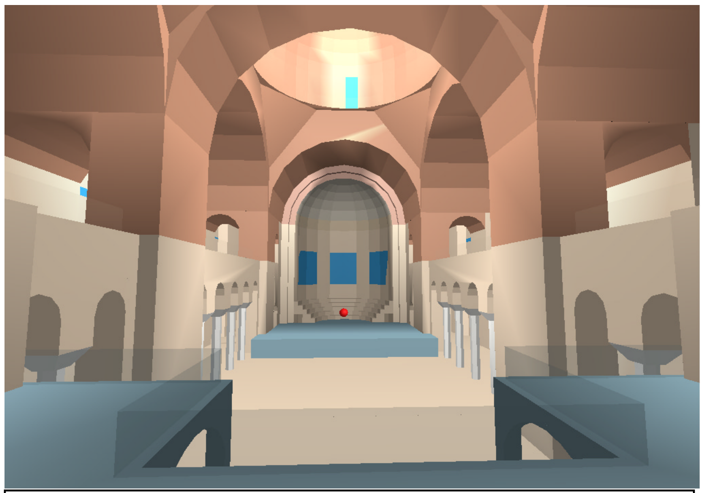
Visualization of a computer model of the Elmia multi-purpose hall in Jönsköbing, Sweden.
Audience areas act as porous absorbers, thus appear in dark red because they are strong absorbers and mainly reflect sound at low frequencies.
Panels such as the side reflectors are membrane absorbers, thus appear in a light blue colour because they are only absorbing little energy and reflect sound best at high frequencies.
Materials in a grey scale indicate materials, which reflect sound without any colouration.

Examples on acoustic colours

A few examples on different acoustic materials and their graph of absorption in the frequency range from 63 – 8000 Hz are displayed below. The colour of the graphs visualises the acoustic colours of the materials.



1) Audience, lightly upholstered seats
2) 55 mm perforated bricks on edge, 78 holes per brick, 11% perforation, no cavity
3) Clinker concrete, no surface finish, 800 kg/m^3
4) Plasterboard on frame, 13 mm boards, 100 mm cavity filled with mineral wool
5) 4 mm plywood boards, 4.5-5 mm o holes in square pattern with approx. 13% perforation, on frame construction: 0.5 m cavity with 100 mm mineral wool at front of cavity
6) 50 mm mineral wool (70 kg/m3) 300 mm in front of wall



Visualization of the Byzantine church Hagia Irène in Istanbul, Turkey.
In the front of the image is a wooden construction, which acts as a membrane absorber, thus appear in a blue colour. Rails are acoustically semi transparent and this is visualised in OpenGL by assigning a visual transparency coefficient. Most of the other surfaces are porous stone and appear in brown nuances indicating high frequency absorption.