Conception acoustique d'un studio d'écoute pour des séances d'auralisation.

Acoustical design of a listening studio for auralization sessions.

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REGION WALLONNE

AURALIAS

1. The « AURALIAS » research project

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

Partners:

- Intelsig group, 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)

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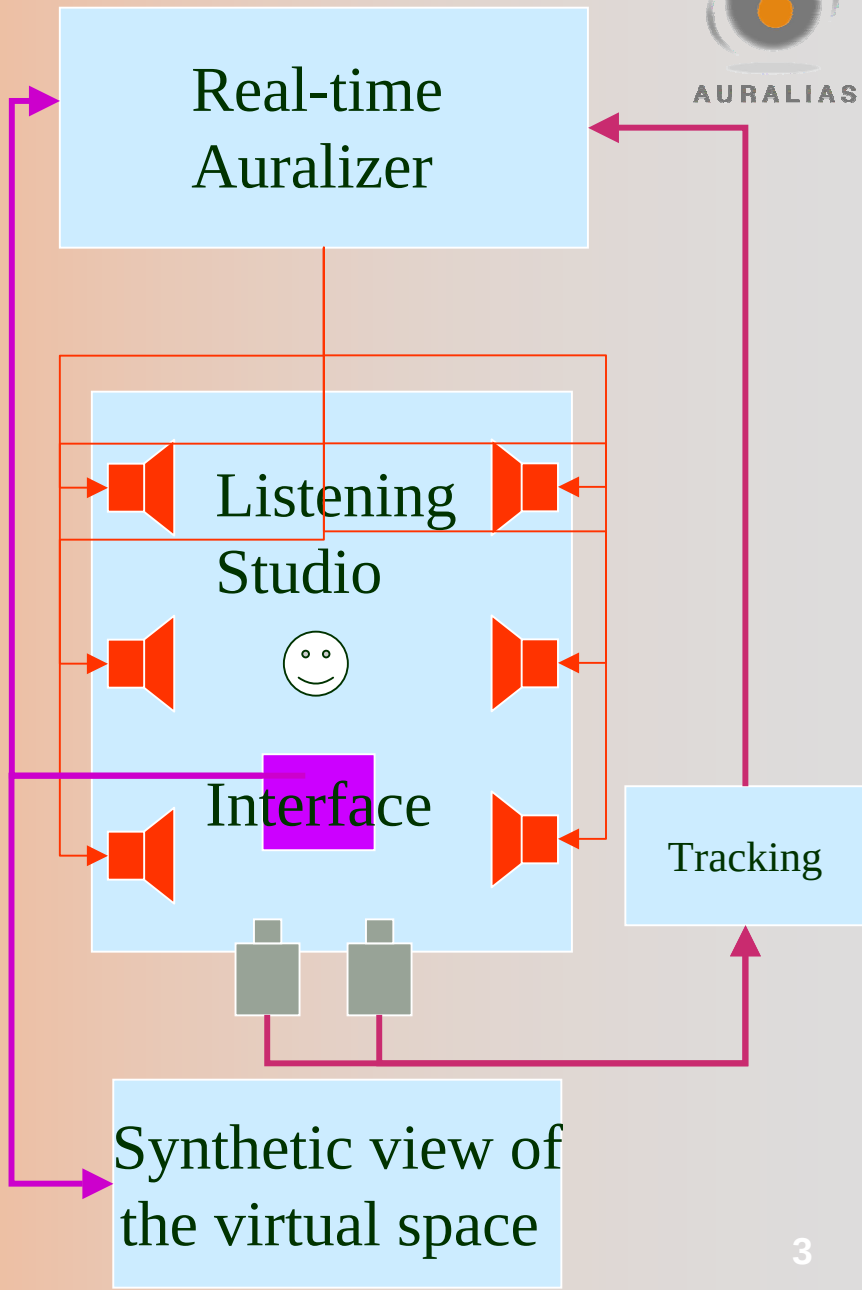
1. AURALIAS

Objectives:

- to develop an auralization system for room acoustics projects,
- to design a system for a small number of users, sharing the same experience,
- to provide auralization by loudspeakers in a listening studio,
- to provide a visual immersion, through an image of the virtual room projected in front of the users,
- to allow interaction with the system: e.g. real-time displacements in the virtual room of the listener and the sound sources.



2. Design of the listening studio

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Main References:

- *Recording spaces, Ph. Newel, Focal Press (1998)*
- *Room Acoustics for Multichannel listening: early reflection control, B. Walker, Proceedings of AES 22nd UK Conference, Cambridge (2007)*
- *Considérations acoustiques pour des petits studios en 5.1, L. Givernaud, Conférences SATIS (2001), http://www.duanrevig.com/Satis%202001.htm*

2. Design of the listening studio

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- *Requirements by AURALIAS:*
  - room dimensions : at least 6m x 6m x 3m,
  - good acoustical insulation,
  - low cost.

- *Acoustical criteria for a listening studio:*
  - the room acoustics should not mask the reverberation of the simulated room,
  - the studio should not be anechoic,
  - reverberation time : Tr = 0.3 – 0.4 s (all freq.),
  - early reflections (0-20ms) < direct sound minus 10 dB,

  - modal content … (next)

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- *Acoustical criteria for a listening studio:*

  - modal content : $V > 40\ m^3$,

  - the ratio H:W:L should approach 1:1.6:2.4,

  - for surround sound 5.1 (*L. Givernaud*):

    $1.1\ (W/H) < L/H < 4.5\ (W/H) - 4$

    $L/H < 3$

    $W/H < 3$

2. Design of the listening studio

Initial situation

1.1 (W/H)=1.91 < L/H

L/H < 4.5 (W/H) –4 = 3.83

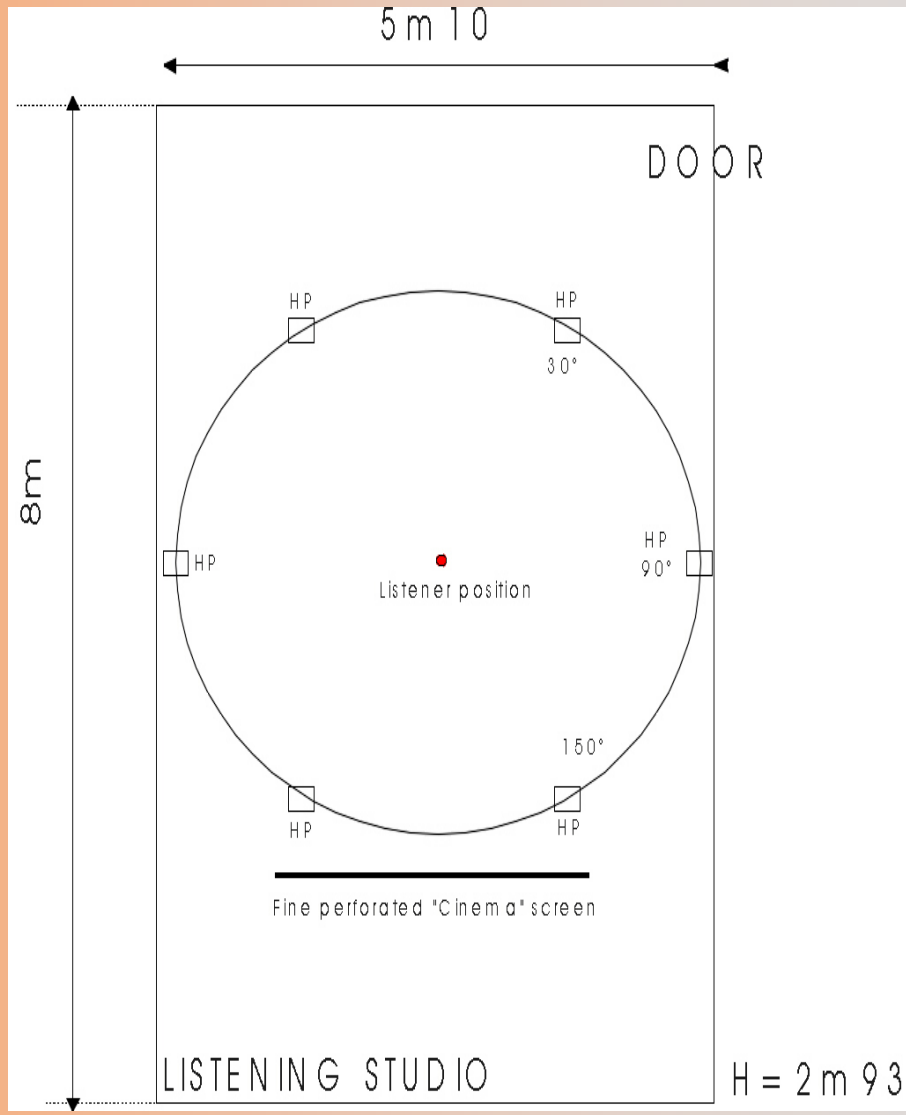
L/H = 2.73 < 3

W/H=1.74 < 3

H:W:L should approach

1:1.6:2.4

(1:1.74:2.73)

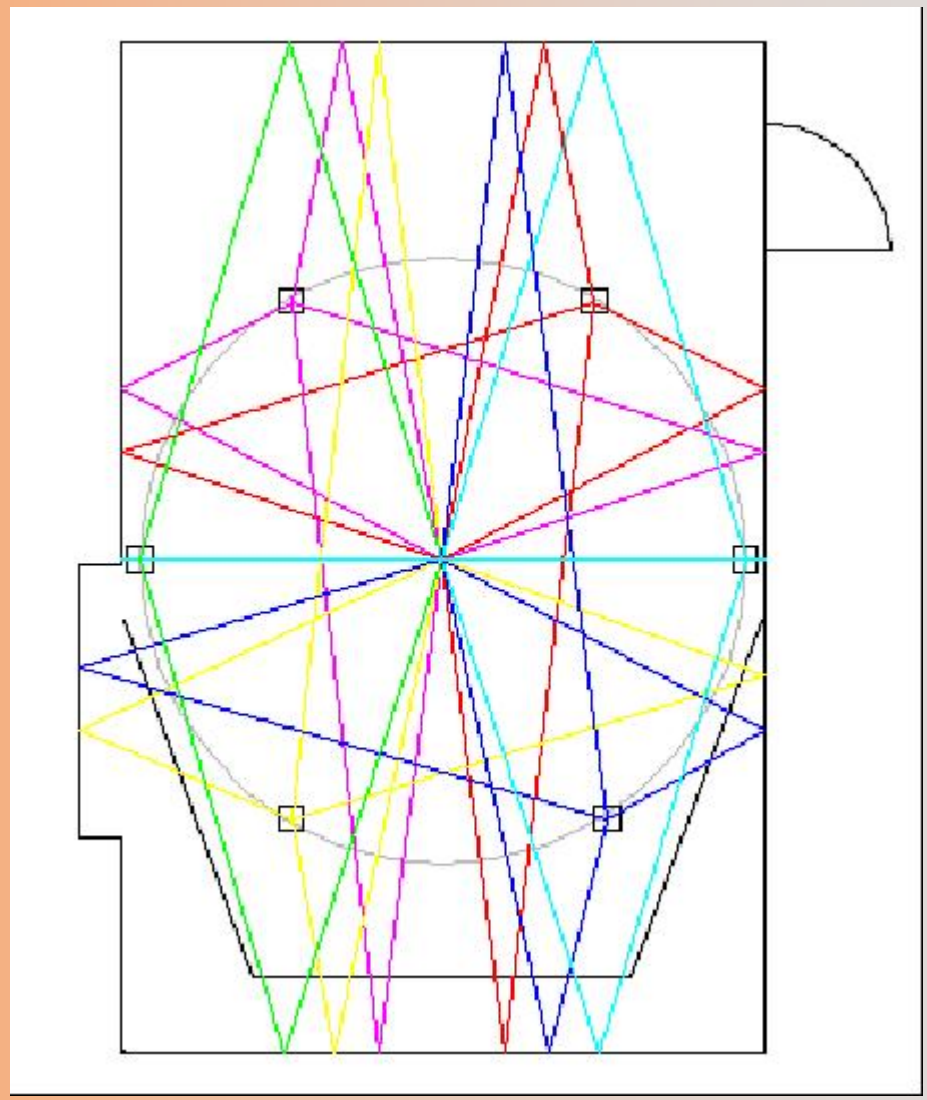


2. Design of the listening studio

Early relections (1st order)

In the horizontal plane.

Identification of the major reflecting zones on the walls.

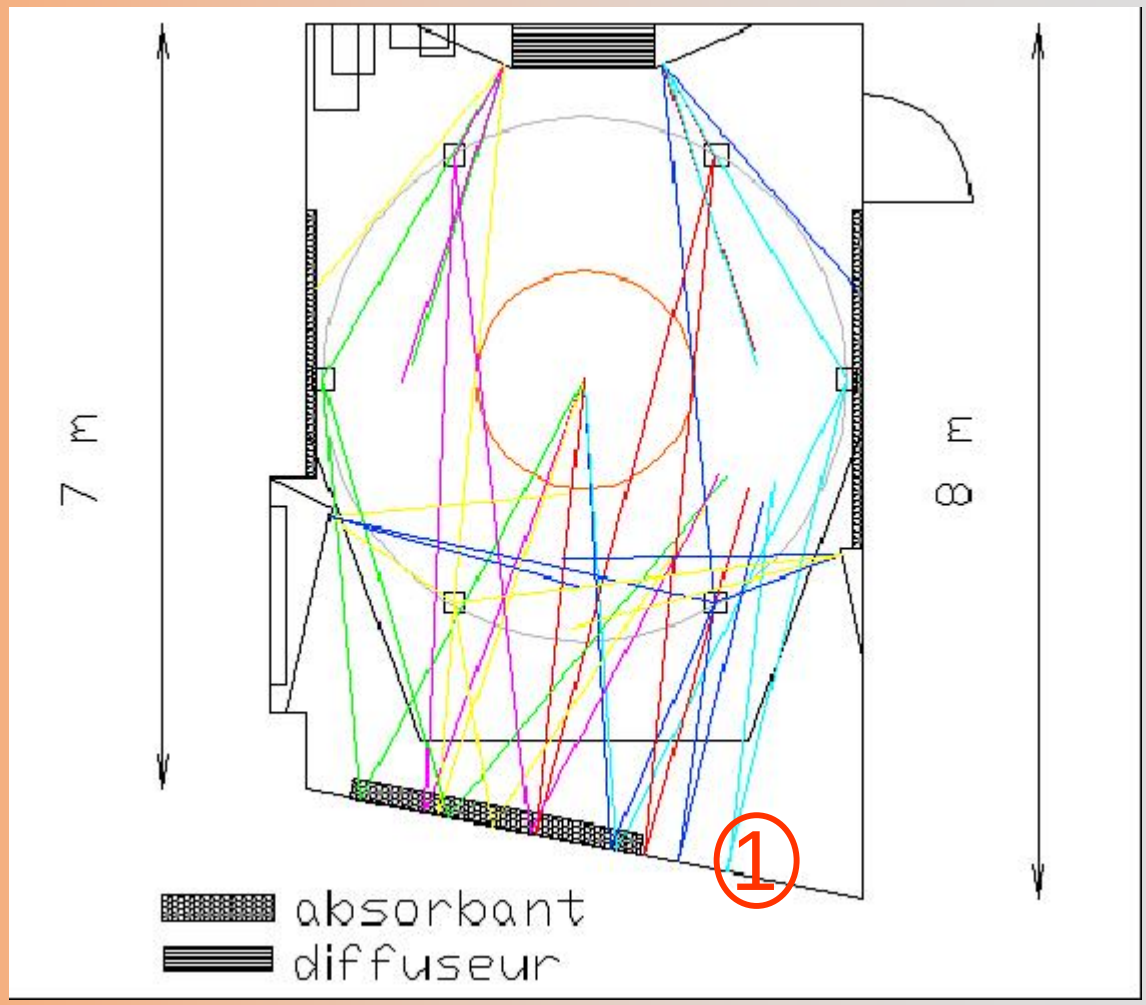


2. Design of the listening studio

Early relections (1st order)

Listening « sweet spot » : 2m diameter.

Treatment n°1 : Changing the orientation of the front wall.

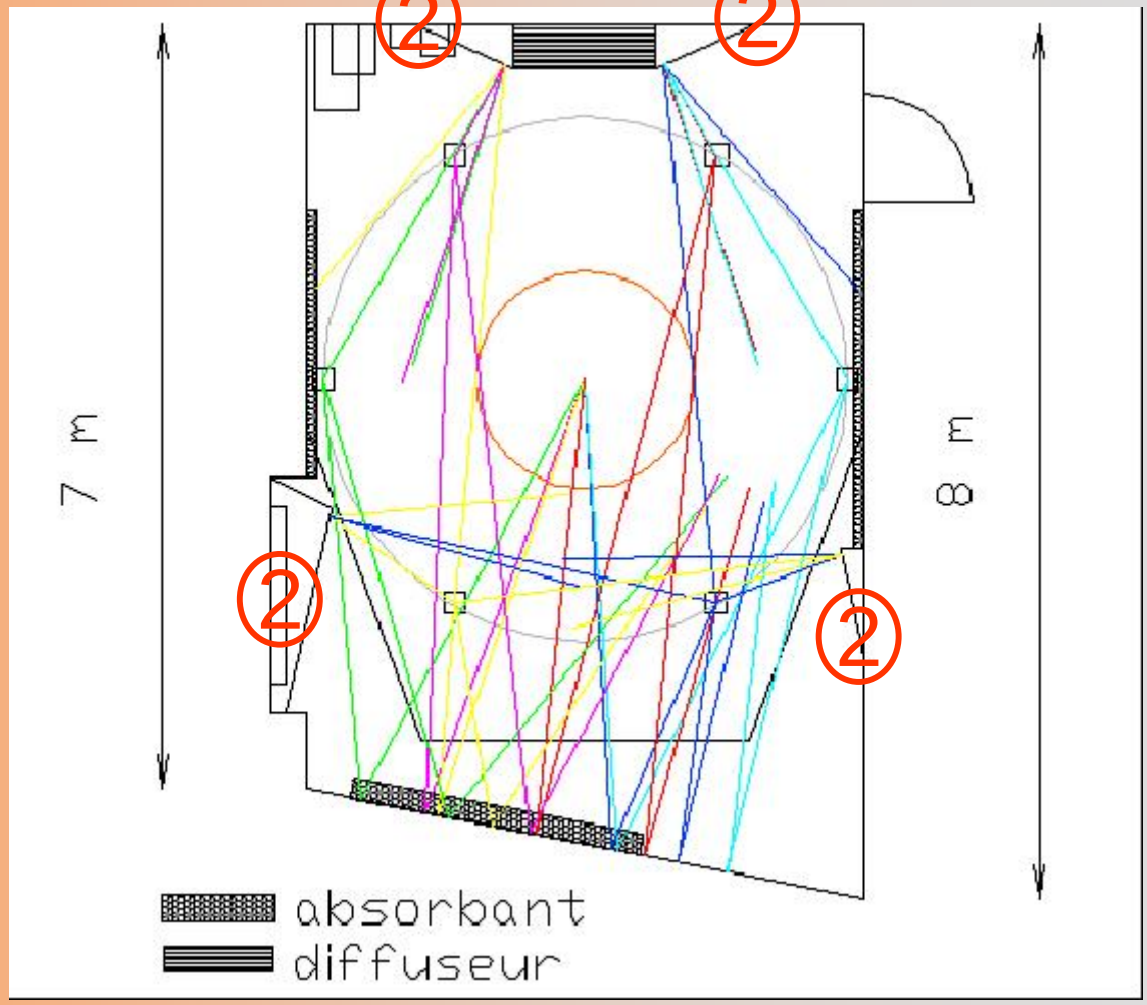


2. Design of the listening studio

Early relections (1st order)

Listening « sweet spot » : 2m diameter.

Treatment n°2 : Reflecting panels.



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Early relections (1st order)

Listening « sweet spot » : 2m diameter.

Treatment n°3 : Absorbing and diffusing panels.

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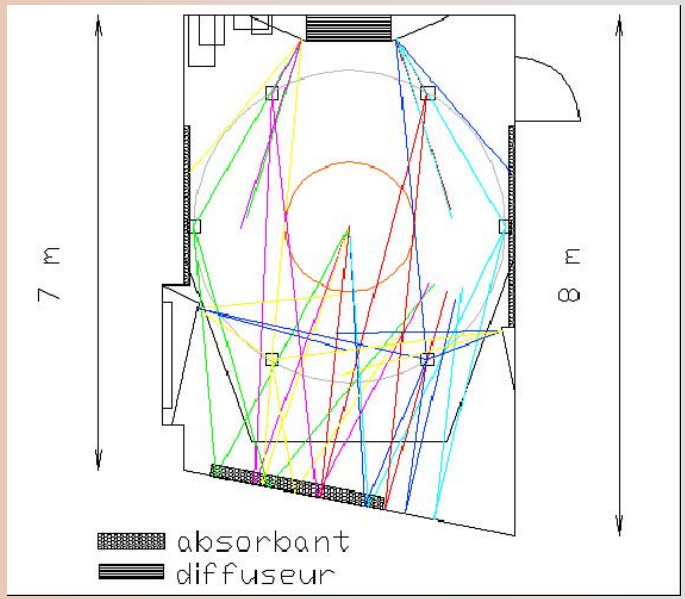
Absorbing material on the front and lateral walls :
- mineral wool panels, 10cm depth



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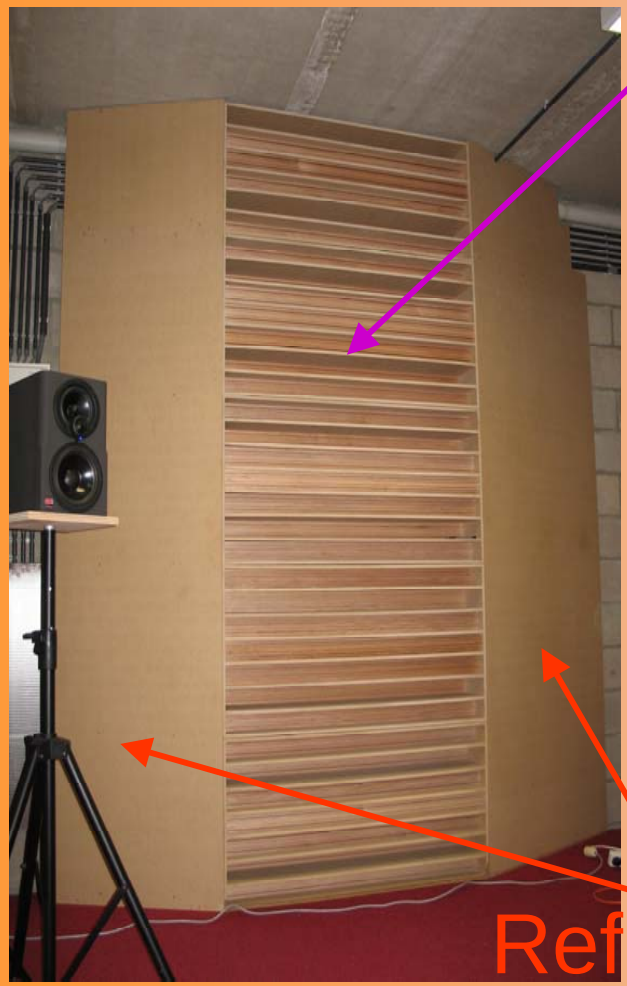
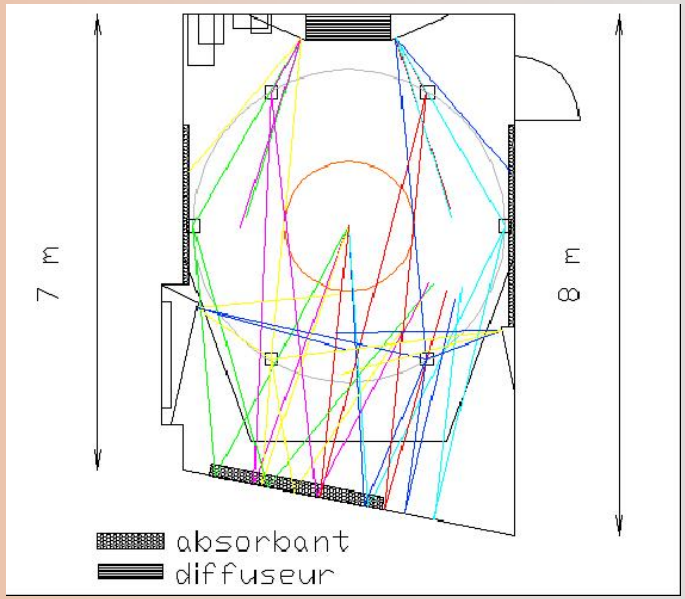


Schroeder wideband diffusers on the back wall :
- one-dimensional, diffusion in the vertical plane.

Reflecting panels



2. Design of the listening studio

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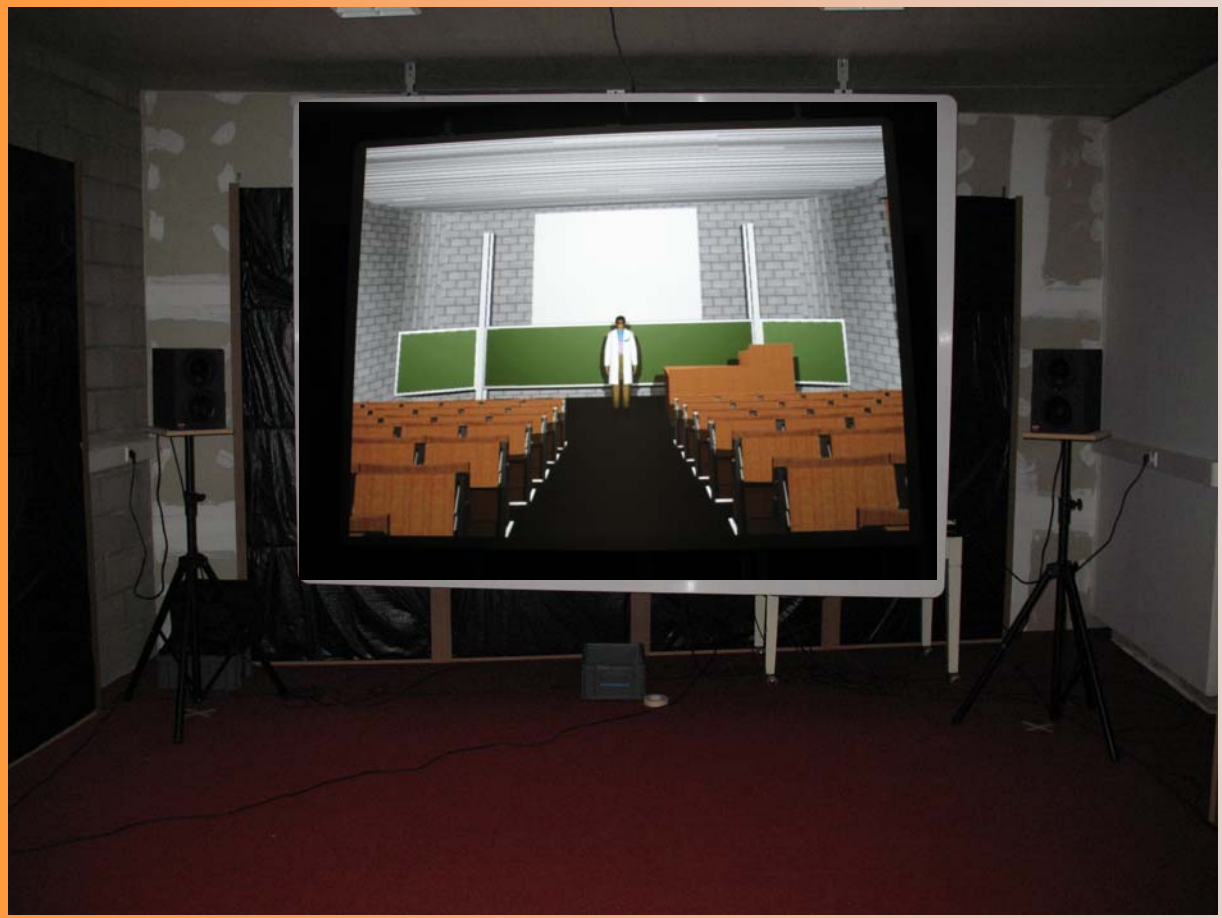
Front view.

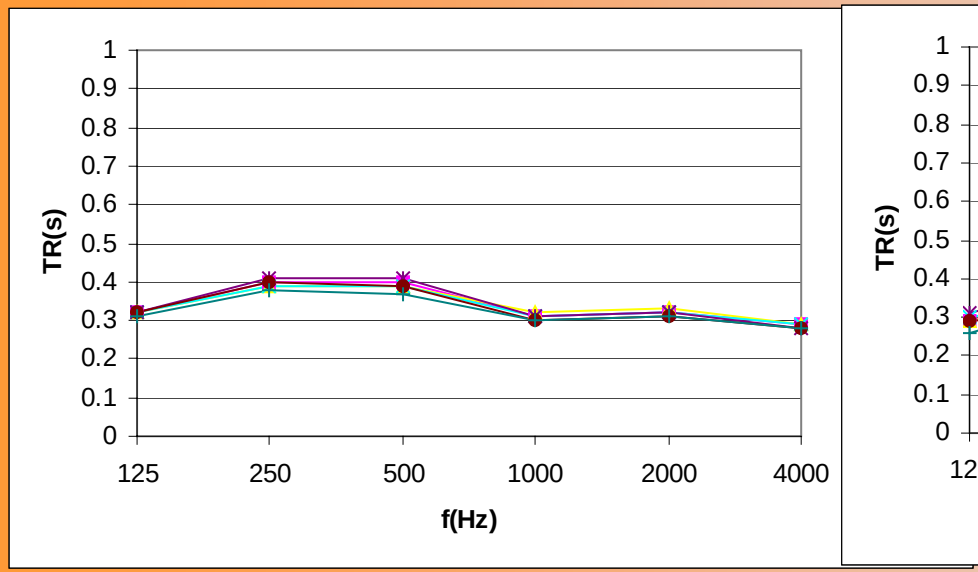
2. Design of the listening studio

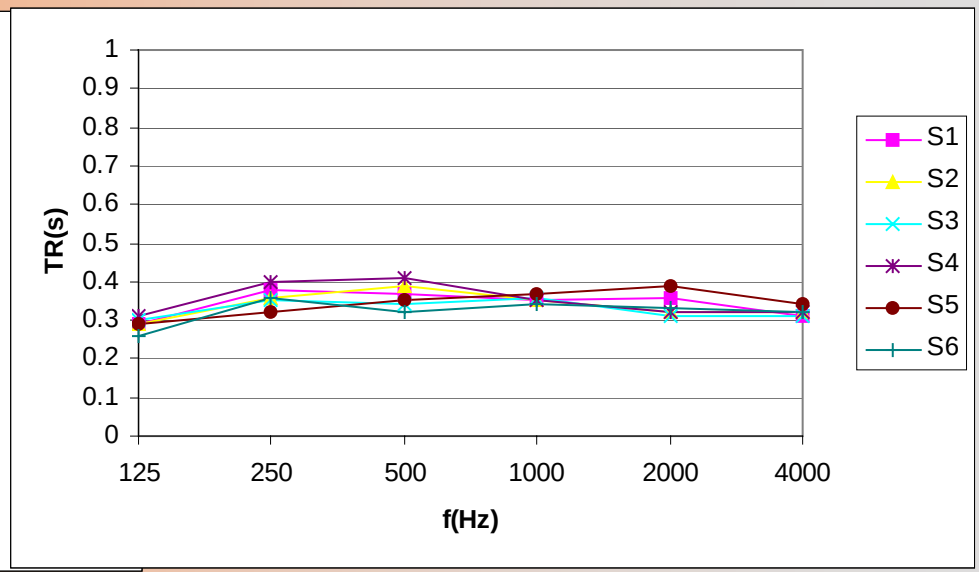
Front view.



3. Acoustical performances

Reverberation times



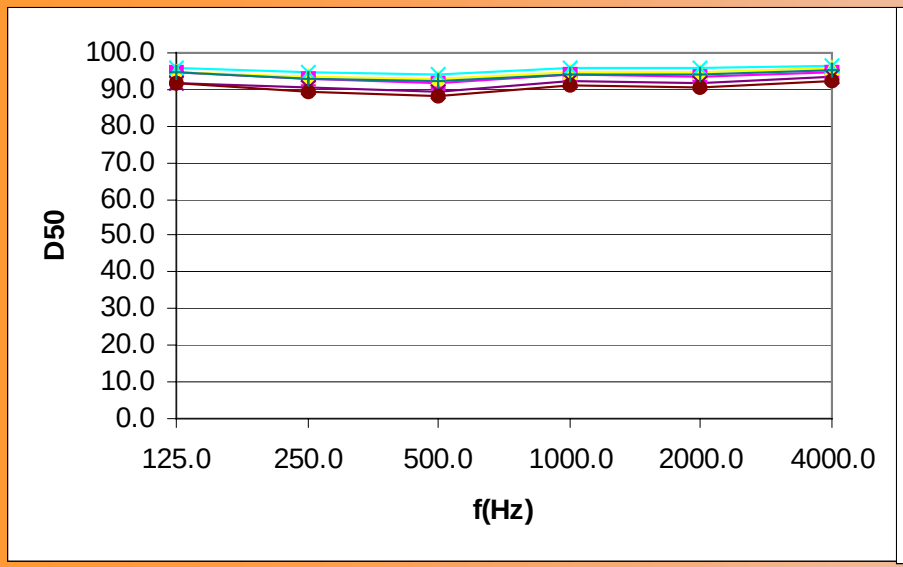


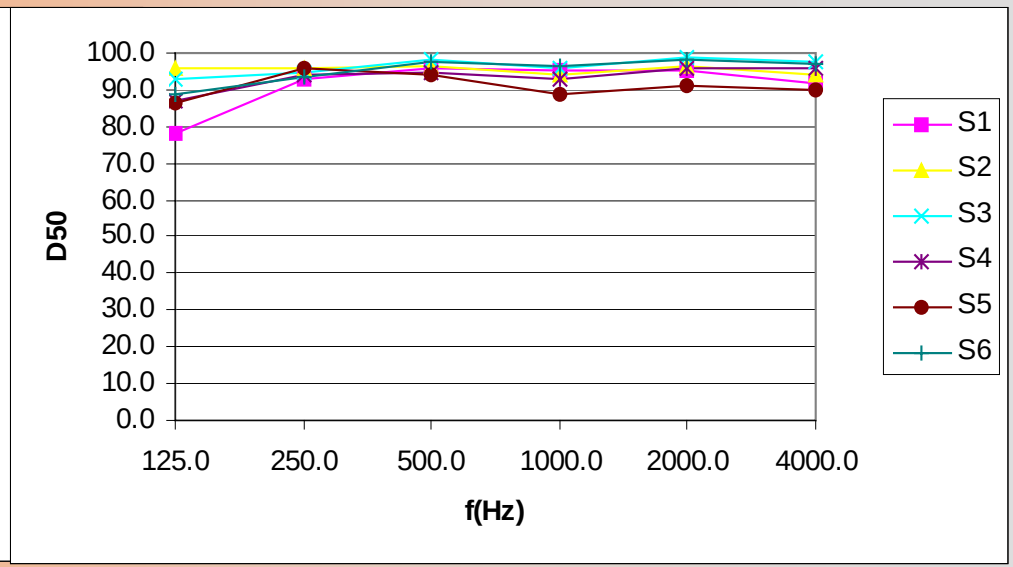
ray-tracing simulation

measured

3. Acoustical performances

Definition (%)



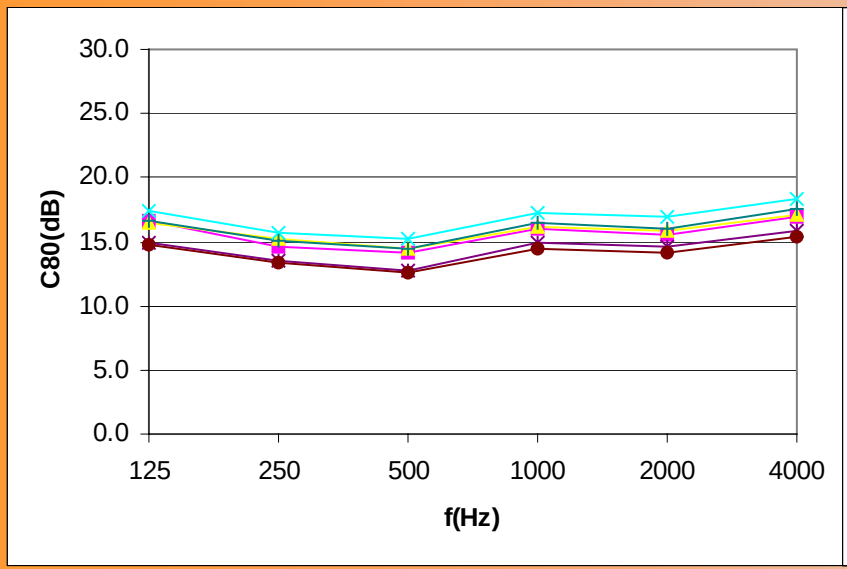


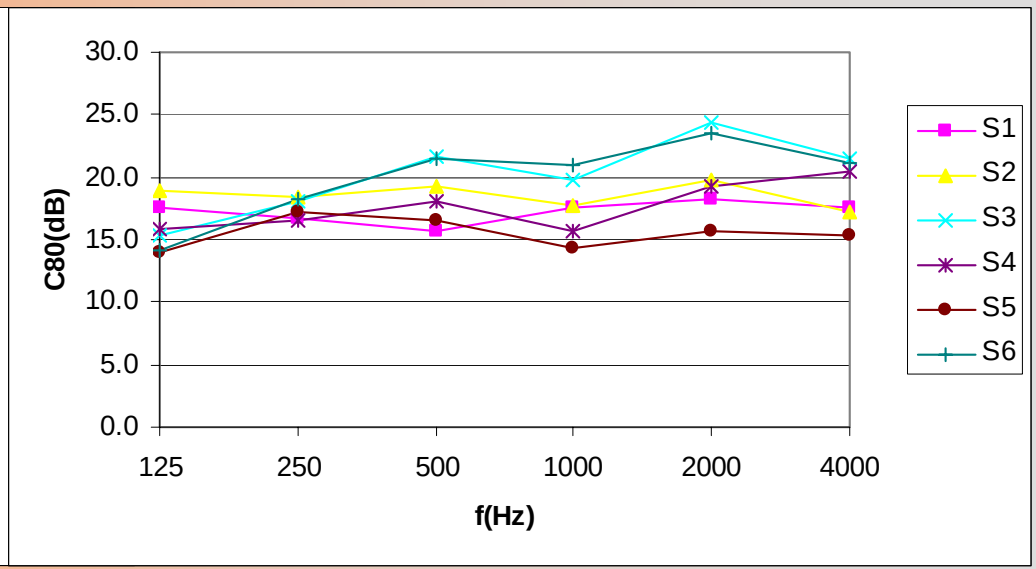
ray-tracing simulation

measured

3. Acoustical performances

Clarity (dB)





ray-tracing simulation

measured

3. Acoustical performances

RASTI

sources	ray-tracing	measure
S1	0.83	0.85
S2	0.85	0.87
S3	0.85	0.9
S4	0.82	0.87
S5	0.8	0.84
S6	0.83	0.89
mean value	0.83	0.87