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Esquis'Sons! Sketching architecture by listening

Théo Marchal^{1,*}, Nicolas Rémy^{1,2}

¹Grenoble School of Architecture Univ. Grenoble Alpes, Research unit AAU-CRESSON, France

²Department of Architecture, Univ. of Thessaly, Greece

Abstract: The Esquis'Sons! application can be used to envision sound atmospheres and prior to designing spaces. The Esquis'Sons application is a compiled module written in the MAX/MSP musical and visual programming language which generates stereophonic sound tracks in relation to geometric parameters extracted from the CAD software Rhinoceros 3D and its plugin Grasshopper. Rhinoceros and Esquis'Sons communicate and sound is played in real time depending on the listening point chosen by the designer and on the architectural scene created. This paper compiles several training periods during which Esquis'Sons has been used in workshop exercises. It also offers material for an architectural study in the rehabilitation of a district. The paper shows that the Esquis'Sons app is a pedagogical tool for designers of space and brings to light several dimensions that are hidden most of the time in the architectural design process: *the distance of creation* is discussed through the sound immersion offered by Esquis'Sons app. *Scales* of the architectural project are jostled by the fuzzy limits of sound phenomena and *time* brings layers of complexity and sensibility in global design.

1 Design principles behind the Esquis'Sons! application

Since 2015, the Esquis'Sons! application has been developed and released in order to help designers to create new building facades by taking into account the sound qualities of their project. The application works as an immersion tool for the evaluation of potential soundscapes designs via listening. Esquis'Sons! started as an exploratory research in which six sustainable neighbourhoods in Europe (Germany, Spain, France and Sweden) have been studied with the objective of describing the sound qualities experimented by inhabitants when they use intermediate spaces located on the facades of building such as balconies, loggias, terraces and external corridors. A cross analysis of the built space's physical dimensions, of the sound environment and of the users' perceptions led to a description of the minimal conditions of existence of these particular sound situations. By comparing

* Corresponding author: marchal.t@grenoble.archi.fr

results from these six *Eco-districts*, an application using parametric conception tools was developed and shared within the designers' community [1].

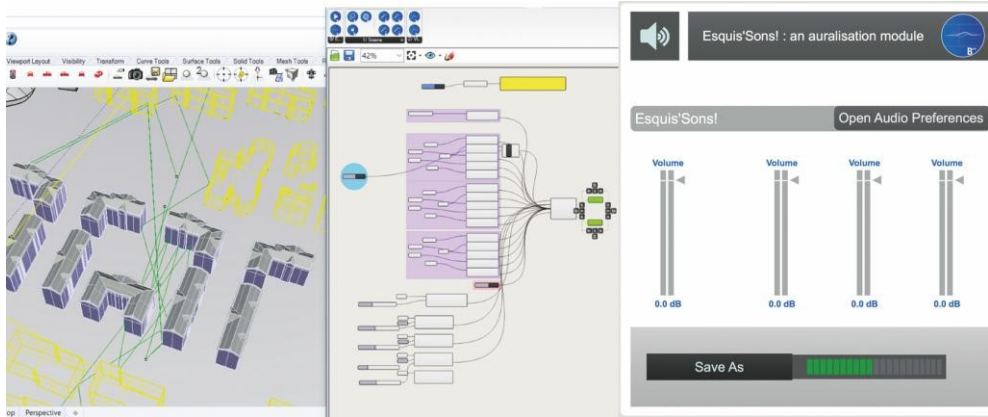


Fig. 1. Esquis'Sons' triple interface. From left to right: rhinoceros visualization, grasshopper module and auralization app.

After three years of development and several uses of this tool with designers, this paper presents how the Esquis'Sons! application can be used in order to envision sound atmospheres and assist the designing process. The application is a compiled module written in the musical and visual programming language MAX/MSP [2] that generates stereo soundtracks related to the geometrical parameters of an architectural project designed with Rhinoceros and extracted with the help of the Grasshopper plugin. The communication between Rhinoceros and Esquis'Sons leads to sound being played in real time depending on the listening point chosen by the designer in the virtual scene created.

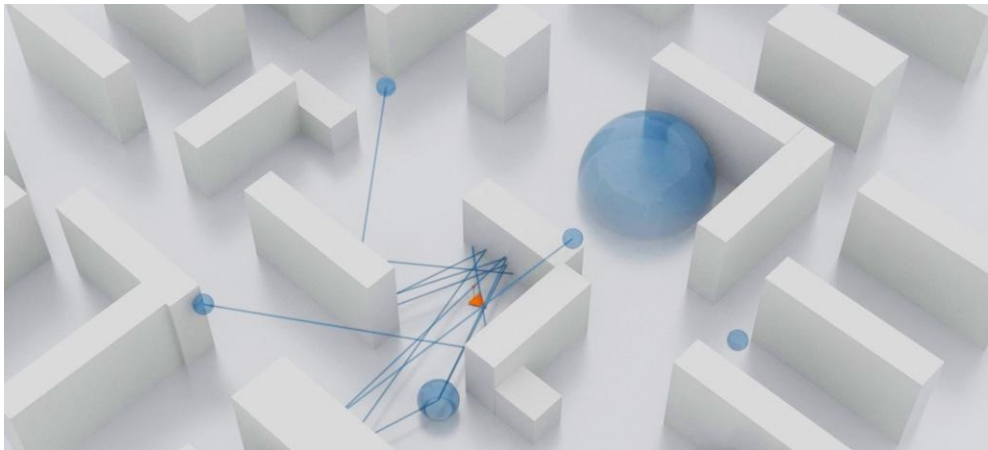


Fig. 2. Esquis'Sons' scene: first reflection visualization (rays), sources (blue spheres) built environment (gray volumes) and listener (red triangle) pointing the "direction of listening".

Esquis'Sons! was designed to allow parallel listening to co-exist: the aim is to make audible – by comparison of these sound atmospheres – sonic consequences of architectural choices made by the designer. A scene is created with the help of the spatial 3D modeler. Then, the scene is sonorized with the Esquis'Sons! application and users can select several listening points that take into account geometrical parameters of the space model.

These parameters are then “translated” into sound mixing properties into the Esquis’Sons! application. Any point of the modelled space can be used as a listening point, distances between the position of the microphone and the sources are automatically calculated and transmitted to the mixing console. The distance between buildings, the openness and closure of the islet, the type of facade, the opacity of the balconies are also evaluated in the geometrical model and generate several filters able to affect the sound sources. Several sources of various nature can be declared in the interface, such as environmental sources (traffic, transports, nature), people’s activity (playgrounds, people walking and talking, markets), which can be mixed by trimming levels in the application's console [3]. The resulting sound sketch constitutes a means to assess the design in a qualitative way with sounds while it is still in progress. Esquis’Sons is not a computational tool in the sense of a software that modelizes and calculates a sound scene with a waiting time to be able to visualize or to hear the result (the sound scene). The space environment is sonorized “live” and placing a listening point in the scene is placing a virtual microphone in an environment that never stops sounding. Accordingly, by selecting several listening points in the scene, designers can switch from one point to the other. By comparing and by listening, designers can hear how their project sounds depending on their position in the spatial model, and, of course, also depending on the properties of their spatial design.

Sound propagation and sound behaviour in urban scenes have been translated into Esquis’Sons by using several mixing effects performed by MAX/MSP software and informed by geometrical parameters calculated by Grasshopper from the spatial 3D model [4]. The *auralization* module is informed by the geometric characteristics of the spatial pattern and vice versa. In other words, this application allows you to sketch a space by listening to it.

After several different releases (the last one was the recoding of the application with Python for grasshopper [5] and a future version compatible with rhino6 windows/mac is coming [6]), Esquis’Sons application has been used in several architectural workshops gathering students and professionals from different fields such as architecture, urbanism, music and arts. The main focus of the workshops was introducing the idea of “designing with sound” with an easy sketching sound tool related to the space we are designing. What assessment can we draw from these experiences and how does Esquis’Sons! help working on the sound ambiances that emerge?

2 The notion of sound sketch

As Esquis’Sons is a simple immersion tool that uses stereo sound tracks listened through headphones connected to a computer (or loudspeakers), it is an easy tool to introduce “sound” in the architectural or urban project: the sound scenes created are made of short sounds arranged in loops, selected in the first phase of this research. Users can also add their own recordings. Mixing effects used are here to express mainly geometrical parameters linked with sound propagation and built form effects (distance, elevation, mask, etc.). The qualities of the sound scene could thus be evaluated through realistic sound tracks.

In French, the name “esquissons” has two meanings. It means “let’s sketch”, but it could also be read as “sketch + sounds”. We are talking about sketching as a tool that makes the sensitive qualities in the design “audibles”. It then tries to translate the sound in an understandable and accessible way without leading to an oversimplification and loss of information. That is made possible by the new digital tools used in architectural and urban design introducing calculation within the design process.

In French, Esquissons is also a grammatical form that uses the imperative form of the present and which, with a sense of humor, commits the designer to sketch a project thanks to the sound. It is a commitment because the tool does not validate or correct a project already defined in detail, it engages the designer to take risks and to consider for a time that the sound traces of his architectural choices. The engagement is therefore exploratory because the designer creates a scene, proposes one or more scenarios, listens, modifies, listens again, does some changes and so on until he is satisfied with what he is hearing. Then, he notices the spatial architectural consequences of these “sonic” choices.

So why sketch? One can say it is a noticeable part of the design process while its purpose is not to validate or invalidate something already finished. By positioning it as a sketching tool, it is a bet to position the sound as one of the project materials. It is also a bet and a goal to challenge sound in its potentiality to be a main vector to thinking and designing spaces in a more sensitive way. The inclusion of the sound directly in the formulation of architectural interrogations allows to question the formal, material and functional issues of a building or an urban project – those aspects are all likely to affect the propagation of the sounds. It also allows questions on the organization and distribution of activities, uses that can also produce very different sound environments. In other words, it is a way to question the directions and aesthetics of a project beyond its visual representations.

Esquis’Sons! was also developed to exploit the potential of new processes of design that emanate from the contemporary ways to think architecture. Digital tools allow an easier articulation between the different phases of a project. Designers no longer have to respect a logical and linear sequence from the sketch to the simulation validating or invalidating their choices. Exploiting digital tools makes easier to think the project as an iterative process and an interaction is needed between evaluation/simulation and design [7]. That logic is even true between tools and machines as it is possible to prototype inside the design process and not only at the end.

3 Esquis’Sons! in use

Since its first release, Esquis’Sons! has been used in several architectural workshops where, each time, students and professional experiment the use of the application in order to create the new sound atmosphere(s) of a place. As we described it before, Esquis’Sons! is not a simulation nor validation tool, but a tool to engage sounds and their composition in the architectural designing process. Esquis’Sons! has been tested and experimented through design exercises during the CRESSON winter school each year. More recently, it has also been used by an architectural office in Paris to support their architectural feasibility study for the renovation of the historic district (classified heritage of the 20th century) of the Abbey in Grenoble. Observing the designers allows us to discuss three architectural issues that arise from the sound material manipulated.

3.1 Design from inside: how does it change the way designers look at the project?

The first findings could be that the tool allows a more “prospective” way of thinking about sound, space and their links. Indeed, designers are not seeing the project from outside anymore (as it is handed sketched or drawn as a plan or section). Designers are "inside" their project in order to listen to it.

Users are really “using” or manipulating the sound, and not representing it visually or mathematically. It reveals its incredible immersive potential. Sound helps to “be inside” because when you are listening to something, there is no such thing as a zoom or an “unzoom” for example, you are listening to a precise point, inside what you drew.

Teaching in studios in architecture and in workshops reveals that that computer-assisted design tools are very occulocentric – not to say only. Sight is the main sense used to design, sketch, draw and validate any project. These tools tend to distance and objectivize the spaces drawn. Students are working in front of an “object” which is put away, on the other side of the screen. By using Esquis’Sons!, and therefore hearing, it brings users back “inside” their design. Simply with the medium of hearing, it offers a strong immersive potential that helps to design spaces in a more sensitive way: it quickly appeared in the various workshops that the participants positioned themselves in the project and that it gave them the possibility to entangle a set of components that conditions the space and the conditions of possibilities of its ambiances. Thinking sound in the project is not just a technical thought or just a sensitive thought and Esquis’Sons! helps to cross those different dimensions or different approaches of sound in space (see sound sketches of Cresson Winterschool, edition 2017 [8]).

3.2 Scales of design: what are the scales of sounds and what are the dimensions of the space that are heard and designed?

The use of Esquis’Sons! in those different workshops showed that sound can introduce a different way of thinking scales in the project. Three broad categories of “scales” can be described and emerge from participants’ productions in the workshops, but one of the stakes observed is a “reimplantation” of the designer into the environment he conceives. The term “dimensions” should be here preferred: it characterizes better the size of the ambiances than the scales of the design. The three categories that came out of those workshops are:

- The **global dimension**, which is basically about the “urban” scope of space: it focuses on the urban environment, the wide ambiances, the distance and the size of the environment, but also on the background noise and the emergences. It mobilizes the articulations of ambiances, and it can bring out notions of homogeneity, heterogeneity and singularities in the project ambiances. In order to illustrate this from the perspective of the architectural project, this dimension appears when the design is made transversely between the district, the block, the building and the building facade.
- The second one is the **architectural dimension** that raises several questions regarding the thresholds, the interfaces, the near and the far or even the displacement and the stay of the bodies in a given space. Working on the porosity of the ambiances, the singularities of the spaces and the singularities of the ambiances between these spaces becomes possible. The categories defined by Gregoire Chelkoff in his work “architectural sound prototypes” [9] could be mobilized here in order to understand the potentialities of Esquis’Sons tool: in another words, it gives the opportunities to test the *articulation*, the *limits* and the *inclusion* of sonic spaces between them and thus to test and work on the composition of architectural spaces.
- The last one is the **particular dimension**. It is more about the perception and the action of the users inside the building’s arrangements (as balconies, terraces, loggias, rooms, passages, etc.) located in a building or at a specific location of a public space (urban furniture for example). It questions the ambiances of proximity, the relation between inside and outside and actually the sound ambiance at the scale

of the human body in action. Again, the focus is on the local emergences but also on their link with the background (feelings of protection, exhibition, projection, feeling of being inside, or outside, etc.). What is the ratio between intimate or peripheral spaces, for example? These dimensions specifically question relations between local ambiances; the interaction with the body is very important here and refers to postures and gesture; can still be illustrated with Esquis'Sons! (listening orientation, uses, social practices, etc.). [10]

Working with Esquis'Sons! then encouraged to investigate and articulate these "dimensions" even when the initial focus was at a precise scale. "Urban scale" design investigates up to the body scale [11], building and architectural designs extend their target and sound intentions to urban design and details [12], and then, detail designs (furniture or facade projects for example) broaden to ambient anchors up to the neighborhood scale [13].

3.3 Sound is time: what does time bring to the project?

Because the basic manipulated material is the sound, Esquis'Sons also deals with another important and crucial parameter: time. Indeed, very often, a visual representation always has the problem of being a snapshot, space is represented by a very specific time. Unfortunately, temporal dimension of the lived space, which is one of the main factors of the ambiances [14] cannot be shown. Because the ambiances change in time, they transform themselves. Our perception is based on a certain "relativity" with the environment and with time. The sound in particular is a dimension of the ambiances and of our environment that can literally not exist without time and that is why it is so difficult to represent without using the sound itself.

Sound only exists in association with time, and listening to the sound sketches makes designers think about space and time together. It could bring different scales of time as for example, the same spot for five minutes or, more often, the desire to listen to space by practicing a path inside the scene (it is one of the first things that people do when they use Esquis'Sons!).

In consequence, using a sound sketching tool brings a very important and specific characteristic of space in the tools for architects or spatial designer: time. It encourages the consideration of the temporal issues associated with an architectural object whether they are on a long-time scale (as variability during the seasons) or on a short time scale (a day, or the time of a given experience). We are more precisely thinking about workshop projects focused on the experience of a walk and the resulting experiences according to temporalities by bringing uses and materiality rather than on a designed object, for example [15]. All these results, their analyses and interpretations are developed and put into perspective in a PhD work in progress [16].

4 Discussion

As seen previously, the Esquis'Sons app is a pedagogical tool for space designers, and it brings to light several dimensions that are hidden most of the time by the domination of the visual sense in the architectural design processes: the question of the distance of creation is discussed by the sound immersion of the designers, scales of the architectural project are jostled by the fuzzy limits of sound phenomena and time bring layers of complexity and sensibility in global design.

To illustrate this part, recently, Esquis’Sons has also been used in a feasibility and programmatic study of the neighborhood *L’Abbaye* in Grenoble (France). The Parisian architectural office Particules [17] used an Esquis’Sons! sound sketch to support their scenario for the rehabilitation of the existing buildings. The district of *L’Abbaye* is a working-class residential area built after the Second World War and currently suffering from a lack of renovation. The majority of apartments, managed by a social housing landlord, are empty because they do not comply with the rules of contemporary construction. The social housing landlord, along with the City Hall had obtained to classify these buildings as elements of the industrial heritage of the 20th century.



Fig. 3. 3D Satellite view (Google map/IGN) of Abbaye District, Grenoble, France, 2019.

All previous studies concluded that it was more advantageous to destroy the 15 buildings concerned and to rebuild new ones that would be better insulated, less energy consuming and more adapted to the uses of the 21st century. Faced with this decision, the former and current residents of the neighborhood have organised themselves in an association in order to defend the hypothesis of the district rehabilitation. The first reason was their attachment to their housing, the second was of course the fear of a very significant increase in rent because of new construction and finally, they argued that the atmosphere of the place is also part of the heritage and needed to be preserved. In this difficult context, the local counsel and the social housing landlord granted the architectural agency Particules the mission to study the feasibility of a rehabilitation plan. Particules worked over a year and has therefore decided to install several teams of architects and researchers in order to understand what makes this place so different or, in other words, to describe which elements of this district are part of the built, cultural and intangible heritage.

The Esquis’Sons! app has been used in order to assist the design and also convince the owners. After an *in-situ* campaign of acoustic measurements, sound recordings and several interviews in order to understand the sound atmospheres that people can experiment in this place, Esquis’Sons! created several sound scenes in order to help the architectural office Particules.

As part of the heritage that had to be “saved”, was the semi-open urban islet form of the building blocks that creates an important cutting effect [18] when people get inside. One of the five existing buildings had to be destroyed (the one with the C shape form, *see figure 3*) but a new one is reconstructed with a similar size and footprint in order to keep the urban typology with three half-closed islets. It offers the district new spaces for public services and facilities. One goal is to rebuild almost in the same size the building islet in order to keep the

specific sound atmospheres that might be created in the center. It is also the place for plenty of potential sonic interactions between the facades' users and the public spaces. It was also decided to reinforce several uses in the public spaces (as playgrounds for children, a public gardening space, increasing the size and the number of markets during the week, open the ground floor of the buildings to rent for local shops and for craftsmen or young companies). Finally, it also gave goals for the "acoustic" qualities of the facade of the new building. All these scenarios have been input in the application and the result can be listened by following the link below.



Fig. 4. Visualization and final Esquis'Sons! sound sketch for the Abbaye District, Grenoble – (Architectural Axonometry with the kind permission of Particules Office) France, video [19]

To conclude, these sound sketches were actually used as a tool for envisioning architecture and sound atmosphere, but also as a tool to create spaces and practices. As described before, it pushed the architectural office to think the global dimension of the district, which means not only the design of the new building but also its links with the local public spaces, the neighbourhood and with all its local environment – playgrounds, roads, parks, schools, and the city. It helped designers to be immersed in the sound of the public spaces and by selecting and listening from several spots it offered the opportunity to think and design the architectural limits of the project. And finally, by composing this scene, time has been reintroduced in the project and a proposal has been designed in order to offer several remarkable sound ambiances during the day, the week and the year.

Esquis'Sons! is a sketching tool, which means manipulating objects and hearing the results can be quite fast. Thus, we see Esquis'Sons! as a real opportunity – in opposition to the traditional and heavy simulation tools – to bring more attention to sound/acoustic and more generally to ambiances and sensitive issues during the design process. The Esquis'Sons! application offers interesting possibilities for the designers to produce sound and ideas for their designs: it welcomes sound in space creation.

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