

# A Simulation Test Bench for Decay Times in Room Acoustics

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## Abstract

An important yet rarely explored problem in room acoustics is how to correlate the decay times of modal resonances to the acoustic properties of the boundaries (walls). The room response is often described by reverberation times, but the reverberation model breaks down at low frequency, where isolated modes are prevailing.

The authors have set up in COMSOL Multiphysics® the simplest model in room acoustics: the rectangular room. For the infinitely rigid rectangular room, analytical solutions are well known, and all modal shapes can be classified in three families: axial, tangential and oblique modes. Once finite impedances are assigned to the walls, modal decay times can be easily computed from the results of an eigenfrequency study.

This model constitutes a good test bench to verify analytical predictions of decay times based on classical textbook treatments, and to experiment with variations of the same problem, in order to get insight in the dynamics of sound energy decay. The paper shows the simulated results of a formula linking wall impedance and decay times, and the comparison of two simulations of the same room, with six absorbing walls or just one. Some outcomes were unexpected and shed some light on common misconceptions.

## Figures used in the abstract

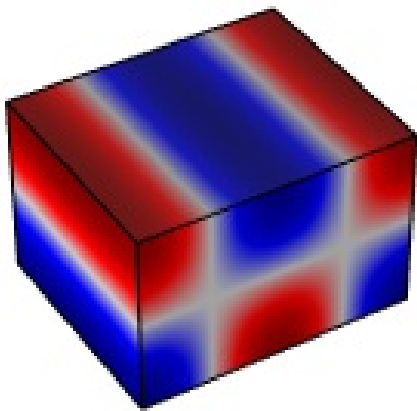


Figure 1: Sound pressure distribution at mode (2,0,1) of the simulated room.