RESONATORIUM FOR SOPRANO AND ARCHITECTURAL SPACE

I Neuhaus I. & F. Neuhaus, Nuglar, Greater Zurich, Switzerland
F Neuhaus I. & F. Neuhaus, Nuglar, Greater Zurich, Switzerland

1 INTRODUCTION

As a duo specializing in interdisciplinary works in soundscape design, room acoustics, site-specific art and music, we have developed a special creative approach focusing on the interplay between architectural resonance spaces and sound sources. Our aim is to produce spatial compositions that create an atmosphere of openness and surroundings that inspire people.

Taking one of our musical works, “Resonatorium” for soprano and architectural space, as an example, we would like to give an idea of our way of working, and hope to open up some fresh perspectives regarding the sound of spaces.

Following an introduction to the piece, we will present excerpts accompanied by short analyses and cuts from a live recording of a performance of it, and show how the composition is based on the interaction between a sound source and a resonance space.

In a coda we will present thoughts regarding the resonance characteristics of architectural spaces and their influence on the quality of living environments; ideas that have been a driving force in our design work for many years and have often led us to new solutions.

2 THE COMPOSITION

We wrote “Resonatorium” when the exceptional Swiss singer Kornelia Bruggmann commissioned us to write a piece of music for her. She did the first performance of it in 2007, and it has been part of her concert programme since then, which also includes works like “Canti del Capricorno” by Giacinto Scelsi.

2.1 Idea and Form

In “Resonatorium” the voice functions as a sonar. The idea the composition is based on is that of making the performance space resonate in ways that bring out its acoustic characteristics, so that they can be heard in its nuances and details. This means that the focus of the musical event is not on the sound source but on the effects it triggers. So the musical problem we had to work out was not how to create interesting melodies, motifs or rhythmical patterns, but how to achieve an interesting sequence of acoustic events by triggering the resonance space in various ways.

To make the effect and perception of the acoustics of the architectural space as clear as possible, the “architectural space” parts of the piece are juxtaposed with parts in which the singer sounds out the internal space of her own body. That way we built the form of the piece, starting with the longest “internal space” part to have a concentrated beginning.

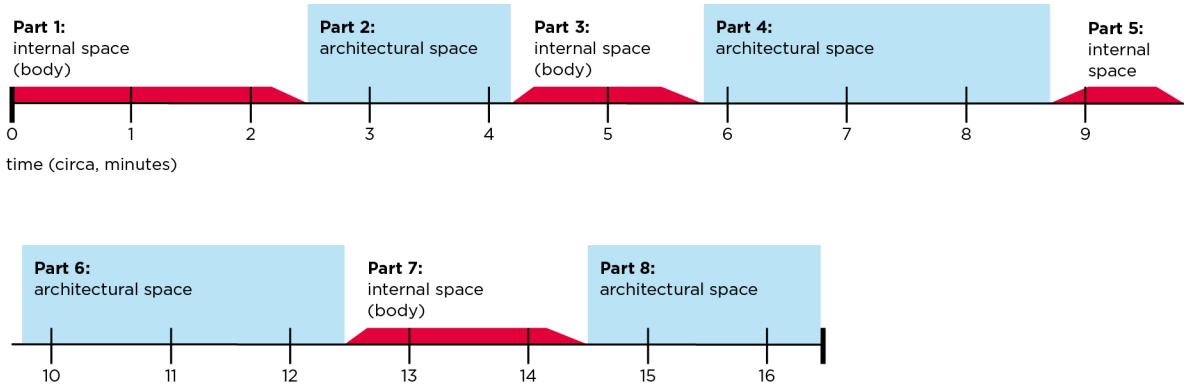

Figure 1: “Resonatorium”, overall form

The way the piece is composed, its sound and character vary considerably depending on the physical environment it is performed in.

2.2 Internal Space (Body)

Before concentrating on the “architectural space” parts, we would like to explain in brief how the “internal space” parts of the composition work.

In the “internal space” parts of “Resonatorium”, the focus is on the singer´s body or rather on the acoustic resonance characteristics of her body. For this we make use of the fact that different vowels correspond acoustically to different parts of the trunk of the human body. The trunk acts as a sound box of the voice. However, other than the sound boxes of most musical instruments, the human trunk is not homogeneous; different parts of the trunk have different resonance qualities. Depending on its specific formant region, each vowel needs to “sit” in a specific part of the trunk to develop its full acoustic quality.[1]

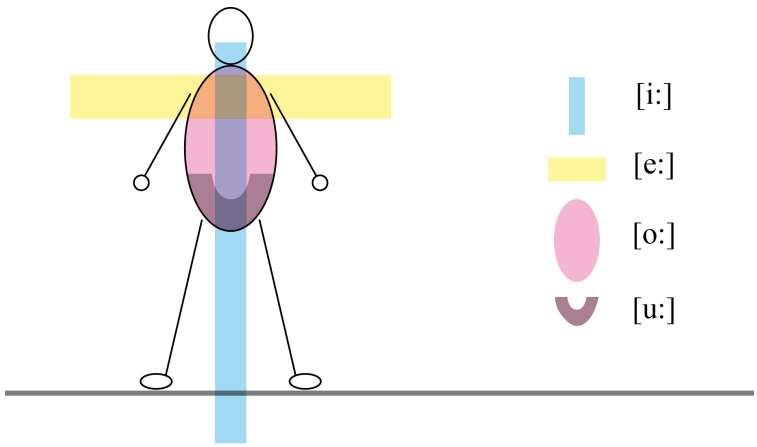

Figure 2: “Resonatorium”, diagram of vowels and corresponding resonance spaces in the human body.

In our composition, the idea is to have the singer sound out these different resonance spaces of her body, not only by using the “correct” corresponding vowel but also the other, “incorrect” ones. This produces musically interesting modulations. The notation is a time-line (example see Figure 3), the top line of which indicates the vowels to be voiced, whereas the bottom line shows where in the trunk they should “sit” (see Figure 2). Pitch and dynamics should not be “made”, but result in a natural way from the voicing process.

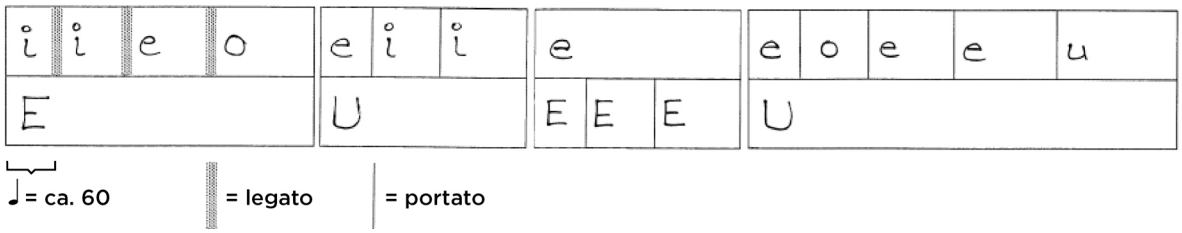

Figure 3: “Resonatorium”, excerpt of Part 7 (fourth and last “internal space” part).

Collaborating with Kornelia has taught us that of the two different kinds of parts the “internal space” parts are especially difficult to do. They require a very straight and technical approach and performance, while at the same time the performer has to present her inner being to the audience.

2.3 Architectural Space

In the “architectural space” parts of “Resonatorium”, a key element is to have the singer trigger the resonances of different parts of the performance space. Graphics like those shown below (Figure 4) indicate what part of the room the singer should trigger (to be read from the singer´s point of view). This concept is based on the ability of trained singers (as well as actors) to control how much of the room they fill with their voice and presence, and direct their voice to particular parts of the room without even turning their head in that direction. That way they can make sure that they reach and can be heard from every place, no matter what action a scene or piece requires.

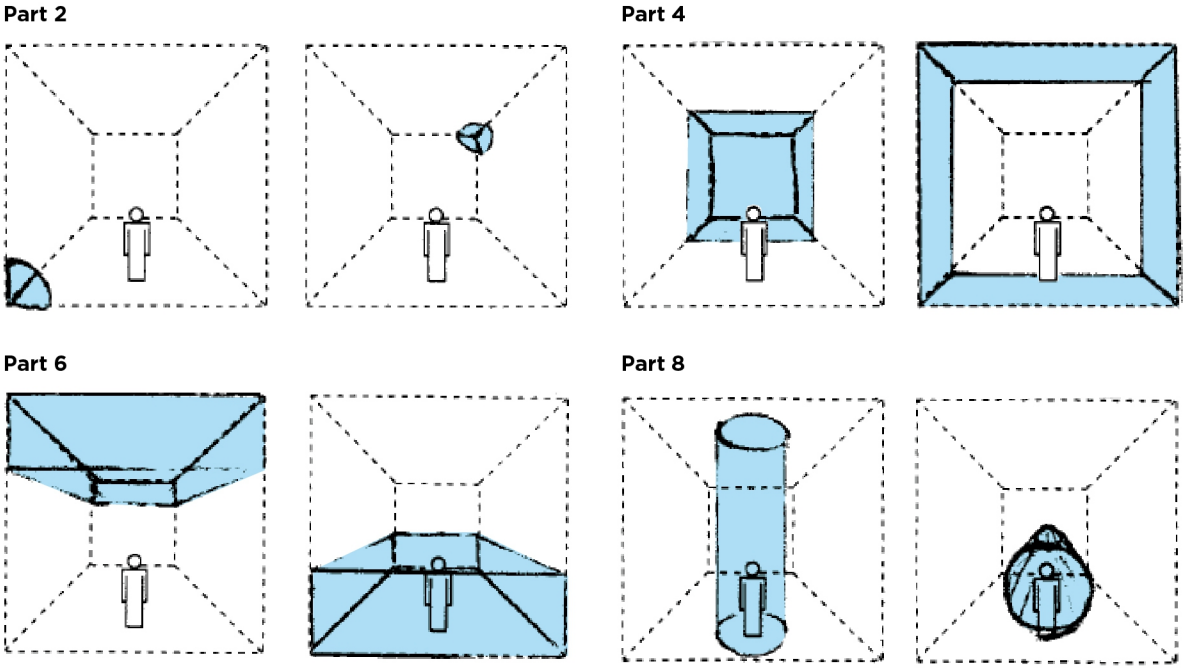

Figure 4: Graphic elements from the score of “Resonatorium”, indicating what part of the room the singer should focus her voice on.

The use of these elements is shown in the following analyses of three excerpts of the piece, which discuss the structure of the composition in more detail.

2.3.1 Analysis: Beginning of Part 2 (First “Architectural Space” Part)

Following the first part of the piece which centres on the internal space of the singer´s body, the second part initiates the interplay between the voice and the architectural space. This part – in particular its beginning – is designed as an exposition that aims to steer the listener´s attention in the direction of this interaction.

Short powerful signals of the same pitch help to hear how the voice makes the room resonate; in a kind of stubborn manner, almost machine-like, the interrelationship between the voice and the room resonances is being established as the main theme. It is not until a bit later that variations set in and the music slowly unfolds.

In tune with the role of this part as an exposition, the singer focuses on the corners of the room, that are being sung at one after the other. The clear orientation of these sound events helps to focus the listener´s attention on different spatial directions and to define the coordinates of the space.

The pitch stays the same throughout the entire movement. That way particular resonances of the space are continually being triggered, forming a kind of “space sound bourdon”. After the initial repetitions of the same notes variations of the phonemes, the timbre of the voice and the dynamics begin. Through these changes – in combination with sending the voice to the various corners – a subtle “melody” of other room resonances emerges above the “space sound bourdon”.

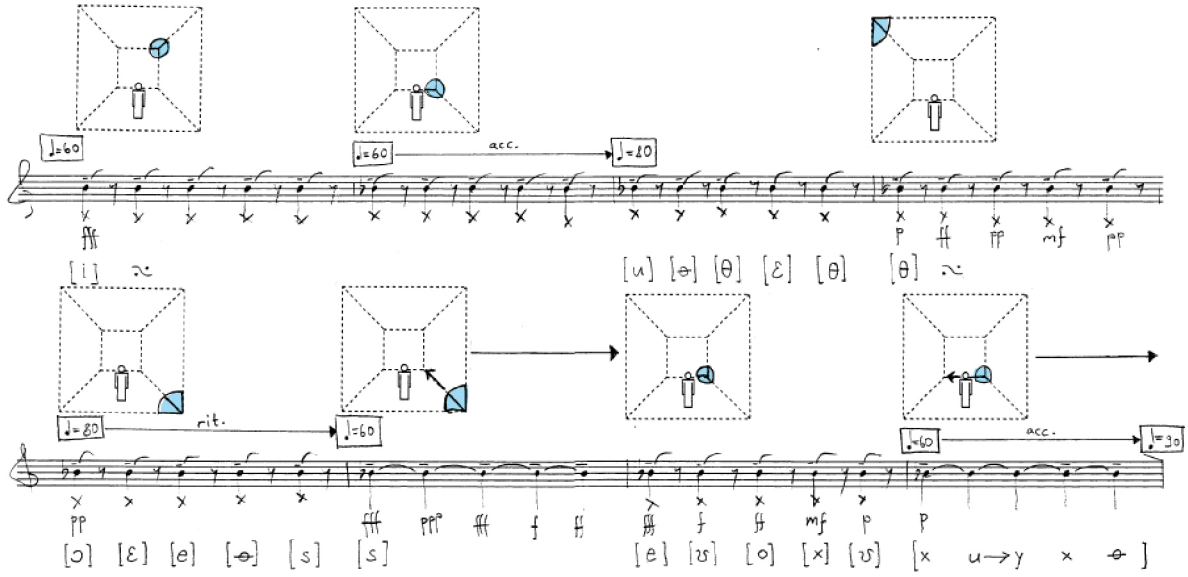

Figure 5: “Resonatorium”, beginning of Part 2 (first “architectural space” part)

To listen to a live recording of this excerpt of the piece please go to
www.ifneuhaus.com/en/resonatorium

2.3.2 Analysis: Middle Section of Part 4 (Second “Architectural Space” Part)

In this part, the positions the voice is directed to in the room alternate between the space behind the singer and the space behind the audience, thus playing back and forth between the front and the back of the room.

Back and forth is the main theme in this part that centres on the interplay between the sound source and the room as a duet, or dialogue.

As in the first “architectural space” part, the room resonances triggered by the voice are emphasized, and the voice goes on producing distinctive sounds followed by rests. Now, however, the rests are considerably longer to make room for the multi-faceted sound of the space.

Contrary to the first “architectural space” part that stays on the same pitch, the singing voice now covers the largest range used in the piece. Within a range of two octaves (between b and b") the focus alternates between different frequency regions.

Using the chromatic scale, different room resonances are being emphasized. This clearly audible pitch-based triggering is achieved through “chords”, delivered as arpeggios.

Every auditorium produces a – rather unique – variety of different reactions to the combination of pitches. This means that fast changes between different pitches produce multi-faceted “dialogues” between the sound source and the room´s response and the music develops fast. To get back again to the basic principle of an interplay between voice and room and to quiet things down a bit, we put in several repetitions of reduced arpeggios using only two notes. This offers the audience an opportunity to catch their breath and listen closely.

The dynamics of the voice are continually set between forte and fortissimo to achieve a long, slow fade-out of the room sound. The phonemes have been chosen to structure the duet of sound source and space: the beginnings of the arpeggios range from voiced consonants such as [d] that cut into the fade-outs, to aspirates such as the [h] that produce more fluid transitions between the sound of the space and the voice.

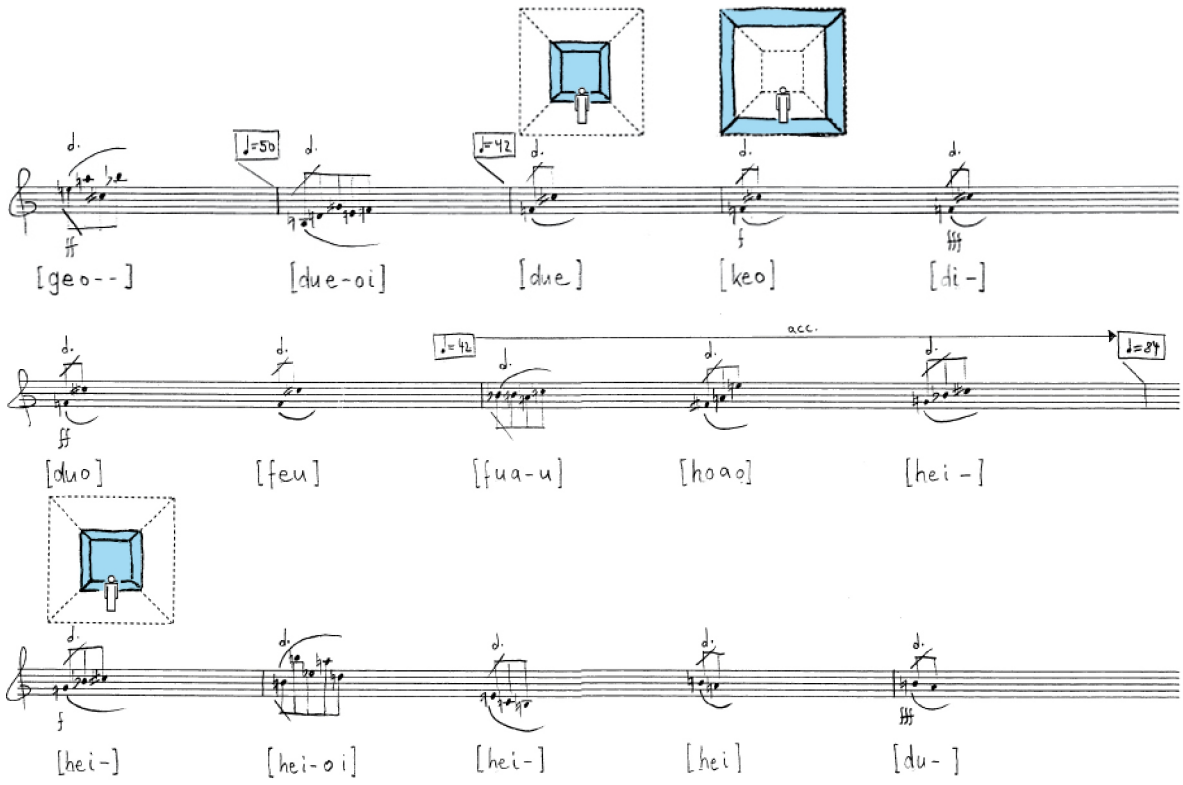

Figure 6: “Resonatorium”, middle section of Part 4 (second “architectural space” part)

To listen to a live recording of this excerpt of the piece please go to
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2.3.3 Analysis: Middle Section of Part 8 (Fourth “Architectural Space” Part, Final Part of the Piece)

In the last part of “Resonatorium”, the interplay between the voice and the room is in its furthest developed stage. Not just “action/reaction” or the dialogue between the two protagonists, but the combination or even merging of sound source and space is the theme of this part.

This is reflected in the spatial orientation. The voice is not being directed to a particular part of the room any more, but is being wrapped around the singer, forming horizontal and vertical cylinders of different dimensions.

In the entire part, the voice operates in the strongest soprano register. As tonal material a succession of single notes in small pitch intervals is being used; the dynamics reach their greatest variety, giving each note a different nuance. The resonating room forms them into a slowly flowing melody, and sound source and space start to merge together.

Through the use of small intervals with micro-tones it becomes audible that spaces react to the subtlest of pitch differences. When a tone triggers a strong room resonance a lot of volume is generated; moving up or down a quarter tone the sound can suddenly take on a more intimate character.

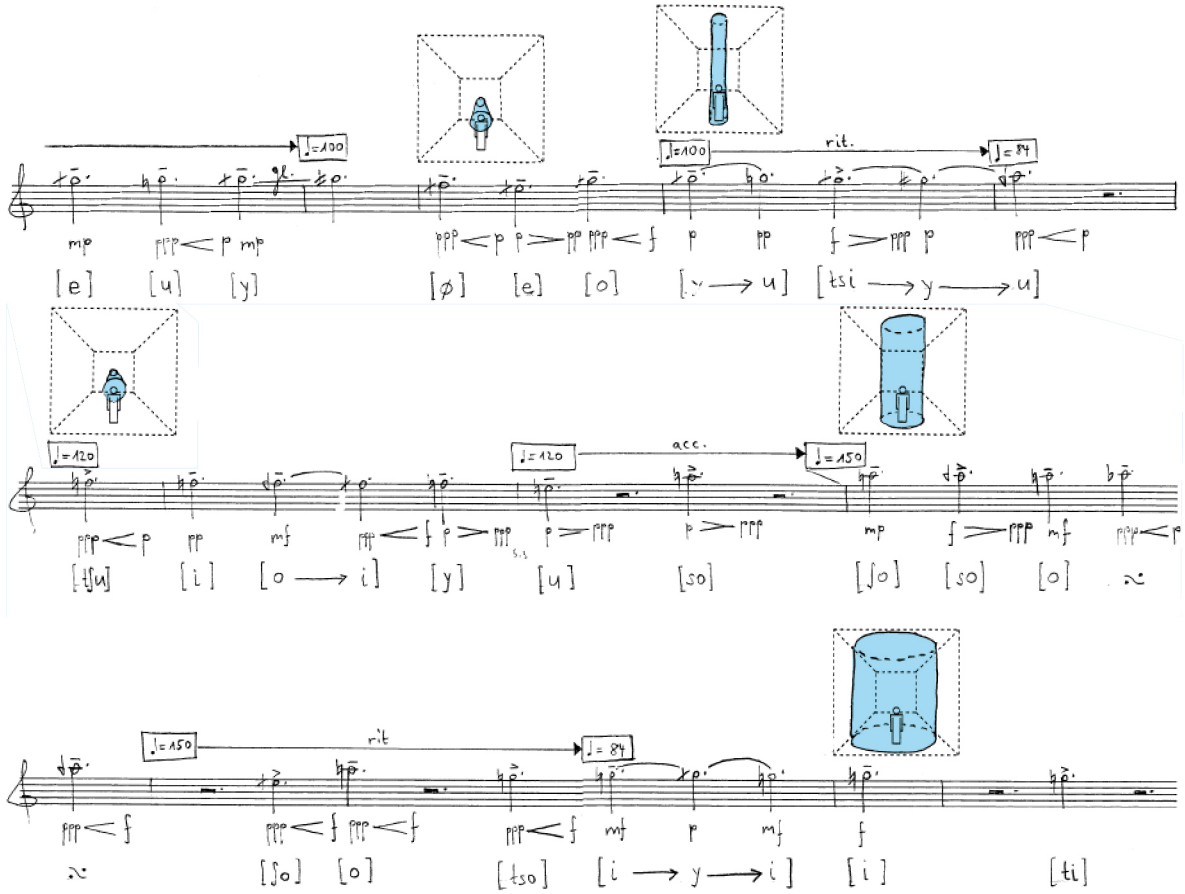

Figure 7: “Resonatorium”, middle section of Part 8 (fourth “architectural space” part)

To listen to a live recording of this excerpt of the piece please go to
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3 THOUGHTS REGARDING THE RESONANCE CHARACTERISTICS OF ARCHITECTURAL SPACES

What we have learned from “Resonatorium” is that, like ourselves, many people seem to find it an interesting experience to be able to hear and become aware of the acoustic facets of a space. It always gives us great pleasure to receive echoes such as the following email that someone who attended a performance of “Resonatorium” wrote to the singer Kornelia Bruggmann:

“This overwhelming experience of space when you made the whole room vibrate and resonate and it became impossible to identify you as the sound source, everything just being sound. I was fascinated and speechless.” [2]

Equally delightful is what Kornelia Bruggmann wrote to us after her first performance of the piece:

“I am still full of the sounds and the sense of close attention that have dominated the room.” [3]

In our experience most people, without being aware of it, seem to able to “read” the sound of spaces very fast and with great subtlety of nuance, and are very good in using their auditory system to discern and judge the general character of an environment, including its purpose and function, vitality, and the degree of safety and peace it provides.

Most of the time, what we perceive as the sound of a room or outdoor space is of course not one single resonance, but the combination of different resonances. Spaces that have a great variety of finely balanced (well-proportioned) resonances in all different frequency regions of the auditory spectrum have a nuanced and colourful sound; such spaces are easy to grasp, make it easy to get one's bearings and to locate and identify events by ear. A great example of such a space is the King´s College Chapel in Cambridge.

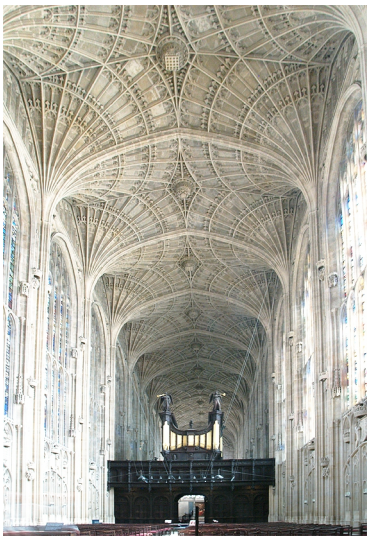

Figure 8: King´s College Chapel, Cambridge[4]

In spaces that have just a few resonance frequencies, on the other hand, these are very likely to dominate the sound, leading to environments that sound monotonous or even develop a droning noise (e.g. tunnels, or poorly proportioned box-like spaces with smooth, unstructured surfaces). In our perception and experience such environments make it difficult to get one´s bearings and identify events, and can be very tiring.

While, due to their architectural features, the first kind of spaces described work outstandingly well acoustically, the other, monotonous kind of environments are hard to bear without additional

absorbers – which do not provide a resonance space with richness, but can at least reduce the strongest monotonies. We believe that the better solution is to aim for the first kind of spaces, because they do better in "responding" to the user and helping people to perceive and read a situation; they usually show a more balanced frequency spectrum, including the low frequency region, and feel airier and more natural – among other things because of a better correspondence of the acoustic and visual information they provide.[5]

We have been putting these research results and experiences to practical use, and have developed a technique of shaping the sound of indoor and outdoor spaces through architectural interventions. In our design work we specialize in creating nuanced, well balanced resonance spaces through structures that improve spatial proportions; in existing spaces we often work with elements like specifically positioned vertical wall or ceiling lamellas. To achieve acoustically interesting, colourful spaces and reduce or eliminate existing monotonies it is necessary to consider that the sound of spaces is a combination of very different wave lengths (ranging from about one centimetre to 20 metres), and to provide structures that correspond to this variety of dimensions. When these (sub)structures are suited to the basic proportions of the space as well as to each other, even "droning" environments can be transformed into transparent, acoustically pleasant surroundings.[6]

4 CLOSING REMARKS

We are aware of it that talking about music and spatial sound is a bit like serving someone a picture of a meal instead of an actual meal, and even listening to a recording is a poor replacement for the actual event. Still we hope we have been able to give an idea of our way of working and maybe even open up a few new perspectives regarding sound sources and spaces.

To us, "Resonatorium" has shown once again that the "response" of spaces to the sound of our actions as well as other events is important to the world we live in. The "response" of spaces not only helps us to identify events, but provides information about our environment in general and our own position in it. It goes without saying that this is where quality matters.

5 REFERENCES

1. Distinguishing between different resonance spaces of the body as to which vowels they support is a technique used by trained actors and speakers. It is unlike the technique classically trained singers use, which is based on a more combined use of the body regions.
2. German original of the quotation: *"Dieses ungeheuerliche Raumerlebnis, wenn Du den ganzen Raum zum Schwingen und Klingen bringst, und Du als Klangquelle nicht mehr wirklich auszumachen bist, nur noch Klang ist. Ich war fasziniert und sprachlos."*
3. German original of the quotation: *„Immer noch bin ich voll der Klänge und der dichten Aufmerksamkeit, die im Raume herrschten."*
4. Thanks for the recommendation, Nigel Cogger!
5. These theories are based on our research into the connections between architectural and urban design and the sound of environments, including several independent field research projects we have conducted in different European cities (Paris, London, various cities and towns in Italy, Germany, England, Holland, Austria, Switzerland) since 2004. Our theories are presented in more detail in our article "Raumklang oder: Lässt sich Architektur als Musik begreifen?", published in "Communicating Music", festschrift for the 80th birthday of Professor Dr. Ernst Lichtenhahn, Peter Lang Verlag, Bern 2014.
6. We have been using this technique successfully for the last eight years, for example for tuning production halls (even solving problems with noise in the 25 Hertz region) and designing indoor public spaces, and have developed it further for shaping the sound of outdoor spaces. Case studies of our works are available at www.ifneuhaus.com.