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The aim of my thesis was to produce a digital tool that could produce a resonant panel based on Helmholtz resonators. Acoustics has been a fascination of mine for a long time, and computational design has greatly fascinated me throughout my time at Tu Delft. When I heard about the ADAM project I knew that this was the direction I wanted to graduate in. After reading some of the previous research, I noticed how the increase of the geometrical complexity to achieve a higher absorption coefficient tied the resonators to additive manufacturing. Seeing as additive manufacturing is quite slow and relatively expensive (at the moment of writing this) compared to more traditional production techniques. Changing the production technique seemed the logical step to reduce the price and increase the accessibility of resonant panels. With a fairly limited knowledge of architectural acoustics there was quite a challenge ahead.

The start of the project consisted mainly of reading, quite a lot of it fact. This was needed to gain the knowledge needed to produce a resonant panel. Besides the acoustical knowledge, the reviewed topics included: production techniques, computational design and optimization techniques. While reading and writing the outline of the project started to form. Having ten weeks purely for literature research proved very useful and interesting. Although during the many hours of reading the desire to start with the design and the experimentation grew larger and larger. Sometimes making it difficult to stay focused.

The initial idea for the project was to run simulations within Comsol to then use that data to design the digital workflow and eventually if there was time produce a model. According to university policy students are not allowed to have Comsol on their personal computers. Martin Tenpierik arranged a university laptop with Comsol that I could use for the duration of the project. To make a long story short, this laptop or any other pc we tried would not run Comsol, even not with the help of ad-hok, IT or the service point. After about three weeks of trying (and not being able to do anything else) we gave up and decided to go with physical tests in the impedance tube instead.

Going with physical test was by far the best decision within the project. I enjoyed designing, printing and testing the samples a lot. Because the samples needed to be produced quite fast there was no time to test printer settings. Therefor across all of the sample sets there are some differences being a kind of separate experiment to see how to best weigh the printing time to the quality of the sample. Since the printer was located next to my bed I could not let It run day and night and printing time was somewhat of an issue. This experimenting with the infill and the infill pattern came back to bite me with experiment five. Reducing the infill to much resulted in the entire experiment failing. Seeing as this was less than a month before the P4 and the reason for the failing not being clear at the time caused for a tough decision.

The choice after the failed experiment was: redoing the experiment and possibly failing again resulting in a rather lackluster conclusion for the project. Or taking a couple steps back and accepting that this part of the research would not work out and focusing on the parts that did work out. I choose to redo the experiments and I am very happy I did. After reassessing the results from the original experiment five it occurred to me that had to be an external factor an not due to the resonator design since all of the samples had the same error. Except the one sample that was printed by a friend of mine. It had

the same error but in a different location. Then I had very solid suspicions that it where the printer settings. It turned out it was.

After the results from the new experiment five where in, the digital workflow could be completed and the entire tool could be tested. Because there was not a lot of time left I was not able to do the measurements for the case study myself. Which I think is a pity.

Looking back on the process it definitely had its ups and downs. When you have spoken with most people in the faculty to do with IT and the problem can not be fixed, to use a Dutch proverb: De moed zakte me in de schoenen (the courage sank into my shoes). But the completion of the digital workflow and conducting the experiments where absolute highlights that I enjoyed a lot.

I think the small sample size of the experiments is a shame but unavoidable in a project of this length. When you set out to do quite a lot (in my opinion) the sample size suffers from it. I would not mind revisiting the experiments in the future in order to redo them and give the conclusions with more certainty. Besides that I would have really liked to do a full scale test or at least a test of a full panel. But due to time and financial concerns this was not a possibility.

All and all I am quite happy with the results of this project. The tool works in a way that I am very happy with. Not using any plugins or external libraries ties neatly into the idea of making resonant panels more accessible because the tool also becomes more accessible. As for the use of the tool, the theoretical results prove to be quite promising but before it can be used it needs to be verified with physical tests. If these turn out well I think the resonant panels could be a good cheaper alternative for low frequency sound absorption.

Finally I would really like to thank my tutors for making me able to do this project. Without their aid I don’t think I would have come nearly as far and achieved the results that where achieved in this project.