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## ACOUSTIC PERFORMANCES OF ANCIENT THEATRES: REAL ANCIENT VERSUS VIRTUAL ARCHITECTURE

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### Abstract

There is strong demand from the public for the access to the outdoor archeological sites during daytime and even more during nighttime, both for archeological visits and for the organization of several types of cultural events, ranging from sport shows, to symposia and concerts. Most archeological sites cannot be considered sustainable for their cultural heritage that has not yet been reached. The building officials and historical societies that manage the use and operation of these ancient architecture buildings or theatre have outlined series of guidelines for their use by the public that includes the role of acoustics and lighting techniques in the modern use of these ancient places.

The acoustic properties of ancient performance spaces for Greek and Roman theaters have been studied for accurate reconstruction from possible alternatives of material and design evolution by many investigators. Parametric studies and examination of computer simulation methodology for ancient theatres provides new indexes to examine the contribution of each design components.

Measured and simulated results show that scattering and diffraction from seat and architectural elements, which are important in outdoors theatres impact the sound quality and condition. The specific changes in material characteristic have increased the reverberation and enhanced the sound levels. Computer simulations using a range of boundary absorption and scattering coefficients play a very important role in supporting the choice of the best or almost the more acceptable reconstruction, or sustainable design approach among different possible alternatives being practiced by superintendants and the managers of these historical sites.

This paper presents application of a newly developed technique in beamforming as a close numerical examination to put in evidence the relevant acoustical aspects of ancient theatres basing the study on the comparison of ancient and modern structures. Application of the CAVE or Virtual Reality laboratory provides a well-established tool for this task. Simulations have been carried out to evaluate the acoustics of the orchestra, of the cavea and of the stage, using the theatre of Ancient Ostia and the Rome Coliseum theatre as a reference for ancient theatre, and the Michigan Stadium as a modern architec-

ture theater. The use of Virtual Reality and virtual reconstructions of these theatre combined with auralization techniques provided the opportunities not only to investigate performance of these theatres in different eras but also provide a different experience for the users within the virtual world of ancient acoustics given the growing computer access and their availability for not only visualization but also virtual acoustics