inter.noise 2000

The 29th International Congress and Exhibition on Noise Control Engineering
27-30 August 2000, Nice, FRANCE

THE GIS CHAOS (DESIGN AND PLANNING OF THE NOISE ENVIRONMENT)

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Keywords:
SOUND CARTOGRAPHY, SOUND ENVIRONMENT, INTERDISCIPLINARITY, GEOGRAPHIC INFORMATION SYSTEM (GIS)

ABSTRACT
Noise has been a subject of much concern for many years now to the "city managers" (elected representatives, town planners, architects...). These latter have effective tools which can carry out the modelling of noise emissions and automatic calculations of noise levels in front of buildings exposed to road infrastructure. The map drawings which follow provide quantitative data (noise levels, areas of sound propagation...) which make it possible to diagnose the situation and decide on the implementation of protective and normative strategies (installing sound-proof walls, deviating traffic...). However, since the application of these strategies or norms the city dwellers do not necessarily feel better off. All studies over the last 15 years have shown the noise environment to be one of the main causes of dissatisfaction in French towns. It is for this reason that new directions of research have been opened up, notably by the CRESSON. They now lead the developer to take qualitative data into account to be able to apprehend better the relation between the town dwellers and their noise environment. The creation of GIS ChAOS has therefore been the occasion of designing an easy-access GIS tool, which would enable the noise situation of a particular site studied to be quickly apprehended. The data base has been created to orientate noise representation towards current operational attitudes and to foster the reflection and imagination of town developers and administrators. As sound qualifies time, ChAOS proposes to represent localised sound temporalities. Furthermore, on a pedagogical strain, this GIS links up the visualisation of qualitative information whilst distinguishing between the representation of the noise environment observed or estimated by an "informed observer" and the noise environment experienced by the town dwellers. Finally, it integrates sound tracks as referential aids to be able to devise concepts of noise planning or to propose and correct a given acoustic environment. In summary, the Paper will state the guiding lines which lead to the setting up of this GIS. It will reveal several possible applications for urban management. CRESSON: Research Centre on the urban noise environment UMR 1563 Architectural and urban surroundings, CNRS / Ministry of culture, Architectural Schools of Grenoble and Nantes, Address: Architectural School of Grenoble, 60 avenue de Constantine, BP 2636, F. 38036 Grenoble Cedex 2 GIS: Geographical Information System. Bibliography: The representation of the urban noise environment using a GIS, by Olivier Balay together with Blaise Arlaud, Sylvie Serbigne, Robert Laurini, Myoung-Ah Kang and Anne-Claire Chanlon. CRESSON (Research Centre on the urban noise environment UMR 1563 Architectural and urban surroundings, CNRS / Ministry of Culture, Architectural Schools of Grenoble and Nantes), LISI (Information systems engineering laboratory, Computer Department, Claude Bernard University, INSA Lyon), LISI, CRESSON, Lyon, Grenoble, October 1999.

1 - A GIS FOR THE QUALITATIVE REPRESENTATION OF THE SOUND ENVIRONMENT

For some years, noise has preoccupied the inhabitants of French cities. Surveys have made it clear that the sound environment is one of the main sources of dissatisfaction in urban areas, however, they have shown that the tools which urban planners dispose of (mainly based on the quantitative estimation of

noise levels) are generally judged insufficient to apprehend and manage the sonorous situation in its complexity. In consequence, new research perspectives are currently leading urban developers to take into account qualitative data, in order to better apprehend the relationship of inhabitants with their sound environment.

The first works of Jean-François Augoyard at the CRESSON (Research Centre on Sound Space and Urban Environment, UMR 1563 / CNRS / Ministry of Culture, Grenoble School of Architecture, 60, avenue de Constantine, BP 2636, F. 38036 Grenoble Cedex 2) date from 1979. Since then, research in this domain has always been fruitful. Based on interdisciplinary methods, it has led to a better understanding of the relations citizens possess with their sound environment and has given experienced planners food for thought. However, at the very moment when the dimension of sound (and not only noise) is forming one of the main preoccupations, it is often judged that the vocabulary and the results of these analyses are of a complex nature and are too difficult to exploit.

The GIS (Geographical Information System) is currently asserting itself as a privileged means of mediation for different urban services, and deserves to be used in order to go further than simply integrating noise levels, with a more participative and operational objective.

2 - WORKING HYPOTHESES

The sound environment with which inhabitants identify contains qualities which the urban manager can take into account. To highlight these means of identification, the ChAOS database − its contents shall be explained below- was created, in order to differentiate the perception of sound by inhabitants from the perceptions of experienced observers (acousticians, sociologists, architects and urban planners) who investigate in the field. By emphasising in this way the lack of connection between these two types of representations, a potential of sonorous management of a place is revealed and reflections as to its planning may emerge.

The sound environment is qualified, not only by the sounds which are emitted therein, but also by the spatial environment in which they evolve (urban configurations). Furthermore, sounds are never "immobile"; they vary constantly as time goes by. They are qualified time. In consequence, it is worthwhile taking these spatial and temporal characteristics into account and integrating them into the GIS.

Finally, the use of sound recordings is what makes ChAOS original. In effect, the soundtrack is the sonorous memory of a quarter. Also, it is only by using this soundtrack that one can demonstrate the sonorous potentials of a place through its every use. Thus, it may constitute a veritable reference when imagining sound planning concepts or when proposing and correcting a given acoustic space.

3 - FIELD OF STUDY AND PARTICIPANTS

The area under study for this work was the quarter of Romarin road, in the first borough of the town of Lyon (Rhône, France). This quarter is typical of a town centre and it is possible to study, through different spatial configurations (streets, squares, courtyards, "traboules" etc.), numerous differentiated sound situations, ranging from calm to very animated environments.

This prototype was produced with the aid of two consecutive studies:

- a study on *"the indicators of the sonorous identity of a quarter"* carried out in 1997 by Olivier Balay, Jean-Luc Bardyn, Cécile Régnault and Blaise Arlaud, CRESSON, and Jacques Lambert, Patricia Champelovier and Marielle Bourcier, INRETS,

- a study on *"the representation of the urban sound environment with the aid of a Geographical Information System"* carried out in 1999 by Olivier Balay and Blaise Arlaud, CRESSON, and Sylvie Servigne, Robert Laurini, Myoung-Ah Kang and Anne-Claire Chanlon, LISI

The first study made it possible to analyse precisely certain places which revealed the identity of the quarter, with interviews and sound takes. The second helped to form a general conception of the GIS, furthermore, complementary observations of the site which were necessary to build the database were made.

4 - PROTOTYPE ORGANISATION AND AVAILABLE MAPS

Rather than listing the different existing databases, it is proposed that one discover the contents of the information available with ChAOS in the same way as with the CD-Rom prototype, that is, by consulting the maps offered in the pull-down menus added to the basic MapInfo© program's functions. These menus can automatically produce different maps including various attributes and modes of analysis, which one

can select, according to predefined representations (colours, legends, fixed maps, animated maps, text and / or sound links, etc.).

4.1 - Maps of the sound patrimony (fig. 1)

This map enables one to discover places and itineraries which are particularly representative of the sound identity of a quarter. These are the identitarian reference spaces. They are represented visually on the map and, thanks to a data entry interface, it is possible to access information in the shape of texts and sounds which characterise these places. This information may be:

- the observers point of view (remarks and exemplarity)

- the inhabitants points of view (syntheses of surveys and interview samples)

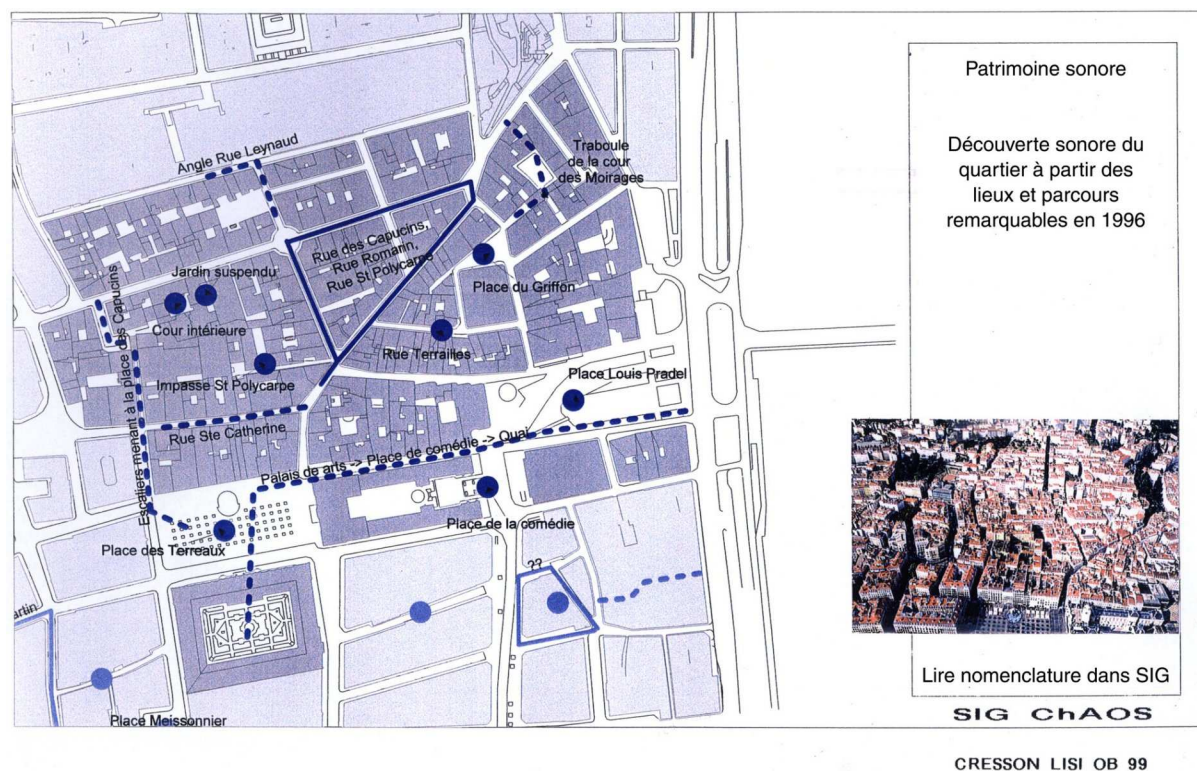- the sound recordings (audio and textual transcriptions)

Figure 1: Maps of the sound patrimony.

4.2 - Thematic maps

Under this generic title are assembled several maps designed to represent different characteristics grouped by themes. They include:

- *The spatial characteristics*

  - Types of sections (streets, dead ends, galleries, stairways, "traboules", etc.)
  - Types of empty spaces (squares, open courtyards, inner courtyards, parks, quays, etc.)
  - Typical cuts / sections (U open tissue, U closed tissue, L, flat)
  - Slopes (present or not)
  - Types of floors (draining asphalt, asphalt, cement, paving, gravel, grass, etc.)
  - Types of plantations (trees, bushes, flowerbeds, potted plants, etc.)
  - - etc.

- *The dominant sonorous background located by the inhabitant or the observer*
  calm / human / natural / technological

- *The spatio-acoustic types* located by the inhabitant or the observer
  reserve of silence / urban acoustic lock / urban acoustic filter / urban acoustic room / revealed by floor sound / revealed by rhythmic time

- *The types of sociability* located by the inhabitant or the observer
  Multiple and varied social activities / interacquaintances and encounters / audible domestic activities / social activities of little significance / daytime social silence / nocturnal activities

- *The sound territories* located by the inhabitant or the observer
  of local social life / of extra-local social life / qualified by urban shapes

- *The remarkable sound signals located by the inhabitant or the observer*
  This map is different from the others in two aspects. First, it represents the signals in the form of localised graphic symbols (and not by differentiated colours of segments and urban spaces as was the case for the preceding maps). Second, it integrates the temporal dimension. In other words, all emerging signals are located as a function of moments and their duration.
  In consequence, the system proposes, via an interface:

  - a fixed map, representing the totality of located signals,

  - a periodic map, representing the signals present during a chosen period (day and hour),

  - animated maps, allowing one to visualise the evolution of the situation and the different rhythms as a function of the appearances and disappearances of sounds during a chosen period.

4.3 - Maps of external data

This last menu includes different kinds of information issuing from external data which may afford useful material to understand the sound environment. These are:

- Complaints linked to noise (located and described)

- Housing density by habitation block (colour variable on the blocks)

- Inventories of the activity sites (located icons)

- Economic activities on the ground floors

- Acoustic classification of the noise level (map of the town of Lyon, first borough)

- Traffic data (colour variable on the road sections and indication of the exact number of vehicles, as well as a choice of the period and a possibility of animation, cf. sonorous signals).

5 - TRANSVERSAL REQUESTS

The interfaces presented above make it possible to show different aspects of the sound environment of a quarter with the aid of different automated maps. The MapInfo program, with the help of the links established between the attributes and the located graphic objects, also allows one make all sorts of transversal requests and to visualise them in one's own time. These let the knowledgeable user seek for answers to all sorts of more specific questions by localised identification (via cartographic visualisation) of all spaces which include the same set of attributes, whether they are sonorous, spatial, temporal, or issuing from spatio- or socio-acoustic analyses.
It is thus possible, for example, to search for:

- Places for which some attributes correspond to those of identitarian reference spaces studied in detail, for instance to try to establish points of similarity.

- Parks and gardens which include no sounds emerging from nature, for instance to visualise the potential introduction of natural sounds into an urban environment.

- Places located as favourable for interacquaintance and encounters even though they are characterised by a large amount of traffic noise, to try, for instance, to understand how to favour these encounters in another place characterised by abundant traffic

- Places with nocturnal human activities which are or are not the object of complaints, for instance to try to understand which elements lead to complaints or, on the contrary, which ones incite tolerance.

- Etc.

6 - CONCLUSION

This work has proposed different ways of setting forth, on a GIS support, a large quantity of information in relation with the sound environment and its perception. Depending on the objectives, much effort has been spent in order to create databases and to set up differentiated types of reading (automated maps, texts, sound recording, cartographic animations, etc.).

Thus, with the tool proposed, one can not only to visualise or cross sound and space data, taking into account temporal characteristics, but also make accessible indicative sonorous sequences and to highlight remarkable sonorous situations which are located by the researcher or the site user. Furthermore, the partition between "located by the user" and "located by the inhabitant" makes it possible to reveal characteristic differences. Concerning sonorous signals for instance, the difference between what the inhabitants emphasise and what the observers note may allow to locate erased noises and noises belonging to the collective memory.

Finally, one must validate the pedagogical role and the conceptual potential of this GIS with the inhabitants and the elected representatives who are responsible for urban planning and management. The point of view of researchers, acousticians, and people responsible for different studies in France and Europe will, finally, make it possible to enrich and simplify the prototype. Nevertheless, it is important to note that the Urban Community of Greater Lyon asked that ChAOS be used to represent the sound dimension of five other quarters in Lyon.