

Abstract

Acoustic ray tracing is a stochastic method for calculating the impulse response of a room. Until recently it couldn't be used in real-time applications due to its huge computational cost. With the advent of GP-GPUs new algorithms have appeared, which can profit from the vast computing capacity of GPUs.

The main goal of my thesis is implementing ray-tracing and HRTF-based auralization with GPUs with real-time applicability. I studied the structure of room's impulse responses to reduce computational costs and this is possible by reusing the reverberant part of the impulse responses.

I have overviewed the Möller-Trombore intersection algorithm and proposed a new method with less computational and memory requirements. I analyzed the problems that are caused by the usage of a finite volume around the listener, like inaccurate distance and direction calculations, and suggested solutions for them. I showed the assembling procedure of an impulse response with frequency dependent and independent materials, too.

I studied the image source method, which was used as reference in the verification of the impulse response obtained by ray tracing. I stood up a link between the statistical attributes of the impulse response and the number of rays.

I implemented the proposed intersection algorithm in CUDA, and using this I created a ray-tracer application. Based on the tests it can be stated that this is appropriate for real-time usage.

I showed a way of realizing HRTF-based auralization using the results of ray-tracing when frequency dependent materials are also present, then I implemented the algorithm in CUDA.