Development of Accurate and Fast Acoustic Calculations using Olive Tree Lab - Acoustics Lib

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ABSTRACT

The framework defines four separate calculation steps:

- model optimization,
- pre-processing,
- sound propagation path detection,
- sound propagation path calculation.

These steps are independent and communicate only through clearly defined interfaces. As a result, different implementations of each part can be combined based on the needs of different calculation methodologies.

The framework is based on geometrical acoustics for sound path detection. Geometrical acoustics can be defined as the description of sound propagation in terms of sound paths or sound paths. Geometrical acoustics is widely used in current commercial software applications which deal with acoustics calculations [1] [2] [3]. It is also the dominant approach in real time approaches for audio rendering in games [1] [5] [6].

EVALUATION OF OTL – ACoustics Lib

Kourion: an ancient Greek theatre in Cyprus

OTL-Acoustics Lib was used to develop the OTL-Terrain Prediction software application, used for the simulation of sound propagation in Kourion [12], an ancient Greek theatre in Cyprus. In Fig 4. we present the comparison of calculated results for excess attenuation together with measured data.

OTL – TERRAIN IMPLEMENTATION

To take in account phenomena combining outdoor sound propagation, sound transmission and room acoustics at the same time, and to simulate sound propagation in a three dimensional environment, using the principle of sound rays to detect sound paths. Then the OTL-Acoustics Lib takes in account: Intensity with distance, interaction with the atmosphere, reflections and diffractions, sound transmission and refraction properties.

Implemented methods are:

- Hadden & Pierce Diffraction 3D model implemented with finite impedances faces using Salomons semi-analytical method including ground effects, Multiple barrier diffraction calculated in a recursive way at any diffraction order.
- In house sound path detection methods.
- Log Spherical Source for evaluation of Each Plane Source.

By evaluating the results it can be concluded that OTL-Terrain Lib results have a good matching with measurements in both cases and perform better than other methods, like ISO 9613-2.

OTL-Acoustics Lib has the following benefits for software engineers a) It is build on top of OTL framework, thus allowing further customization by the addition or removal of various components of the calculation b) It provides a default calculation behavior for the simulation of sound propagation in 3D spaces c) its default behavior has been used in commercially available software applications, therefore it has been evaluated for its accuracy and speed and it has been shown that it can simulate accurately sound propagation in 3D spaces.

CONCLUSIONS

OTL-Acoustics Lib is a commercially available library that provides accurate and flexible calculations for sound propagation in 3D spaces. We have demonstrated the flexibility of our approach and the possibility of numerous applications of OTL-Acoustics Lib in various acoustics calculation problems.