Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Ioannis Tsionis
Student number	4873440
Telephone number	
Private e-mail address	

Studio		
Name / Theme	Building Technology track – Sustainable Design Graduation Studio	
Main mentor	Martin Tenpierik	Climate Design
Second mentor	Michela Turrin	Design Informatics
Argumentation of choice of the studio	The design of urban elements concerning acoustic performance through sustainable strategies and materialization and parameterization of design choices.	

Graduation project	
Title of the graduation project	Make Some Noise Schiphol – Study on a parametric architectural strategy for the design of aircraft noise abatement landscape elements within cities.
Goal	
Location:	Rijsenhout, Netherlands
The posed problem,	1. Aircraft noise exposed residential area (Rijsenhout) near Amsterdam Schiphol airport and the constant exposure of inhabitants to harmful noise levels (>70dB). 2. Absence of a typology of landscape configurations that act as noise barriers against aircraft sources within a city environment.
research questions and	*How can acoustic parametric landscape design and optimization tools contribute in the reduction of aircraft noise and to what extent can it improve the soundscape quality of areas near airports?* To specify this better, generated sub questions will guide the literature and research approach in order to reach a desired outcome. These are listed below: 1. To what extend can the structure of a computational acoustics study for outdoor environments be simplified and inserted into a design environment? 2. How can the propagation of aircraft sound rays affected by atmospheric refraction be represented inside a parametric design environment? 3. To what extent can parametric landscape elements be verified as an efficient aircraft noise barrier method within noise exposed urban areas?

	4. How can performance-driven variations of parametric landscape elements and materialization contribute in the dispersion and absorption of low frequencies of aircraft sound waves?
design assignment in which these result.	*To understand the extent to which acoustic parametric landscape design can be adopted as a strategy and provide solutions, regarding aircraft noise abatement on varying urban morphologies, materialization, existing building geometries and flight paths.* This research objective aims at the following: 1. To understand how the structure of an outdoor environment computational acoustics simulation can be broken down in parts and to what extend can it be simplified. 2. To develop a (graphical) representation of sound rays directionality of an aircraft source influenced by atmospheric refraction within a parametric design environment. 3. To verify landscape configurations' efficiency on improving the soundscape of urban areas against aircraft noise. 4. To understand how acoustic parametric design and materialization of landscape elements can affect the aircraft noise propagation of low frequencies at residential areas around airports.

Process

Method description

Research design

Objective 1

1. Comprehension of Nord2000 simulation method and its workflow.
2. Forming of an acoustics equation sheet, through literature and similar computational acoustics methods.
3. Development of the 3D urban context, within Rhino software.
4. Gathering of meteorological data, through Climate Consultant software and references.

Objective 2

5. Input of atmospheric parameters, within Grasshopper environment.
6. Use of ray casting method to calculate soundwave curvature, through plugins and Grasshopper components.
7. Export graphical data regarding sound propagation, through Grasshopper

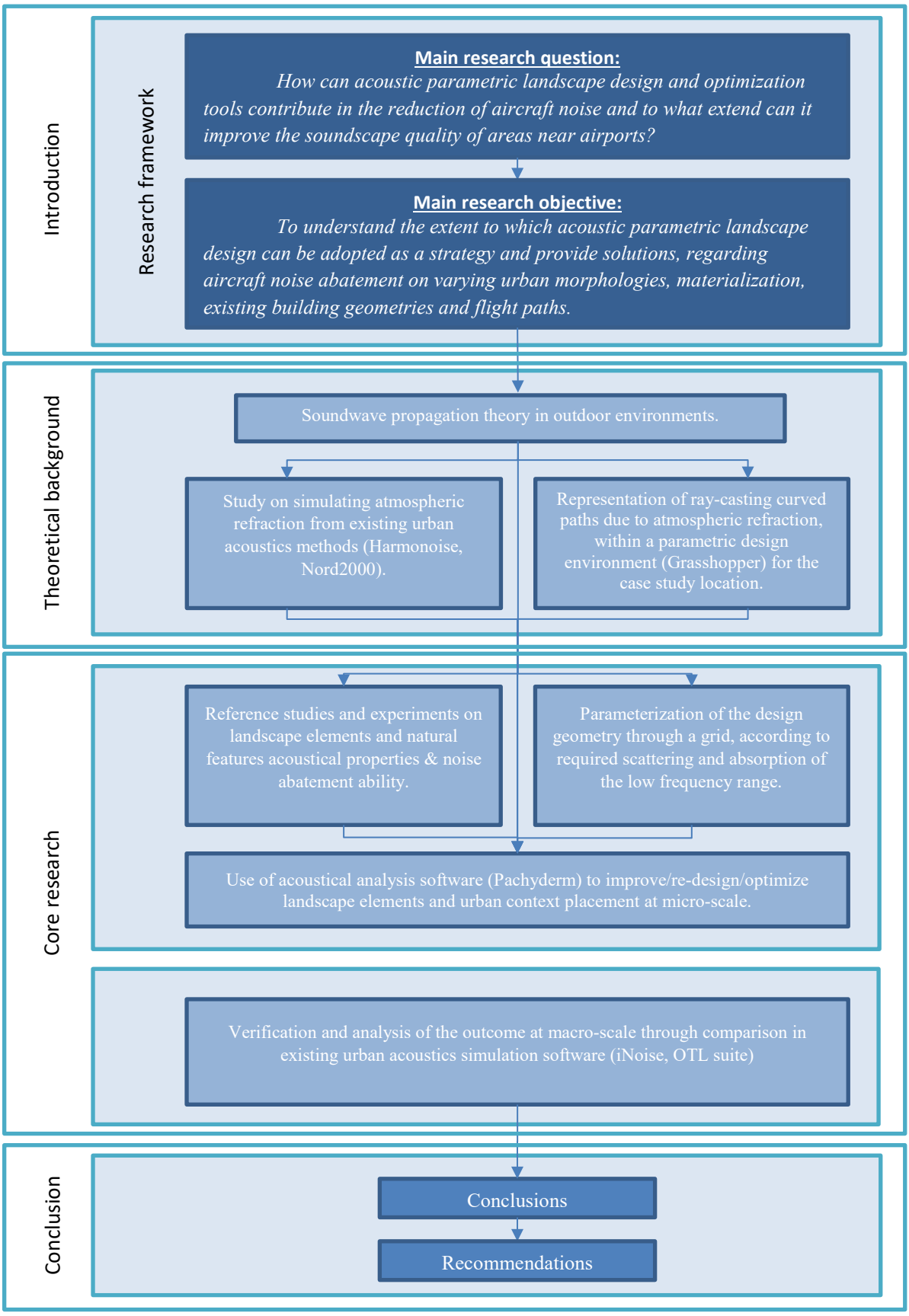
Objective 3

8. Data acquisition from study on referenced experiments, regarding landscape elements on their acoustical properties.
9. Parameterization of an urban grid, within Grasshopper environment.
10. Analyze configurations input within the built environment, through Pachyderm acoustics.
11. Design of geometric (parameterized) surfaces within Grasshopper.
12. Calculation of the scattering and absorption of generated geometrical surfaces, through Pachyderm acoustics software.

Objective 4

13. Optimization of acoustical elements and urban planning through Grasshopper & Pachyderm software.
14. Generate scenarios of building arrangement and combinations of acoustical elements within Rhino 3D environment.
15. Evaluation of the calculation process in macroscale, through other (iNoise) urban acoustics software.
16. Model making of urban planning scenarios & acoustical elements.

Research approach



Literature and general practical preference

Aish, R. (2005). From Intuition to Precision. In Digital Design: The Quest for New Paradigms, 10-14. Lisbon: eCAADe

Arntzen, M. (2014). Aircraft noise calculation and synthesis in a non-standard atmosphere. (doctoral dissertation). Delft University of Technology, Delft, Netherlands. https://doi.org/10.4233/uuid:c56e213c-82db-423d-a5bd-503554653413

Arntzen, M., Rizzi, S. A., Visser, H. G. & Simons, D. G. (2014). Framework for Simulating Aircraft Flyover Noise Through Nonstandard Atmospheres. J. Aircr. 51, 956–966

Attenborough, K. (2007). Sound propagation in the atmosphere. in Handbook of acoustics (ed. Rossing, T.) 113–147, Springer Science+Business Media

Burry, M. (2003). Between Intuition and Process: Parametric Design and Rapid Prototyping. In Architecture in the Digital Age Design and Manufacturing, Kolarevic, B. ,ed., 149-162. New York and London: Spon Press.

Connelly, M., & Hodgson, M. (2015). Experimental investigation of the sound absorption characteristics of vegetated roofs. Building and Environment, 92, 335–346. doi: 10.1016/j.buildenv.2015.04.023

Cox, T., & D'antonio, P. (2009). Acoustic absorbers and diffusers: Theory, design and application. Taylor & Francis, London

Cox, T.J., Dalenback, B.I., D'Antonio, P., Embrechts, J.J., Jeon, J.Y., Mommertz, E., Vorlander, M. (2006). A tutorial on scattering and diffusion coefficients for room acoustic surfaces, Acta Acust. United Acust. 92 (1) 1-5.

DELTA (2006). Nord2000. Comprehensive Outdoor Sound Propagation Model. Part 2: Propagation in an Atmosphere with Refraction. Horsholm, Denmark.

Hörmeyer, J., Rolfes, R. (2018). Numerical Model for Prediction of Sound Propagation Emitted from Wind Turbines. Euronoise 2018 - Conference Proceedings, Crete, Greece

Hornikx, M. (2016, June 27). Ten questions concerning computational urban acoustics. Retrieved from https://www.sciencedirect.com/science/article/pii/S0360132316302359

ICAO (2016). Aircraft Noise. Available from: http://www.icao. int/environmental-protection/Pages/noise.aspx [Accessed 3 January 2020].

Jónsson, G. B., & Jacobsen, F. (2008). A Comparison of Two Engineering Models for Outdoor Sound Propagation: Harmonoise and Nord2000. Acta Acustica United with Acustica, 94(2), 282–289. doi: 10.3813/aaa.918031

Kim, Y. H., Jang, H. S., Lee, P. J., & Jeon, J. Y. (2011). Acoustical properties of vegetation including ground Surfaces for scale model reproduction. Forum Acusticum

Krimm, J. (2018). Acoustically effective façades design (doctoral dissertation). Delft University of Technology, Delft, Netherlands

Krimm, J., Knaack, U., & Techen, H. (2017). Updated urban facade design for quieter outdoor spaces. Journal of Facade Design and Engineering, 5(1), 63-75. https://doi.org/10.7480/jfde.2017.1.1422

Lugten, M. (2014). Re-sil(i)ence: Design patterns for an aircraft noise abating spatial environment (master thesis). Delft University of Technology, Delft, Netherlands

Lugten, M, C. (2018). Tranquillity by design (doctoral dissertation).Clare College, Cambridge, England

Maleki, K., & Hosseini, S.M. (2011). Investigation of the effects of leaves, branches and canopies of trees on noise pollution reduction.

Nota, R., Barelds, R., van Maercke, D. (2005). Technical Report HAR32TR-040922-DGMR20: Harmonoise WP 3 Engineering method for road traffic and railway noise after validation and fine-tuning. Retrieved from the Information Sociate and Technology (IST) Programme

Oxman, R. (2008). Towards a Performance based Generation and Formation Model in Architectural Design. In IJAC International Journal of Architectural Computing Vol. 6, 1-17.

Peters, B. (2010, September 1). Integrating Sound Scattering Measurements in the Design of Complex Architectural Surfaces: Informing a parametric design strategy with acoustic measurements from rapid prototype scale models. Retrieved January 8, 2020, from https://adk.elsevierpure.com/en/publications/integrating-sound-scattering-measurements-in-the-design-of-comple.

Peters, B. (2009). Parametric Acoustic Surfaces. ACADIA. Retrieved from https://www.researchgate.net/publication/38977141_Parametric_Acoustic_Surfaces

Peters, B. (2007). The Smithsonian Courtyard Enclosure: a Case-Study of Digital Design Processes. In Expanding Bodies: Art "Cities" Environment: Proceedings of the 27th Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA), 74-83. ACADIA. Halifax, Nova Scotia, Canada: Dalhousie, NSCAD & CDRN.

Salomons, E. M. (2001). Computational atmospheric acoustics. Kluwer Academic Publishers

Science Communication Unit (2017). Science for Environment Policy. Noise abatement approaches. Future Brief 17. Produced for the European Commission DG Environment by the Science Communication Unit, UWE, Bristol. Available at: http://ec.europa.eu/science-environment-policy

Thomas P., Boes, M., Van Renterghem, T., Botteldooren, D., Hornikx, M., Desmet, W., Nilsson, M. (2012). Auralisation of a car pass-by behind a low finite length vegetated noise barrier, in: Proc. of 9th European Conference on Noise Control, pp. 932e937

Vlaun, N. (2015). Sound Working Environments: Optimizing the acoustic properties of open plan workspaces using parametric models (master thesis). Delft University of Technology, Delft, Netherlands

Zaporozhets, O., Tokarev, V. & Attenborough, K. (2011). Aircraft Noise: Assessment, Prediction and Control. Taylor & Francis

Time Planning

Week / Method	1	2	3	4	5	6	7	8 P3	9	10	11	12	13	14	15	16 P4
Literature study																
Acoustics study																
Simulation model																
Urban plan design																
Element design																
Model making																
Result analysis																
Evaluation																
Optimization																

Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (BT), and your master programme (MSc AUBS)?

   From an engineering point of view, aircraft noise is a problem concerning urban acoustics principles, noise reduction methods within a built environment, as well as the sustainable way of living inside noise-exposed regions. Apart from the study of urban acoustics theory, the research topic aims to use sustainable methods of engineering, in the means of material selection and natural elements design towards a comfortable micro-climate, in addition to improving the soundscape quality of the area. Moreover, one of the main research goals is to base the study within a parametric environment that gives optimization process benefits. This adopts the computational design values studied inside the master track. And since the selected case study consists of a wider building block of residential spaces, it can be referred to architects designing facades and courtyards, or landscape designers and urbanists planning public spaces within a city frame. In this way, this study contributes to the wider architectural research framework.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework?

   Noise annoyance produced by aircraft flyovers affects the population of residential areas near airports. In order to explore this subject, a wider study scale than the one of a building promises to be more effective. Thus, the results will have an impact on an urban scale, as they aim to be applied in urban planning strategies, landscape designs and materialization of public spaces. Furthermore, the goal is to provide a configuration typology of landscape acoustical elements that can be used by an architect at the process of designing with concern to aircraft noise and its abatement strategies. The configurations should provide acoustic performance data inside a parametric design environment, making it more effective to communicate the complexity of contemporary architectural design choices with engineering data. Finally, once the configurations are verified, this research should provide forward steps towards reducing the research gap of aircraft noise prediction alongside the design of noise abatement strategies.