Applicability of the Soundscape Approach in the Legal Context

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Introduction

The soundscape approach gains in importance and is applied in diverse contexts in order to research the way humans experience their acoustic environment. The soundscape approach has frequently shown that it is necessary to implement new methods and approaches in order to fully understand the human perception of environmental noise in a specific environment and ambiance. Simply said, soundscape researchers are not only interested in the answer to the question *how much*, but also interested in the clarification of the issue *why*. Only than a reliable interpretation of the "how much"- dimension is possible. Nevertheless, environmental noise assessment and control is still exclusively based on laws, guidelines and regulations, which refer only to simple sound pressure level indicators. Although, it is widely accepted that the simple measurement and interpretation of sound pressure levels failed in describing adequately environmental noise annoyance, the noise policy is still driven by simple assumptions and sound pressure level indicators. These simple indicators are well-established and deeply ingrained in noise policy over decades. However, several applications of the soundscape concept in the context of the redesign of urban places show already the feasibility and potential of the soundscape approach [1, 2]. Is the soundscape approach compatible to the current legal framework of noise policy and noise control or are there any insurmountable obstacles?

Measurement Conditions

Several environmental noise regulations use specific terms and definitions, which have a certain similarity to aspects of the soundscape concept. For example, the height of the microphones should be chosen according to the actual or expected height of the receiver (ISO 1996-2 [3]). Since in soundscape investigations usually typical receiver positions are considered, this definition appears to be compatible to the soundscape concept. In contrast to the "indoor" noise measurement position according to the ISO 1996-2 [3], where the microphone position should be in 0.5 m in front of an open window, the soundscape concept would prefer more typical receiver positions. This means that comparable to the ANSI S12.9 standard [4], where it is defined that the choice of the measurement positions depends on the purpose of the measurements, the measurement positions in soundscape investigations must orientate on the respective type of investigated soundscape.

Another point concerns the measurement height. The height of the microphones should be chosen according to the actual or expected height of the receiver (ISO 1996-2 [3]). Of course, the measurement height cannot follow the noise maps principle, where the sound pressure level calculations are related to a height of 4 m. It is very reasonable to apply a typical height of adult receiver ranging from 1.5 m to 2 m.

Regarding measurement time intervals, the ISO 1996 [3] standard defines that the reference time intervals shall be chosen to take into account typical human activities and variations in the operation of the noise source (ISO 1996-3). With respect to soundscape investigations the term "in variations in the operation of the noise source" must be replaced by "variations caused by the prominent noise sources". Prominent noise sources represent sources, which could be classified with soundscape related terms such as signals, soundmarks or keynote sounds.

In the European research project "Imagine" [5] the duration of the measurement should be sufficiently long to encompass all emission situations which are needed to obtain a representative average. With respect to soundscape investigations this definition should be supplemented with the expression to obtain a representative "picture" of the whole soundscape with its expected important, typical emissions.

However, it has to be emphasized that several elements and components of the soundscape concept cannot be simply integrated into existing environmental noise standards and guidelines.

For example, with conventional one-channel microphone measurements it is not possible to sufficiently grasp the physical entity of the acoustic environment. Because of complex environmental sound situations caused by several spatially distributed sound sources it is important to use binaural technology to consider masking effects, sound impression, spatial distribution and complex phase relations adequately. Measurements with binaural technology are necessary if subsequent (aurally-accurate) reproductions of noise are required, e.g. in the case of further examination of the sounds in laboratory listening tests [6]. "Copies" of the acoustic environment as close as possible to humans' perception are needed especially regarding archiving and re-experiencing the acoustic scenery for comparability and analyses reasons.

Moreover, for example the ISO 1996-2 [3] proposes that measurement positions should be chosen in the vicinity of each of the sources in order to reduce the influence of the others. This does not correspond to the soundscape concept. In the soundscape investigation the main focus lies not in separating the different source contributions, but to record and analyze environmental sound as a combination of all relevant sound sources. The separation of the contributions of the different sound sources is considered for analytical and legal reasons in noise policy, but the examination of the whole remains inevitable. The concept of the soundscape as a "musical composition" [7] requires to analyze the acoustic

environment as a whole as well as in its different facets, comparable to the study of music.

Another aspect concerns the preferred noise descriptor. In accordance to the ISO 1996-3 the preferred noise descriptor for the specification of noise limits is the equivalent continuous A-weighted SPL. Although, there is no agreement upon the most valuable acoustic indicator regarding the description of the acoustic environment in the scope of soundscapes so far, it is very likely that the simple time-averaged A-weighted SPL will not turn out to be the preferred and most important noise indicator.

Finally, as already mentioned the use of binaural technologies seems to be imperative in order to be able to record and reproduce environmental noise in an aurally-accurate way. The use of binaural measurement technologies is not supported in current legal framework so far.

Adjustment and Penalties

In the scope of environmental noise penalties and adjustments are applied in order to compensate the insufficiency of an acoustic indicator and to consider perceptually-relevant phenomena adequately [8]. For example, the continuous equivalent A-weighted sound pressure level is not able to grasp certain annoyance-related issues, for example caused by prominent discrete tones, informational content, impulsive events or strong low frequency content. These noise properties are not covered by the sound pressure level and penalties must be defined to take into account the fact that certain noise features are responsible for an increased noise annoyance. Frequently, the decision for or against the grant of penalties is taken by experts and consultants. For example, the TA Lärm defines that penalties for times with increased sensitivity (Sunday and public holidays) must not be applied in case of specific local conditions [8]. The consideration of specific local conditions is the main theme of the soundscape approach. It is conceivable that soundscape experts, who investigate a certain urban area in detail, decide about necessary penalties or adjustments. Decisions with respect to a "revision" of physical data in order to capture specific local conditions must be grounded on detailed knowledge about the area. This represents a major aspect and the strength of the soundscape concept, the detection of the specifics and particularities of an (acoustic) environment with its impact on the community (and vice versa). Therefore, the general idea of defining soundscape related adjustments to "improve" physical data is compatible to general noise policy concepts. Of course, this kind of reduction of complexity, expressing perception relevant aspects into dB-equivalents, does not reflect the original concept of the soundscape approach. However, it could be a first step in combining the current noise legislatives with soundscape ideas.

Conclusions

There is a need for guidelines to provide for a basis for the measurement of soundscapes. A common basis of measurement procedures appears very important, since it would support the development to bring forward new concepts and ideas within environmental noise research. Moreover, accuracy requirements must be defined and potential measurement uncertainties must be determined in order to gain more acceptance from decision makers and politicians. Although some general incompatibilities between soundscape concepts and environmental noise assessment and control regulations remain, the soundscape approach could partially be integrated in already existing standards and guidelines. Of course, the existing environmental noise standards have to be extended in order to reflect the soundscape concept requirements.

However, the acoustical measurement of environmental noise is only the physical representation of the urban place. Thus, it is very important that the openness of the soundscape approach is not constricted to a kind of "corset of detailed regulations"; this would mean that the soundscape approach loses its general strength. The flexibility and openness of the soundscape approach is needed in order to match the procedure to the specifics and particularities of the investigated place.

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