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PARAMETRIC TOOL TO SKETCH SONIC AMBIENCES

Esquissons, a plugin for ecological and educational issues

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Abstract. This paper presents the process and outcomes of a thematic winter school on designing sustainable soundscapes. It aims to present a new parametric tool: Esquis'Sons! that has been initiated during a French research project on sustainable sound environment and then developed as part of Theo Marchal's PhD. Combining Rhinoceros and Grasshopper, the Esquis'Sons! tool has allowed the integration of the sound dimension during the design phase of architectural spaces. The thematic school aims to test the validity of this tool through experimenting it with multidisciplinary teams involving architecture, urban design, acoustics, art, landscape and sociology. We have chosen to use this methodology on two urban districts located in Grenoble, France in order to auralize in real time the different intervention scenarios proposed by participants for ameliorating the experience of sound in the two districts.

ملخص. تشارك الورقة البحثية مسار ومخرجات العملية التعليمية لورشة عمل حول تصميم الفراغات الصوتية المستدامة. وتهدف إلى تقييم أداة برمجية بارامترية plug-in تحت مسمى Esquis'Son! تم برمجتها خلال مشروع بحثي فرنسي وتم إستخدامها في رسالة الدكتوراه الخاصة بماتيو مارشال بكلية العمارة بجرنوبل. الأداة البرمجية تعمل مع برنامجي رينوسيروس وجراسهوبر بحيث تم إدماج البعد الصوتي في المرحلة التصميمية للفراغات المعمارية والعمرانية. في هذا الإطار كان الهدف الرئيسي من ورشة العمل هو

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إختبار مدي كفاءه هذه الأداة البارامترية وذلك من خلال دراسة تطبيقية علي أحياء عمرانية بمدينة جرونوبل قام بها فريق عمل من مختلف التخصصات والتي تشمل العمارة والعمران والصوتيات وتنسيق الموقع وعلم الإجتماع. كان الهدف من ورشة العمل هو دراسة التغير في الأصوات العمرانية عند إقتراح تغيير في الشكل العمراني والمعماري للمكان والذي يقترحه المشتركين في ورشة العمل من أجل تحسين الخبرة الحسية الصوتية في الاحياء العمرانية تحت الدراسة.

1. Esquis'Sons! Design support tools for sustainable sound environments

Esquis'Sons! is a parametric tool that constitutes the main focus of this paper. Its name couples two French terms: *esquisse* and *son*. *Esquisse* in French is equivalent to "Sketch" in English; it signifies an architectural tool for elaborating the main design concept and corresponds to the early design phase as well; while *son* means sounds. This combination '*Esquis'Sons!*' highlights the objective behind the creation of this tool, which involves primarily introducing the sound dimension as a main design material to be manipulated in the early stages of the design process.

Esquis'Sons! is therefore a sound sketch tool built as a parametric interface using the Grasshopper plug-in in order to link Rhinoceros (3D modeling) and Max MSP (3D sound creation). The tool allows for the possibility to hear sound scenes generated from a digital model of space in 3D. It also allows for assigning acoustic characteristics, such as the level of porosity of volumes and faces, to spatial contexts, in addition to positioning points of listening anywhere in the 3D modeled space. The auralization module is informed by the geometrical characteristics of the spatial model and vice versa. We then adjust the qualities and the origin of the sound

tool status applicable in any urban context (Marchal, 2015). The next step was to test the validity of the Esquis'Sons tool in an educational exercise. We have chosen the form of an intensive one-week thematic school on soundscapes that took place in Grenoble in January 2017 during the week of sound- A European event on Sounds. Managed by the Cresson research team at the Grenoble School of Architecture, the objective of this thematic winter school was to introduce the sound dimension in contemporary architectural issues by coupling work on sound environments and dense urban forms. Sound, which is today an important element to enhance the quality of life of the built space, is particularly important in the increasingly dense urban environment.

In fact, dense urban forms propose a specific architectural language in which aspects such as building heights, shared spaces or more generally the question of interfaces play an important role in constituting ordinary listening and changing sound practices. Providing a dynamic relation to the surrounding, varying from ground to sky, from near to far or from intimacy to exposure, the dense habitat brings out remarkable listening situations, including suspension, immersion, nesting, panoramic sound, dual listening, exposure, or acoustic retreat (Gamal Said, Marchal, 2017).

Based on a space-sound pairing concept, the winter school focused on two archetypal dense urban forms: towers and courtyards, therefore defining a language of protrusions and voids (Figure 1). In this urban configuration, the interfaces located at the articulation between private and public spaces, such as balconies, loggias, corridors and landings, form shared sound spaces, which constitute in this winter school the main architectural object of study. They are as much configured by the sound qualities of the street as they themselves configure the sound qualities of the latter. It is in this reciprocal exchange that we shall consider these liminal spaces, in the way that they redraw new acoustic arenas and negotiate their intimacy with public spaces. In dialogue with the existing environment, we sketch sound atmospheres based on the Esquis'Sons tool.

In order to auralize in real time the different audio-spatial intervention scenarios, participants engaged in *in situ* sound recordings, representations, manipulations and sketches, where the intention was to explore sounds in order to create an atmosphere (Figure 2).

Participants of the winter school were invited to pursue the following steps: The first step is to define a spatial context, which was to be modeled in Rhinoceros3D via Grasshopper. The second step is to set listening points by associating a point in the model with the position of the listening point from which auralization is to be calculated in real-time. In the third step, they build a sound scene by defining sources associated with points « source_location » in the Rhinoceros / Grasshopper 3D model. The last step involves auralization in real-time by connecting these different objects to the

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main sketch motor through which we obtain a sound result (Remy, *et al.* 2016).

3. Sound Diagnosis in Two Urban Districts in Grenoble

Two districts in Grenoble, France, Village Olympique and Vigny Musset were chosen as case studies for conducting the sound diagnosis and modification (Figure 03). The urban configurations of the two districts are composed of pedestrian spaces which are qualified in terms of sound as impermeable in certain spaces and porous in others due to the presence of *sound doors* opening to the outside, or completely open, exposed to urban traffic.

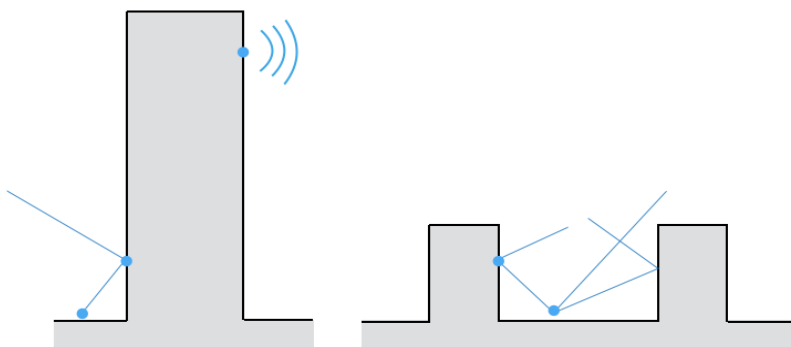


Figure. 1. The two urban fabrics: courtyards and towers and their acoustic behavior

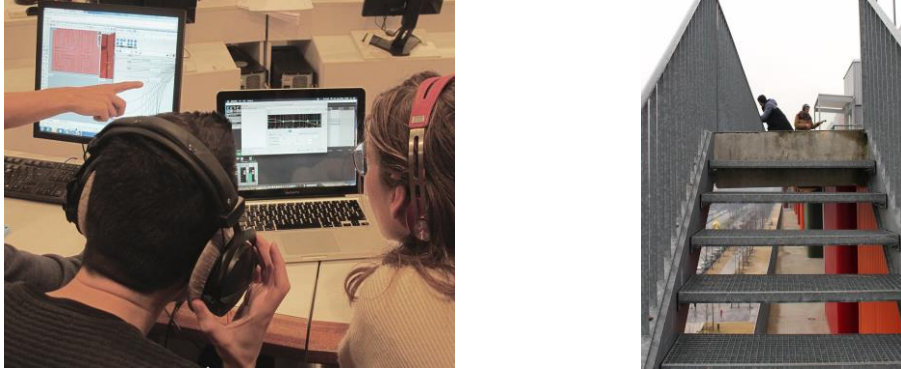


Figure 2. The in-situ sound recordings and the studios for elaborating the sound scenarios

Despite the contrast in urban and architectural forms of the two districts, their geographical juxtaposition has allowed participants to compare and articulate them by means of transversal listening. Two sound walks were conducted, one was free and silent during the day and the other was nocturnal and guided by Pascal Amphoux. These listening exercises have allowed participants to identify certain sono-architectural typologies and to distinguish the sound markers and the singularity of the soundscapes of both districts. Beyond a simple diagnosis, the main objective of this phase is to spot specific characteristics in order to steer prospective transformation.



Figure 3. The urban form of Vigny-Musset to left composed of courtyards and Village Olympic to the right composed of linear pedestrian streets with residential towers.

4. Sound Intervention Scenarios using Esquis'sons tool

The main objective of the thematic winter school is to use the Esquis'sons tool to design and project new sound environments for both districts. In

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order to attain this goal, participants manipulated different scales to change the existing soundscape: the urban neighborhood, the architectural buildings and courtyards, until reaching architectural elements at the body scale (*dispositifs architecturaux*). The proposed interventions focused on the notions of height, porosity, and temporality as main features of a dense sound configuration.

Several categories of sound intervention scenarios were identified. Some propose important spatial modifications in order to change their sound perception, such as “Variations in suspension”. Others propose an implantation of new sound sources or a displacement of the existing ones in order to modify the soundscape itself and to offer new listening experiences such as sonic markers (*Amers Sonores*) or “From the fountain to the market”. Finally, certain scenarios target the quality of the sound spaces themselves through modifying their uses, such as the example of “Degrees of publicity”. Six sound intervention scenarios were proposed in this workshop:

4.1. DEGREES OF PUBLICITY, *DEGRÉE DE PUBLICITÉ*

Scale of intervention: the courtyard as an urban element

The main idea of this project is to remove or open the gates and the grid surrounding the courtyard. This simple intervention changes the status of the courtyard as a private entity to a public space. This modification helps accommodating other usage patterns such as traversing, encounters, etc. The sonic sketch helped incorporating by sounds the increase in the degree of permeability between the interior ambience of the courtyard and the outer one of the street. The soundtrack permits to better understand the transformation in the sound environment of the courtyard (Figure 4).

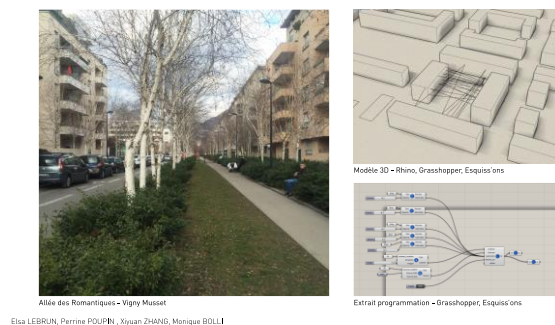


Figure 4. The location of the intervention scenario in Vigny-Musset with a Rhino and Grasshopper sketch.

4.2 THE FLYING BENCH, *LE BANC VOLANT*

Scale of intervention: the tower as building

The main idea is to work the relationship between building heights as a main characteristic of the dense urban form and sound perception. By modifying the presence of a sound source (a ball game), the Esquis'sons tool enabled a continuous reconfiguration of the listening experience as one climbs the stairs of a tower located in the Olympic Village. The building height underlines the change in sound perception through alternating between near and faraway sounds.

4.3 InTERREaction

Scale of intervention: the street and the courtyard

This project proposes a sound perspective for the pedestrian alley “Allée des Romantiques” -mainly in front of Marie Reynoard School in Vigny-Musset. It is a green linear space or promenade traversing the district and delimits enclosed spaces (courtyard and school). The proposed sound sketch seeks to make the urban configuration more porous, create spaces for sociability, and make the school entrance more secure by prohibiting vehicular passage. Participants propose rural imprints by transforming certain green spaces into community gardens. The change in land covering (gravel and soil) creates a sonorous ground that marks the thresholds between public and private space (Figure 5).

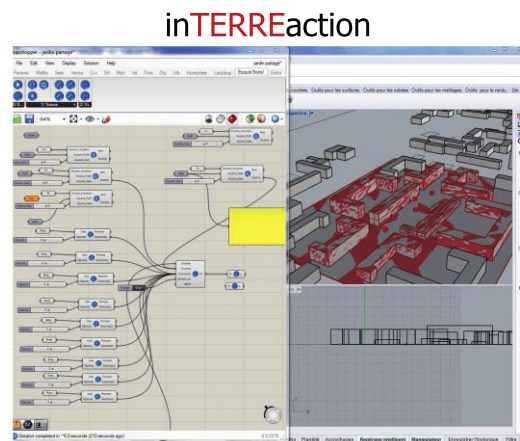


Figure 5. The location of the intervention scenario of InTERREaction in Vigny-Musset with a Rhino and Grasshopper sketch.

4.4 **Sonic markers, *Amers Sonores***

Scale of intervention: the district

The project seeks to characterize certain places from a sound point of view by creating sound markers. In fact, the Esquis'sons! tool allows to insert different sound sources and to vary their size. The injection of the sonic markers brings an entirely new dimension of a more or less distant listening to the neighborhood. Facing the homogenization of the sound space of Vigny-Musset, the proposed sonic sketch helps adding some relief to the sonic experience.

4.5 **Variations in suspension, *Variations en suspension***

Scale of intervention: the district

The sound-walk along the two districts - Vigny Musset and the Olympic Village –led the group to compare the two sound environments. The objective of this project is to import the different sono-spatial typologies composing the soundscape of the Olympic Village (pedestrian bridges, heights of the towers, and sound door) into the district of Vigny-Musset. In this optic, the team proposes a traversing sonorous bridge. The chosen path for this bridge flies over different urban elements such as the courtyard, street, pedestrian street, and main garden, giving rise to a new listening experience. The sonic sketch offers new porosities between private and public spaces: the street, school yard, buildings, courtyards, gardens and avenues. The variation in height along the bridge provides a more distant perception of the district's soundscape.

4.6 **From the fountain to the market, *De la fontaine au marché***

Scale of intervention: the neighborhood

This project is about designing a new soundwalk that is available to hear on smart phones. After capturing the existing different sounds along the chosen path, the team develops a more exotic soundscape of Vigny-Musset! In the gridiron pattern of Vigny-Musset, the group wants to create sonic poles. It proposes to insert charismatic sources and to polarize public life in order to give back to the courtyards their main role as spaces of intimacy. A market,

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a fountain, a tropical greenhouse or a zoo, are examples. You are all invited to log in to hear the sounds of tomorrow!

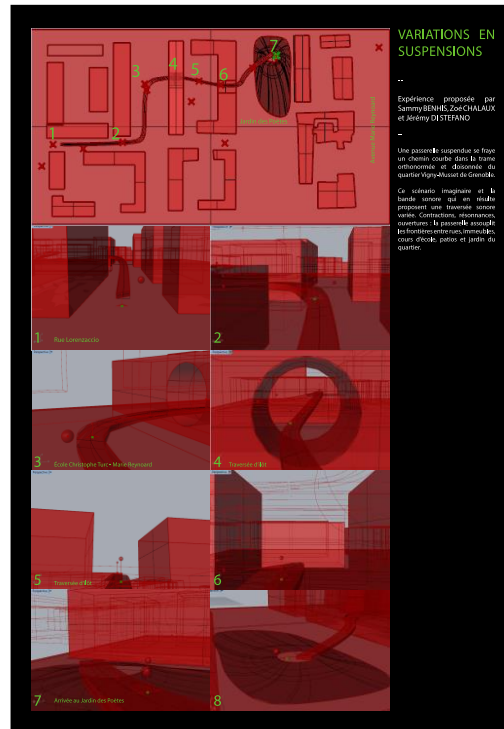


Figure 6. A sketch of Variation in suspension in Vigny-Musset using Rhino and Grasshopper

5. Conclusion

The Esquis'Sons tool has allowed participants to propose real sound projects that constitute a solid material to listen and to debate. Thanks to this tool, it is possible to « sonorize » a 3D virtual environment and then to hear the consequences of architectural choices. In other words, this application allows you to sketch a space while listening to it.

The projection of new sound scenarios results from combining the use of digital design tools (Rhinoceros / Grasshopper / Esquis'Sons!) with fieldwork by means of in situ sound recording and brief interviews with the inhabitants. The hybridization of the different working methods over three half-days has made it possible to bridge the theoretical presentations given during the week on the methods and fundamentals of the Cressonian approach to understand, modify, and create sound spaces and to apply them in an empirical exercise.

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Elaborating on a variety of sound sketches using Esquis'Sons! adds another dimension in understanding architectural and urban configurations. It opens new perspectives in fabricating and transforming city spaces. Putting the soundscape into debate has enriched and consolidated different sound projections. The proposed intensive one-week exercise helped elaborate rich prospective sound scenarios both in terms of content and presentation. In brief, it was a fruitful exchange!

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