



POLITECNICO  
DI TORINO

# Honors thesis

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COURSE OF Architecture Construction City

*Abstract*

## **Modeling of adaptive panels to control sound scattering in large environments**

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The work presented started with an analysis of the actual situation on the theme of adaptive structures, widening the starting knowledge, with the result to understand more clearly the potentialities implied in a full exploitation of this kind of technology, and the changes that their diffusion would generate. Every time there is a new challenge, new competences and problems must be solved to achieve a good result and produce a convincing project for a specific case. Beside these mutable experiences there are some principles and fundamental knowledge which does not change; these include foldable geometries, modeling and prototyping process as well as the capability to manage the development of the project considering all the issues involved with the right balance. The compresence of more aspects, each of them with its requirements, has been managed throughout all the process appealing to them at the right moment. The project took in consideration one specific theme, the acoustic, aiming to produce a proposal of an adaptive object able to increase the efficiency and versatility of conference and music hall. The result of the project is an adaptive panel, which varying its spatial configuration provokes a change in sound reflection which rebound on the acoustic of the room.

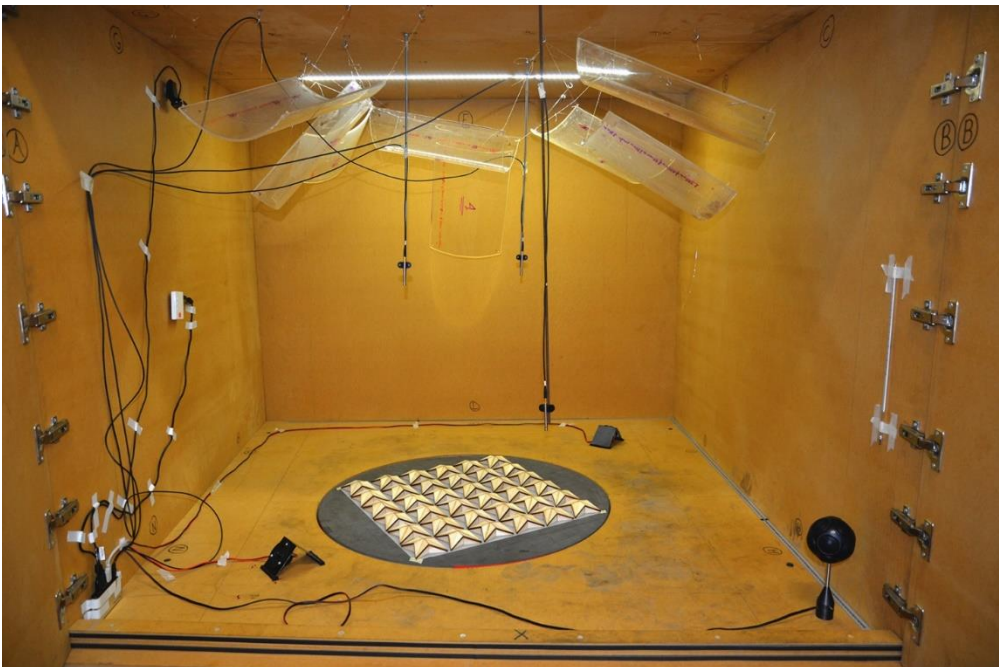
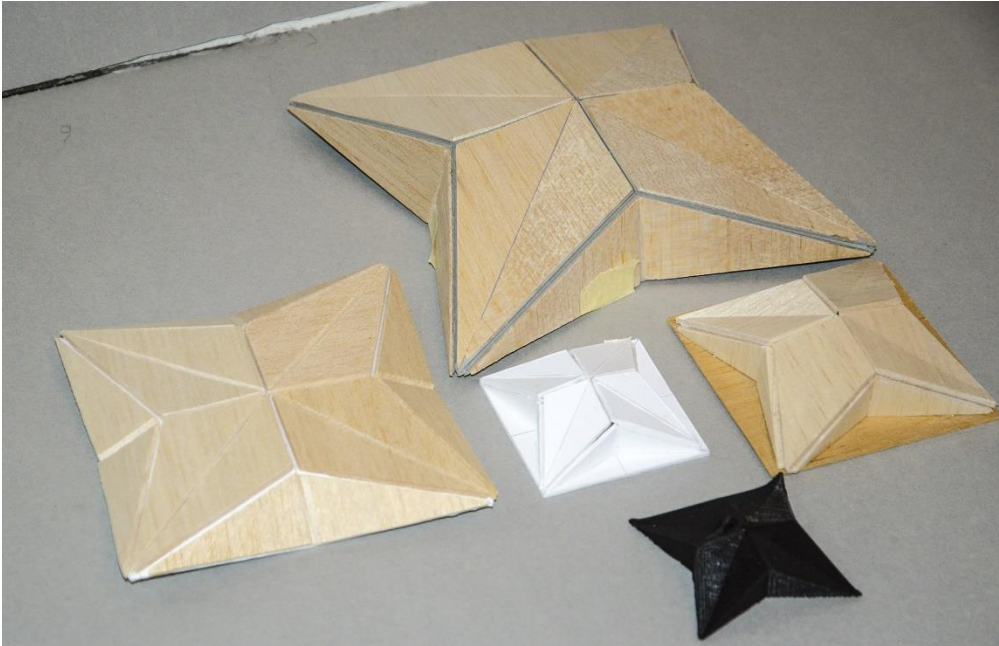
Since the beginning the study and search for the suitable geometry to use dealing with the implications coming from the acoustic needs. Each decisional step under the geometric and material point of view needed a feedback from the sound knowledge to properly select one road or another. To solve other issue differently it has relied on the information coming from the study of the scientific publications about the different topic involved in the project, such as for the issue of the thick rigid origami.

Beyond the engaging aspect related with the adaptive structures, that often is used to convince of their strength, a proof of their goodness and efficiency must be provided to present a more complete and convincing project. The laboratory measurement to determine the scattering coefficient of a surface covered with the selected geometry wanted to answer to this need. The deep study of the specific application contributes to enhance the completeness of the work giving a description of its behavior that often lacks in the presentation of this kind of solutions.

In order to provide a more complete and wide work, after having measure the scattering coefficient of the panels, it has been simulated their installation inside an existing space, this study guaranteed to understand their real effect on a sound field comparing the results obtained with the reference case. Form the analysis emerge an evident change in the distribution of the energy which ensures a real impact of the scattering diffusion on the environment perception. There is no a precise indication for the best acoustic conditions. There is no agreement in fact on which are the values that provides the best perception, moreover the acoustic needs change according to the type of event that it is host in the space. Music and speak require different reverberation times as clarity and definition levels. A static space will provide always the same conditions, the installment of adaptive panels designed in this work ensures the possibility to modify the space and the acoustic response of the surfaces. The space as sound becomes dynamic, able to meet the needs of each moment depending on the type of event and number of people in the space. Adaptiveness opens new possibilities, new horizons, a new way to conceive structures and objects which include the dimension of time. A new variable is inserted in the design process and problem

solving, but rather than another aspect to consider or problem to solve it can become a new degree of freedom, a starting point for a new generation of objects and products. The research and the examples are still in their preliminary and explorative phase, the effects of a massive introduction of adaptive products in all the aspect of human life are difficult to predict, but of course they will generate a significant innovation affecting our society, our habits and our cities.

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