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Immersive concert experience at home


Tapio Lokki, Associate Professor
Department of Computer Science
Aalto University School of Science, Finland




physics today
January 2014

Two ways of recording spatial sound

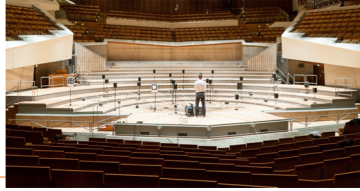
"traditional"
Microphone array




"signals * acoustics"
(Semi) anechoic signals
*



Spatial Impulse Responses



Binaural technology



3Dio

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"Simulator" for a symphony orchestra



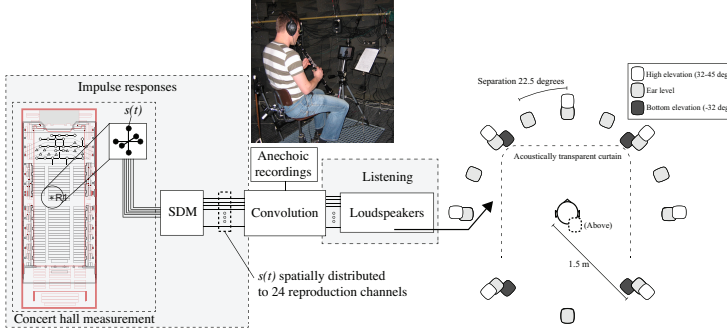


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Auralization in the laboratory

[Tervo, Pätynen, Kuusinen and Lokki, JAES 2013]



Impulse responses

Concert hall measurement

SDM

Convolution

Loudspeakers

Listening

Anechoic recordings

Acoustically transparent curtain

Person

1.5 m

Separation 22.5 degrees

High elevation (32-45 deg.)
Ear level
Bottom elevation (-32 deg.)

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Listening with a multichannel system



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Which concert halls people like?

- 6 concert halls
- 3 seats (same seats in each hall)
- 2 music excerpts

AC = Concertgebouw, Amsterdam



BK = Konzerthaus, Berlin



VM = Musikverein, Vienna



BP = Philharmonie, Berlin



CP = Philharmonie, Cologne



MT = Music Center, Helsinki

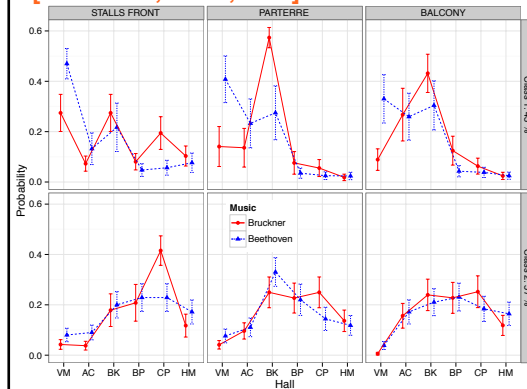


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Preferences of 28 listeners

[Lokki et al., JASA, 2016]



(at least) two
preference
groups

Music matters

Seats are
different

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“Good acoustics” is a matter of TASTE!

However, some halls have a world-wide reputation!
Why?



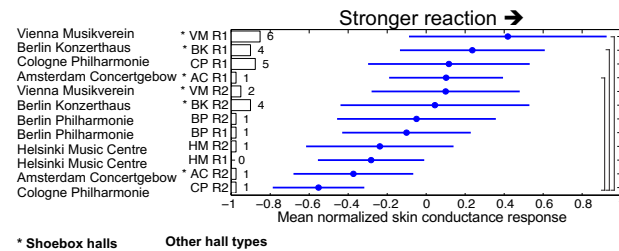
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Passive listening, 28 subjects

[Pätynen & Lokki, JASA 2016]

Skin conductivity response (SCR) was measured, while subjects listened to the same *crescendo* in different halls (in random order)



A listening test, 28 subjects

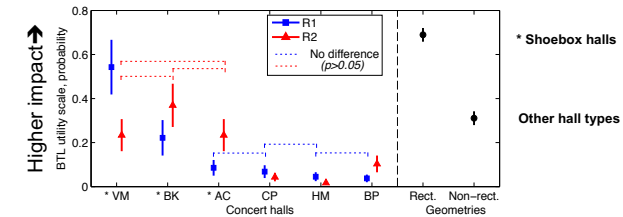
[Pätynen & Lokki, JASA 2016]

Paired comparison between six halls

- R1 = frontal seat at 11m
- R2 = more far parterre at 19m

Choice criteria: “impact”, “imposing”, “impressive”, “striking”

- NOT PREFERENCE **subjective impact**



All tests done in a laboratory

⇒ we can bring “authentic immersive audio” to the lab, also without any visuals



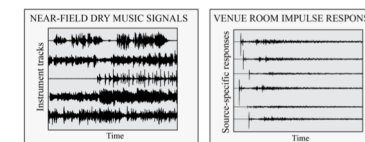
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Bang & Olufsen, DK

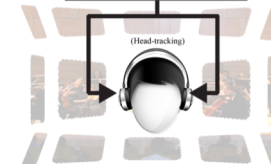
Immersive concerts at home - individual control of rendering

Close-mic
recording of
instruments



Spatial room
impulse responses
from each source

ICHO: Immersive
concerts at home
(2016 – 2020),
Funded by SA



User can choose:
- Listening room
- Listening position

Result: more
authentic experience

Immersive concerts at home

RSO playing Sibelius,
recorded by
E. Mäenmets



Listening with head-tracked headphones

The concert hall can be changed

The acoustical features can be changed

- Requires close mics for instrument groups
- Enables more control for a user
- Some recording and broadcasting processes need to be reconsidered
- Visuals could be “normal HD video”



Thank you for your attention

Tapio.Lokki@aalto.fi
<https://users.aalto.fi/~ktlokki>

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