Thesis subject

Context

The concept of "soundscape/soundscape" was introduced in the 1970s and has been defined since 2014 as "the acoustic environment as perceived or experienced or understood by an individual or social group in a context" (ISO 12913-1, 2014). This approach recognizes the complexity of both the acoustic environment (complexity of sound sources and temporal dynamics) and its modes of perception. This paradigm shift allows for a more holistic approach, to support both earlier and more relevant decision making during urban development or redevelopment, involving different stakeholders: users, residents, designers or decision makers. However, there are still few tools and methods for analyzing, describing or representing all the components of the soundscape at the city level.

Problem statement

The first objective of this project will be to work on AI methods to infer perceptual data from sound signals coming from sensors (e.g. perceived presence time of sound sources, pleasant or animated character of a sound environment, etc.) and from self-learning and self-supervised learning with tasks dedicated to sensor networks. Within the framework of the ANR Cense project (https://cense.ifsttar.fr), a dense sensor network has been deployed in the city center of Lorient where large amounts of raw audio data have been acquired over a three-year period. These data will be complemented by corpora from measurement campaigns in other European cities in order to generalize the inference methods. In the long run, the goal is to provide the acoustic community with robust and efficient source detectors
and specializable to new urban areas for a low human cost. The second objective will be to propose cartographic representations of the acquired data and the result of their analysis, and to study the use of these representations by the target audiences (see context). Overly simplified maps reduce the complexity of the phenomena represented, causing a risk of disengagement and misunderstanding of the data. One solution is to keep certain details of the analysis results to show the complexity of the phenomena, which has the effect of engaging users in a more detailed understanding of the phenomena and the biases associated with the models. The difficulties will therefore be to identify the significant parameters of the sound analysis, and then to propose mappings that on the one hand preserve these parameters, and on the other hand expose the biases of the inference model. In particular, spatio-temporal immersive representations of periodic sound phenomena and the uncertainty of model results will be studied. The interaction with these representations will be ensured by an adaptive learning method to progressively accustom the users to the complexity of the information. In order to validate the understanding of these cartographic representations and their prospective uses, user tests of soundscape identification will be conducted with professional users in urban planning identified at the beginning of the project.

Work plan

- Bibliographic study
- Acquisition of field data on the uses of sound maps
- Compilation of data from the Cense network
- Creation of a new annotated evaluation database with several perceptual and cognitive dimensions
- Annotation of sub-corpora of public databases from the DCASE challenge including different cities
- Development of innovative sound source detectors through the creation of pretextual tasks adapted to the structure of data from sensor networks for unsupervised learning of neural folds used in source detectors
- Temporally and spatially expanding the parsimonious dataset using synthetic data generated from artificial intelligence algorithms (e.g. advanced spatiotemporal kriging methods)
- Design of multidimensional sensitive sound maps
- Exploration of adaptive learning to display interactive sound maps ● Implementation of user tests in laboratory and operational situations

References

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