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Open Source Sound Field Synthesis Toolbox

Introduction
Sound Field Synthesis (SFS) aims at production of wave fronts within a large target region enveloped by a massive number of loudspeakers. Nowadays, these techniques are known as Wave Field Synthesis (WFS) as an implicit solution of the SFS problem and as explicit solutions, like Ambisonics in the spherical domain and Spectral Division Method in the cartesian domain. Research and development on Ambisonics and WFS proceeded since the 1970s and the late 1980s, being most lively in the last decade due to DSP power available. This resulted in many SFS systems at research institutes with different rendering methods, thus complicating comparability and reproducibility. In order to pool the outcomes of different SFS approaches the Matlab/Octave based Sound Field Synthesis Toolbox was initiated 2010 as an open source project by the authors. This toolbox was later accompanied by online theoretical documentation giving an overview on the SFS approaches and citing the reference literature. In 2013 porting of the SFS Toolbox to Python was initiated, serving as convenient framework together with Jupyter notebooks. In this contribution we discuss the authors. This toolbox was later accompanied by online theoretical documentation giving an overview on the Matlab/Octave based Sound Field Synthesis Toolbox was initiated 2010 as an open source project by available. This resulted in many SFS systems at research institutes with different rendering methods, thus proceeded since the 1970s and the late 1980s, being most lively in the last decade due to DSP power.

Fundamental Concept

Anechoic Environment
Point Source
Dipole Source
Line Source
Plane Wave
ECHOIC ENVIRONMENT
Modal Model for Point Source in Rectangular Room
Binaural Room Impulse Response (Binaural Synthesis)

Spatially Oriented Format for Acoustics (SOFA)

Sound Propagation Models for Loudspeakers
Anechoic Environment
Point Source
Dipole Source
Line Source
Plane Wave

Binaural Room Impulse Response (Binaural Synthesis)

Visualisation
Spatial Visualisation
Sound Particle Velocity
Sound Particles

Temporal Visualisation
Impulse Responses
Frequency Spectrum

Legend
implemented in Python
implemented in MATLAB/Octave
implemented in both Toolboxes planned
both implementations of the toolbox are free software in the terms of the MIT license. Documentation and additional information can be found at https://sfs.readthedocs.io

By the synthesis toolbox described here, spatial representations of sound fields can be computed. As a result, desired sound fields for arbitrary loudspeaker geometries can be created. This toolbox provides a convenient framework together with Jupyter notebooks. Sound propagation models in echoic environments are used to study the effect of the playback room which is generally not considered by the synthesis methods. For binaural synthesis, methods for the selection and interpolation of the impulse responses are provided. The toolbox supports the Spatially Oriented Format for Acoustics (SOFA).