POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Architecture
Honors theses

Loudness: algorithmic design of an acoustic shell for a rock stage
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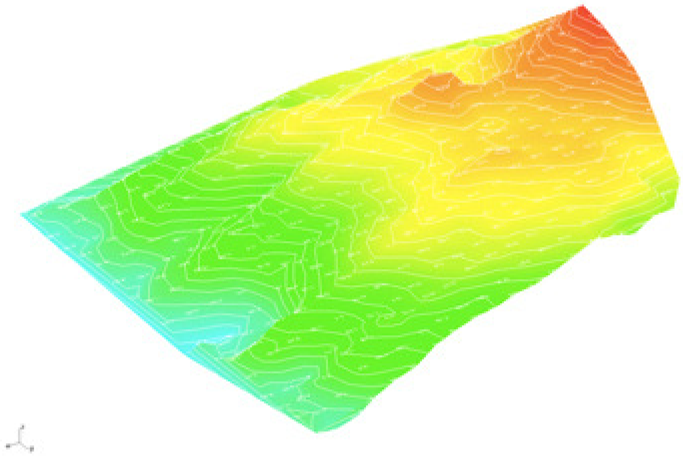
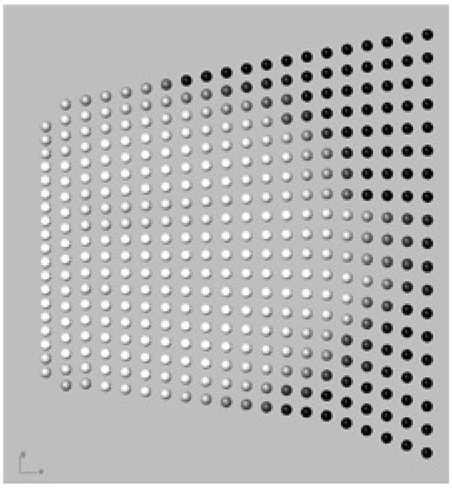
Our thesis aims to promote the contamination among different music genres, both historically and culturally (such as rock and classical music) through the integration of a standard system for active acoustics (the rock stage) with an *ad hoc* system for passive acoustics (the acoustic shell).
The first part of our work acts as a theoretical introduction of some key-concepts useful for the comprehension and the development of the acoustic project, which synthetically revolves around issues such as free field sound propagation, acoustic reflection, geometrical acoustics and sound perception.
The second part begins with a case study analysis, the Collisioni Festival main stage, performed in Barolo in July 2012. We followed the construction site and the building procedure of the stage, focusing our attention mainly on the Layher© system, an internationally spread system for the building of temporary structures in the live performance field.

View of Collisioni main stage during the performance days

Collisioni stage is actually the starting point for the development of the thesis project: an acoustic-driven form finding project. The object of our research is the morphology of an acoustic shell, an acoustic element able to gather and reflect acoustic energy in an outdoor performance space; this reason, linked to the concept of energetic concentration, brings our project in a very particular field of the acoustic sciences, very far away from the design of a concert hall or, for example, of an auditorium.
From a strictly geometrical point of view, our acoustic shell is defined as a free-form surface: this is another peculiar aspect of our project, further addressed towards an experimental domain of research involving the use of complex and doubly-curved surfaces for acoustic aims.
The project is developed through a massive use of digital tools for design (parametric modeling, scripting, genetic research, acoustic analysis and data visualization), partially developed *in-house,* so defining a semi-automated iterative process of digital morphogenesis and acoustic analysis, while, at the same time, outlining an experimental methodology of acoustic design.

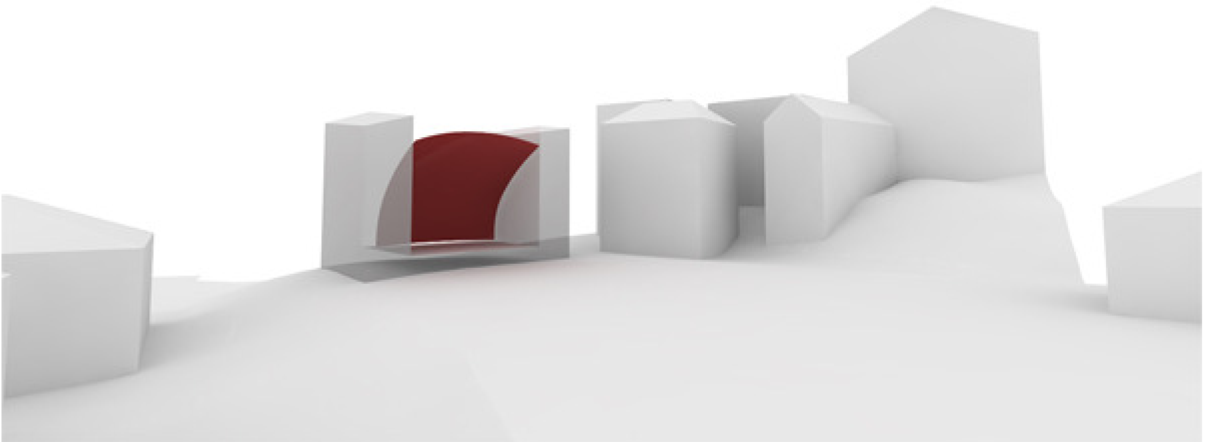




Chromatic 3D map of G parameter values (left) and visualization of “satisfied” acoustical receivers based upon G parameter (right)

The form-finding research process is subdivided in two phases, a more intuitive and more manual-oriented one, addressed towards the definition of a raw shape, and a more refined and more automated one, aiming to a performance improving and to a formal definition of the previously obtained shape, using small scale and detail operations.

This morphogenetic process is able to produce many formal variations based on different kind of choices; the so defined different morphologies are later analyzed and evaluated through the acoustical parameter G (loudness or acoustical gain), always relating to the urban and environmental context of Barolo.
The research ends with the choice of one surface morphology, judged as the fittest thanks to the numerical results of the acoustic simulations and to further, more architecture related considerations.
A special attention has been given to the use and to the functional behavior of genetic algorithms, automated tools for the research of solutions to optimization problems, as well as to the usage and functioning of Pachyderm, a still work-in-progress, open-source software for acoustic simulation.



Conceptual model of the final surface within its context

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