

Acoustic Grounds Winter Workshop | Project Weeks

March 08-17 2023

Location:

UD seminar room and on zoom:

Topic: Acoustic Grounds Winter Workshop

<https://tum-conf.zoom.us/j/61215497972?pwd=NHZRYzdRWnEzUmRIZmgrUmFpM3RJUT09>

Meeting ID: 612 1549 7972

Passcode: 2023

Introduction

Noise pollution is the number two environmental health risk in Europe (World Health Organization 2011). As the global population has become predominantly urban, a growing number of people are exposed to and affected by urban noise. The health risks associated with noise range from acoustic discomfort, sleep disturbance, and cognitive impairment to ischemic heart disease. It is estimated that in Western Europe alone, at least 1.6 million healthy years of life are lost because of environmental noise (ibid). Airports are significant contributors to urban noise (Boucein et al. 2017). Unlike indoor noise, which is extensively addressed using digital tools in architecture, there are limited parallel efforts in landscape architecture (Niesten, Tenpierik, and Krimm 2022). In this context, mitigating outdoor noise through ground forming can replace the standard use of sound barriers and offer noise reduction means together with recreational use (Sorvig and Thompson 2018). The winter workshop will explore the use of digital tools for designing acoustic grounds.

Digital tools and robotic platforms are increasingly being utilized for environmental purposes, allowing new ways to explore, monitor, and adapt environments (Cantrell and Mekies 2018; Walliss and Rahmann 2016). This allows examining their use in creating performative urban landscapes which respond to environmental challenges and changing conditions. On the one hand, these tools are increasingly precise, and on the other hand, they allow incorporating information from natural phenomena which are often chaotic and disordered. This allows developing urban and performative design in response to pressing global challenges, amongst them, noise pollution.

Objective and Site

With this question in mind, we are looking at the airport environments as a case study (Bar-Sinai et al. 2023). The seminar will focus on translating noise landscapes, produced by large urban infrastructure or traffic into responsive landforms. In contrast to common industrial solutions (such as noise barriers along roads), we will develop designs in which landforms have a functional role in the urban landscape and can mitigate noise effects. We will then compare the acoustic performance of these landscapes and their potential to respond to the specific noise on-site. Our case study site is situated in Hallbergmoos, southwest of the Munich International Airport. Building on previous seminars, we will sample noise online and on-site, develop a design for acoustic grounds - a park based on landforms that can mitigate the noise. We will then simulate and test the design of in response to the noise we record.

Format

The course is interdisciplinary, open to students from TUM. All work will be undertaken in groups. The course will be adapted to the interdisciplinary composition of the participants.

We will meet in a hybrid of online/in person meetings for the first few days, and then physically in Munich in the following days (see schedule below). The work will be presented in the final day of the workshop in a presentation and booklet format. Full materials and files would be handed in at the last day. In addition, as per the requirements of the Project Weeks initiative, all participants will have to fill a mandatory survey at the end of the project as part of the course requirements.

Seminar thematic sections:

1. Analyzing noise and understanding noise landscapes:

In the first phase we look into how noise data can be interpreted, measured and represented. We also look into how noise landscapes are shaped in the case of Munich Airport's immediate surroundings. This will be performed by harvesting data from airport noise monitoring stations, and through on-site measurements to understand real-life impact of noise.

2. Exploring / Testing of different conditions and designs

Based on the understanding and models of the first phase, we will move on to working in the two groups described above.

Group 1 Environment – testing how environmental conditions impact the simulation.

This group will explore the simulation conditions and test how changes in the size of the model affect the simulation environment and therefore the results. The parameters that will be tested are (1) the simulation box – how the size impacts the results, and how weather conditions can be translated to the box-settings; (2) materials - how the noise landscape and mitigation is affected when using different materials (texture, surface conditions, etc.); (3) noise emitter location – impact on noise mitigation when the noise source is on the ground, in the air, or part of a few, parallel, emitter. The aim of this group is to produce a graph of this sort summarizing the impact of these environmental conditions on the acoustic performance. The parameters that best represent the reality will be used to test the results of group 2.

Group 2 - Form- testing how variety and irregularity in the design effects on noise mitigation. This group will look at the optimization of the design section for noise mitigation. Drawing on our most recent results of the research, the group will test extruded sections that include (1) different sized undulations (i.e., 1.5, 2.0, 2.5 m high); and more variations of the previous designs (high to low, solid sections with a valley, etc.); (2) irregularity in the mound height/shape, such as by introducing sub-undulations ; (3) the best performing sections will be tested in a hybrid section – that include 2-3 different ones.

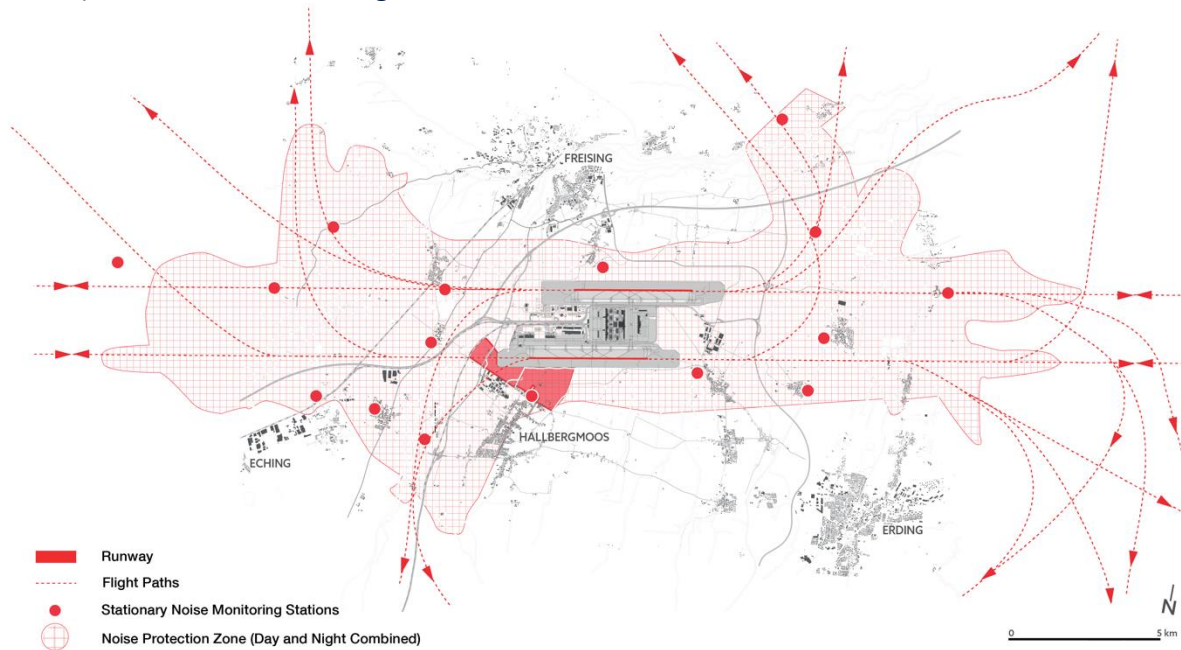
This group will explore while building upon the already existing design. We will test different height and designs of mounds and compare them. The aim of this group is to narrow down the based mound-forming pattern that enhances acoustic performance.

3. Assessment and comparative analysis

We will compare and evaluate the various forms and their acoustic performance and effectiveness in noise mitigation in urban design. Followingly, we will link the best results of the two groups toward the last day of the workshop in order to test the best performing scenarios.

Teaching team

The workshop is taught by Dr. Karen Lee Bar-Sinai, Dr. Tom Shaked and Ph.D. Candidate Elif Simge Fettahoglu, with the involvement of the Munich Airport, and experts on noise landscapes – Prof. Benedikt Boucsein, Chair of Urban Design, Dr. Jochen Krimm (Frankfurt University of Applied Sciences), and with the teaching assistants Ekaterina Pestriakova and Liubov Kniazeva.



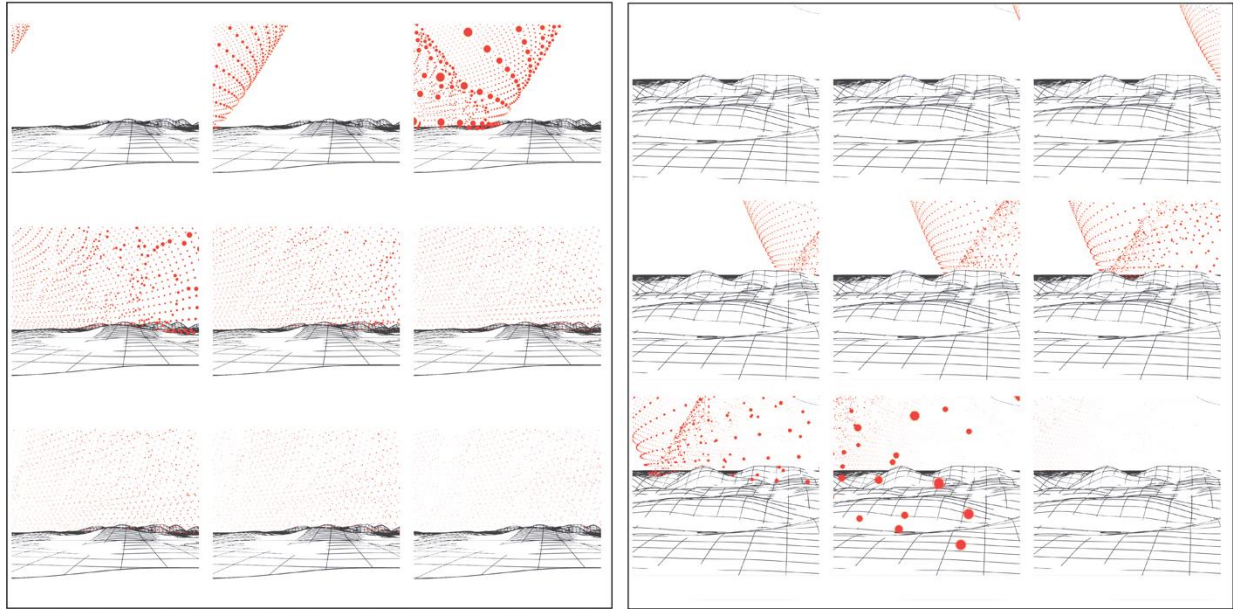


Image: (top) The location of the selected case study, situated in Hallbergmoos, southwest of the Munich International Airport. The map shows the site in relation to the flight trajectories and the stationary noise monitoring stations. (bottom) acoustic simulations of landforms (Bar-Sinai et al. 2023).

Program:

Date	time	activity
	Section 1: Analyzing noise and understanding noise landscapes	
Wednesday 08.03.2023	9:30-10:45	(zoom) Introduction and introductory lecture - goals and expected outcome (zoom). Ekaterina/Liubov present last semester's work
	11:00 -12:30	(zoom) Introduction to Urban Acoustics and Measurement/ Dr. Jochen Krimm
	13:30 - 18:30	Site visit with student TAs, and forming working groups <i>*keep ticket receipts for reimbursement</i>
Thursday 09.03.2023	09:30-10:45	Discuss and prepare measurements for presentations (self work in groups)
	11:00-12:30	(zoom) Discussion on measurements and site impressions
	12:30 –13:00	Measurement files – correction by groups (self work)
	14:30-17:00 (breaks in-between)	(zoom) Technical lectures - parametric design, introduction to our code (zoom) - parametric design, introduction to our code (zoom), planning the work day tomorrow
	Section 2: Exploring / Testing of different conditions and designs	
Friday 10.03.2023	09:00-17:00	Independent work in groups
Monday - Thursday	09:00-17:00	Guided work in groups, Check in Monday with Dr. Jochen Krimm for discussing strategies.
Tuesday 14.3.2023	13:00-14:30	mid review discussion
	Section 3: Assessment and comparative analysis	
Thursday	09:00-14:00	Simulations and combination between group 1 and 2
	14:00-17:00	Beginning to prepare presentation
Friday 17.3.2023	09:00 -11:30	Preparation of presentation
	11:30 -12:00	Review of Project Weeks (mandatory)
	12:00-13:30	Presentation: UD seminar room
	13:30-14:00	Review session and conclusion

References

- Bar-Sinai, Karen Lee, Tom Shaked, Elif Simge Fettahoglu, Jochen Krimm, and Benedikt Boucsein. 2023. "Embedding Acoustic Analysis in Landscape Architecture Design Processes: A Case Study of Munich Airport." *Buildings* 13(1). doi: 10.3390/buildings13010143.
- Boucsein, B., K. Christiaanse, E. Kasioumi, and C. Salewski. 2017. *The Noise Landscape: A Spatial Exploration of Airports and Cities*. nai010 publishers.
- Cantrell, Bradley E., and Adam Mekies. 2018. *Codify: Parametric and Computational Design in Landscape Architecture*. New York ; London: Routledge; Taylor & Francis Group.
- Hornikx, Maarten. 2016. "Ten Questions Concerning Computational Urban Acoustics." *Building and Environment* 106:409–21. doi: <https://doi.org/10.1016/j.buildenv.2016.06.028>.
- Lugten, Martijn. 2019. "Tranquillity by Design - Architectural and Landscape Interventions to Improve the Soundscape Quality in Urban Areas Exposed to Aircraft Noise."
- Niesten, J., M. J. Tenpierik, and J. Krimm. 2022. "Sound Predictions in an Urban Context." *Building Acoustics* 29(1):27–52. doi: 10.1177/1351010X211034665.
- Sorvig, Kim, and J. William Thompson. 2018. "Quietly Defend Silence." Pp. 363–72 in *Sustainable Landscape Construction: A Guide to Green Building Outdoors*, edited by K. Sorvig and J. W. Thompson. Washington, DC: Island Press/Center for Resource Economics.
- Van Der Harten, Arthur. 2013. "Pachyderm Acoustical Simulation: Towards Open-Source Sound Analysis." *Architectural Design* 83(2):138–39. doi: 10.1002/ad.1570.
- Walliss, Jillian, and Heike Rahmann. 2016. *Landscape Architecture and Digital Technologies: Re-Conceptualising Design and Making*. Abingdon, Oxon, UK: Routledge.
- World Health Organization. 2011. *Burden of Disease from Environmental Noise: Quantification of Healthy Life Years Lost in Europe*. Regional Office for Europe: World Health Organization. Regional Office for Europe.
- Yan, Feng, Jingjing Shen, Wuxia Zhang, Leiting Ye, and Xinfeng Lin. 2022. "A Review of the Application of Green Walls in the Acoustic Field." *Building Acoustics* 29(2):295–313. doi: 10.1177/1351010X221096789.