Listening to the city

Architecture as soundscape

The Ciutat Vella has many architectural landmarks and public spaces. Since the 1980s the district in Barcelona has excelled in its pedestrian-focused policy and the quality of the street experience. This success has led to the ‘Barcelona Model’ being a benchmark for worldwide urban regeneration. Recently, the city council has sought to preserve the area’s identity, and policies to manage and control busking have been instigated. The site offers a rich source for improved understandings of how public spaces can be regulated and renovated. Dr Llorca-Bofi, architect and researcher at the Institute of Technical Acoustics, RWTH Aachen University, has been researching the role of architecture and acoustics in these spaces. His work offers insights on the conflicts and opportunities relating to street musicians, and the potential for optimising acoustics in the city space.

Buskers in the Ciutat Vella may favour certain sites, as they are visible to people while being outside the main pedestrian flow where they could cause an obstruction. Yet research has been lacking that defines the impact music has on perceptions of space and place. Better definitions would provide knowledge of how pedestrian flow and acoustics impact street performers, helping to inform public administrators.

Plaza del Rei is an intimate open space in the old city of Barcelona. Its soundscape is normally shaped by street musicians. This 3D model is combined with real acoustic measurements used for simulation studies. The user can see, listen and walk in every direction of the virtual space in an immersive laboratory.

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The four areas in Ciutat Vella are regarded as ‘open music halls’ where sound quality can be impaired by the through flow of people. The study categorises performance space into two types: one for spontaneous performance that relies upon a high level of through movement, the second suited to organised events that can host a larger audience. This method of analysing spatial configuration and acoustics in compact urban spaces helps identify possible new spaces for street performance.

3D MODELLING

In order to measure and therefore understand how acoustics work in different auditoriums and spaces, Dr Llorca-Bofi and colleagues have developed a method using photogrammetry, a technique that creates 3D models of performance spaces like concert halls through building up a series of images that represent the hall. A series of between 400 and 800 overlapping photographs are added to software to build a basic model that closely matches the physical environment it represents. Issues remain due to the technicalities and geometries of successfully imaging some details, for example spotlights and balcony architecture. Although these technicalities are challenging, the models offer improved accuracy; reliance on architectural drawings of a room can be misleading due to inaccuracies. 3D modelling can be useful for acoustic and visual simulations, and the technique is a user-friendly method for obtaining spatial information of a hall.

SPACE SYNTAX AND URBAN ACOUSTICS

Issues related to space syntax and urban acoustics such as noise pollution have been researched previously, but no studies so far have been conducted on the influence of urban configurations on the daily activity of street music performance. Dr Llorca-Bofi and colleagues conducted a general analysis of natural pedestrian movement in Barcelona and of four public spaces in Ciutat Vella. The analysis looked at the potential for the forming of groups and interactions as people flow through the area. The acoustic features were measured for each site and were then combined with spatial analyses to understand the correlations and frictions between the spatial and acoustic values. In car-oriented areas of the city, pedestrians are forced onto narrow sidewalks, while other areas have the potential to provide suitable spots for performers. Generally, street performers favour sites where they can set up stage close to the main flow of people while avoiding conflict due to narrow passages and streets. The findings can help in planning for a successful street performance culture through identifying

and musicians on suitable sites for busking. Space syntax is one way to understand the built environment and the diverse social occurrences and interactions within it, ranging from space and people’s behaviour within it, due to their movement patterns being shaped by the urban grid. This natural movement theory helps determine if designated sites for busking are suitable and can inform the identification of future locations that are connected to the main flows of pedestrians.

PERCEPTIONS OF LOUDNESS

Those simulations play an important role when reproducing sound in laboratory settings. In those situations, there can be a mismatch between the perception of sound coming from speakers and the sound received through headphones. Adjusting for this difference is important when developing authentic scene representations in 3D virtual reality. Loudness is encoded based on the distance from a source and what materials are in the space. ‘Wrong loudness’ in virtual settings can distract the user from full immersion in a scene. Dr Llorca-Bofi and colleagues conducted a test with listeners who were asked to rate if the sound coming from a loudspeaker or from headphones was louder. Three different rooms were used: an office space, a reverberation chamber and a semi-anechoic chamber that absorbs soundwaves. The results indicate that low-frequency and closed materials are in the space. ‘Wrong loudness’ in virtual settings can distract the user from full immersion in a scene. Dr Llorca-Bofi and colleagues conducted a test with listeners who were asked to rate if the sound coming from a loudspeaker or from headphones was louder. Three different rooms were used: an office space, a reverberation chamber and a semi-anechoic chamber that absorbs soundwaves. The results indicate that low-frequency and closed
Behind the Research
Dr Josep Llorca-Bofí

Bio
Dr Josep Llorca-Bofí is an architect and post-doctoral researcher at the Institute of Technical Acoustics, RWTH Aachen University. He was awarded the coveted Professional Piano Award at Conservatory Phase before attending higher education in the Barcelona School of Architecture –UPC. During his time in UPC, Josep served as an assistant professor at the Architectural Representation department. He handles both building and room acoustics in order to grasp a possible representation of ‘space and sound’ – a phenomenon that seems familiar to everyone when it comes into the combination of ‘architecture and music’.

Research Objectives
Dr Llorca-Bofí studies how the architectural design of cities influences outdoor acoustics.

Fundings
This work was supported by the Ministerio de Ciencia e Innovación (BIA2016-77464-C2-1-R; BIA2016-77464-C2-2-1-R) and also this project was also supported by the National Programme of Research, Development and Innovation aimed to the Society Challenges BIA2016-77464-C2-1-R & BIA2016-77464-C2-2-R of the National Plan for Scientific Research, Development and Technological Innovation 2013–2016, Government of Spain, titled “Innovation 2013–2016, Government of Spain, titled

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Yes. The increasing interest in the sound qualities of cities puts this field of research under the spotlight. In particular, our researches have been in the debate for soundscapes studies in cities like Valladolid (Ruiz et al., 2018), and have been speaking at the XIII International Congress on Acoustics, 9–13th September, Aachen, Germany. Available at: https://doi.org/10.4995/ega.2019.11780


Personal Response

The architecture student Rebekah excelled with her drawings. Like her colleagues, she perceived without seeing it. The resulting test helps improve sound reproduction in simulated circumstances, thus developing accuracy and reliability in test settings.

TEACHING TOOLS
One element of research and teaching on architectural acoustics and public space has been the development of teaching tools to help train architectural students. As a guide to inspiration and the generation of ideas, visuals have often been used; however, sound can also inspire ideas. Dr Llorca-Bofí has developed a soundscape based on domestic sounds such as voices and doors opening, which students were asked to listen to and then design the space it suggested to them. The ‘design fixation model’ uses external stimuli at the start of a project to stimulate ideas. Dr Llorca-Bofí has also inspired ideas. Dr Llorca-Bofí is an architect and post-doctoral researcher at the Institute of Technical Acoustics, RWTH Aachen University. He was awarded the coveted Professional Piano Award at Conservatory Phase before attending higher education in the Barcelona School of Architecture –UPC. During his time in UPC, Josep served as an assistant professor at the Architectural Representation department. He handles both building and room acoustics in order to grasp a possible representation of ‘space and sound’ – a phenomenon that seems familiar to everyone when it comes into the combination of ‘architecture and music’.

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• Dipl-Ing Ingo Witew
• Prof Ernest Redondo
• Prof Michael Vorländer
• Prof Sophia Psarra
• Dr Alvaro Clua

Collaborators

Sustainable development, personalising education, and drawing.

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