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Challenges and Perspectives on the Construction of *SPACE*, a Full-Periphonic Ambisonic Studio for Soundscape Composition

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ABSTRACT

This paper summarizes the conceptual development and the engineering challenges, of the 21-loudspeaker studio at the Conservatory "G.Rossini", envisioned as a didactic/production facility for electroacoustic music and environmental sound-art projects related to soundscape ecology studies. The areas of investigation are: 1) the configuration of the loudspeaker array – including a study on the optimization to the available space, detailed 3d visual renderings and architectural prospects, order capabilities of the system and scalability to standard planar configurations, 2) the design of the acoustic properties of the room – including general principles, acoustic analysis during the various phases of wall/ceiling/floor construction and materials employed, 3) new perspectives on the use of the resource for soundscape composition and site-specific oriented creations with particular attention to the overall process of 3D field recording and reproduction of natural soundscapes.

CHALLENGES IN THE AUDIO REPRODUCTION OF SOUNDSCAPES

The study of soundscapes often requires studio analysis of field recording data, which implies, as a crucial assessment tool, carefull listening sessions over loudspeakers systems. The majority of standards for audio reproduction are usually two-dimensional planar systems (stereophony, quadraphony, 5.1 surround, octaphony, etc.), which in fact flatten the original spherical soundscape into a plane in front or around listeners (Monacchi 2011).
In reality, it is largely due to the richness of spatial information – sound sources' direction, depth and relative perspective – that we are able to separate sound sources and perceive soundscapes as complex multilayered frameworks of communication. When it comes to recording and reproduction, this dense information is severely impaired, especially when we try to convey sound environments through conventional reproduction techniques.
Connected to the author's long-term environmental sound-art project ***Fragments of Extinction*** – *Acoustic Biodiversity of the Primary Equatorial Rainforests*, in which the detailed space reconstruction of the ecosystems is pivotal to the core of the project, we have built in Pesaro a full-periphonic studio which is able to reproduce and maintain all the spatial attributes of a recorded soundscape, in its original entire spherical radiation.
The facility, named ***SPACE – Sound Projection Ambisonic Controlled Environment***, is a data playback and music composition environment, where the intrinsic acoustic properties of the room, the loudspeaker array, the electroacoustic and digital systems have been designed to achieve the highest spatial reliability for the scope of rendering natural soundscapes.

In the paper, the conceptual and technical challenges encountered during the various construction phases of the studio, are discussed in details. This extremely concise poster version reports only few schemes.

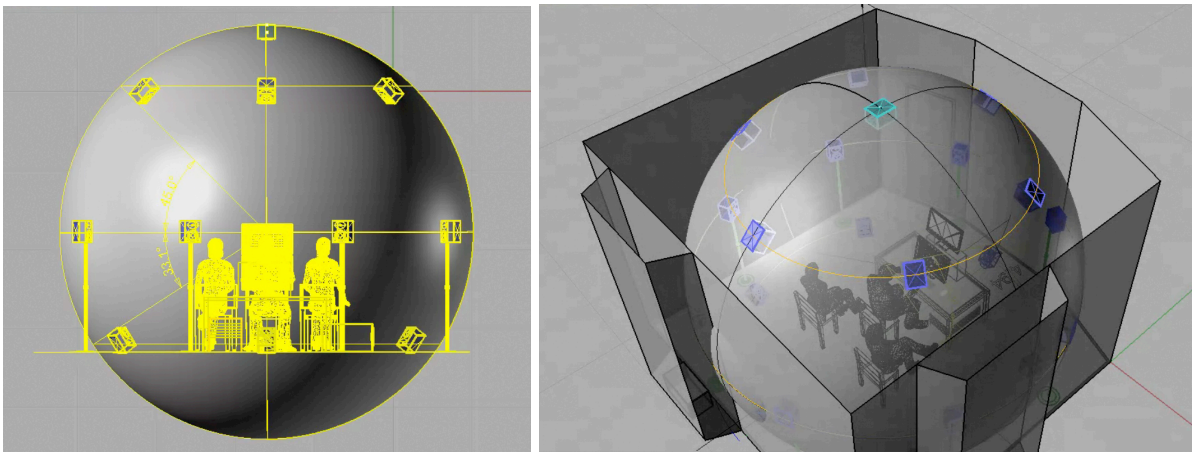


Fig. 1, 2: *S.P.A.C.E.* – final project (21 loudspeakers on 4 rings of 6+8+6+1), frontal view and perspective

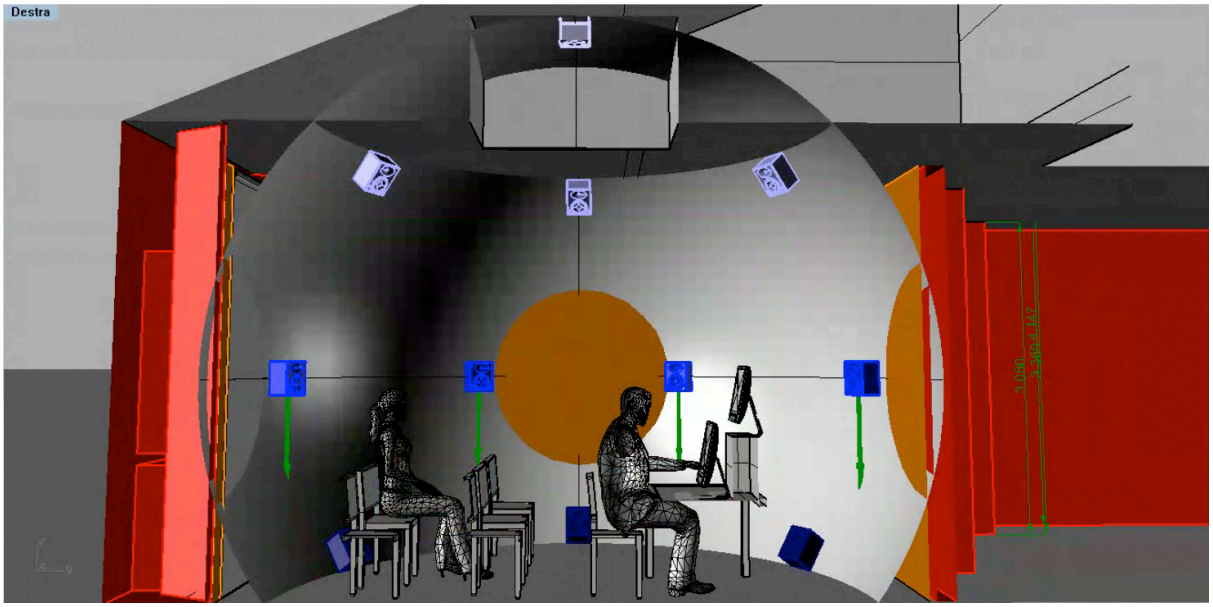


Fig. 3: *S.P.A.C.E.* – quasi-final project, lateral half-section view

NOTES ON VENUE'S ACOUSTICS

The room has been constructed with great attention to the acoustical properties inherent in the site and all the covering materials. In order to absorb a considerable amount of the reverberated energy, without trying to be anechoic, a perforated wooden material (Pream – Screenball P15F03) has been chosen. The material combines optimal acoustic performance with agreeable aesthetics. Perforated plasterwork false-ceiling and wooden floor laid upon an elastic film, plus 2 membrane resonators at rear angles, were constructed to minimize reverberation in low and mid-low frequencies. The intention was to reach an ideal 0.2-0.3 sec. RT60 over the entire spectrum, thus controlling reverberation without completely removing early reflections. Measurements were performed during each of the 9 construction phases. The initial and final states are illustrated below.

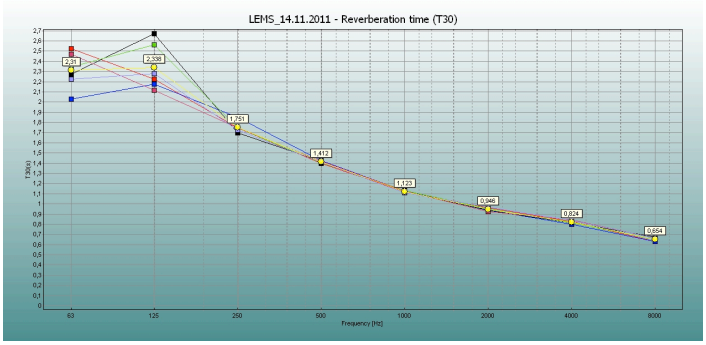
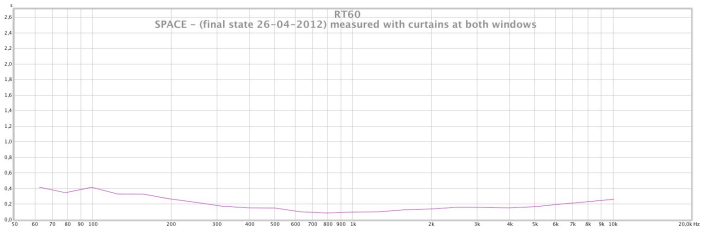


Fig. 4: acoustic measurement session n.1 – Built walls, no false ceiling, empty room (considering the relatively small venue, note the high T30, which spanned from 0.6 to 2.3 sec)



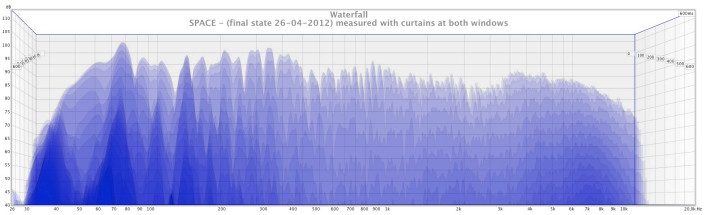


Fig. 5, 6: acoustic measurement session n.9 – Final state of the venue with perforated ceiling, perforated wooden walls, wooden floor, 2 velvet window curtains, (note that the RT60 is now around 0.2 sec – although some modal resonances are still present on the first 2-3 octaves of the spectrum but occurring after 0.2-0.3 sec and at a considerably lower level of 25-30 dB, thus less problematic and solvable with disseminated Helmoltz absorbers)

SUMMARY

Several adaptations at various phases of the project were required. From concept to realization, these included: the reconstruction of walls, various issues related to binding architectural norms and regulations, lack of space, and limited funding. Working within such pre-existing constraints, we succeeded in producing – without compromise – all of the following: 1) Adapting the loudspeakers array to the ideal spherical setup (software compensation stage not needed); 2) Maximizing the floor space within the new venue; 3) Reaching a full 3rd-order ambisonic capability in 3D; 4) Covering the maximum periphonic dimension without suspending seats in a metal grate; 5) Organizing speakers' clusters in rings (compatibility with planar multich. standards); 6) Achieving optimal venue's acoustics (all-spectrum-balanced minimal reverb time); 7) Hiding all the 44 speakers' connection cables; 8) Outfitting the venue for hosting extremely hi-q electroacoustic technology; 9) Preparing the venue for: a) research setup; b) performance setup for 15-20 people.

ACKNOWLEDGEMENTS

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REFERENCES

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