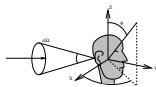


AURALIZATION SYSTEM WITH HIGH FIDELITY SPATIAL INFORMATION

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Theory

Directional RIR



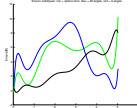
$$h_{SR}(\theta, \phi, t) d\Omega$$

is the RIR associated to a very small solid angle $d\Omega$ including the direction of interest and evaluated at the listener location

$M = 26$ solid angles (directional microphones)



Statistical errors : Comparison for several Directional resolutions



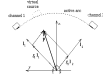
Headphone Reproduction

For headphones auralization the sound contribution coming from a given direction of incidence (first reflections) or from a given solid angle (other contributions) must be convolved with the corresponding HRTF

$$s_{Binaural_{g,d}} = \sum_{refl=1}^P ((s_{Mono} \otimes Imp_{refl}) \otimes hrtf_{g,d}((\theta_{refl} - \alpha), \phi_{refl})) + \sum_{k=1}^M ((s_{Mono} \otimes RID_k) \otimes hrtf_{g,d}((\theta_k - \alpha), \phi_k))$$

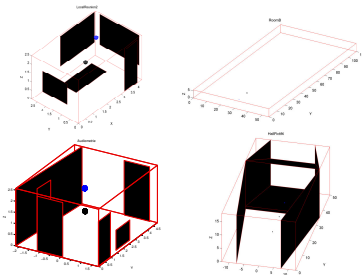
Loudspeakers Reproduction

VBAP Panning law is used

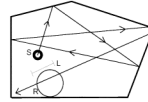


$$S_j = \sum_{refl=1}^P ((s_{Mono} \otimes Imp_{refl}) \times Ccoeff_j(\theta_{refl}, \phi_{refl})) + \sum_{k=1}^M ((s_{Mono} \otimes RID_k) \times Ccoeff_j(\theta_k, \phi_k))$$

Rooms



Echograms to Impulse responses



Ray tracing Software

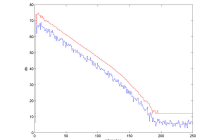
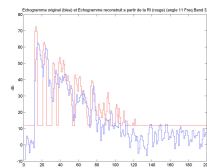


Directional echogram

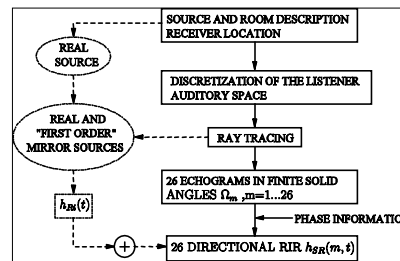


Directional Room Impulse Response

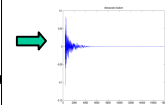
Comparison between echogram and reconstructed echogram for IR :



Algorithm with separate first reflections



One impulse response is obtained for each audio channel



Auralization

- Real-time **partitioned convolution** (low latency)

For example, in case of headphones:

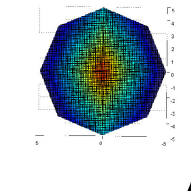
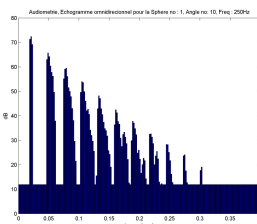
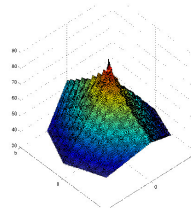
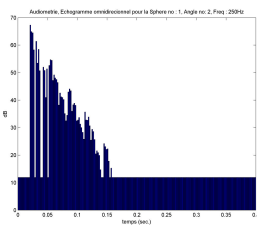
$$y_L = anecho * BRIR_L$$

$$y_R = anecho * BRIR_R$$

- Output on soundcard (alsa driver)

- Interactivity (GUI, head-tracker, mouse, keyboard)

Echograms and Decay Curves



Directional TR30

Instead of traditional spatial parameters (for example IACC or Lateral fraction), we suggest the use of **directional parameters** such as **Tr30Dir**, **E80Dir** or **E160Dir**.

