Sound topologies as a spatial description of the soundscape

The qualitative sound map of Rossio square in Lisbon.

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Introduction

In the qualitative approaches of the acoustical environment, the psychoacoustics criteria of quality focus on the signal, and the subjective criteria usually describe the way in which a community perceives a noise. It misses an intermediate criterion that allows us to describe the sounds in a soundscape before even applying a socio-cultural or aesthetic judgement on it.

The qualitative mapping should thus distinctly report the sounds that make a (urban) sound environment intelligible with the same ratio that they are perceived in situ. The report of the soundscape must be spatial so that one can distinguish the limits of each source in the map.

This way, quality is defined as the acoustic atribute of an object or group of objects. Perception and language are used to complete the instrumentation and help the analysis. They are not explored as a field of variables.

Let one describe the method [1] and the first results.

The sound topologies

Sound topology is the spatial distribution of a sound distinguished from its background. It is obtained by a semantic filtering of a local sound environment. The semantic filtering was obtained by using a "subject" in the protocol of the acoustic analysis of a locally recorded data, and by using the cocktail effect and the masking effect. The masking noise of a source is the objective value that caracterise it on the map.

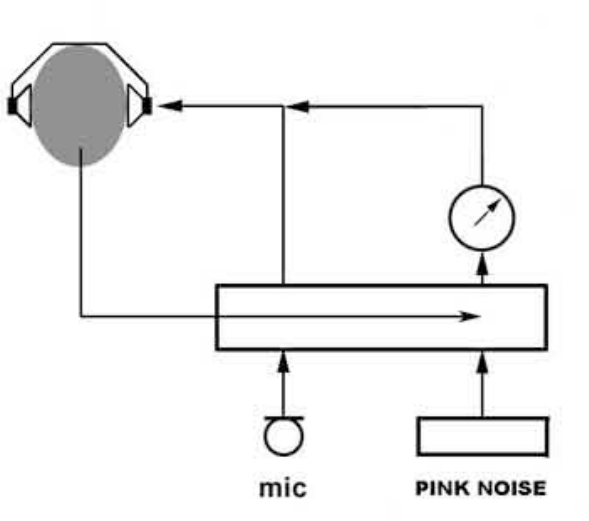

Figure 1: Perception integrated into the measurement device.

The method was applied to a part of the Rossio square in Lisbon, a major square in this city. A qualitative sound map was then obtained.

Figure 2: Don Pedro IV (Rossio) square in Lisbon.

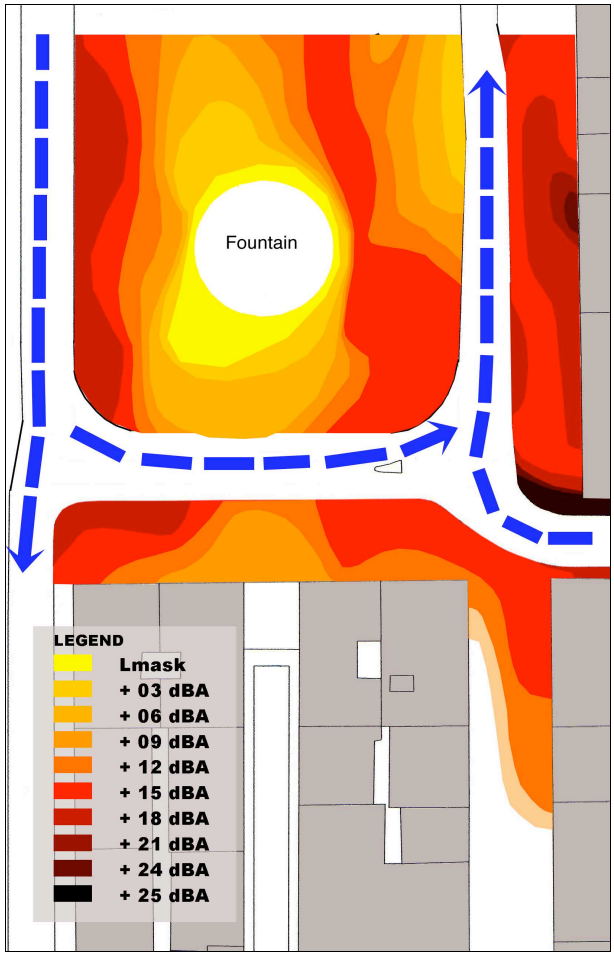

Figure 3: Traffic sound topologies.

Figure.1 shows the traffic sound topologies [2] at *Praça do Rossio* in Lisbon. It acts as a mask for the other sources of the local soundscape. Its fluctuations make the other sources less heard or totally inaudible. The qualitative sound map of road traffic (fig.3) is very similar to the quantitative one (Figure 6) because traffic noise is dominant.

This masking effect becomes obvious in the following maps (Figures 4 and 5). One can observe the contractions of the sound topologies of the two sources: ambient electroacoustic music (green) and fountain's water (blue).

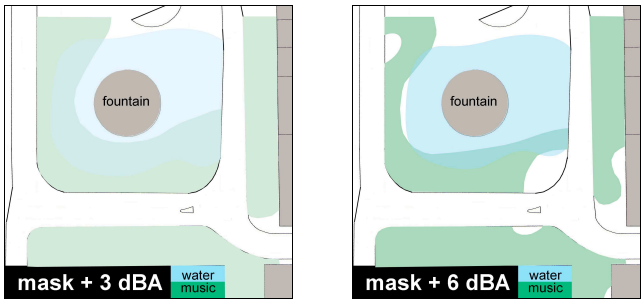

Figure 4: Water and music sound topologies with 3 dBA and 6 dBA of added pink noise.

One can define exactly at which place each source becomes inaudible depending on the level of the masking background (uncolored areas). In these deaf zones the walkers are out of "contact" with the water and music sound topologies.

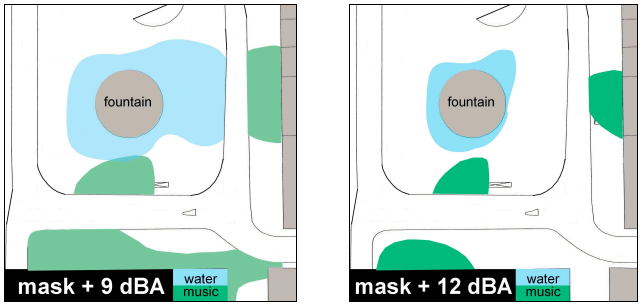

Figure 5: Water and music sound topologies with 9 dBA and 12 dBA of added pink noise.

The added masking pink noise simulate the fluctuations of the traffic noise and make obvious the contractions and the dilatations of the water and music sound topologies (Figures 4 and 5). Contrary to solid topologies, sound topologies are very fluctuating. They reflect the intern fluctuations of the soundscape even if the total level does not change.

The soundscape composition

Generaly, in the visual landscape, the individual perceptions are known to be different one from the others. What really counts is the composition of the landscape from the nearest plan to the background. By analogy, the soundscape composition depend on the acoustic plans that are perceived locally from the dominant over the background noise. This method and its results allow one to know exactly the composition of the soundscape in each local point of listening, from the nearer (louder) to the unheard sound (Figure 6).

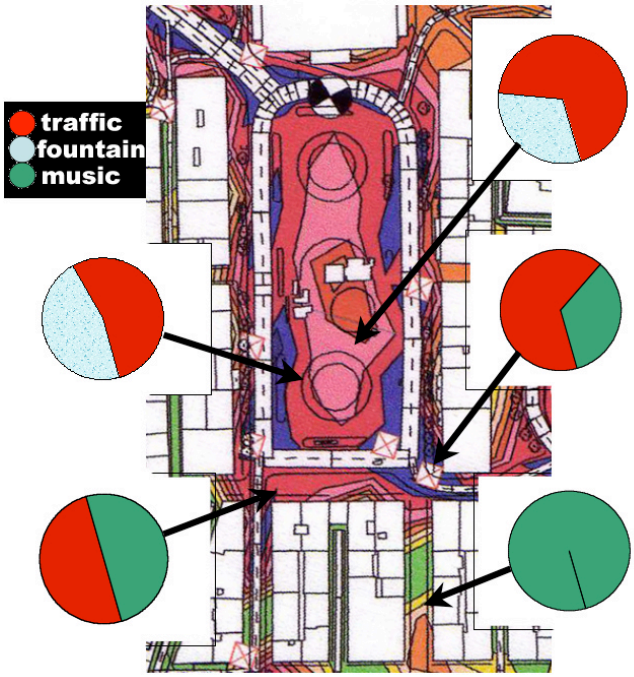

Figure 6: Soundscape sources ratio in local listening points

Conclusion

In conclusion, one can resume the most important contributions like this :

- Quality is a sound attribute of an object that makes sense to the listenner (a sound or a group of sounds).
- Perception and language act as a semantic filter. They distinguish objectively the sound shapes of the soundscape.
- Sound shapes are defined as sound topologies.
- The qualitative sound map is just a complement to the quantitative one because the values obtained do not measure the acoustic level of the different sources but the added pink noise necessary to mask them.
- The values obtained alow the drawing of topologies of each source and the composition of the soundscape in each local point of listening.

One believes that this type of qualitative map can target with more precision the actions on the urban sound environment, mainly, to regulate the problem of annoyance, or management and recombining of the soundscape or control of its evolution in the short and the long term.
One hopes that a higher acuity in the visual representation of sound makes any action on the urban sound environment more precise.

References

[1] M.Boubezari, J. L Bento Coelho *"Towards a qualitative noise map based on measurement and perception, the case of Rossio square in Lisbon"* TecniAcoustica, 34th National Congress of Acoustics, Bilbao, 2003.

[2] M. Boubezari, *"Méthode exploratoire sur les pratiques intuitives de maîtrise du confort acoustique"*, PHD in architecture, Cresson, Grenoble, 2001.