**Interactive Rendering of artificial reverberation effects for complex environments**

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The goal of this project is to design a new model for artificial reverberation effects which can be efficiently controlled using a 3D model of the environment.
Artificial reverberation filters are traditionaly controlled with a few high level parameters directly defined on the filter (reverb time, decay rate for different frequencies, size of the room, etc.) [1]. Each of this parameters influences the shape of the filter which is usually modeled as an exponentially decaying noise.
The novel approach must be able to deal with general environments, both indoor and outdoor and hence must extend prior work which has mostly been devoted to the rendering of "room effects".

One possible solution would be to determine "clusters" of reflections. Each cluster can be rendered as a short artificial reverberation filters. High-level control parameters (e..g, length, decay shape, etc.) of these short reverberation filters must then be estimated for different frequencies and possibly spatial directions [2]. This estimation can be done in an off-line step (e.g., through ray-casting or even finite-element approaches) and pre-stored in the manner of pre-computed radiance transfer approaches in computer graphics [3,4].
This estimation can be conducted on complex objects in order to replace them by a simplified representation (bounding box + 3D position + pre-computed directional scattering response).
Then, by keeping track of the shortest scattering path for all possible incoming directions (i.e., separating the response into a pure delay+ filter component), it should be possible to move the objects/listener/sources and re-compute an approximate global response in real-time.

Comparison of the obtained reverberation effects compared to real-life measurements of similar situations will be conducted to assess the approach.

**References**

[1] Thomas Funkhouser, Nicolas Tsingos and Jean-Marc Jot.
Survey of Methods for Modeling Sound Propagation in Interactive Virtual Environment Systems, SIGGRAPH 2002 course notes

[2] Spatial impulse response rendering (http://www.acoustics.hut.fi/research/cat/sirr/)

[3] Precomputed Radiance Transfer : Theory and practice.
Jan Kautz, Jaakko Lehtinen and Peter-Pike Sloan, SIGGRAPH 2005 course notes
(http://people.csail.mit.edu/kautz/PRTCourse/)

[4] Precomputed Acoustic Transfer (http://graphics.cs.cmu.edu/projects/pat/)