Politecnico di Torino

Honors Thesis

Master of Science in Architecture Construction City

Abstract

AMBISONICS AS A TOOL FOR ARCHITECTURAL PRESERVATION. THE VIRTUAL SOUNDSCAPE OF THE THEATRE OF TINDARI

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December 2021

The acoustic environment is very influential on how we experience some of our architectural heritage. This is especially relevant for ancient amphitheaters, that were designed to achieve high sound quality and good speech intelligibility, and this is why they are one of the main themes of the emerging field of archeoacoustics. It is important to properly measure, document, and make virtual reconstructions of the acoustics of these places in order to preserve and communicate their behavior, opening the possibility to experience spaces that are no more accessible.

The object of this investigation is the soundscape of the theatre of Tindari, which has changed considerably during the centuries. A combination of visual and acoustic experience in a virtual reality environment provides an immersive exploration of the different phases of its evolution aiming to be helpful for researchers and to attract more attention on the subject from a broader public. This can also constitute a new tool for evaluating the effect of architectural interventions on the acoustic performance of the building during the design process through direct sensorial experience.

The visual rendering consists of equirectangular panoramic images, reconstructed from several viewing points, each associated with an High Order Ambisonics impulse response, computed with the hybrid ray tracing method of Odeon, and the pyramid tracing algorithm of Ramsete. Anechoic samples are then convolved with these impulse responses to create the virtual soundtrack for each viewing point. The results are stored in video files with proper metadata which allow them to be watched with an HMD (such as an Oculus Quest 2) or on Youtube.

The study makes use of the results of previous research, which has validated an acoustic model of the current deteriorated state of the theater by matching the acoustic parameters obtained in the virtual simulation with those obtained by real on-site measurements.

This model was further developed to reach a higher level of accuracy and, from this baseline, shapes and materials were modified to create a virtual reconstruction of two previous configurations of the theatre and one proposed future configuration featuring a tailored acoustic shell aimed at optimizing its uditory comfort.

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