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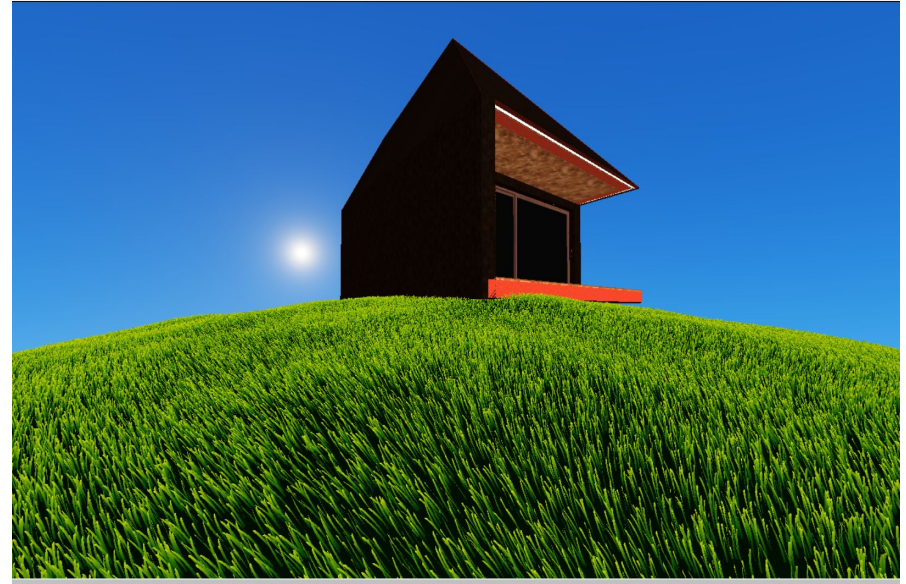
Play the place : Web-based experience of an architectural space using 3D Audio

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Stephan Zimmerli (Architect and Musician)
Mathieu Barthet (QMUL)

Introduction

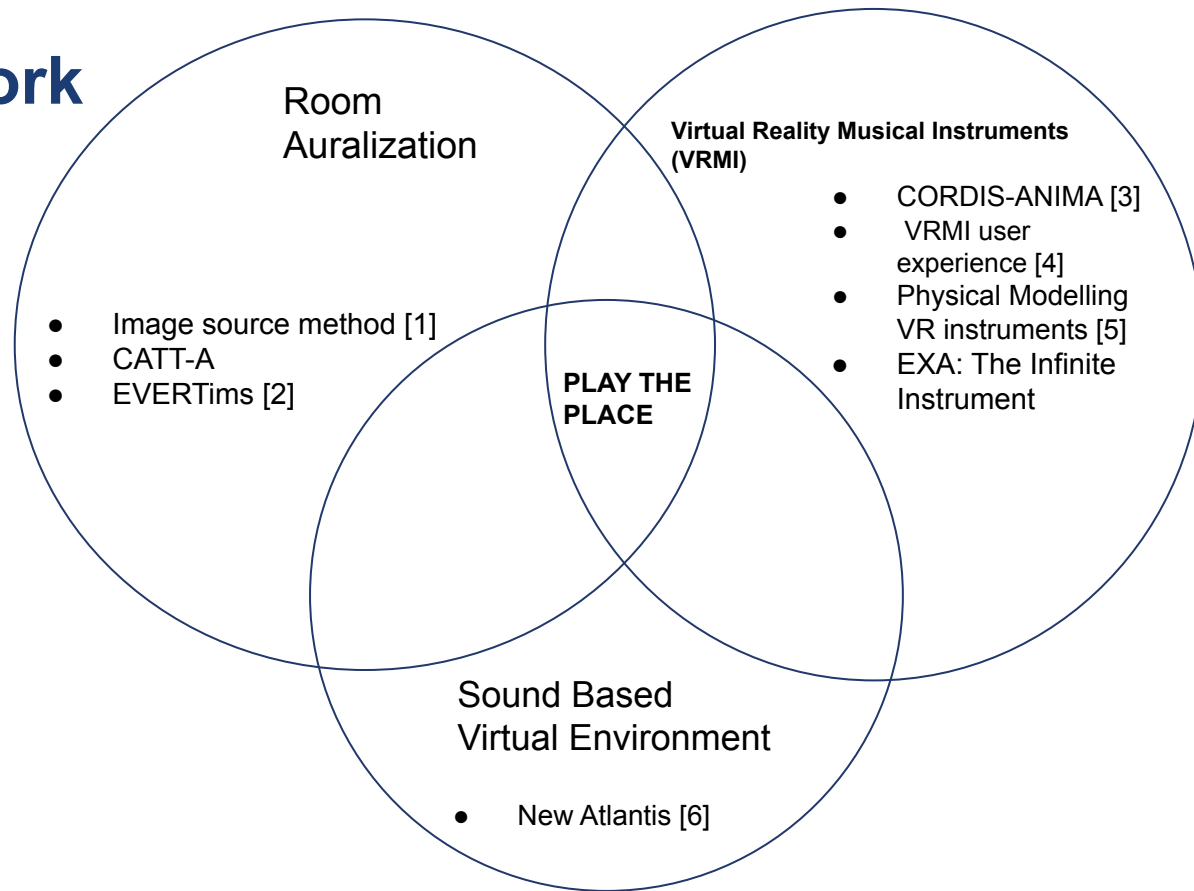
Buildings can be acoustically engineered to ensure that they have a good acoustics but during design, it is difficult for architects to foresee how a space would sound in its location.

- This work explores how an architect could “play the place” to experience and evaluate the acoustics of the design using web technologies.
- This work is a collaboration with architect and musician Stephan Zimmerli related to his project of small studio for music ideation and creation in a rural environment ("Studiolo")
- We designed a browser-based environment ("Play the Place") to experience in an interactive and playful way how the Studiolo would sound.



A screenshot of “play the place” with the Studiolo model

Related Work



The Studiolo Klein Leberau project

The Studiolo Klein Leberau is a project crossing over the realms of architecture and music.

- Focussed on Reverberation
- Rural Space
- Mezzanine that can be opened or closed

Studiolo VE design criteria:

Our design goal was to create a virtual environment (VE) simulating the acoustics of the Studiolo by integrating several VRMIs into the VE so that users (including architects) could assess the environment sonically.

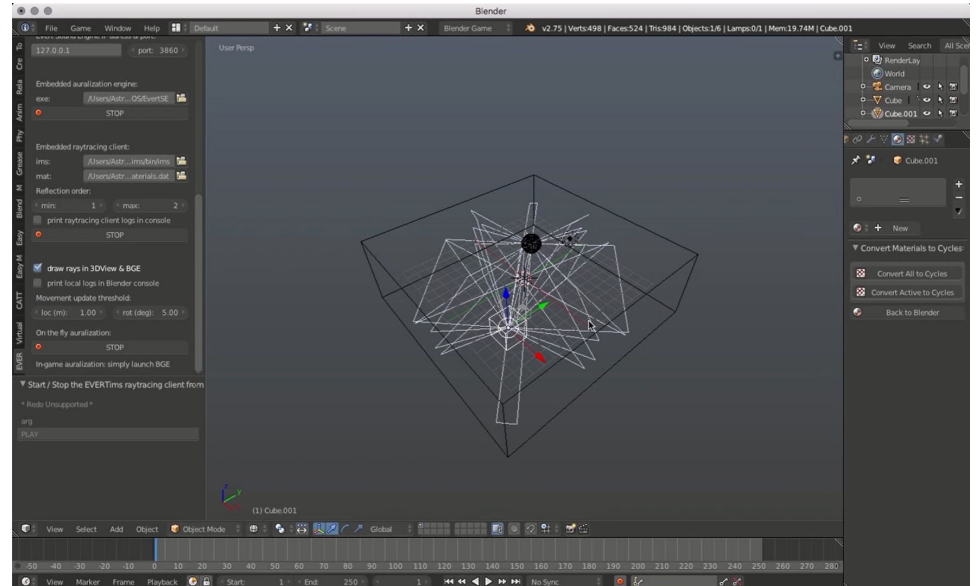


Small scale wooden studiolo model - courtesy of Stephan and Eric Zimmerli

Room impulse response generation

EVERTims [5] open source framework for real-time auralization.

- Extension of the Image Source Method
- Blender plugin
- Generates a binaural impulse response for room model based on listener-source position room dimensions and material.



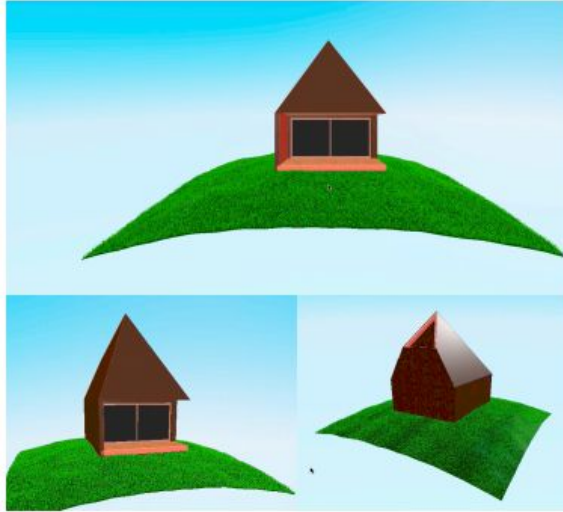
EVERTims raytracing client inside blender

The Studiolo Web App

Hosted at studiolo.glitch.me

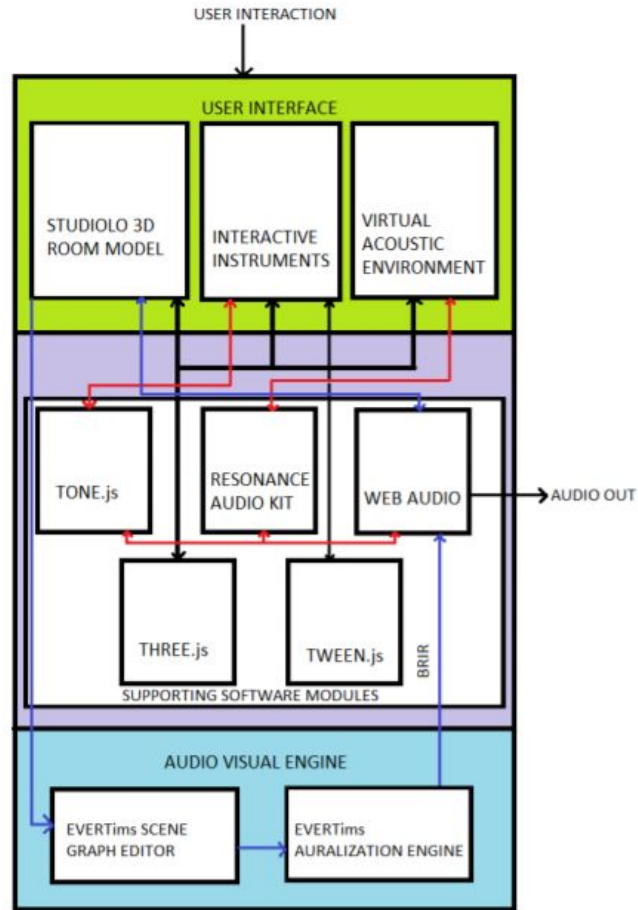
Software environment

- THREE.js - front end
- Tone.js - VRMI
- Resonance Audio Web Kit - 3D Audio
- Tween.js - Animations
- Web Audio API - Audio Engine



Studiolo Web App

Web App Architecture



The Studiolo Web App

❖ Environment and navigation

- THREE.js
- Resonance audio web kit

❖ Studiolo soundscape

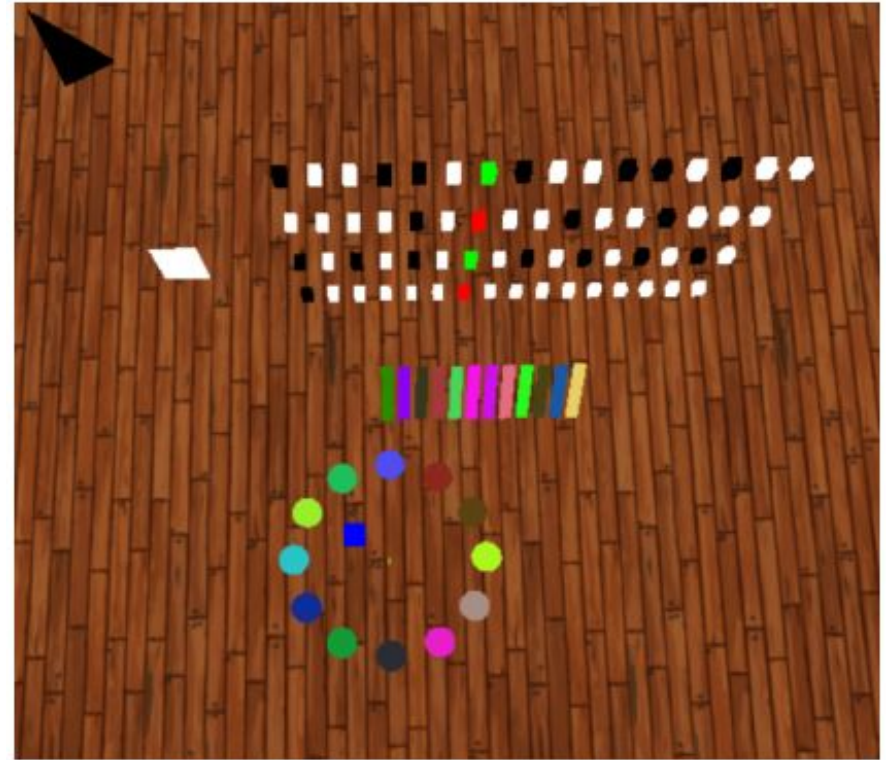
- Sounds sourced from freesound.org
- Rural soundscape

❖ VRMI

- Drum Synthesizer
- Piano/Keyboard Synthesizer
- Circular Synthesizer

❖ Audio engine and spatialisation

- Web audio API
- Panner 3D
- Tone.convolver



VRMIs placed inside the studiolo web app environment

Critical Analysis

Stephan Zimmerli (Musician/Architect)

- It aims to provide a working tool that deals simultaneously with the material space of architecture and the acoustic nature of music.
- “when I play, I usually envision or feel the space around me, but in the world of digital simulations, I miss this richness of interaction”
- The program could benefit from some more fine-tuning:
 - Visually: raw mapping textures and shrill colours are distracting
 - More sensitive and responsive textures of sound, to start addressing the “tactile” dimension of sound

Raghul Velsamy (Architect/Photographer)

- Useful for presenting the acoustic experience of a space during early stages of the design process.
- If browser extensions can be launched from inside an architectural design software it would integrate acoustic design inside the architects workflow.

Conclusion

- A web app integrating a 3D architectural design with 3D audio

capabilities was implemented using Web Audio.

Future Work

- Impulse response interpolation to account for multiple listener positions.
- Integrating EVERTims with Web Audio.
- New interactive tools enabling architects to assess the sound of a space
- Web-based participatory music experiences focusing on sonic properties of a space.

References

- 1) Allen, Jont & Berkley, David. (1979). Image method for efficiently simulating small-room acoustics. The Journal of the Acoustical Society of America. 65. 943-950. 10.1121/1.382599.
- 2) S. Laine, S. Siltanen, T. Lokki, and L. Savioja, “*Accelerated beam tracing algorithm*”, Applied Acoustics, vol. 70, no. 1, pp. 172-181, 2009
- 3) Cadoz, C., Luciani, A., & Florens, J. L. (1993). CORDIS-ANIMA: a Modeling and simulation system for sound and image synthesis: the general formalism. Computer music journal, 17(1), 19-29
- 4) Deacon, Thomas & Stockman, Tony & Barthelet, Mathieu. (2017). User Experience in an Interactive Music Virtual Reality System: An Exploratory Study. 192-216. In Proc. Int. Symposium on Computer Music Multidisciplinary Research (CMMR)
- 5) Karjalainen, M. & Maki-Patola, T.. (2004). Physics-based modeling of musical instruments for interactive virtual reality. 223 - 226. 10.1109/MMSP.2004.1436533.
- 6) Sinclair, Peter & Cahen, Roland & Tanant, Jonathan & Gena, Peter. (2017). New Atlantis: Audio Experimentation in a Shared Online World. 229-246. In Proc. Int. Symposium on Computer Music Multidisciplinary Research (CMMR). Springer
- 7) Poirier-Quinot, David & Katz, Brian & Noisternig, Markus. (2017). EVERTims: Open source framework for real-time auralization in architectural acoustics and virtual reality.

Thank you



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