Tutorial:
Interactive low-delay audio processing using the open source toolbox for acoustic scene creation and rendering (TASCAR)

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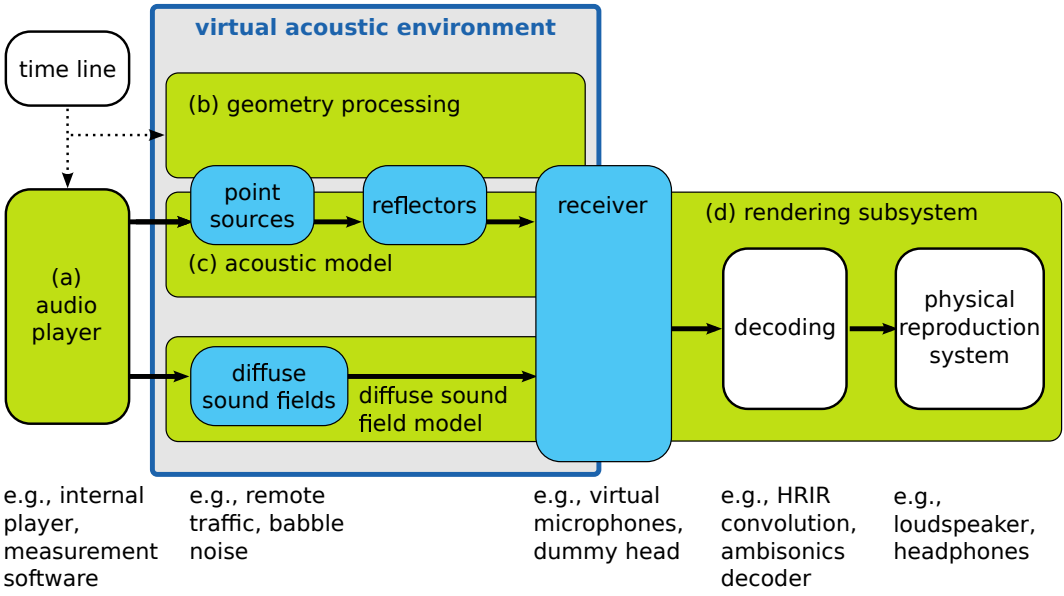
What is TASCAR?

TASCAR

Toolbox for Acoustic Scene Creation And Rendering

- Installation (Ubuntu 14.04, 16.04, 18.04):
  `http://install.tascar.org/`
- Workshop material:
  `http://github.com/gisogrimm/iia2019/`
- Virtual Acoustic Environments
- Interactive, Real-time Rendering
- Moving sources, Acoustic modelling
- Text based Scene design


virtual acoustic environment
time line
(b) geometry processing
point sources
reflectors
receiver
(d) rendering subsystem
(a) audio player
(c) acoustic model
decoding
physical reproduction system
diffuse sound fields
diffuse sound field model
e.g., internal player, measurement software
e.g., remote traffic, babble noise
e.g., virtual microphones, dummy head
e.g., HRIR convolution, ambisonics decoder
e.g., loudspeaker, headphones

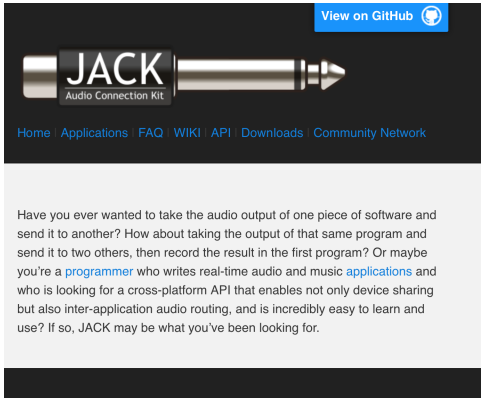
TASCAR is built on Jack. But who is Jack?

Jack is used for:

- Link between audio player and acoustic simulation
- Routing from TASCAR to hardware
- Streaming from/to Matlab
- Embedding of diffuse reverberation
- Time line of audio and data logging

`http://jackaudio.org/`

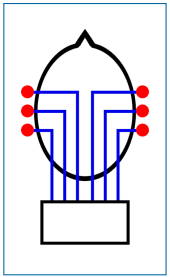
Front ends: qjackctl and patchage

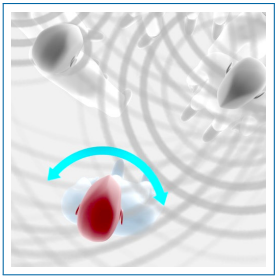


TASCAR basics:

a bit of live coding

Hearing aid benefit

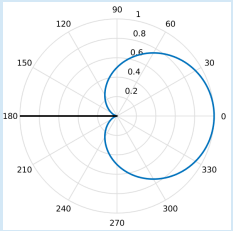




Hearing aid benefit: Algorithm

Largest benefit of hearing aids is achieved by directional microphones

- Adaptive Differential Microphone (Elko & Pong, 1995)
- Directivity adapted to minimise energy of back-facing signal
- Typical SNR benefit: 3 to 6 dB, robust!
- openMHA implementation (`http://openmha.org/`)



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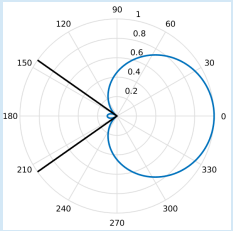

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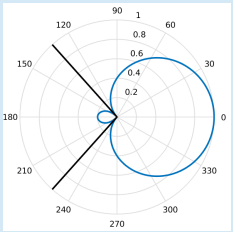

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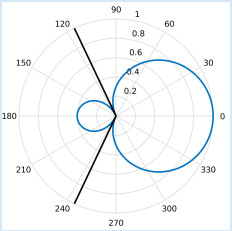

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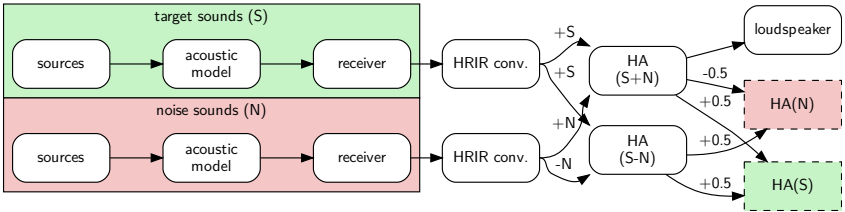
Quantification of benefit

- Signal-to-noise ratio at output versus input (SNR benefit)
- Knowledge of S and N at input and output of hearing aid required (Hagerman & Olofsson, 2004)



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Coupling to a game engine

Coupling to a game engine

- Add visual components to acoustic environment
- Control acoustic environments based on motion in game engine

Coupling to a game engine

- Add visual components to acoustic environment
  - Positions from TASCAR to game engine
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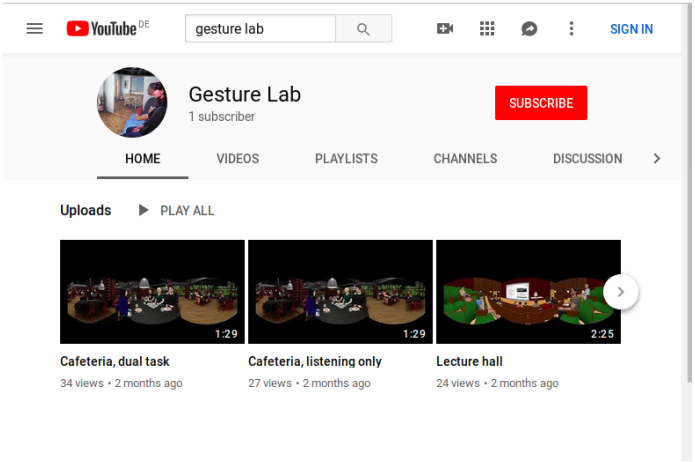
  - Positions from game engine to TASCAR

Coupling to a game engine

- Add visual components to acoustic environment
  - Positions from TASCAR to game engine
- Control acoustic environments based on motion in game engine
  - Positions from game engine to TASCAR
- Open Sound Control (OSC) interface

Coupling to a game engine
Interactive audio-visual environments



TASCAR on stage:

spatialization and in-ear monitoring

TASCAR on stage: Motivation

- Concert project “Harmony of the Spheres”

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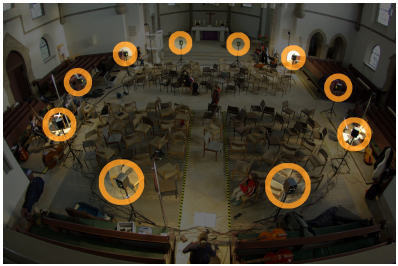

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- Precedence effect: **low-delay spatialization**
  - Processed sound should arrive earlier (or only marginally after) direct sound

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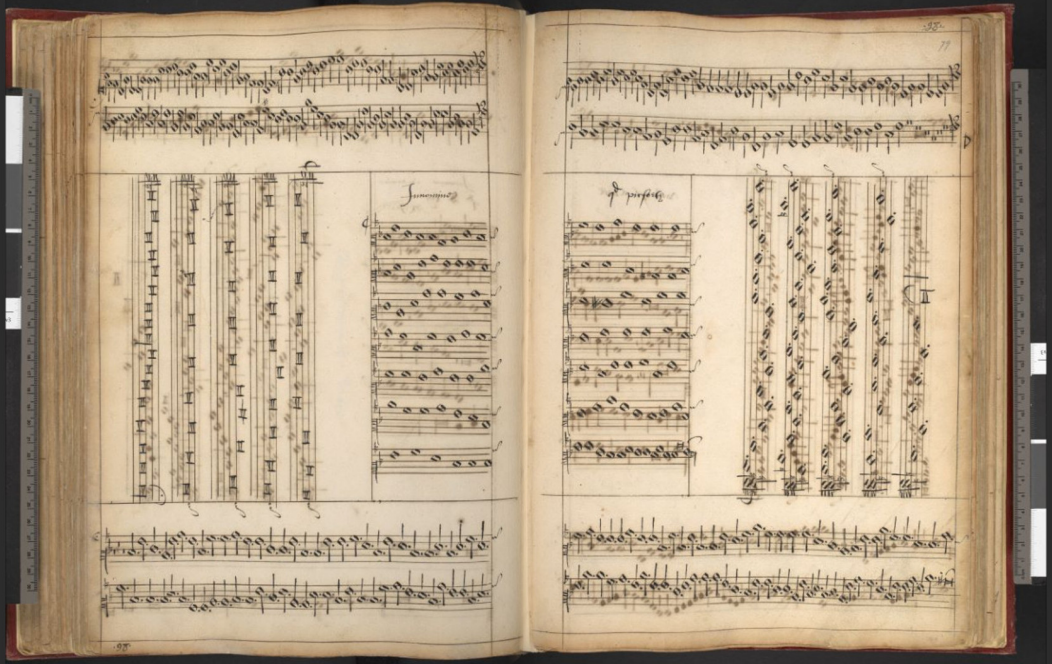
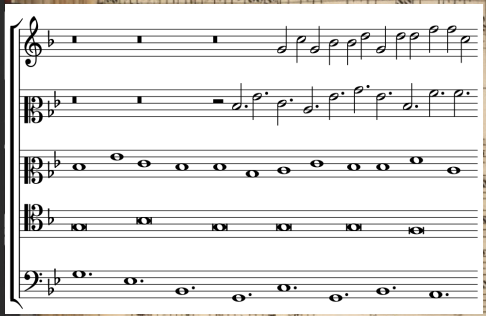
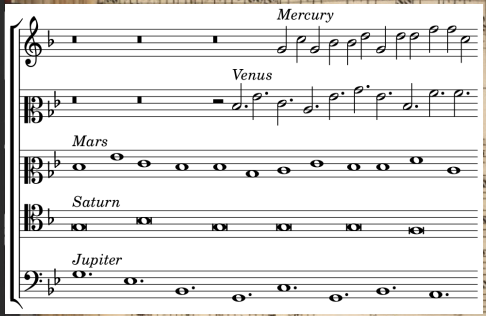
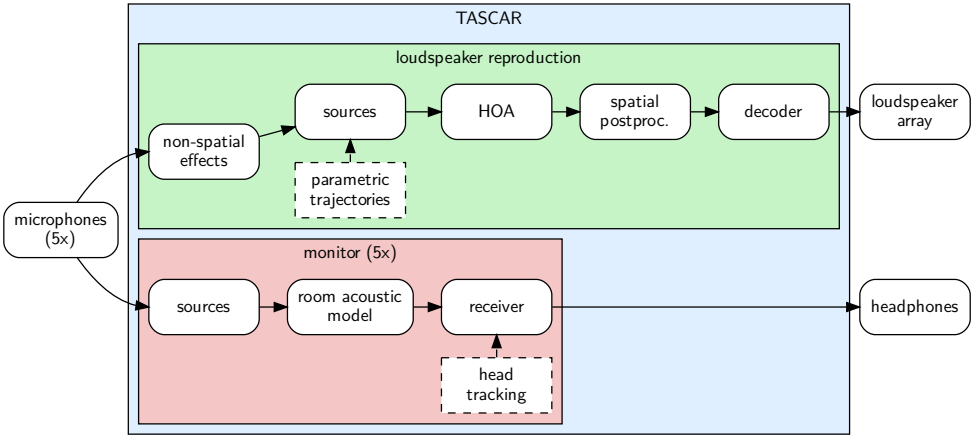
- Precedence effect: **low-delay spatialization**
  - Processed sound should arrive earlier (or only marginally after) direct sound
- Huge distance between musicians: **in ear monitoring**
  - Provide dynamic spatial cues for musicians
  - Improved identification of acoustically similar instruments






Mercury
Venus
Mars
Saturn
Jupiter


Systême de Copernic.
Firmament
Cercle de ♄ Saturne
Cercle de ♃ Jupiter
Cercle de ♂ Mars
Cercle de la Lune
Cercle de la Terre
Cercle de Venus
Cercle de Mercure
Sphere de Saturne
Sphere de Jupiter


TASCAR
loudspeaker reproduction
sources
HOA
spatial postproc.
decoder
loudspeaker array
non-spatial effects
parametric trajectories
microphones (5x)
monitor (5x)
sources
room acoustic model
receiver
headphones
head tracking