AURALIAS:
An audio-immersive system for auralizing room acoustics projects

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1. The « AURALIAS » research project

« Audio-visual immersion for Room Acoustics applications
Linked with an Interactive Auralization System »

AURALIAS

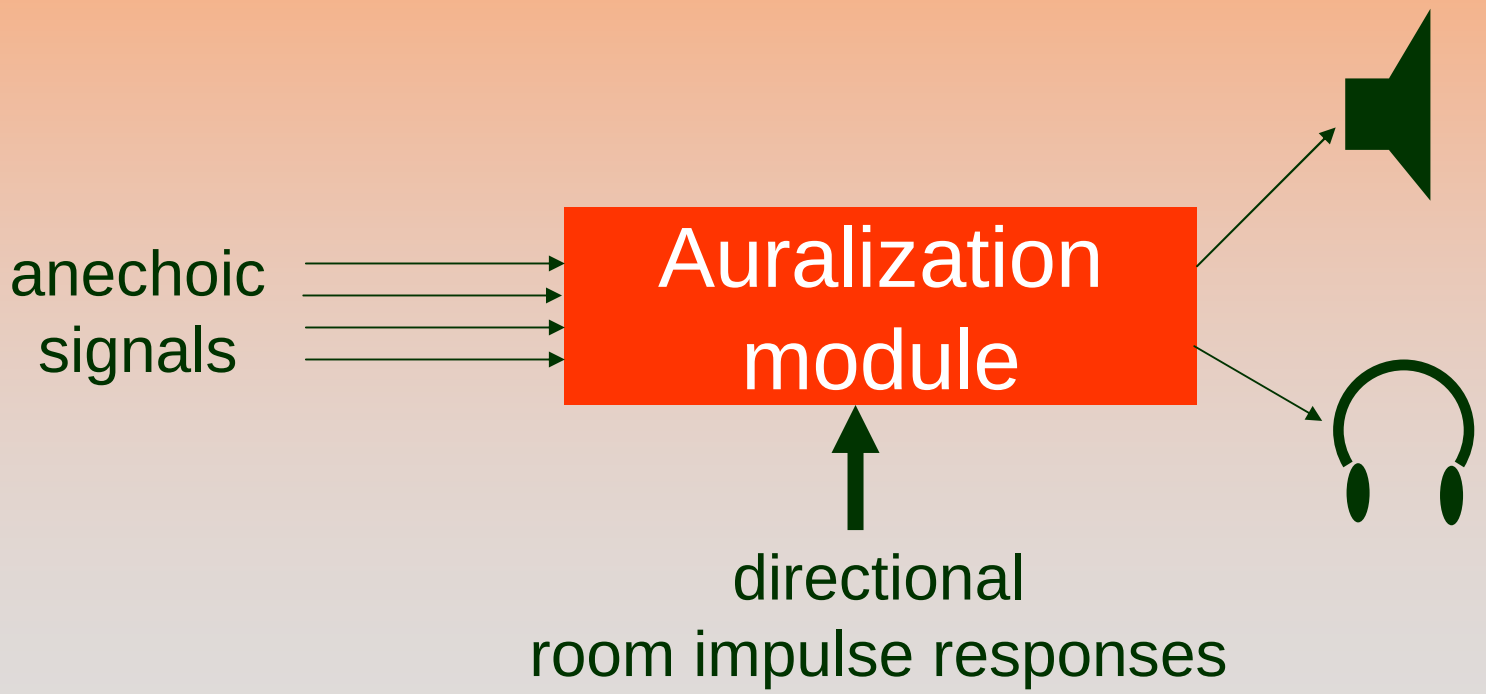
REGION WALLONNE

Partners:

- Intelsig group & Acoustics laboratory,university of Liege
  (acoustics, signal and image processing)
- LISA research unit, university of Brussels
  (computer science, image processing)
- LUCID group, university of Liege
  (architecture, human-machine interaction)

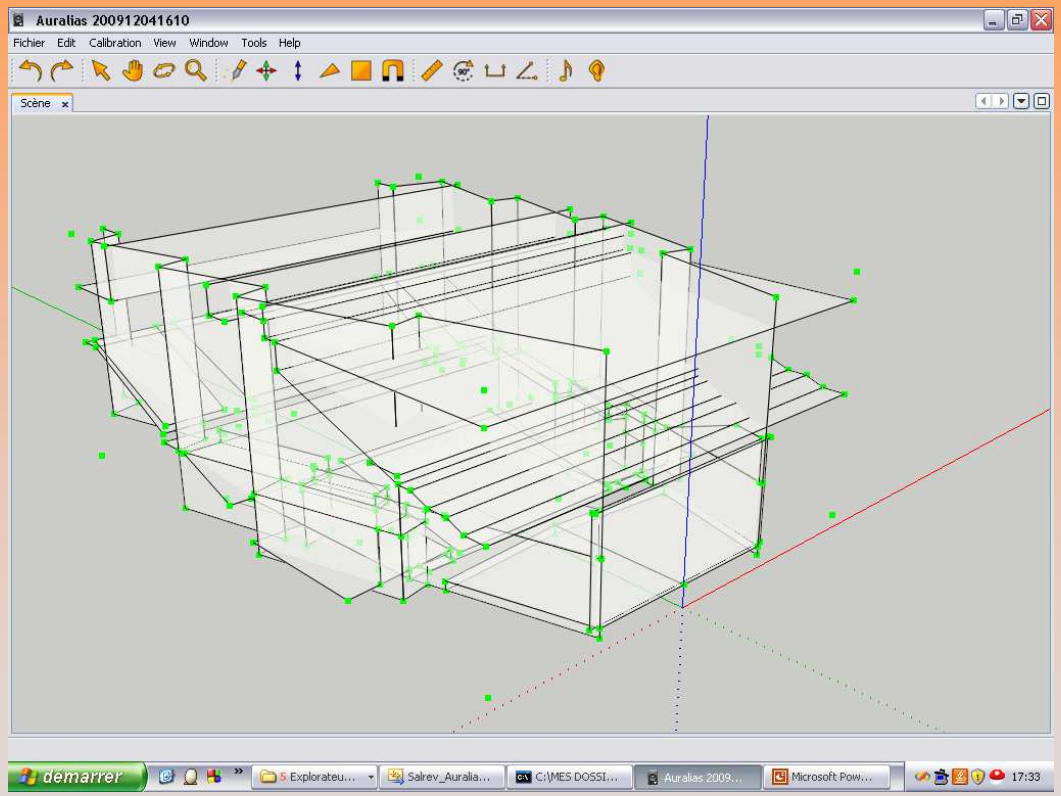
1. AURALIAS: what is Auralization ?

« The technique of creating audible sound files from simulated data »

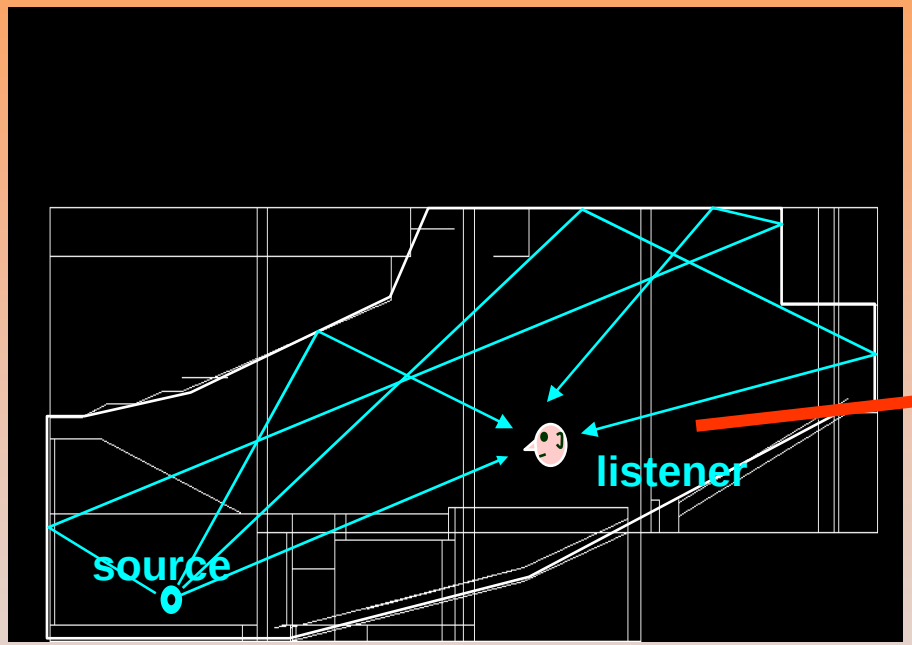


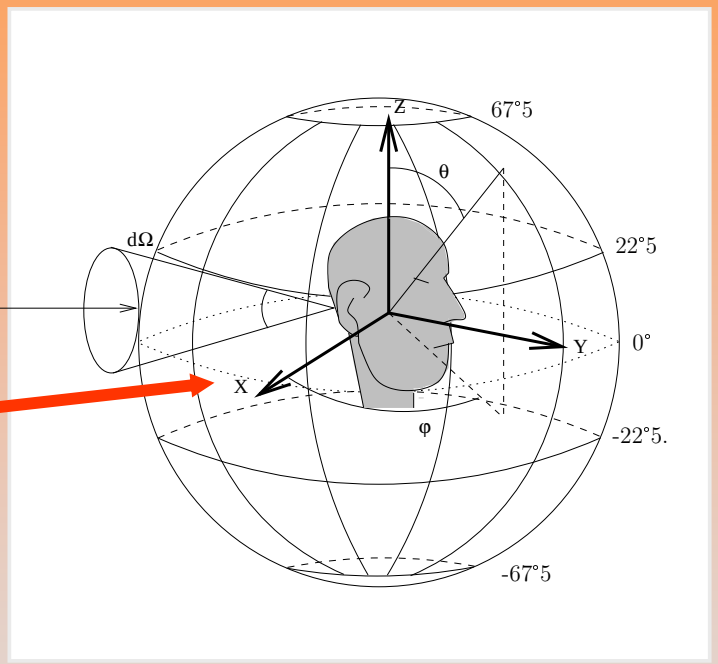
2. The acoustical model of the room

- Geometrical model
- Acoustical properties of surfaces and medium
- Source(s)
- Receptors



2. The acoustical model: ray tracing and image sources

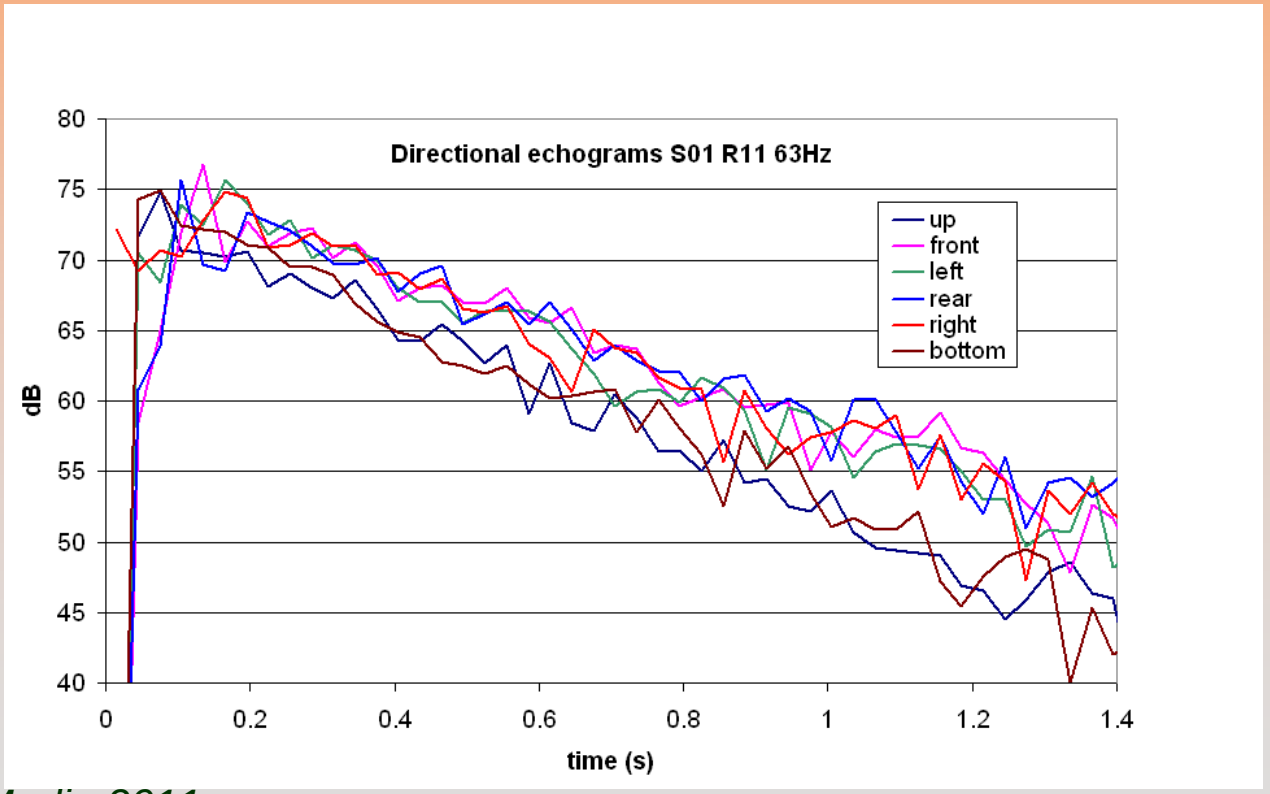




Computation of directional echograms at each « virtual » listener's position.

2. The acoustical model: directional echograms

*Directional echograms show the distribution of **sound energy (dB)** reaching the receptor as a function of **time delay (s)** after a sound impulse has been emitted by the source.*

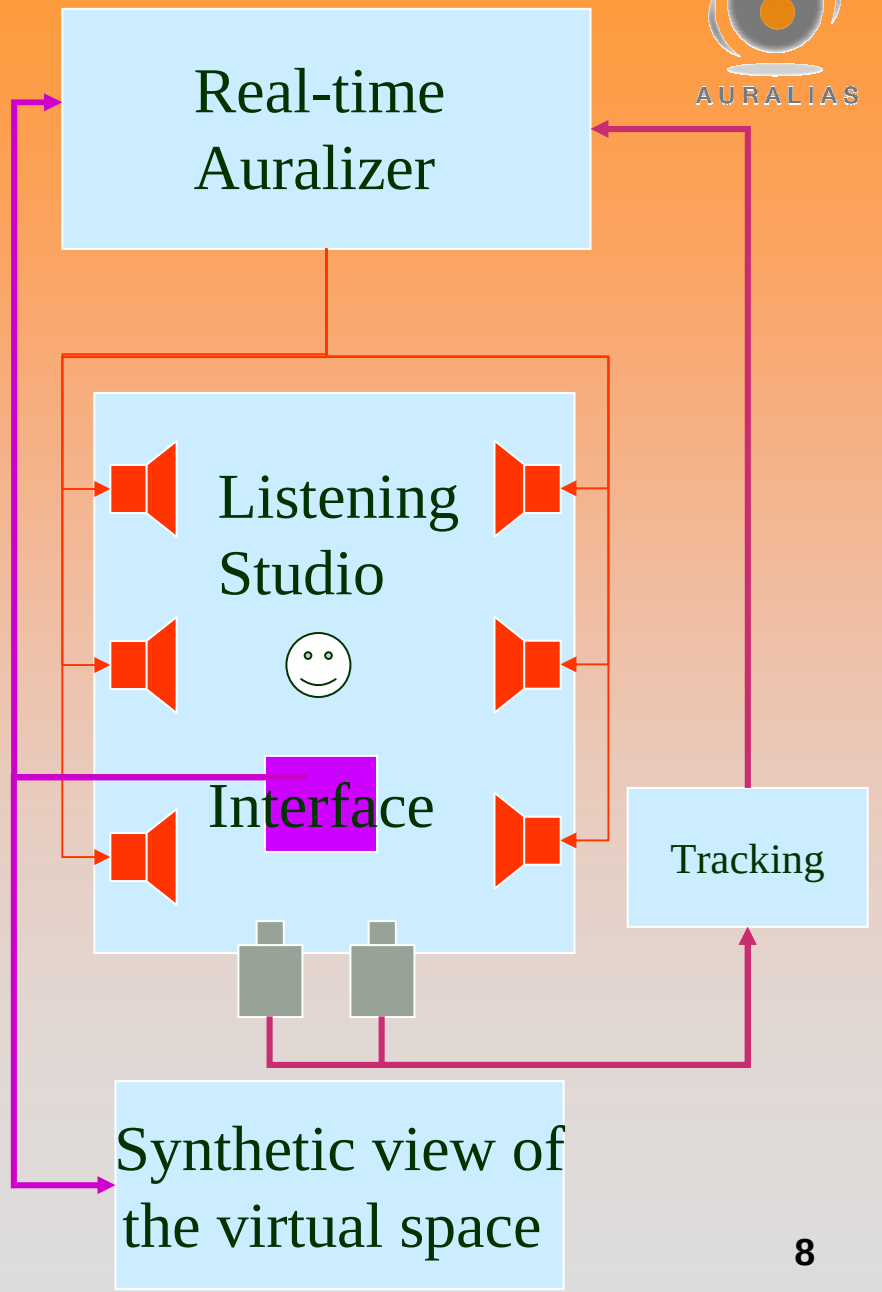


2. The acoustical model: summary

- *Geometrical model + acoustical properties of surfaces and medium + source(s) and receptors*
- *Image sources (up to a pre-defined order, including the real source)*
- *Sound ray-tracing*
- *Results are directional echograms*
  - *for each pair of source-receptor positions*
  - *in each frequency band (8 octave bands)*
  - *6 or 26 solid angles around each receptor position*

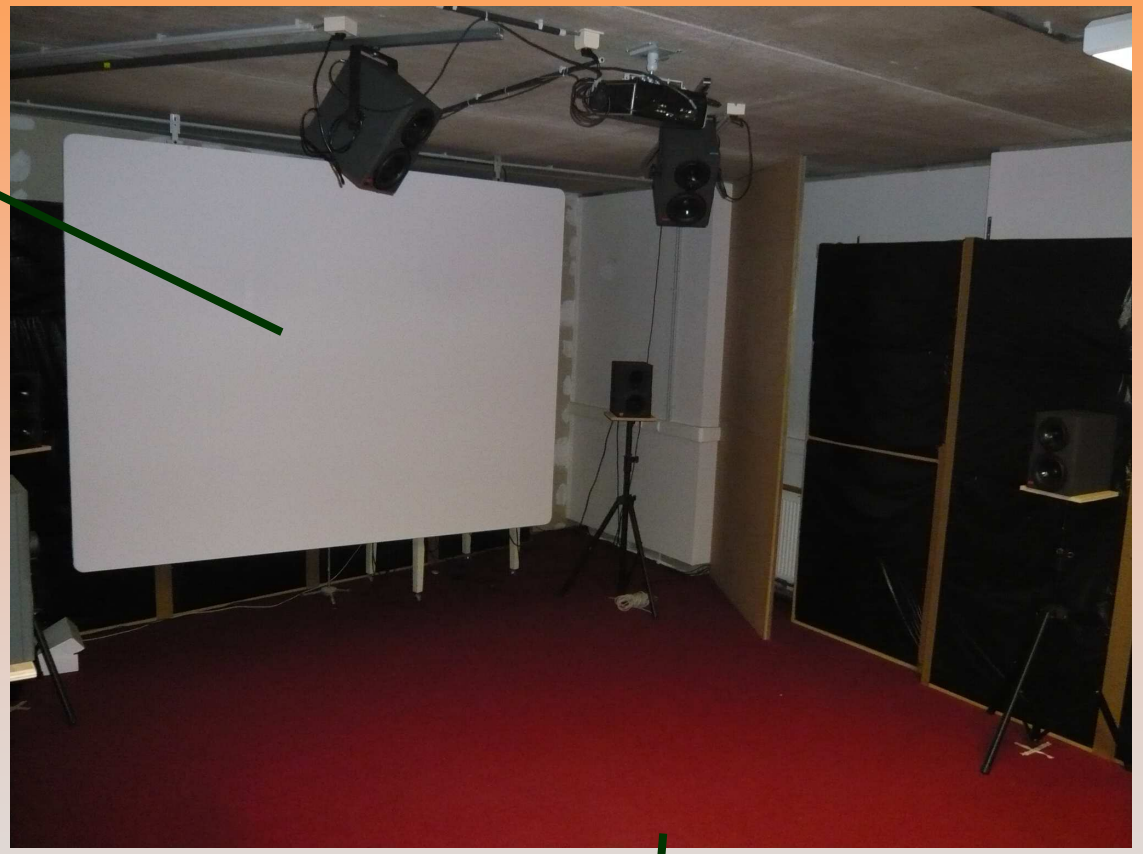
3. AURALIAS: objectives

- develop an auralization system for room acoustics projects,
- for a small number of users, sharing the same experience,
- auralization by loudspeakers in a listening studio,
- provide a 2D view of the virtual room in front of the users,
- allow real-time interaction with the system.



4. View of the immersive studio (1)

Screen with 2D view of the room

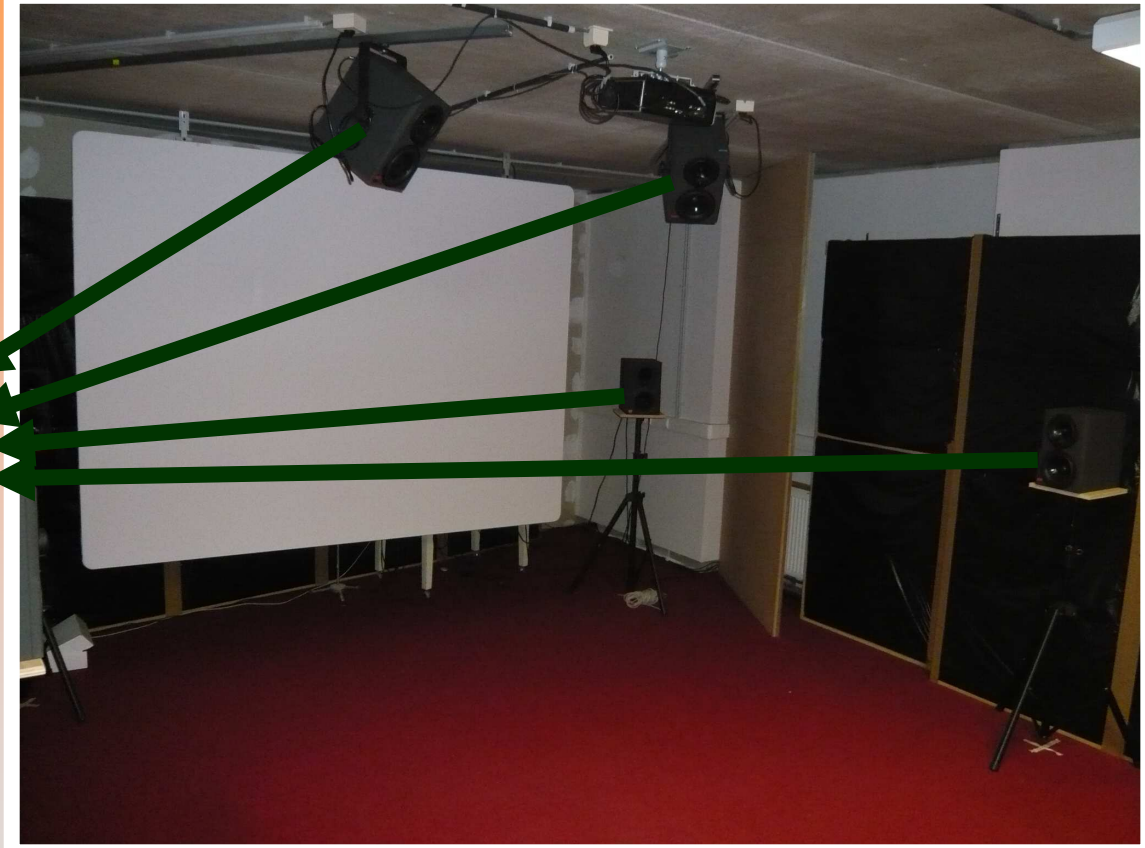


Listener position

4. View of the immersive studio (2)

Loudspeakers:

Vector-Based Amplitude Panning (VBAP)



4. View of the immersive studio (3)

Absorbing materials and acoustic diffusers.

5. Signal processing and sound reproduction

AURALIAS

- *Image sources are computed in real-time and their corresponding **impulse responses** are accurately located in the VBAP reproduction system.*

- *Directional echograms are computed « off-line » (not in real-time), for each source, at some pre-defined receptor positions.*

- *From each directional echogram a **directional room impulse response (DRIR)** is derived.*

- *Frequency block segmented convolution: permanent task*

6. Hardware

AURALIAS

- *CPU (X2) : Intel Xeon E5520 – 2,26 GHz*
- *GPU : Leadtek PX9600GT – nVidia 9600GT*
- *Ram : 12Go*
- *6 (8) FAR « XMD range », Digital active 3-way loudspeakers*
- *sound card : EDIROL AudioCapture FA – 101*
- *SHURE PG30 wireless headsets microphone: to listen to his own voice*

7. Further works in AURALIAS

- *testing the « fidelity » of auralizations*
- *in-situ measurements of directional (spatial) room impulse responses*
- *improving the spatial sound reproduction (Ambisonics ?)*
- *applying to real room acoustics projects*