

**SONIC DRIFT CDA: PERFORMANCE OF AN AI-BASED SONIC
GEOGRAPHIC DÉRIVE**

**SONIC DRIFT CDA: DESEMPENHO DE UM DÉRIVE SÓNIC
GEOGRÁFICO BASEADO EM IA**

Caroline Claus

ReSilence Artist in Residency
Independent researcher
contact@clauscaroline.be

Georgios Loupas

Research Associate
Information Technologies Institute - CERTH, Thessaloniki, Greece
loupgeor@iti.gr

Paraskevi Kritopoulou

Research Associate
Information Technologies Institute - CERTH, Thessaloniki, Greece
pakrito@iti.gr

Nefeli Georgakopoulou

Senior Research Associate
Information Technologies Institute - CERTH, Thessaloniki, Greece
neveli.valeria@iti.gr

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ABSTRACT

Our project, conceptualized as an Arts Driven Experiment (ADE), engages in a critical study of the complex relationship between sonic spatial shifts and the evolving configuration of an urban landscape and environment in transformation. By rethinking the acoustic horizon in terms of flatline constructs, we aim to address sonic spatial shifts by focusing on instances of disruption in the behavior of alluring sonic figurations as they traverse dynamic urban spaces. A sonic cartography is constructed through the performance of an AI-based sonic-geographic dérive. The project is situated in the northern part of Chaussée d'Anvers (CDA), Brussels, with the objective of providing information on the transformative potential of a sonic affective approach for the redevelopment of the Brussels Territory North.

KEYWORDS: urban regeneration. sonic space shift. dérive. artificial intelligence. sonic cartography. urban planning

RESUMO

O nosso projeto, conceptualizado como uma Experiência Conduzida pelas Artes (ADE), envolve-se num estudo crítico da relação complexa entre as mudanças espaciais sónicas e a configuração em evolução de uma paisagem urbana e ambiente em transformação. Ao repensar o horizonte acústico em termos de construções de linha plana, pretendemos abordar as mudanças espaciais sónicas, concentrando-nos em instâncias de perturbação no comportamento de figurações sónicas sedutoras à medida que atravessam espaços urbanos dinâmicos. Uma cartografia sónica é construída através da performance de um dérive sónico-geográfico baseado em IA. O projeto situa-se na parte norte da Chaussée d'Anvers (CDA), em Bruxelas, com o objetivo de fornecer informações sobre o potencial transformador de uma abordagem afectiva sónica para a requalificação do Território Norte de Bruxelas.

PALAVRAS-CHAVE: regeneração urbana. deslocamento espacial sónico. dérive. inteligência artificial. cartografia sónica. planeamento urbano

1. INTRODUCTION / INTRODUÇÃO

The following essay draws on an arts-driven experiment conducted by the artist-researcher and the interdisciplinary team of data researchers as part of a S+T+ARTS Horizon EU residency, ReSilence Grant Agreement No. 101070278. The project aims to revisit soundscape-based approaches by re-evaluating the acoustic horizon of an urban area undergoing rapid change in terms of flatline constructs. It adopts an AI-based sonic-geographic methodology to identify shifts in sonic space, with a particular emphasis on the disruption of emotional states in relation to urban re-development strategies. This results in the creation of a sonic cartography of the public space surrounding an urban block along the Brussels Chaussée d' Anvers (CDA).

2. SONIC SPACE SHIFTS

2.1. Compact City

In addition to the city's inherent compactness due to its geographic location, capital status, and the demographic trends that are driving up housing demand, Brussels Capital Region has adopted the compact city as a strategic urban planning approach (Mabilde, 2020). The compact city model is associated with urban planning strategies that emphasize proximity, the creation of vibrant neighborhoods that combine residential and commercial functions, and accessibility to green space and public services. A central objective is to create space for pedestrians, with a density that is high enough to allow for the efficient operation of public transport. From a design perspective, the compact city model aims for a diversity of urban form that allows different modes of urban life to coexist in different ways, ensuring that urban living is both feasible and attractive to the super-diversity that characterizes a city's population. The majority of compact city strategies that address sound in qualitative terms are based on the "soundscape" concept and have been designed to improve the perceived "acoustic comfort" of urban environments (Radicchi et al., 2018). The objective of this project is to engage in critical reflection on soundscape-based analysis by reconsidering the acoustic horizon of a rapidly changing urban area in terms of flatline constructs and sonic space shifts as emotional disruption .

2.2. Flatline Construct

Murray Schafer (1977) proposed an interpretive framework for the acoustic environment, conceptualizing it as a "soundscape." Schafer's approach aimed to foster a more nuanced appreciation of sound that extends beyond a mere perception of noise. To describe the expression of a sound's acoustic profile within a given geographical area, he proposes the notion of "acoustic space." Likewise, Blesser and Salter's (2009) use the concept of the "acoustic horizon" to delineate an anthropocentric experiential boundary of listening, based on the inclusion or exclusion of specific sonic events. These two perceptual concepts of sonic spatiality are inextricably linked to the idea of a community of listeners and their capacity to perceive and process aural stimuli. Schafer's argument for a "tuning the world" involves a critical reflection on the presence of "flatline constructs." According to Schafer, this phenomenon occurs when the sonic environment becomes homogeneous, lacking in diversity and vitality. He links the prevalence of flatlines to a number of anthropocentric factors, including noise pollution and the prevalence of mechanical sounds, as well as the suppression of natural sounds.

Mark Fisher (1999) uses the term "flatline construct" to reflect upon the convergence of the inorganic and organic realms onto a singular plane of immanence. In order to explore the experiences of lost futures in the present, he employs the concept of a "gothic flatline" to delineate the prevailing condition in contemporary society as one of pervasive stillness and decay, evoking the atmosphere of a gothic novel. His philosophical analysis of the impact of cybernetic elements in contemporary society is informed by Derrida's concept of "hauntology". Compared to Schafer's critique, Fisher's conception is more intensively and affectively oriented. In their audio essay describing a walk along the Suffolk coast, Fisher and the narrator Justin Barton (2019) introduce the term "unplace" to signify an unknown spatiality that encompasses individuals and the surrounding environment. To facilitate the navigation of contemporary landscapes, which are characterized by latencies, losses, and new forms of sensitivity in relation to global urban dynamics and the ubiquity of new digital media, Shaviro (2010) proposes a framework for understanding the behavior of "alluring

figurations". He describes alluring figurations as dense nodes of intensity and interaction, acting as anchor points and capable of being connected to the convergence of many feelings, which conduct multiplicities of affective flows. Fisher's analysis of flatline constructs and Shaviro's emphasis on alluring objects contributed to the formulation of a sonic affective spatial approach that engages with the boundaries of the perceptual concepts and metrics of soundscapes and acoustic horizons.

2.3. Sonic Space Shifts

In the context of this project, the concept of a "sonic space" is defined as a heterogeneous and intermittent spatial construction, characterized by a dynamic interplay between sonic affective flows and possible positions within it. Each position is associated with a slight variation in the degree of sonic-spatial intensity. A "sonic space shift" represents a critical transformation, which can be considered analogous to what architectural theorist Sanford Kwinter (2002) describes as a 'singularity.' This relational definition of sonic space, both in terms of expression and experience, is informed by research in the fields of sonic geography and sound art (Ganchrow, 2009; Gallagher, 2016). Despite their pervasiveness in urban environments, sonic affective flows are frequently overlooked as they traverse the materiality and bodies of an urban space. The notion of an unperceived sound space seems to align with the concept of "unplace," which denotes the existence of an unknown spatiality that encompasses both the individual and the surrounding environment. A defining feature of this affective conception of sonic spatiality is its capacity to consider the experience of urban space in a state of distraction. Intervening in physical space may have an impact on the behavior of such flows, as well as on the composition and form of a sound space. This conceptualization allows for the association of a sonic space shift with disruption, both in terms of experience and expression.

2.4. Research Questions

The redevelopment of an urban area into a more compact city is a complex undertaking. The process of urban densification and renewal requires a multifaceted approach, whereby a variety of considerations are employed to justify or refute the selection of specific urban sites, infrastructure, and forms. In urban planning and design research, the sonic environment is increasingly being assessed, predominantly in relation to noise pollution and acoustic comfort, as part of strategies formulated in response to other environmental, social, and economic challenges. The project explores the boundaries of soundscape approaches by focusing on the city as a source of sonic affective flows that contribute to the formation of sonic space shifts. A series of urban planning and design strategies are reexamined using an AI-based sonic geographic *dérive* to create a sonic cartography of fast-changing urban landscape. Accordingly, the following research questions have been formulated:

- Do strategies for modeling compact cities involve sonic space shifts?
- In what ways might artificial intelligence be employed to assist in a sonic affective spatial approach?

- Is it possible to move beyond the analysis of perceptible acoustic horizons and the comfort of landscapes and environments in transformation through an AI powered analysis?

3. AI BASED SONIC GEOGRAPHIC DÉRIVE

3.1. Dérive

The International Situationist Movement's practice of "dérive" is interpreted as a sonic method for AI-powered listening to the sonic space shifts of a landscape and urban environment in transformation. It is situated in a complex and dynamic landscape, where a multitude of interacting factors and data points contribute to an unpredictable outcome. The movement's trajectory follows the paths of a series of disruptive or alluring sonic figurations that can be linked to prevailing urban strategies. By focusing on alluring sonic figurations as an analytical tool, it becomes possible to explore a de-centering of subjective evaluations unless it is clearly marked as such. In the context of this project, a series of sonic figurations are identified which serve as indicators of feelings of disruption in relation to the strategies employed in the city. The selected figurations delineate specific scales, forms, and positions corresponding to the urban sites and strategies of observation. The allure of each sonic figuration is explored as a portal to an unplace, an urban sonic spatiality that is not necessarily limited to the specific site of survey.

3.2. Observatory

The project employs two distinct methodologies for data collection. These are situated within the context of the project's observatory. Audio recordings were conducted in two distinct settings: on the rooftop and during a series of audio walks in the public space surrounding the urban block of survey. The schedule of recording was structured around sunrise, sunset, and midnight transitions. The particular configuration of listening positions and observation periods exemplify the spatial argument of investigating sonic spatial shifts in relation to prevailing and potential urban strategies. The project combines two types of audio recording: passive logging from a rooftop position or top level, and active field recording from a street-level position or ground level. Rooftop audio recording is conducted by four kits each of which combines low-cost, full-spectrum acoustic logger, used as a USB microphone, connected to a single board computer with appropriate software installed to achieve GDPR compliance. The street-level recordings were conducted using a contact microphone with an XLR impedance adapter, a shotgun higher-order, frequency-dependent directive microphone, a stereo pair of omnidirectional microphones in combination with a 4-preamp, 8-track, 32-bit float audio recorder. The data was collected in the early spring of 2024, during the weekend, out of an interest in recording the sonic environment of residential living.

3.3. Cartography

An analysis of sonic space shifts within the urban sonic environment of a landscape in transformation is conducted through the creation of an AI-based sonic cartography of transformative urban spaces. The AI-based experiment is designed to articulate sonic spatial shifts as disturbances that have the potential to evoke either psychological distress or delight. A second goal of this AI-based endeavor is to provide a richer understanding of

affective modes of transmission in relation to prevailing proximity-based approaches designed to promote well-being in public spaces. A third goal is to evaluate the use of AI-based models in urban sound planning and design research. A triangulation of methods and sources is employed to facilitate interdisciplinary understanding and synthesis. The specific arrangement of listening positions and observation periods exemplifies the spatial argument of investigating sonic spatial shifts in relation to prevailing and potential urban strategies. The alluring sonic figurations serve as structural markers for the sonic cartography, both in its visual and auditory formats. The allure of each sonic figuration is evaluated in terms of its sonic materiality and the emotional response it evokes, making use of AI-based models.

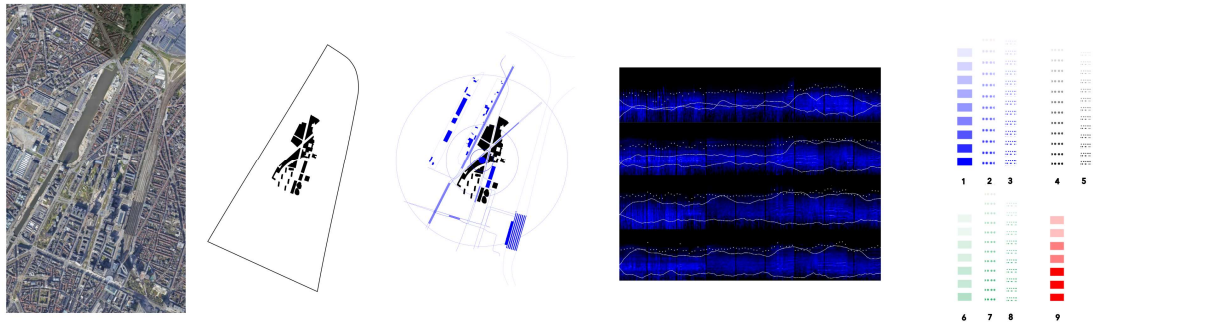
The sonic cartography pairs an urban analysis with an AI-based Audio Emotion Recognition (AER) analysis of the passive rooftop recordings and active street-level recordings. A transformer model pre-trained on the *AudioSet* dataset is trained on the *Emo-Soundscapes* dataset (Fan et al., 2017). This model processes the sound without considering its categorical information. Moreover, the Universal Source Separation (USS) algorithm (Kong et al., 2023) provides insight into the presence of sounds according to local figuration by use of soundscape ecology classifications (biophony and technophony). To represent the arousal and valence fluctuation of sound spaces, the AER algorithm is used (Figure 4). For active recordings, the *2D Arousal-Valence Chart* illustrates the stress/calming level of each recorded position. The frequency analysis aims to detect the presence of subsonic and supersonic noise in LAeq (equivalent continuous sound pressure level), which has been repeatedly indicated as a source of discomfort in existing research (Pawlaczyk-Łuszczynska et al., 2005; Araújo et al., 2020; Fletcher et al., 2018). These indices of subsonic (lfn) and ultrasonic (hfn) frequencies, are interpreted as sonic affective expressions in terms of additional sonic materiality. The intensity presence of each observed figuration is calibrated on a scale ranging from 0 to 1,414 and represents the average duration for which it may appear acoustically. The predicted stress level of each figuration is calibrated on a scale of 0 to 1, from the respective values of arousal and valence.

4. BRUSSELS NORTH – CDA

4.1. CDA North

The area of CDA North is situated along the northern section of Chaussée d' Anvers, a historic main road in the Brussels North District. The surrounding landscape and urban environment of the Brussels North district is characterized by a juxtaposition of urban forms, scales, and temporalities. This apparent incompatibility is compensated by the presence of extensive open spaces, which contribute to the character of CDA North's perceivable acoustic horizon (Figures 1–4). The old neighborhood of CDA North has a high population density of 20,808 people per square kilometer (CityTools et al., 2021). The population density is anticipated to increase in the future. The area has a relatively higher population of young adults and has a multicultural profile. Currently, this area of Brussels serves as an entry point for newcomers. With Brussels Territory North, the Brussels Region has put forth a unified vision for the redevelopment of an area extending beyond the North district, with the aim of fostering renewed interest and aligning it with the objectives of the Brussels Region. For the area of CDA North, pertinent planning tools are the *Draft of the Master Plan (RPA) MAX*, *Green -Bleu Network*, *Plan Bruit*, the *Urban Renewal Contract*

Citroën-Vergote and the Sustainable Neighborhood Contract Helihaven-Antwerp (Perspective, n.d.; CityTools et al., 2021).



Figures 1 – 5. Google Earth Satellite View of Brussels North District in 2021. CDA North Urban Block in Brussels North District in 2024. Acoustic Horizon CDA North in 2024. Spectrogram analysis of frequency, intensity, arousal and valence (upper and lower white lines respectively), presence of technophony (dots) using passive logging of the CDA North Acoustic Horizon in 2024. Legend explaining the indices levels from low (faint colored) to high (vivid colored) [bleu indices of technophony presence, lfn and hfn; green indices of biophony presence, lfn and hfn; red indices of stress; black indices of lfn and hfn exclusive figuration of analysis]

The project concentrates on the scale of a mixed-use urban block located at the intersection of Chaussée D' Anvers (CDA), Helihaven Avenue and Masui Street. Its primary focus is a sequence of three transformative urban spaces: the President's Garden, a privatized public green space located at the corner of CDA and Helihaven Avenue; an industrial infrastructure site in the northern Helihaven area undergoing regeneration; and the junction square connecting CDA with Masui Street.

4.2. Sonic Affective Cartography

The AI-driven analysis of the alluring behavior of sonic figurations at sites observed along the Chaussée d'Anvers indicates both affective and experiential connections between compact city strategies and sonic spatial shifts. To be more precise, it indicates that sonic space shifts can be indexed in terms of sonic materiality and emotions extending beyond the experience of acoustic loudness.

4.2.1. President Garden

The *Draft Master Plan RPA MAX* (2023) proposes the removal of the hotel function and presents three possible scenarios for the future development of this urban space. It provides the opportunity for the construction of eight-story high buildings along the streetside, this in accordance with the directive for the development of a park and climate, biodiversity, and landscape axis. However, the draft of the master plan fails to address the capacity of the existing forest parcel with a tall tree canopy to transmit sonic affects in the surrounding public space of Chaussée d'Anvers and Helihavenlaan.

The inaccessibility of the private garden and its uncertain future public status render the urban sound space an unfulfilled urban spatiality, awaiting the involvement of its future public. The garden's dense vegetation adds a distinctive sonic figuration to CDA North's urban landscape. In addition to the fencing, the contouring of motorized traffic flows obstructs public access to the urban sound space of President Garden. In the absence of motorized traffic and activity on nearby construction sites, this sonic figuration occupies a greater volume of urban space. In the AI-based tracing of the sonic figuration of the President Garden, the allure of this sonic figuration becomes articulated in the synthesis

cartography of the spatial distribution of its presence in relation to building layout scenarios and building implantation scenarios, as well as AI-based predictions of corresponding stress experiences. The analysis (Figures 6 – 10, legend Figure 5) indicates the presence of its allure in the surrounding public space. Indicators of stress level for the surrounding public space are lower in the presence of figuration (compare Figures 8 and 10, and Figures 7 and 9). The results of the experimental AI based analysis indicate that an inclusion of the green space and its accompanying sonic figuration could potentially lead to a sonic space shift associated with an increased experience of stress in the surrounding space and adjacent buildings.



Figures 6–10. Google Earth Satellite View of plot with garden in 2021. Presence of the sonic figuration in the public space surrounding the private plot (% / audible / non audible). Stress Level in the presence of the figuration. Presence of non-audible frequencies in the absence of the figuration. Stress Level in the absence of the figuration.

4.2.2. Helihaven Avenue

Helihaven Avenue is an old industrial 20th century urban fabric that has survived the modernist period of this area. It follows an old railway line that connected the northern part of Brussels with the Groendreef station and includes some old industrial complexes. Over the last two years, it has undergone a qualitative redevelopment, both in its northern part and in the section opposite the *Klavertjevier* primary school, as part of urban renewal programs, the implementation of a green network and private development. The transformation of this old industrial infrastructure site can be experienced both visually and aurally.



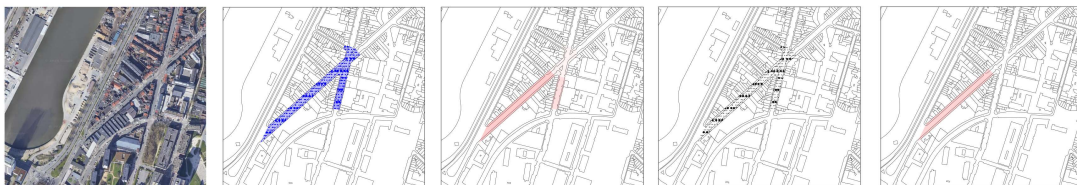
Figures 11–15. Google Earth Satellite View of the northern part of Helihaven Avenue in 2021. Presence of the sonic figuration in the public space of Helihaven Avenue (% / audible / non audible). Stress Level in the presence of the figuration. Presence of non-audible frequencies in the absence of the figuration. Stress Level in the absence of the figuration

The sonic materiality generated by the contact of moving vehicles with the cobblestones, combined with the presence of echoes in empty warehouses and vast open spaces, articulates the industrial character of this sonic space and provides a resonant sense of place. The uncertain future of this materiality reflects the presence of an ongoing sonic space shift. As in other places in Brussels, the cobblestones face a number of challenges, including gradual replacement by other materials such as asphalt (Deferm et al., 2015). Deformations in the sound space could result from rezoning, densification, replacement of the industrial fabric, and redesign of the avenue for soft mobility. In the AI-based tracing

(Figures 12 - 15) of the sonic figuration linked to the industrial complex of Helihaven Avenue, the allure is reflected in a relatively high stress level (additionally augmented the presence of its audible and inaudible sonic materiality, in particular at those locations where impact sounds are enclosed by adjacent industrial buildings. However, the absence of this figuration does not seem to exclude a relatively high level of stress for this site (compare Figures 13 and 15) as in President Garden case.

4.2.3. Masui Street

In the evening and at night, street racers circulate endlessly in Brussels Territory North, appearing to be everywhere and nowhere at once. Their performance is affectively charged and ironically distant. Racing car vibrations are strikingly present on the acoustic horizon of CDA North. The allure of a racing car exerts a profound effect on those who are exposed to its sonorous vibrations. Racers exploit the inherent sonic-vibrational elements and qualities of engine mechanics exploring the perceived limits of auditory perception and experience. This sonic figuration is indicative of complex social realities and demonstrate a fundamental drive for expression. The sonic figuration of a car speeding through Masui Street also affects and allures other people living in the area. The extended linearity and high facades of both Masui and the Antwerp stone road frame a sound space taking shape through reflection and sound amplification. The dominance of this figuration fades on Sundays and holidays. Low activity creates a mix of human voices and alternating blasts of mechanical sounds. Environmental sounds are underrepresented here.



Figures 16 – 20. Google Earth Satellite View of Masui Street in 2021. Presence of the sonic figuration in the public space of Masui Street (% / audible / non audible). Stress Level in the presence of the figuration. Presence of non-audible frequencies in the absence of the figuration. Stress Level in the absence of the figuration.

Strategies and programs for urban renewal express the ambition to improve the quality of urban life at Junction CDA Masui, including improving the public space experience for soft mobility and offering quality commercial services and local shops. The program proposes a comprehensive redesign of the intersection between Masui Street and Chaussee d'Anvers. In the AI-based tracing of the sonic figuration associated with street racing in Masuistreet, the allure is reflected in a relatively increased level of stress associated with the presence of its audible and inaudible sonic materiality (Figures 16 – 20, legend Figure 5), particularly in those locations where cars can accelerate and motorized sound and vibration are enclosed by the tall and mineral surrounding building. The analysis seems to indicate a decrease in stress levels in the absence of these sources (compare Figures 18 and 20). A focus on affect in terms of stress level analysis therefore seems to support a rationale for a reduction of motorized traffic in this part of CDA North.

5. CONCLUSION

The outcome of the AI-based *dérive* suggests that strategies for modeling compact cities that involve processes of densification and regeneration can be linked to sonic space shifts

resulting from changes in physical infrastructure and land use. Processes of urban densification and redevelopment, such as those proposed for President's Garden and Heli Haven, may involve the introduction of disruptions that create new, often uncertain sonic realities that defy conventional spatial delineations. The analysis demonstrates that these shifts can be addressed by relating critical urban strategies to the alluring behavior of sonic figurations through an analysis of variations in stress levels. The study explores outside the conventional scope of acoustic analysis by integrating AI to investigate the affective and more nuanced emotional impacts of urban strategies. The AI-driven insights into how the sounds of street racing or natural environments affect emotional well-being suggest the presence of unplace spaces that are emotionally resonant yet disconnected from conventional spatial anchors. AI-based tools and existing research suggest that both inaudible and audible sounds have an impact on stress levels, highlighting the importance of considering both perceptible and imperceptible sonic dimensions in the process of urban planning and design. This artistic exploration of an AI-driven methodology promises a more nuanced understanding of how contemporary urban contexts challenge conventional notions of space and place. It encourages a comprehensive approach that incorporates emotional and affective sonic dimensions into urban planning and design.

A final challenge that we seek to address is to ensure that the complex data and insights that we have accumulated are readily accessible and impactful in both written and auditory formats. In order to address this issue, a series of interdisciplinary strategies is proposed, targeting both urban planners and a larger audience of people living and working in the area:

- Audio essay: The audio format employs a combination of field recordings and AI-based data, relying on sensory, experiential narratives to evoke the emotional impact of urban sonic strategies, with a de-emphasis on conventional conversational formats.
- Installations and exhibits: The implementation of sound installations in the public space of Chaussée d'Anvers and museums, accompanied by visual aids and workshops, is intended to engage visitors with the sonic environment.
- As a long-term strategy, we propose the creation of interactive sound maps that present sonic space shifts in a hyper-audible manner. These maps could be used by professionals and a wider audience to experiment with the implementation of urban strategies. The cartography presents a synthesis of analytical and aesthetic elements, rendering it accessible to both experts and the general public.

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