A Grain of

A Multimodal Representation of the City's Ecology Through Material and Sound

Enza Migliore*
School of Design, Southern University of Science and Technology
Shenzhen, P.R. China
emigliore@sustech.edu.cn

Hanyu Qu
School of Design, Southern University of Science and Technology
Shenzhen, P.R. China
quhy@mail.sustech.edu.cn

Marcel Zaes Sagesser
School of Design, Southern University of Science and Technology
Shenzhen, P.R. China
msagesser@sustech.edu.cn

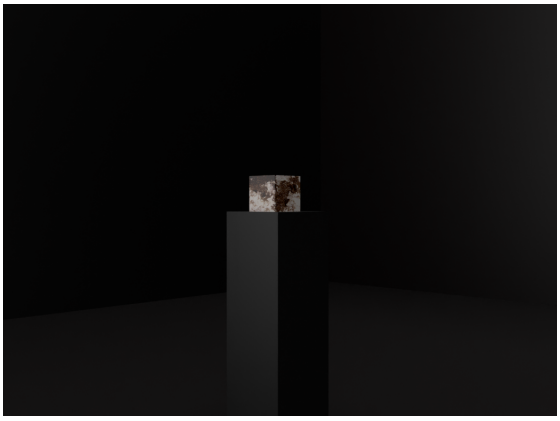

Figure 1: 3d model of art installation as exhibited, material cube with sound on plinth

ABSTRACT

"A Grain of" is an art installation made by the authors: a small cube (25 x 25 x 25cm) of custom-made matter, sitting on a plinth, emitting sound from within. Its underlying idea is to take a "grain" from a dense, contemporary urban space and translate it into an art installation that makes the city experienceable for the audience. This small cube holds some of the material and sonic ecology of the city from which it stems embedded in it. In this paper, the authors describe the technical processes that they have used to sample and reinterpret the city's material and sonic ecologies, including Atomic Force Microscopy (AFM), 3d printing, field recording, and sound synthesis. They offer some theoretical notes towards the grain of the city in order to investigate how this process of technical translation produces an experience with affective, poetic, and speculative potential. They argue that this experience lets its audience critically rethink the old enduring binaries between *natural* and *artificial* or between the *city* and *nature*.

*All three authors contributed equally to this research.

TEI '23, February 26 – March 1, 2023, Warsaw, Poland

ACM ISBN 978-1-4503-9977-7/23/02.
https://doi.org/10.1145/3569009.3576178

CCS CONCEPTS

• **Human-centered computing** → **Visual analytics**; • **Applied computing** → **Fine arts**; **Media arts**; **Sound and music computing**.

KEYWORDS

material ecology, sonic ecology, urban space, speculative design, material inquiry, media art, fine art, sound art, art installation

ACM Reference Format:
Enza Migliore, Hanyu Qu, and Marcel Zaes Sagesser. 2023. A Grain of: A Multimodal Representation of the City's Ecology Through Material and Sound. In *TEI '23: Proceedings of the Seventeenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '23), February 26-March 1, 2023, Warsaw, Poland*. ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3569009.3576178

1 INTRODUCTION: THE ART INSTALLATION

"A Grain of" is an art installation made by the authors: a small cube of custom-made matter, sitting on a plinth, emitting sound from within (see figure 1). It draws its main inspiration from a *grain* of the city — i.e. some smallest unit of a larger structure such as the "seed-like particle" that is the etymological root of "grain" [2]. The primary idea is that the dynamic coexistence of people, nature, and built elements in dense urban settings inform the material ecologies within these environments to the extent that it becomes difficult – if not impossible – to distinguish between what might have been *natural*, *organical*, *cultural* or *human-made* in the first place. The art installation "A Grain of" takes such a *grain* from the city to the art gallery, so that the audience may gain an affective relationship

to the hybrid material realities of the city by interacting with the installation. Yet, this change of location of this single "grain" from the city to the art venue is not without complexity, as the authors introduce a series of methods that translate, reinterpret, resize, and mediate this grain into something else: they sample from the city's streetsides arbitrarily found soil and sound recordings and further analyze and process them in the lab to develop imaginative, speculative material-sonic worlds. It is this very physical-sonic artifact that the audience interacts with in the exhibition gallery.

In this paper, the authors briefly describe their cross-disciplinary, collaborative art installation "A Grain of" including the procedures of translation that lie at its ground. They offer some theoretical notes to analyze a contemporary city's ecology through material and sound. They argue that "A Grain of", by reinterpreting and enlarging a found grain of a city within an art venue, and by using a multimodal representation including material and sound, may produce for the audience a sense of heightened awareness for the complex material realities of dense, contemporary urban landscapes.

2 AGAINST BINARIES: THE CITY'S MATERIAL ECOLOGY

Our contemporary cities, especially those densely populated and with compact, concrete-heavy urban areas, are often described as built entities that oppose nature, and binaries between nature and culture, or between city and the countryside, endure [15, p. 65] [6, p. 36] [16, p. 506] [13, p. 84]. Yet, we are critical about such a nature-culture binary as we think that the humanly built environments always coexist with the natural elements that they may at once eliminate but also give rise to. In terms of a city's material ecology, we deal with what we call "hybrids": pieces of matter that contain traces of both industrially-made and organic structures. We understand the material-sonic ecology of a city also as a poetic space upon which imagination can grow. The idea of bringing a *grain* of the city from the streetside to the art gallery takes up exactly that, namely the idea that we put to work the imagination of our audience when interacting with the presented art installation.

Figure 2: One of the streetside sampling locations for soil, sand, puddle water, contact microphone recording, and ambient sound recording (City of Shenzhen)

3 PRODUCING HYBRID MATTER

For "A Grain of", we used found and excavated matter from the city's streetsides (soil, sand, puddle water) as components in industrial production to develop new material entities that are hybrids between the richness of material traces from the city and "clean" industrial production (see figure 2). We produced an experimental material expression of which the cube is shaped: a hollow cube with a rich textural surface. The materiality of the cube we produced through mixed methods, technologies, and scale transitions, merging science, design, industry, and crafting. From the scientific observation through Atomic Force Microscopy (AFM), we obtained the three-dimensional morphology of grains from the collected soil at microscopic scale. This otherwise invisible anatomy we translated, through experiments of scale, into a texture for the hybrid-produced material, which also embeds traces of raw matter. The materiality of this project is an interface to experience the invisible essence of our urban surroundings. We present it as flexible and viscous, capable of escaping all the binary codes of human vs. non-human, natural vs.artificial, and digital vs. physical.

Methodologically, we approach the hybrid and complex nature of contemporary matter through practices of material speculation, which are introduced by Wakkary et al. [17] as complementary to design fiction and drawing on the literary theory of possible worlds. This approach is based on the production of specially designed artifacts, as counterfactual artifacts, which are insinuated in our everyday world as alternatives. Material speculation utilizes physical design artifacts to generate possibilities to reason upon. A key aspect of counterfactual artifacts is the encounter with people, in fact, "the possible world or fictional account is not embodied fully in the counterfactual artifact rather it is generated by interactors in the encounter or experience of the counterfactual artifact." [17, p. 100] The material expression of the cube offers both an alternative experience of the actual matter of our urban surroundings and an opportunity to experiment and speculate on contemporary production processes. The object is realized through what we could consider a form of "hybrid crafting" [9, p. 684]. "The digital age continues to challenge craft. As digital technology enters craft processes, any skill- and knowledge-based craft concepts must embrace abstract tools, too." [9, p. 683]. We use sophisticated scientific tools, such as Atomic Force Microscopy (AFM), combined with common digital manufacturing and iterative prototyping with different techniques and materials, as a contemporary form of post-industrial design manufacturing. We translate the data obtained from the AFM into 3d models through additive manufacturing. During the process, we interpreted and scientifically manipulated the gained data by adopting different scales of visualization, and we finally selected the morphology which represents the anatomy of the collected matter, which is displayed in figure 3.

4 THE SONIC GRAIN

A similar rationale than in the city's material ecology also guides our thinking when it comes to the sonic ecology that we find in densely populated urban settings. In sound, binaries between music and noise, or between sound and noise, remain perhaps even more enduring than the nature-culture binaries [3, p. 2]. The sonic ecology of a city is rather well studied in academic research [1] [4],

Figure 3: Experiments of manufacturing, first prototype of Sample1, wet vegetal matter under decomposition (soil #1). 3d printing, opaque white resin. On the left, we used a logarithmic vertical scale, and on the right, a linear vertical scale.

[5] [10] [14], yet in the everyday it is often put away as pollution or noise with a hint of depreciation – provided it is noticed at all. Cathy Lane and Angus Carlyle remind us that field recording – a practice of documentary media used to represent sonic environments – can provide us with "unique insights into the world that no other documentary medium is able to deliver" [7, p. 13]. Beyond sound as a way of knowing, they understand it in terms of its "affective pleasures" [7, p. 13] for the listener – a pleasure that lies less in the indexed knowledge than in the very sound itself. Following Lane and Carlyle, we believe that listening to the sonic ecology of a city can teach us additional knowledge about how its ecology is composed. We take this exercise of listening as an opportunity to move beyond any noise-sound binary, and we instead understand the sonic ecology as "vibrational practice" that "always comes into being through an unfolding and dynamic material set of relations" [3, p. 10].

We recorded the city from each streetside location from which we also took soil with both a contact microphone that picks up vibrations from the ground and a regular condenser microphone that captures the surrounding ambient noise. The spectrograms and waveforms of both microphones are displayed in figures 4 and 5. Through this technical array of microphones that we put out in the city, we sampled a sonic ecology that is made of background traffic sound, foreground footsteps and individual passing cars, low-frequency vibrations from heavy trucks, nearby subway trains, construction noise, and ambient noise from wind, rain, insects and birds. Along the lines of our observations with the soil samples, these recordings exemplify the hybrid nature of the urban sonic ecology, which contains, and deeply mixes, natural with human-made and technological sounds. We particularly attend the city's most unspectacular sonic ecologies, found in the streetside underwoods between cars, waste, worms and rats. These are the locations which commonly go unnoticed [5, p. 8]. But in each such sonic "grain" that we collect, that is, record, we can find the entirety of the (sonic) city. The captured samples were then subjected to technological processes in order to enrich them and to emphasize their hybridity on an affective level. We took pure digital sine waves, and we run these sine wave tones through a granular synthesis algorithm that cuts the wave up in little 10ms chunks, repeats and overlaps these little chunks so to produce a dense, granulated sonic texture [11] [12] that may remind us of a large number of grains sounding together – displayed in figure 6. Ultimately, the granulated sine wave texture is blended with the mixed city sample. The outcome is a sonic composition that is site-specific to the city from which it stems and to the material grain that the cube is made of.

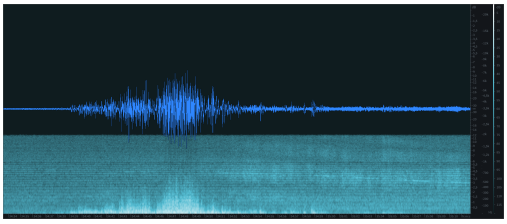

Figure 4: Spectrogram & waveform of streetside sound recording with contact microphone, showing low frequency rumble under 400 Hertz (here in a 40sec excerpt)

5 CONCLUSION: THE GRAIN AS AN INTERFACE

What the audience in the gallery experiences is an art installation that makes sound: a small cube on a plinth. This small cube, metaphorically and literally, holds some of the material and sonic ecology of the city embedded in it. The audience experiences how the physical material world of that city interacts with its sonic reality. The art installation produces a small-scale multimodal experience from within a small cube – thereby inviting spectators to "micro-immerse" themselves when approaching it. "A Grain of" is a small and subtle installation that refrains from giving answers and instead incentivizes the audience to view our contemporary urban settings differently. At the basis of the work lies a material-sonic sample, acting as an "inter-face" [8, p. 148] – an actual touching surface between matter, light, and sound as well as a "space between" [8, p. 148] (the human and the machine) – for experiencing the multimodal sonic and material ecologies of the sampled city.

ACKNOWLEDGMENTS

The authors would like to thank Massimiliano Galluzzi, Scientific Researcher at the Shenzhen Institute of Advanced Technology, Chinese Academy of Science, for partnering with us in this project; particularly for his time, thoughtfulness and ideas when creating microscopic analyses of our material samples in the lab. We would also like to thank the research assistants Binghuang Xu and Che Ran for their continuous support in this research project, as well as the SUSTech School of Design in Shenzhen for funding and supporting this research project so thoroughly. A huge thank you also goes to the SUSTech School of Design's administrative team who accompanied us several times when conducting outdoor fieldwork across the city of Shenzhen.

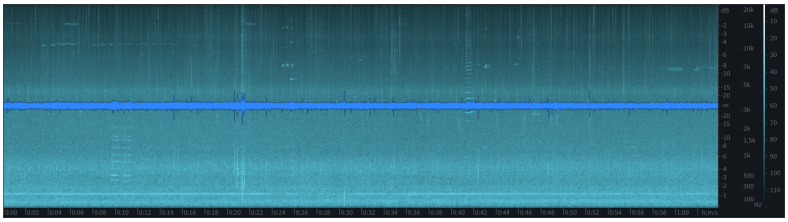

Figure 5: Spectrogram & waveform of streetside sound recording with ambient condensor microphone, showing mostly mid and high frequency noise (here in a 1min excerpt)

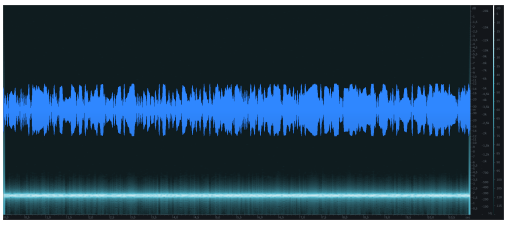

Figure 6: Spectrogram & waveform of synthetic sine wave tones processed with granluar synthesis algorithm. The representation indicates the many short rhythmic 'grains' that add to the sonic texture (here in a 10sec excerpt)

REFERENCES

[1] Jacques Attali. 1985. *Noise: The Political Economy of Music.* University of Minnesota Press. Google-Books-ID: fXBrngEACAAJ.

[2] Julia Cresswell and Julia Cresswell. 2021. *Oxford Dictionary of Word Origins* (third edition, third edition ed.). Oxford University Press, Oxford, New York.

[3] Nina Sun Eidsheim. 2015. *Sensing Sound: Singing and Listening as Vibrational Practice.* Duke University Press, Durham; London. OCLC: 925029589.

[4] Steven Feld. 2015. Acoustemology. In *Keywords in sound*, David Novak and Matt Sakakeeny (Eds.). Duke University Press, Durham NC, 208–221. OCLC: 885231605.

[5] Matthew Gandy. 2014. Acoustic Terrains: An Introduction. In *The Acoustic City.* Jovis.

[6] Thomas Kvan and Justyna Karakiewicz (Eds.). 2019. *Urban Galapagos: Transition to Sustainability in Complex Adaptive Systems.* Springer International Publishing, Cham. https://doi.org/10.1007/978-3-319-99534-2

[7] Cathy Lane and Angus Carlyle. 2013. *In the Field: The Art of Field Recording.* Uniformbooks. Google-Books-ID: ZbMLmAEACAAJ.

[8] Anna Munster. 2011. Interfaciality. In *Materializing New Media: Embodiment in Information Aesthetics.* Dartmouth College Press, Lebanon. http://grail.eblib.com.au/patron/FullRecord.aspx?p=1085079 OCLC: 880909106.

[9] Michael Nitsche and Anna Weisling. 2019. When is it not Craft?: Materiality and Mediation when Craft and Computing Meet. In *Proceedings of the Thirteenth International Conference on Tangible, Embedded, and Embodied Interaction.* ACM, Tempe Arizona USA, 683–689. https://doi.org/10.1145/3294109.3295651

[10] Nina Power. 2014. Soft Coercion, the City, and the Recorded Female Voice. In *The acoustic city*, Matthew Gandy (Ed.). Jovis, Berlin. OCLC: 898657619.

[11] Curtis Roads. 1988. Introduction to Granular Synthesis. *Computer Music Journal* 12, 2 (1988), 11–13. https://doi.org/10.2307/3679937

[12] Curtis Roads. 2001. *Microsound* (1st edition ed.). The MIT Press, Cambridge, Mass.

[13] Deborah Bird Rose. 2015. Flying Foxes in Sydney. In *Manifesto for living in the anthropocene* (first published ed.), Katherine Gibson, Deborah Bird Rose, and Ruth Fincher (Eds.). Punctum Books, Brooklyn, NY.

[14] Jonathan Sterne. 2013. Soundscape, Landscape, Escape. In *Soundscapes of the Urban Past*, Karin Bijsterveld (Ed.). Transcript Verlag, 181–194. https://www.jstor.org/stable/j.ctv1xxsqf.11

[15] Erik Swyngedouw. 1996. The City as a Hybrid: On Nature, Society and Cyborg Urbanization. *Capitalism Nature Socialism* 7, 2 (June 1996), 65–80. https://doi.org/10.1080/10455759609358679

[16] David Wachsmuth. 2012. Three Ecologies: Urban Metabolism and the Society-Nature Opposition. *The Sociological Quarterly* 53, 4 (Sept. 2012), 506–523. https://doi.org/10.1111/j.1533-8525.2012.01247.x

[17] Ron Wakkary, William Odom, Sabrina Hauser, Garnet Hertz, and Henry Lin. 2015. Material Speculation: Actual Artifacts for Critical Inquiry. *AAHCC* 1, 1 (Oct. 2015), 12. https://doi.org/10.7146/aahcc.v1i1.21299

Received 6 January 2023; revised ; accepted