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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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)
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.

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2. Design of the listening studio

Main References:

• *Recording spaces, Ph. Newel, Focal Press* (1998)


• *Considérations acoustiques pour des petits studios en 5.1, L. Givernaud, Conférences SATIS* (2001), [http://www.duanrevig.com/Satis%20202001.htm](http://www.duanrevig.com/Satis%20202001.htm)
2. Design of the listening studio

- **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)
2. Design of the listening studio

- **Acoustical criteria for a listening studio:**
  
  - modal content: $V > 40 \text{ m}^3$,
  
  - the ratio $H:W:L$ should approach $1:1.6:2.4$,
  
  - for surround sound 5.1 (*L. Givernaud*):
    
    1. $1.1 \ (W/H) < L/H < 4.5 \ (W/H)$ –4
    2. $L/H < 3$
    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 reflections (1st order)

In the horizontal plane.

Identification of the major reflecting zones on the walls.

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Early relections (1st order)

Listening « sweet spot » : 2m diameter.

Treatment n°1 : Changing the orientation of the front wall.
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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.
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Front view.
2. Design of the listening studio

Front view.
3. Acoustical performances

Reverberation times

ray-tracing simulation measured

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3. Acoustical performances

Definition (%)

ray-tracing simulation

measured

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3. Acoustical performances

Clarity (dB)

ray-tracing simulation
measured

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3. Acoustical performances

RASTI

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