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Towards a realistic ray tracing for room acoustics

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We present a recently developed ray tracing engine for room acoustics computations whose improved physics provide more realistic results than present state of the art methods. Ray tracing has been widely applied within the graphics community to obtain realistic shadings, but the computational cost reduction has oriented efforts towards fast computations of apparently realistic images rather than physically correct results. In the case of audio ray tracers, a similar tendency has led to relatively fast shading algorithms that often miss its physical basis, preventing the resulting impulse responses from converging to physically correct solutions.

Our engine improves this situation by focusing on two main issues. First, it ensures the mathematical convergence of the algorithms by maintaining the coherence between the computation of the direction of the reflected rays and the computation of the contribution of the sources to a given point in the environment. Second, the engine works directly in the frequency domain. This allows for the implementation of frequency-dependent phenomena, from surface impedance and reflections to frequency-dependent source directivity patterns. We present a comparative study of the proposed ray tracing engine with the state of the art, emphasizing properties like realism, coherence and convergence.