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Advances in Environmental Acoustics

Editorial

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Urban sound: waste versus resource

Sound is one of the environmental factors that determines the quality of the outdoor environment. As the majority of people live in urban areas [1], environmental acoustics mainly deals with sound in these areas. There is a large variety of sources of sound in urban areas, ranging from motorcycles and buses, to barking dogs, street musicians and playing children. The propagation of these sounds outdoors is influenced by the urban fabric, the surface nature and properties of materials of the ground, buildings and other outdoor objects, as well as meteorological conditions. As a result, we perceive a sound field that is highly time and space dependent. While some of the sounds are specifically intended to transfer valuable information, as sirens of emergency vehicles and church bells, there are two main axes along which urban sound is considered in science. The approach that historically has attracted most attention is to consider the majority of urban sound as waste, treating it as environmental noise, which has been defined as [2] ‘an unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic, and from sites of industrial activity’. The main health effects due to environmental noise, which have been quantified by WHO as the disability-adjusted life-years (DALYs) [3], are annoyance, sleep disturbance, cognitive impairment in children, cardiovascular diseases and tinnitus. WHO has produced community noise guidelines [4] and night noise guidelines [5]. Recently, environmental noise guidelines for the European region have been published [6], which also include guidelines for leisure noise and wind turbine noise. Environmental noise has been extensively combatted by researchers through noise control: by developing noise reduction measures at the source, in the propagation path, and close to the receivers. Some examples of these are respectively silent car tyres, noise barriers and high sound insulating windows. Besides the technological efforts to reduce noise, the identification of urban areas where such actions are needed are of key importance in managing environmental noise. At a European scale, this occurs by means of the European Noise Directive, which requires EU cities to produce periodic noise maps, and amongst others derive noise action plans based on the maps [2].

In contrast to treating urban sounds as noise, the awareness that the positive aspects of sound in urban areas should be qualified, quantified and promoted is the second axis of treating urban sound. This approach implies that sound is considered as a resource rather than waste. Indeed, sound environments can be restorative, enjoyable, and the sound environment can be responsible for the appraised character of an urban space. A soundscape has been defined as “[the] acoustic environment as perceived or experienced and/or understood by a person or people, in context” [7]. Thus ‘soundscape’ is different from ‘acoustic environment’ as the former refers to a perceptual construct, and the latter to a physical phenomenon [8]. Soundscaping is the research area that deals with developing the urban sound environment focusing towards the preferred sounds at a certain urban location, and how to mask the unwanted sounds at the same time. This approach thus requires a differentiation between the type of sound sources. This research field is under development and still needs more underpinning science and practical guidance [8].

To optimize sound environments in cities, both approaches are needed. If the focus of reducing noise dominates, there is risk that noise control measures indeed create quiet areas and avoid adverse health effects, but that these areas do not possess other qualities that are preferred for such outdoor spaces. At the other hand, in an urban area close to big traffic infrastructures, noise control is primarily needed to reduce adverse health effects, and soundscaping in terms of working with preferred sounds will not have first priority.

Research needs

With the clear evidence on health effects due to environmental noise, the increase of the global urbanization [1] and thereby the number and types of sources of sound, and the increased awareness for the value of urban sounds as a resource, the research area of environmental acoustics deserves continuous developments in order to enable that healthy and positive acoustic environments can be created. Some recent trends in research subjects in this area are large scale acoustic monitoring systems [9]-[16], virtual acoustic techniques [17]-[21], improved methods for predicting urban sound fields [22]-[29], and new ways to define positive valued environments [8], [30]-[34].

Because of the need for more scientific and technological contributions to the field of environmental acoustics, this virtual special issue on advances in environmental acoustics was launched. Seven topics have been identified for which research is needed and for all of these topics, at least one research paper has been published. An overview of these seven topics and the 18 published papers of this issue is given below.

1) Acoustic characterization and analysis of outdoor sound sources

- Wang et al., Indoor substation low-noise design and sound absorbing structure improvement considering power transformer acoustic radiation characteristics. <https://doi.org/10.1016/j.buildenv.2018.12.035>

2) New ways of measuring or predicting environmental sound fields

- Cai et al., Evaluation of road traffic noise exposure based on high-resolution population distribution and grid-level noise data, <https://doi.org/10.1016/j.buildenv.2018.08.037>
- Hornikx et al., The wind effect on sound propagation over urban areas: Predictions for generic urban sections, <https://doi.org/10.1016/j.buildenv.2018.08.041>
- Picaut et al., An open-science crowdsourcing approach for producing community noise maps using smartphones, <https://doi.org/10.1016/j.buildenv.2018.10.049>
- Trikootam and Hornikx, The wind effect on sound propagation over urban areas: Experimental approach with an uncontrolled sound source, <https://doi.org/10.1016/j.buildenv.2018.11.037>
- Guillaume et al., Statistical study of the relationships between mobile and fixed stations measurements in urban environment, <https://doi.org/10.1016/j.buildenv.2018.12.014>

3) Research on environmental noise control measures

- Lam et al., Active control of sound through full-sized open windows, <https://doi.org/10.1016/j.buildenv.2018.05.042>
- Liu and Hornikx, Effect of water content on noise attenuation over vegetated roofs: Results from two field studies, <https://doi.org/10.1016/j.buildenv.2018.09.022>
- Zhao et al., Configuring fixed-coefficient active control systems for traffic noise reduction, <https://doi.org/10.1016/j.buildenv.2018.12.037>

4) Studies on effects of environmental noise on health

- Lee et al., Characterizing perceived aspects of adverse impact of noise on construction managers on construction sites, <https://doi.org/10.1016/j.buildenv.2019.02.005>
- Smith et al., Effects of ground-borne noise from railway tunnels on sleep: A polysomnographic study, <https://doi.org/10.1016/j.buildenv.2018.12.009>

- Radun et al., Variables associated with wind turbine noise annoyance and sleep disturbance, <https://doi.org/10.1016/j.buildenv.2018.12.039>
- 5) Studies towards positive sound environments including soundscaping
 - Zhang et al., Sounds and sound preferences in Han Buddhist temples, <https://doi.org/10.1016/j.buildenv.2018.06.012>
 - Filipan et al., Auditory sensory saliency as a better predictor of change than sound amplitude in pleasantness assessment of reproduced urban soundscapes, <https://doi.org/10.1016/j.buildenv.2018.10.054>
- 6) Application of state-of-art techniques in virtual acoustics to environmental studies
 - Jiang et al., How do shared-street design and traffic restriction improve urban soundscape and human experience? -An online survey with virtual reality, <https://doi.org/10.1016/j.buildenv.2018.07.005>
 - Jeon and Jo, Three-dimensional virtual reality-based subjective evaluation of road traffic noise heard in urban high-rise residential buildings, <https://doi.org/10.1016/j.buildenv.2018.11.004>
 - Hong et al., Quality assessment of acoustic environment reproduction methods for cinematic virtual reality in soundscape applications, <https://doi.org/10.1016/j.buildenv.2018.12.004>
- 7) Best practice studies on environmental acoustic interventions
 - Lee et al., Investigation of the effect of vegetation on soundscape of an urban religious precinct: Case study of Myeong-dong Cathedral in Seoul, <https://doi.org/10.1016/j.buildenv.2019.03.046>

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