TECNIACUSTICA VALLADOLID·2013

44º CONGRESO ESPAÑOL DE ACÚSTICA
ENCUENTRO IBÉRICO DE ACÚSTICA
EAA EUROPEAN SYMPOSIUM ON ENVIRONMENTAL ACOUSTICS AND NOISE MAPPING

URBAN PARK SOUNDSCAPE

PACS: 43.50.Rq

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ABSTRACT

Most Europeans now live in urban or suburban areas. The cities must thus offer their citizens good environmental conditions. The acoustic environment is one the primary indicators of the perceived quality of life in cities. Fulfilling the requirements of the European Environmental Noise Directive of 2002 (END) aiming at reducing and managing noise in large agglomerations must be taken as only part of an overall strategy that all city councils must embrace. Urban areas with differentiated soundscapes, such as parks, are well frequented by the urban populations for escaping the surrounding more aggressive areas and for psychological restoration. A study of urban parks in cities in Portugal and Brazil have shown that the citizens perceive a much higher sound quality in urban parks due not just to lower sound pressure levels but also to a higher correlation with their activities and expectations. Urban parks can represent quiet areas in the END sense within easy reach and with wealthy sound compositions. The research program and some findings are described and discussed.

INTRODUCTION

The current trend for world population growth points to an increasing concentration on urban areas. In 2008, for the first time in human history, the majority of people in the world lived in cities. The United Nations predict that in 2050 the number has grown to two thirds of the world population [1]. In Europe, roughly four out of five citizens live in towns of different sizes. Globally, cities have assumed a central role in the economic and social world of the 21st century.

The urban fabric is then an increasingly important source of environmental considerations, since the citizens expectations of quality of life are abiding by ever increasing high standards. The quality of the acoustic environment is one of the leading indicators of quality of life, and noise is a primary source of complaints in most cities. Local authorities are facing ever more complex challenges on noise reduction and on improving the quality of the local soundscape.

Acousticians, architects, and urban planners have a crucial role in defining and establishing pleasant urban sound climates. It is absolutely necessary to reduce sound from mechanical origins to levels that are not detrimental to human health and wellbeing. However, reducing sound levels do not necessarily lead to improved quality of life in urban areas.

The Environmental Noise Directive (END) 2002/49/EC relating to the assessment and management of environmental noise [2] encourages the implementation and protection of quiet areas, though the definition of a 'quiet area' has been under discussion for some time. The principle is the maintenance, protection and development of areas where the quality of the acoustic environment is good and where the citizens can find a pleasant soundscape and a relaxing sound environment with less aggressive components from mechanical sources. Urban gardens, parks and some squares may adequately fulfill these goals.

The soundscape in an urban park is usually rather complex, where traffic noise, though with lower sound pressure levels than in neighboring areas, may determine the overall sound environment, but includes natural components that associate with more pleasant atmospheres, thus contributing to the feeling of comfort, psychological restoration and escape from urban noise aggression.

A soundscape study of various urban squares and parks in cities both in Portugal (Lisbon) and in Brazil (Belém and São Paulo) was undertaken both to assess the sound quality in the urban parks and understand its perception by the users and to try to develop tools to improve existing parks or design new ones.

A new method was developed for the representation of the soundscape composition and its different percepts in the form of qualitative sound maps representing the different sound sources in layers.

SOUNDSCAPE ANALYSIS

The soundscape of various urban parks and squares well frequented by the local and visiting population of different cities was analyzed through sound pressure measurements and observations [3-4].

The different sound components of the soundscape were identified and measured by a listening procedure by a panel of listeners where the masking effect and the separating power of the ear, which then acts like a semantic filter in the multi-layer sound situation, were used [3]. The results represent limiting curves of *in-situ* audibility of the separate sound components, since a masking white noise was introduced in order to identify the limits of audibility and thus of perception of the different components of the soundscape in each measuring location.

The landscape was observed together with the soundscape composition in the different parts of the parks to assess the coherence between sound and other senses, especially visual. The variations of both soundscape and park use during the week or on weekends were dully registered.

Questionnaires were also filled by the park users who gave not just their appraisal of the sound quality of the park environment but also comments on their expectations and their motivations for using the park. Their positive appreciation did not always correlate well with the sound levels meaning that they usually valued the different and more pleasant sounds inside the park and the resulting change from the mechanical sounds (mostly traffic) outside. They also valued the context of such differences, the coherence with the differentiated landscape and with their activities (leisure, social, sport).

The correlation of the measured results with existing quantitative sound maps was analyzed, since the standard noise maps (either strategic or detailed) are only able to represent overall values which include sounds that may be perceived as noise (mechanical such as traffic or construction) or pleasant sounds (human voices, animal sounds, music, even some mechanical sounds), depending on context.

Figure 1 shows the prevalent sound components as perceived in different points of Rossio square, Lisbon, Portugal, together with the overall environmental noise values provided by the quantitative noise map for the area.

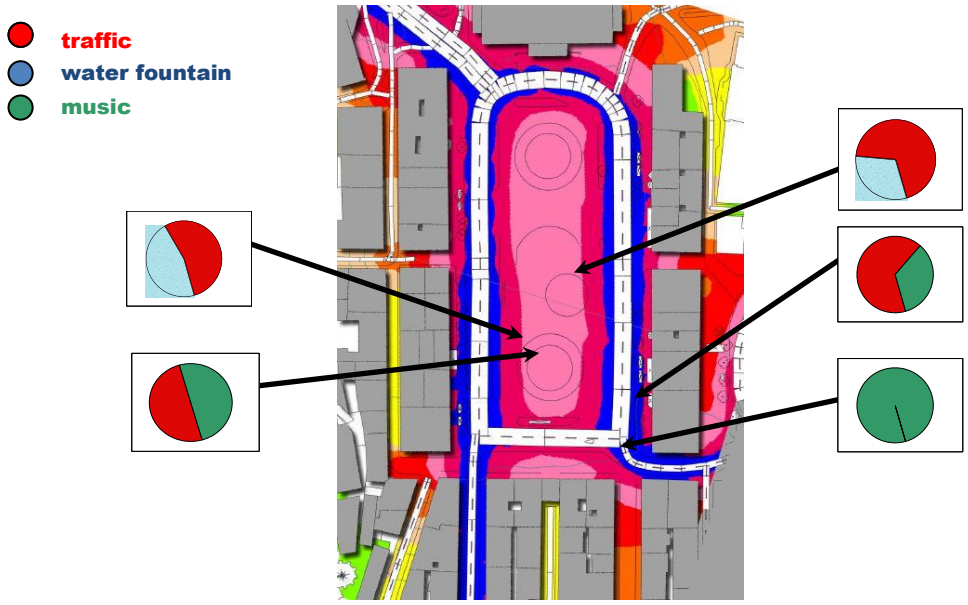

Figure 1. Mapping sounds in Rossio square, Lisbon, Portugal

Figure 2 shows the geographical distribution of the areas of influence of different sounds in two parks in the city of Belém, Brazil.

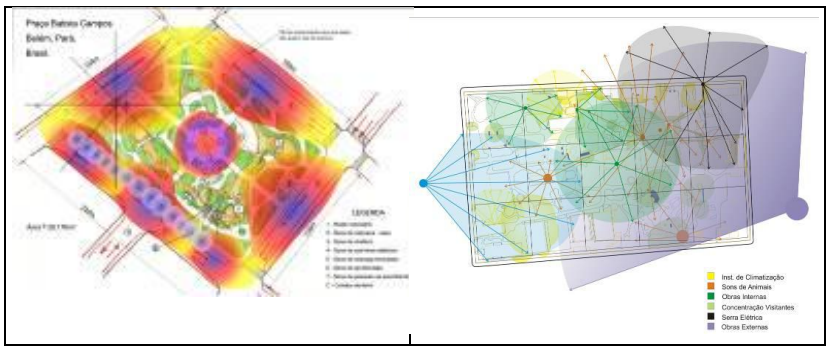

Figure 2. Sound pressure levels at the Batista Campos square (left) and Zoobotanical garden (right), in the city of Belém, Brazil.

The urban parks offer a soundscape that features lower sound pressure values, at least in some inner locations, but especially a sound composition well differentiated from outside where traffic noise usually dominates. The presence of pleasant sounds in context with the landscape and

with the users' activities is a major point of interest for the users of the parks.

It seemed thus important to be able to establish the limits of audibility of the different sound components and to map their areas of perception, though soundscape listening is immersive contrary to the point of view of the map. The perception is attentive, fluctuating, and above all subjective, but this work did not intend to reflect this complexity but rather to highlight the common object of soundscape perception.

SOUNDSCAPE MAPPING

Since the quantitative noise maps are only able to provide values for the overall sound pressure levels, techniques were developed to draw qualitative sound maps based on perception differentiating between the various sound components [5-8]. The limit of audibility was one of the criteria of the method. The percepts define, spatially and perceptually, the soundscape plans in the same way as in the visual landscape. Since these plans are in permanent inter-masking, it is necessary to test the limits of audibility of each sound source, identified and masked by another soundscape source.

Figure 1 shows a sample of the quantitative noise map of the Rossio Square in Lisbon, Portugal, where the overall levels in the central area are high. However, these levels are contributed by sound components which can be perceived as unpleasant and thus as noise, such as traffic, and by others which are in context which the place and either are not unpleasant or are even appreciated such as water sounds, music, or human and bird sounds [6].

Figure 3 shows the maps for the most relevant sound sources contributing to these overall levels, as obtained by the listening measuring method [3], as layers of information on the soundscape in each point.

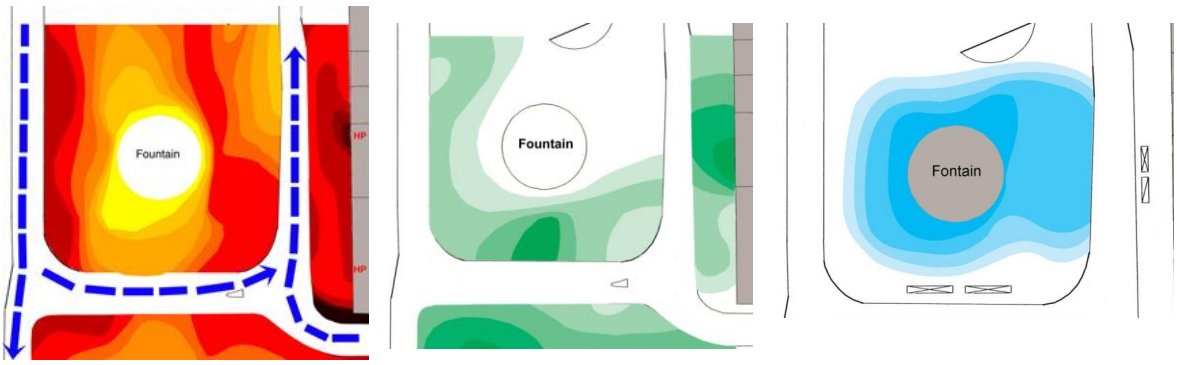

Figure 3. Areas of perception of road traffic (left), music (middle), and water sounds (right) at Rossio square, Lisbon, Portugal

Figure 4 shows a simple representation of the areas of perception of different sounds in the Rodrigues Alves Botanical garden, in Belém, Brazil.

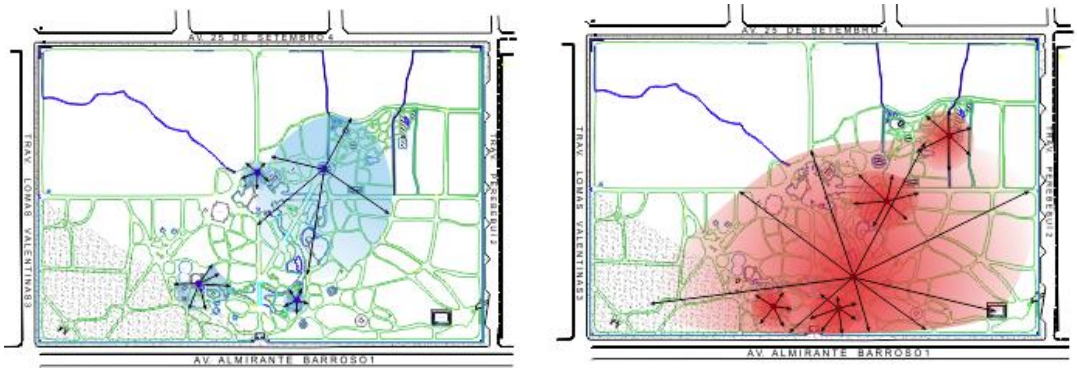

Figure 4. Areas of perception of water sounds (left) and animal sounds (right) at Rodrigues Alves Botanical garden, Belém, Brazil.

A soundscape mapping procedure was devised using common sound modeling and prediction software [7]. All contributing sound sources naturally present *in-situ*, are considered. Their limits of audibility are identified and their acoustic properties, in terms of both strength and frequency spectral contents are measured and then modeled. The existing sound propagation properties are identified and considered in the model. Local observations are used for calibration and validation of the model.

This method allows the mapping of the local soundscape which comprises the maps of the different sound components as perceived in each location.

Figure 5 shows the sound maps of the different contributing components of the soundscape in Principe Real square, Lisbon, Portugal [7]. The lowest level represents the limit of audibility as perceived by the user of the place [7-8].

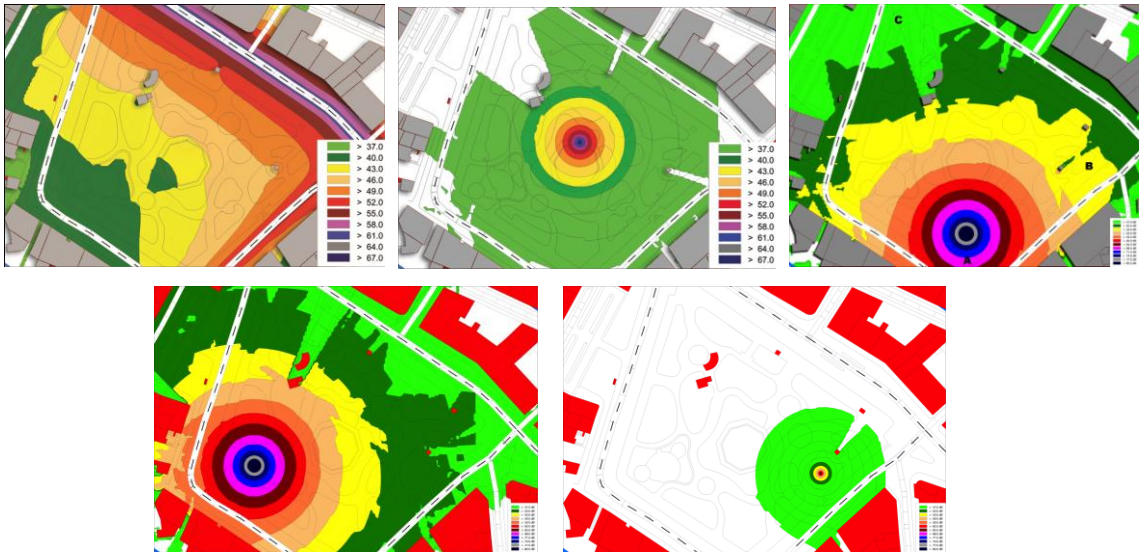

Figure 5. Map of the soundscape components of Principe Real square, Lisbon, Portugal: road traffic (above left); squawking ducks (above middle); people talking (above right); children playground (below left); bird singing (below right).

Figure 6 shows the whole composition, the soundscape map of Principe Real square. Each color represents a different sound component where the different shades correspond to 3 dB intervals.

The overall level in each place results from the added contributions of all sources.

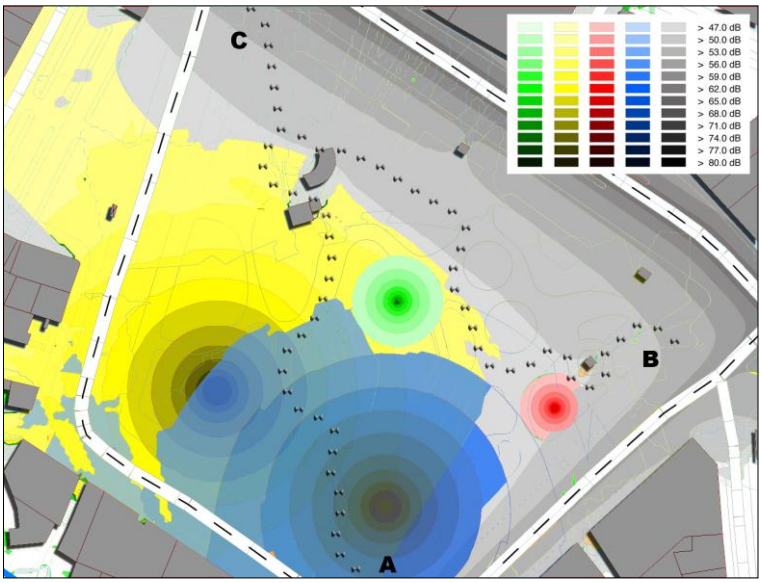

Figure 6. Soundscape map of Principe Real square, Lisbon, Portugal: road traffic (grey); children playground (yellow); people talking (blue); squawking ducks (green); bird singing (red).

These maps can be used as tools for the design of soundscapes in urban areas especially parks and areas of sound improved environment to provide sound differentiation and restoration for the citizens [8].

CONCLUSIONS

Urban parks offer an escape for the citizens to experience improved sound quality and restoration. The European Environmental Directive encourages the maintenance, protection and development of quiet areas, where the quality of the acoustic environment should be good and where the citizens can relax and find a more pleasant soundscape. Urban gardens, parks and some squares can fulfill these goals. Urban planners should be well aware of these potentialities and be able to adequately design new sound quality areas.

A study was conducted on the soundscape of urban parks of various types, in different cities. The urban parks were seen to offer a soundscape that may feature lower sound pressure values in some inner locations, but the users especially valued the more pleasant sound composition well differentiated from the outside where traffic noise, construction and other mechanical sounds are perceived as noise. The presence of pleasant sounds in context with the landscape and with the users' activities was found to be a major feature well appreciated by the park users.

Techniques were developed to analyze the urban park soundscape by perception and to map its different sound components. The limit of audibility of each sound component is a prerequisite for the perception of the soundscape in the complexity of its composition, since the human perception of the sonic environment depends on several factors such as intentionality, attention, or the overall coherence.

Soundscape mapping was accomplished by identifying the limits of audibility of the various sound components and modeling the different corresponding sources using common modeling

software and local observations and measurements for calibration and validation.

The soundscape maps can be efficient tools when used by architects and planners to improve existing or design new urban parks.

ACKNOWLEDGEMENTS

This work was supported by the Portuguese Foundation for Science and Technology (FCT-CAPS/IST plurianual funding through the POS_C Program that includes FEDER funds, FCT project PTDC/AMB/73207/2006 EYE-hEAR Qualitative sound maps for visualization of the urban soundscapes, and FCT R&D strategic project).

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