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Co-composition processes:

Form, structure and time across sculpture and sound

Volume II
(Appendices)

Eleni-Ira Panourgia

Doctor of Philosophy
The University of Edinburgh
2018

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Appendix 1: Text and images

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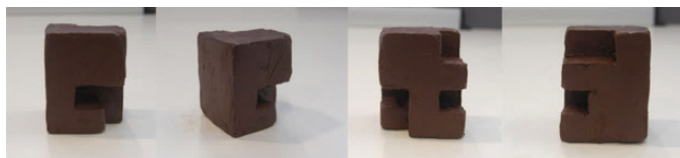
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Sounding Stile

Version one: new sculptural object

Having as starting point the development of the sculptural object, I applied the method from the first version of *Sounding Stile* for transferring the shape of its four main viewpoints to a graphic score based on proportions.



duration in quarters: each unit (1:1) equals one quarter

D sharp	1:1	1:1	3:2	1:2
D	1:3	4:3	3:2	1:3
C sharp	1:2	4:3	1:1	1:2
C	1:3	4:3	1:2	1:2

Piano

Piano

Piano

Piano

The four main viewpoints of this geometric three-dimensional form have been graphically represented. The general surface that have been created is divided into 1:1 rectangle units. These units form in some cases larger groups with proportions of 1:2, 1:3, 4:3 and 3:2. I have correlated these visual proportions to ratios that generate musical intervals: 1:1 for the unison, 2:1 for the octave, 3:2 for the perfect fifth, 4:3 for the perfect fourth and 1:3 for the twelfth (Pescic, 2013; Barker, 1984). The horizontal axis indicates duration and the vertical pitch. Each unit 1:1 stands vertically for one semitone and horizontally for one quarter.

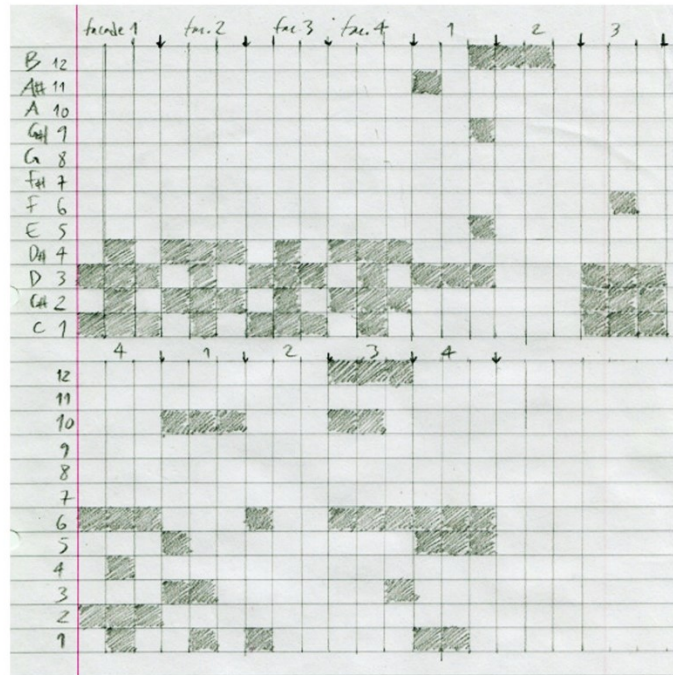
Pescic, P. (2013) 'Euler's Musical Mathematics'. *Mathematical Intelligencer*, 35(2), 35-43.

doi:10.1007/s00283-013-9369-5

Barker, A. (1984) *Greek musical writings* (Cambridge readings in the literature of music). Cambridge ; New York: Cambridge University Press.

Version two: improvisation graphic notation and score

The graphic notation below shows an additional method of *Sounding Stile's* second version, which expanded the sound piece through improvisation. It used as starting point the graphic representation of Andre's Stile four main viewpoints and the chromatic scale (left part of the notation diagram). It sought to transfer in this graphic way, notes to new viewpoints for developing a sculpture.

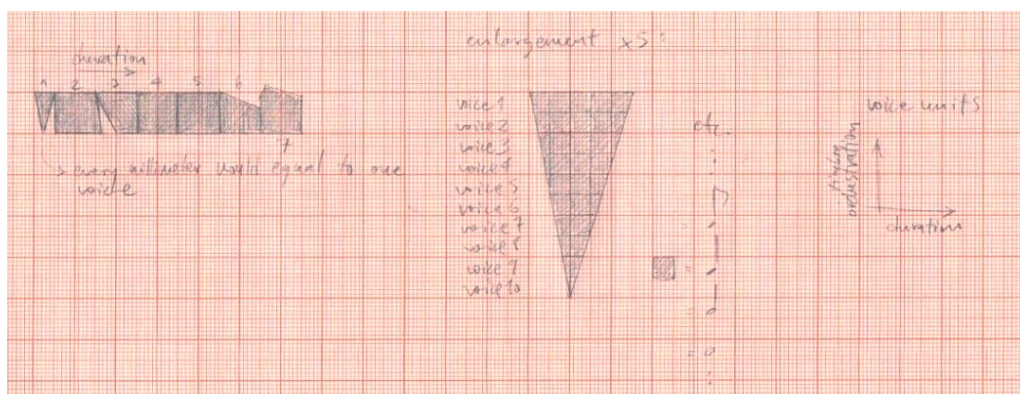


The musical score is for a string quartet in 3/4 time. It consists of four staves: Violin I, Violin II, Viola, and Violoncello. The key signature has one sharp (F#). The score is divided into two systems. The first system starts at measure 1. Violin I has a fingering '4' above the first note. Violin II has a fingering '3' above the first note. Viola has a fingering '2' above the first note. The Violoncello part has 'pizz.' written below the staff. The second system starts at measure 7. The Violoncello part has 'pizz.' written above the staff and 'arco' written above the staff in the final measure.

Sides

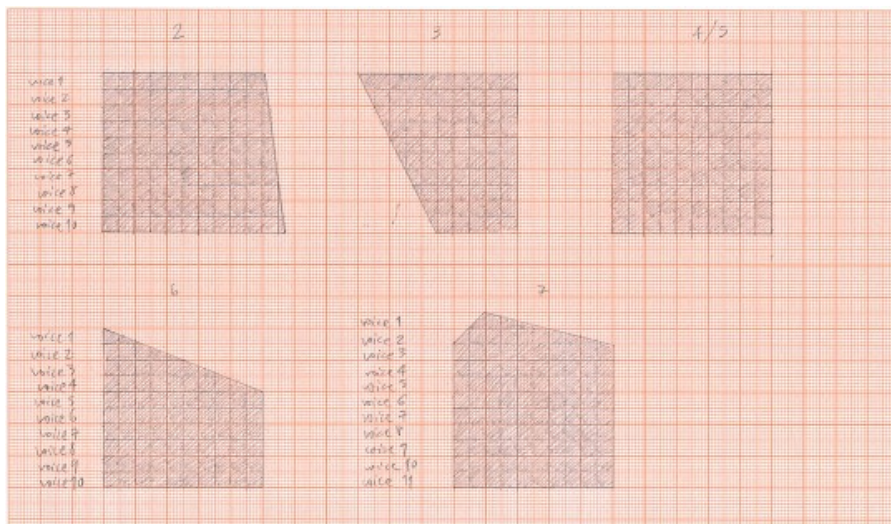
First experimentation

A first version of *Sides* explored the mapping of the three-dimensional object's sides to multiple sound sources and duration, reflecting on Nathalie Miebach's methods of transition and mapping between three-dimensional forms and sound through notation¹. A selection of data was mapped into scores based on grids, which were interpreted by musicians. Miebach was then translating the scores into three-dimensional objects through a method of weaving². It was not the data translations that Miebach realized in her work, but her method of moving from sound to three-dimensional objects, which was reconsidered here from a co-compositional perspective. In the first version of the work *Sides*, the visual representation of the three-dimensional object was realized on grid paper. Each side was divided into sound sources depending on the shapes of the sides, mapping duration to a square unit, as a revised version of *Sounding Stile's* notation method. The difference here was that notation concerned parts of the visual representation of the sculptural objects and not as a whole; it also looked beyond pitch-duration relationships. It still employed the idea of calculation but only to form a general structure for sound pieces, which defined the number of sources and their duration.



¹ <http://nathaliemiebach.com/weatherscores.html> [accessed 19 September 2017].

² <https://claralieu.wordpress.com/2010/03/08/transforations-installation-opening-gallery-talk/> [accessed 28 September 2017].



Variation scores

Theme

Allegro

Piano

5

Pno.

Variation 1

Moderato

Piano

5

Pno.

7

Pno.

Variation 2

Moderato

Piano

4

Pno.

7

Pno.

Variation 3

Moderato

Piano

Pno.

Variation 4

Allegro

Piano

Pno.

Variation 5

Moderato

Piano

Pno.

Variation 6

Allegro

Piano

5

Pno.

8

Pno.

Variation 7

Allegro

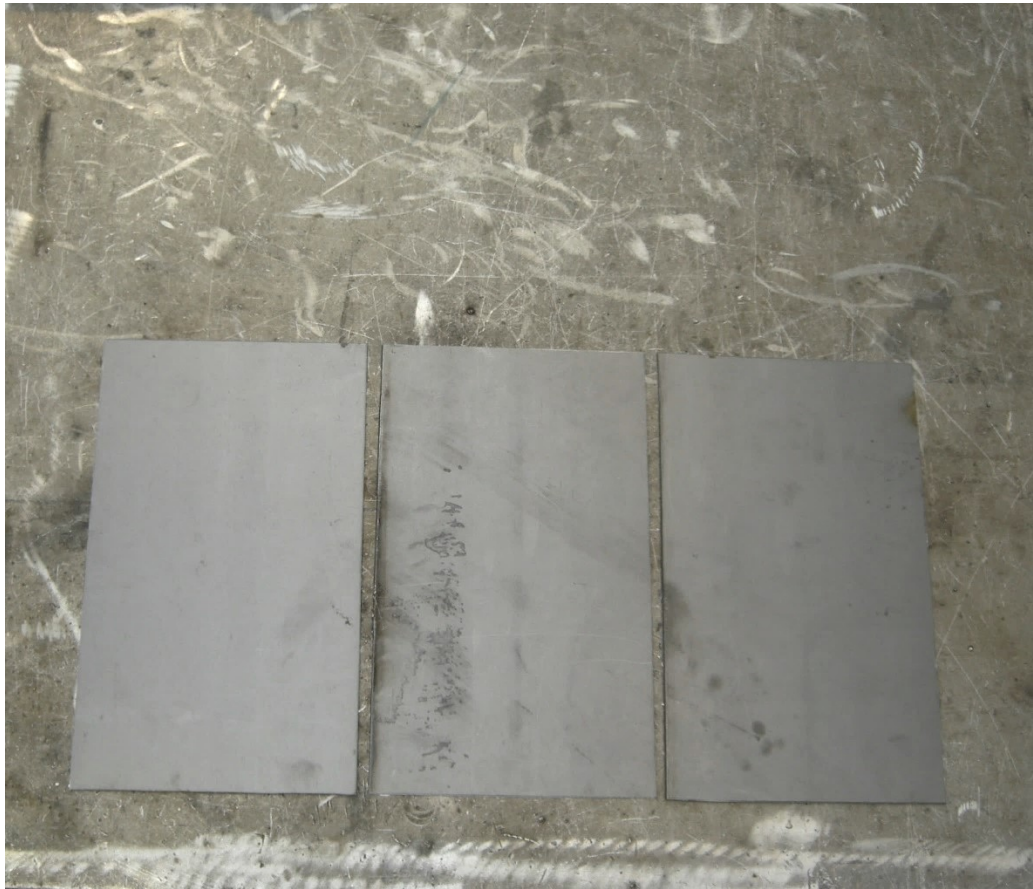
Piano

5

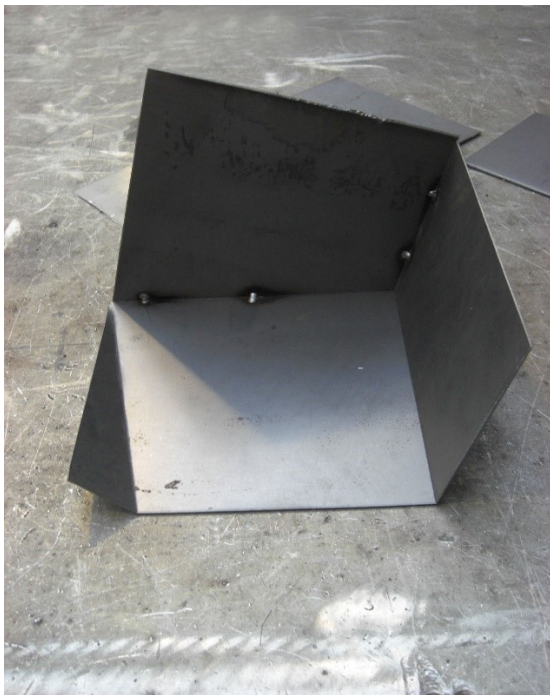
Pno.

Actions in sound

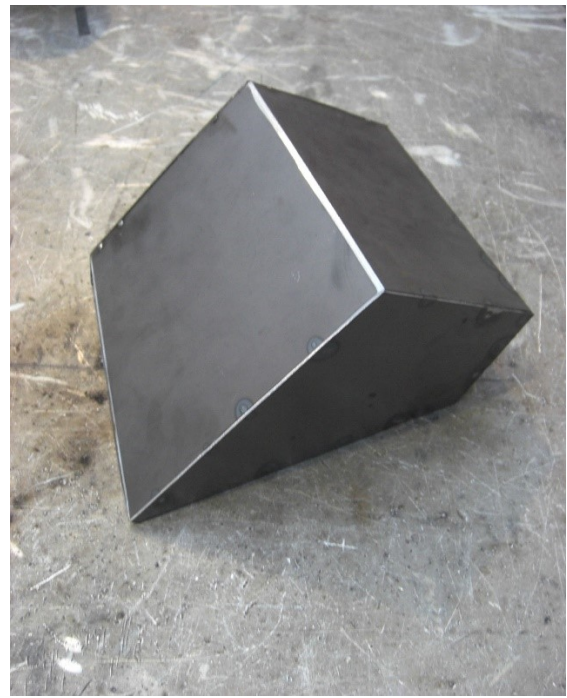
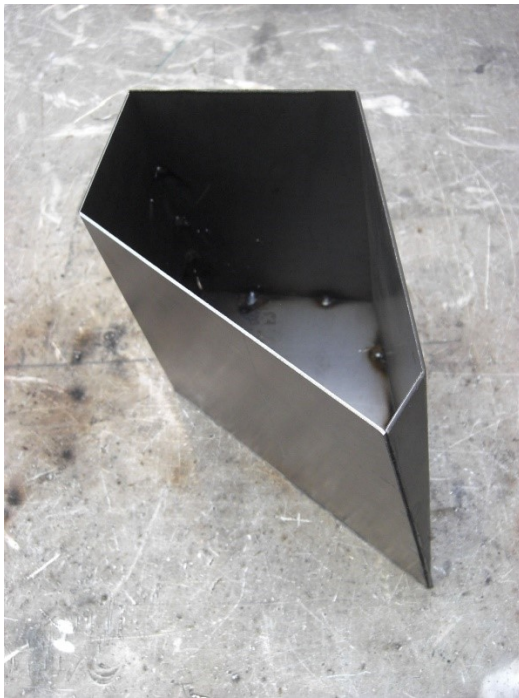
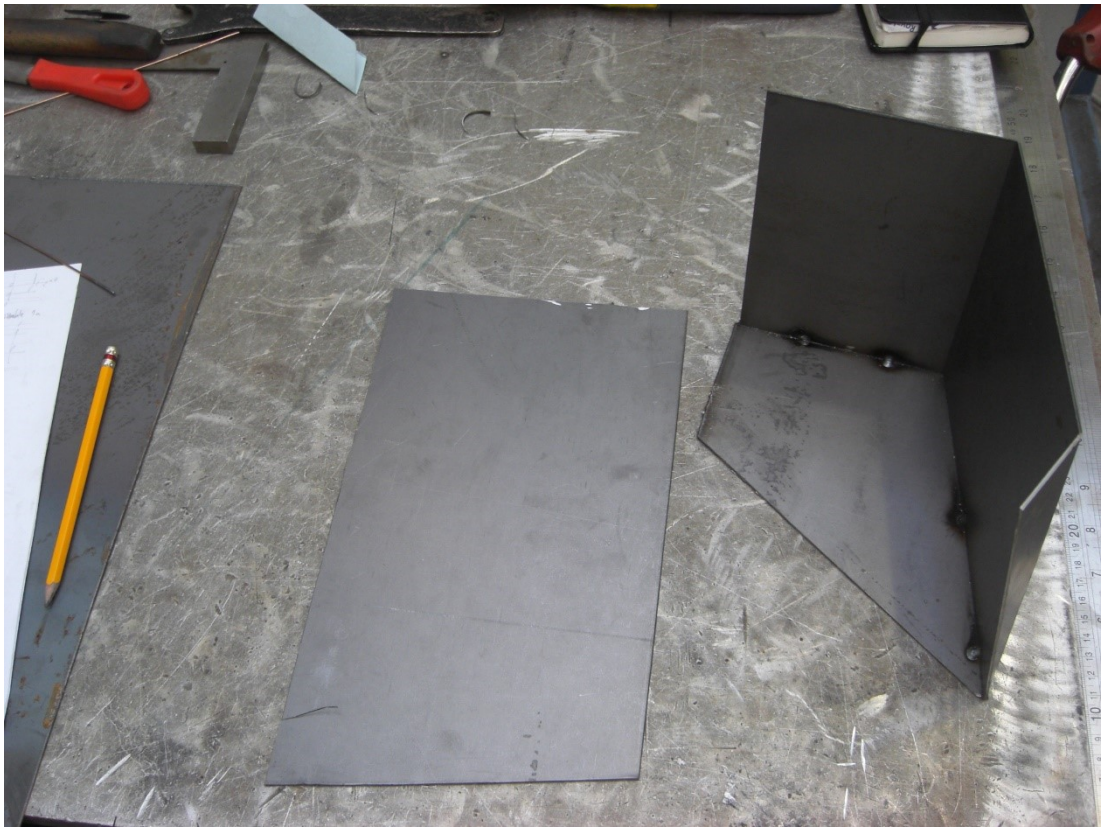
Photos of the making process



sheets (top), carving/folding (bottom left), assemble 1a (bottom right)



assemble 1b (top left), cut/folding (top right), welded (bottom left), carving/folding (bottom right)



side/cut and notating (top), assemble/welded (bottom left), grinding (bottom right)

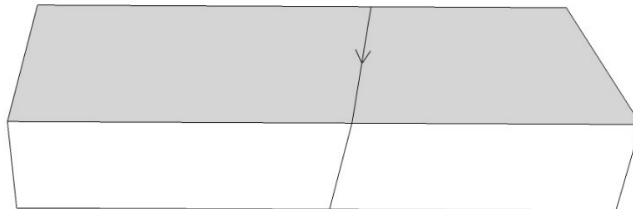
Score

The image shows a handwritten musical score consisting of several systems of staves. Each system typically includes a treble clef staff and a bass clef staff. The lyrics are written below the staves and include terms such as 'sheets', 'canins', 'foldins', 'assemble 1a', 'assemble 1b', 'sheet 2st', 'welded canins', 'foldins', 'assemble changed', 'side cut', 'sides together', 'side cut', 'coring', 'foldins', 'withins', 'assemble 2', 'ven side', 'withins', 'grinding', 'hammerins', 'assemble welded', 'grinding', 'welding 1', 'turnins', 'welding 2', 'grinding', 'welding 1b', 'welding 2b', 'welding 3', and 'grinding'. The notation includes various musical symbols such as notes, rests, accidentals, and dynamic markings.

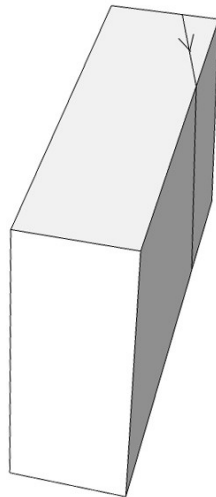
Of blocks

Frequency script

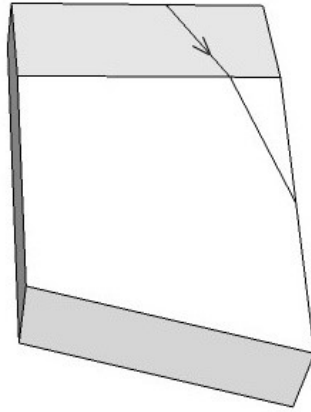
1. 440Hz reducing gradually for 17''
-1Hz every 1''



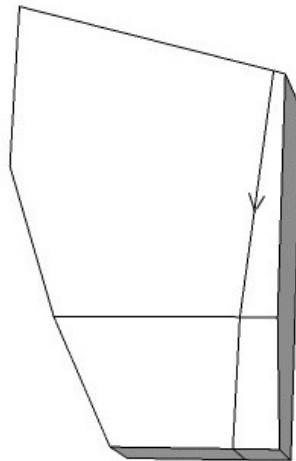
2. 440Hz reducing gradually for 28''



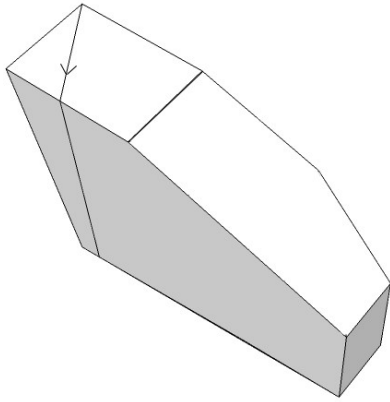
3. 440Hz reducing gradually for 23''



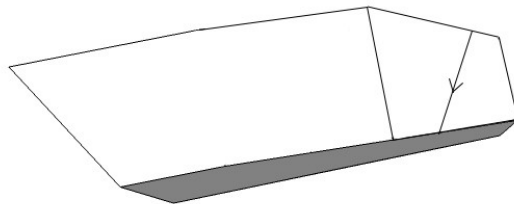
4. 440Hz reducing gradually for 19''



5. 440Hz reducing gradually for 23''



6. 440Hz reducing gradually for 13''



Sculptural spectrograms

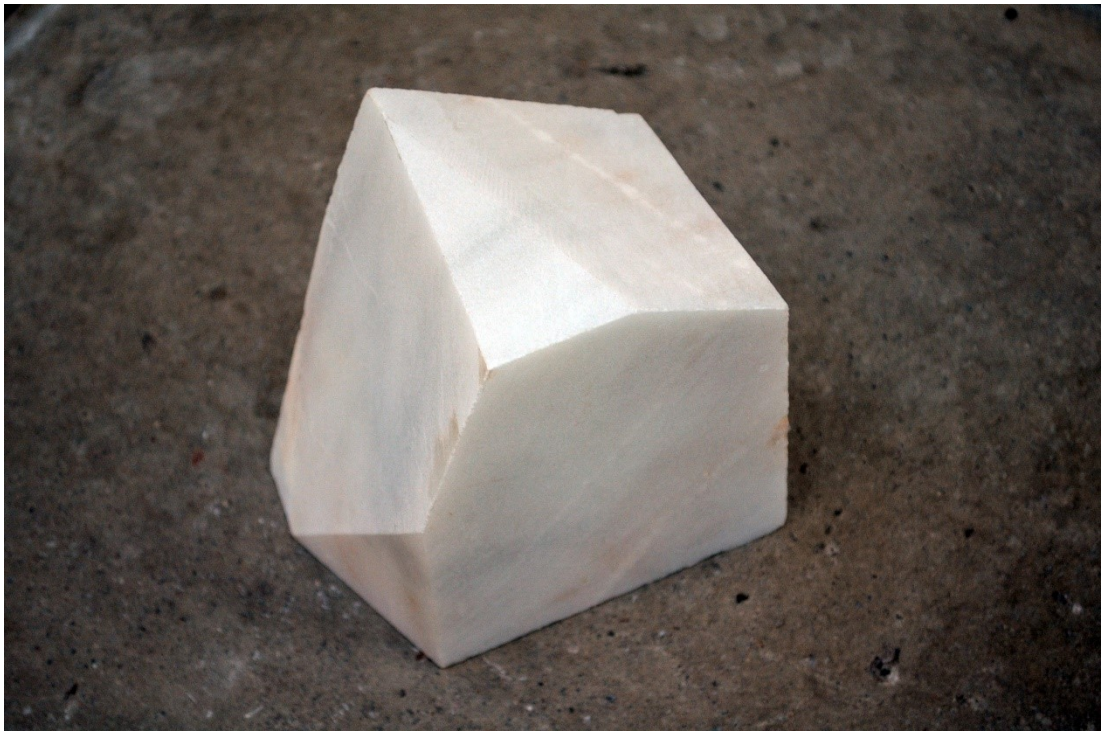
Photos of steel object





Photos of marble object





Photos of grinding glass



Photos of glass object



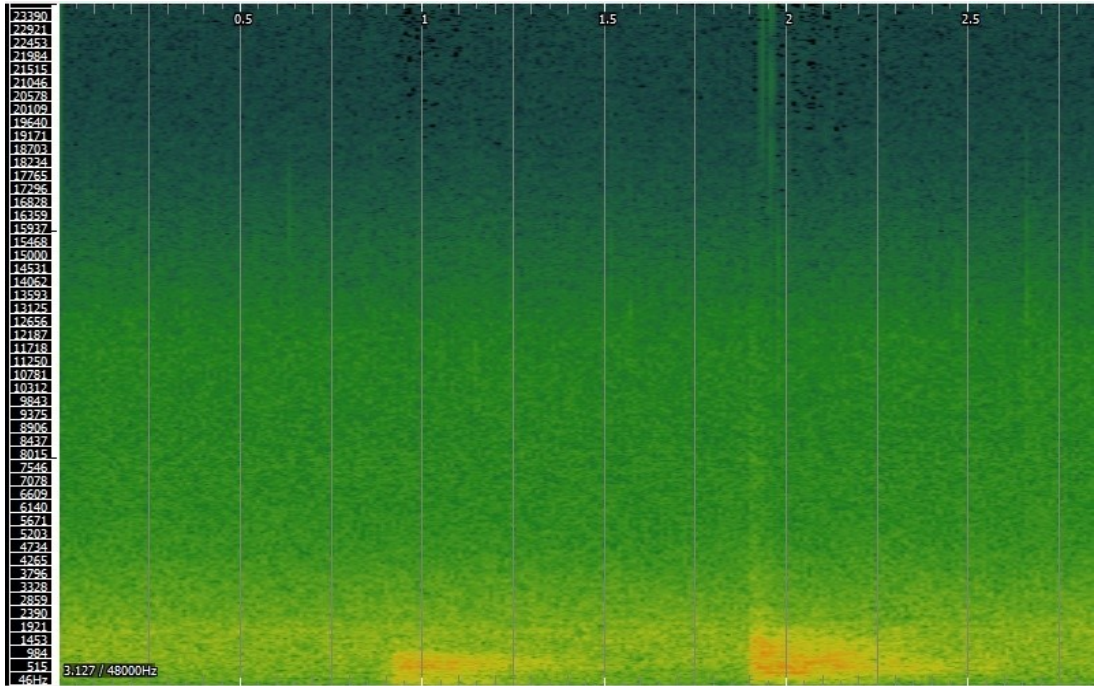


Spectrogram analyses

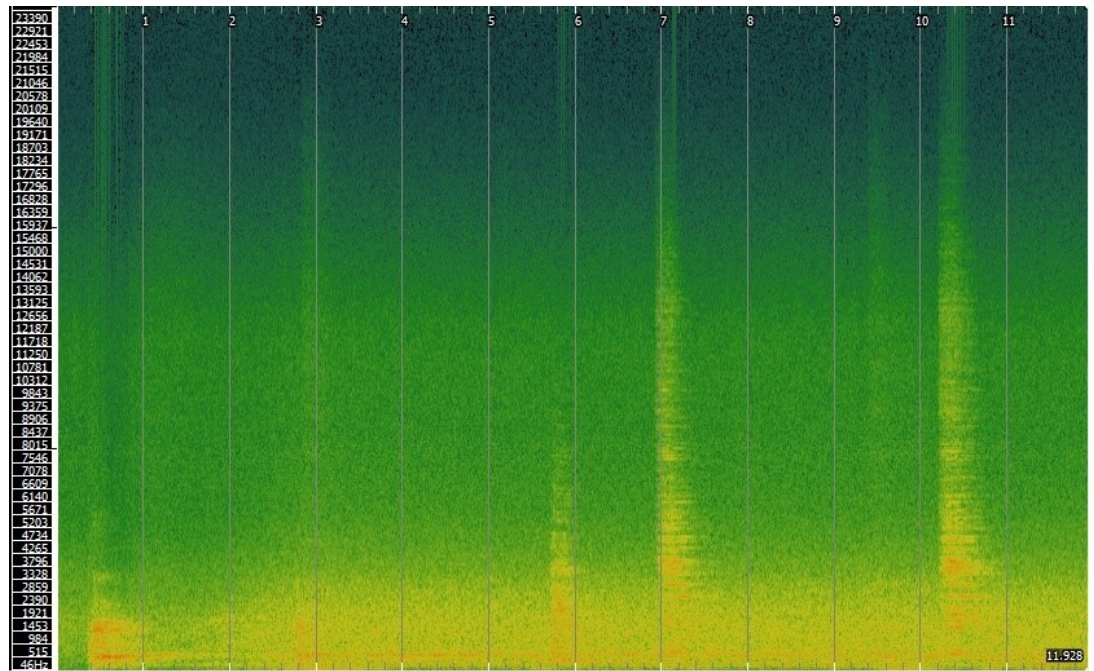
Images from the spectrogram analysis of the sound recordings from the making processes were analyzed with the software Sonic Visualiser. They include a time ruler and a sound frequency column on the left part of the image. A description of this analysis follows based on the spectrograms, the recordings and the video documentation:

Concerning the making process in marble, as we can see from the spectrogram of the action of placing the marble on the track slider of the marble cutter, there is a sound lasting for almost 0.5s before 1s, which is then repeated more intensely before 2s. It is the sound of placing the marble on the metal track slider. The spectrogram of adjusting the marble by moving and pushing shows each time that it is on a potential position for cutting, it is being tested by bringing it closer to the operating blade until they are in contact. Before 1s we can see the initiation of the operation of the blade, followed by moving the piece of marble that produces sound before 3s and before 6s and testing its position with the blade in 7s and again after 10s. As we can observe in the spectrogram of the action of cutting marble in the machine, there are no obvious changes, the sound continues in the same way throughout the sample until before 20s when it gradually moves towards termination. Concerning the intensity of the sound during the action of cutting, the energy at this stage is much greater than at the other two.

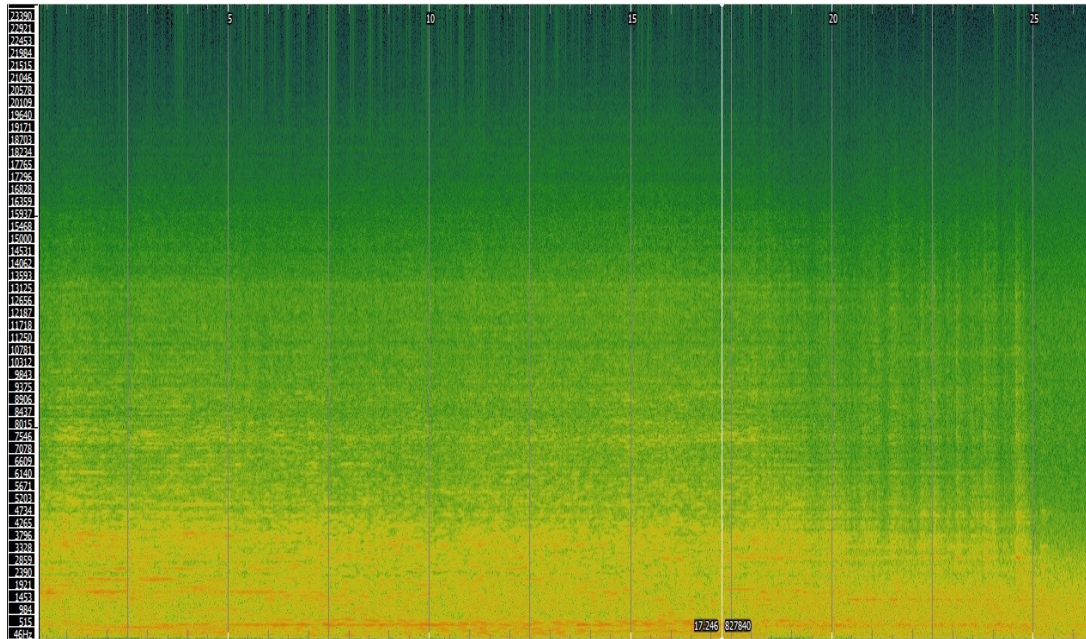
Spectrogram of placing marble on the machine



Spectrogram of adjusting marble in relation to the blade

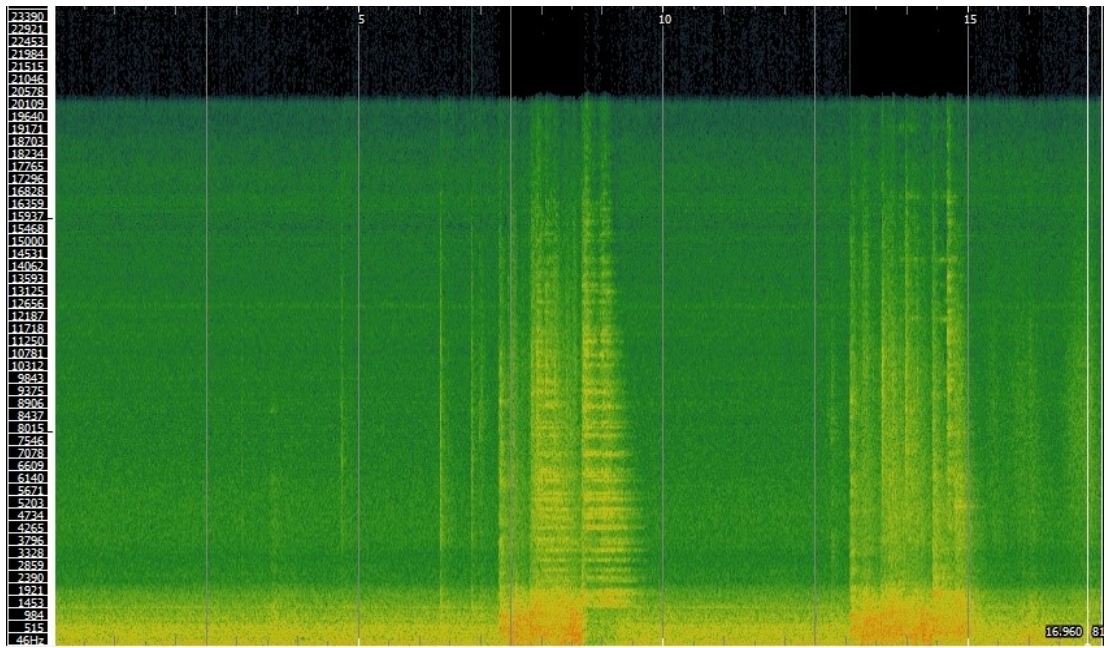


Spectrogram of cutting marble

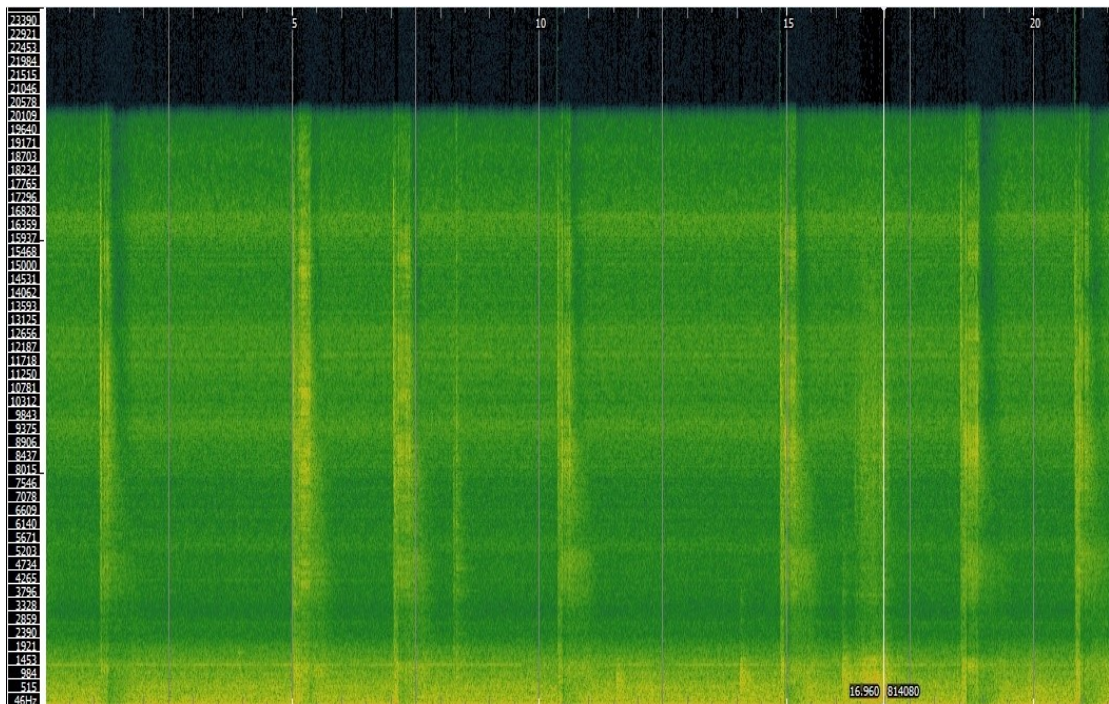


For the making process in steel, the sound of the action of cutting the sheets in the electric guillotine was analyzed as a spectrogram (Figure 45); after 6s, sound is produced from the action of adjusting the sheet prior to cutting. This action is evolving in steps, followed by cutting and pieces falling on the ground after cutting. Figure 46 shows the spectrogram of the action of welding that is happening in a rhythmic manner. In the spectrogram of grinding, at around 10.500Hz and 16.000Hz respectively, we can see two lines that represent the sound of the disc of the grinder. The fluctuation of the lines indicates their changing of frequency as for example, between 5s and 8s. This depends on the contact of the grinder to the material. In 8s-12s there is a repetitive activity due to the back and forth movement that is happening during grinding. In the spectrogram of grinding and rotating the object, the difference with the previous action lies in the line that occurs in the spectrogram from the sound of the disc of the grinder. Its fluctuation is now more intense. Additionally, parts such in 3s-5s, 8s-9s, 12s-13s and 15s-18s show the sound from the rotation of the object. The most intense action of this process is grinding, in which energy is greater than cutting in the guillotine or welding.

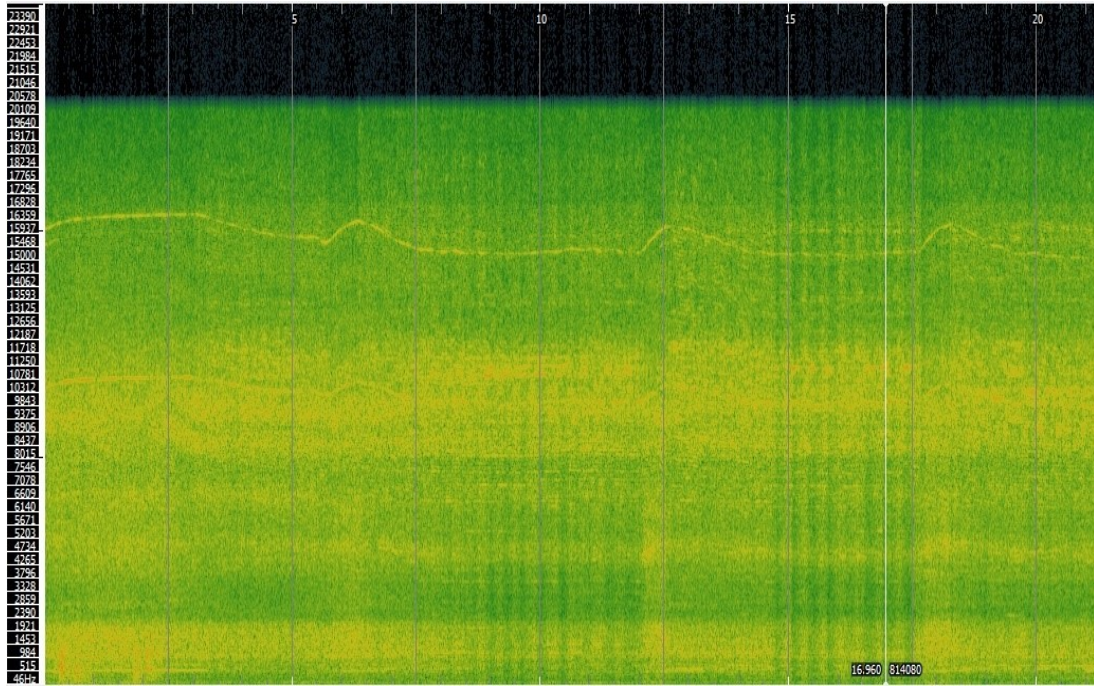
Spectrogram of cutting steel sheets in the guillotine



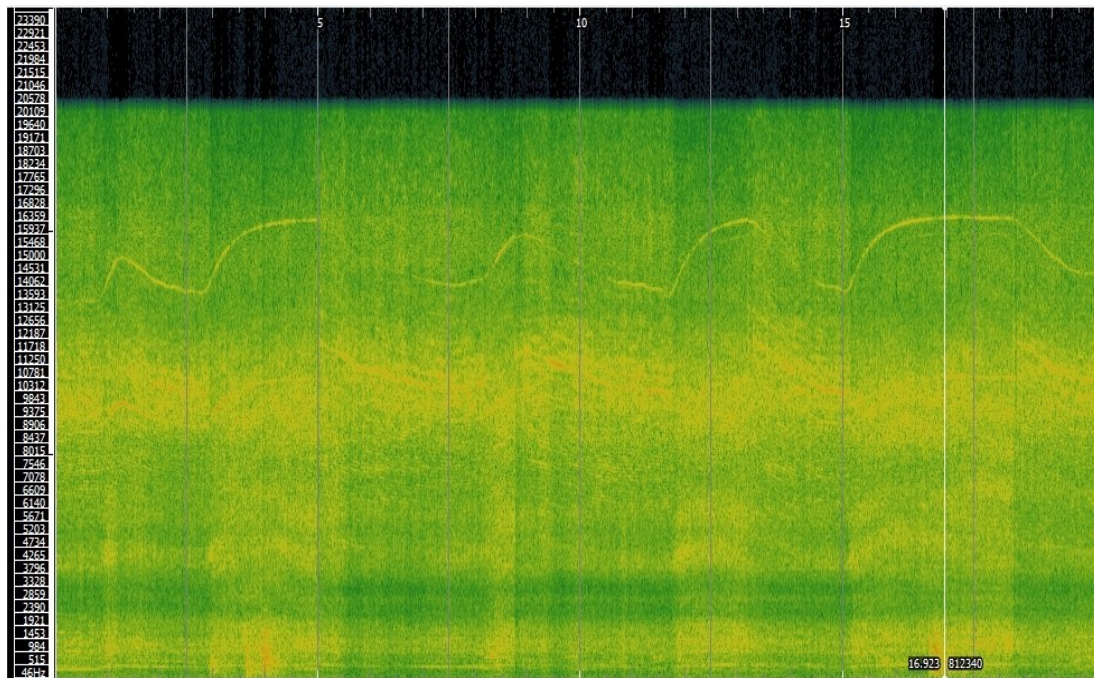
Spectrogram of welding



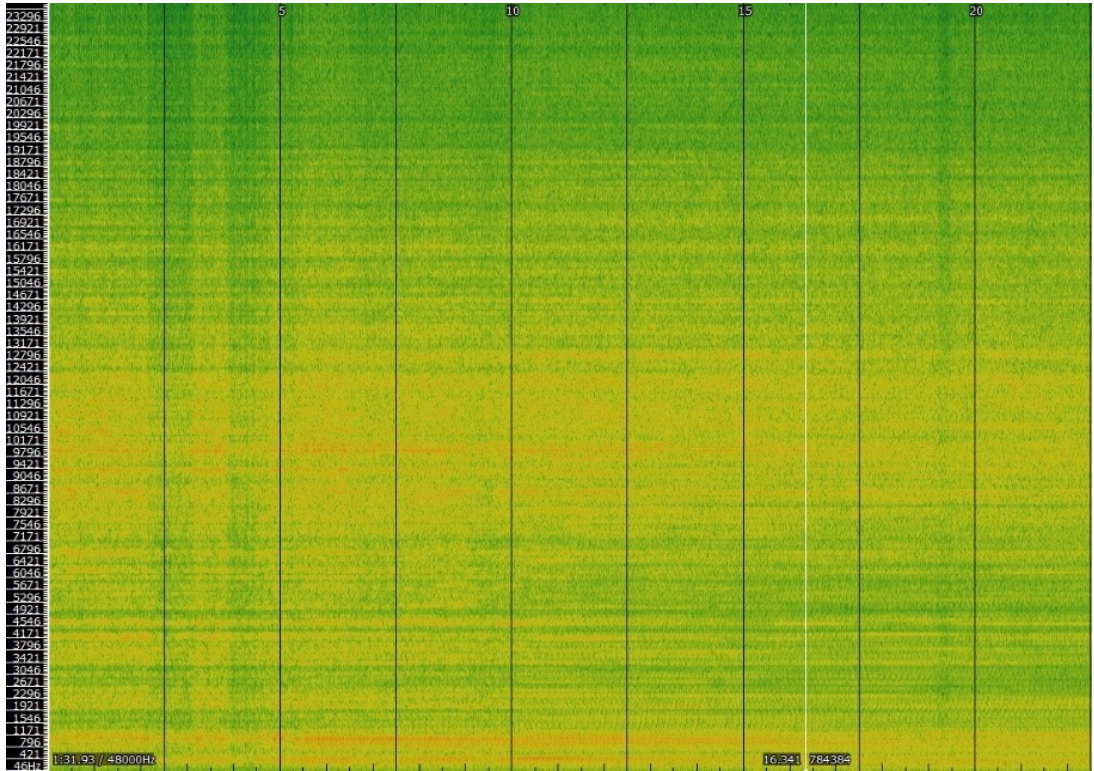
Spectrogram of grinding steel



Spectrogram of grinding steel and rotating



Spectrogram of cutting glass



Spectrogram of grinding glass

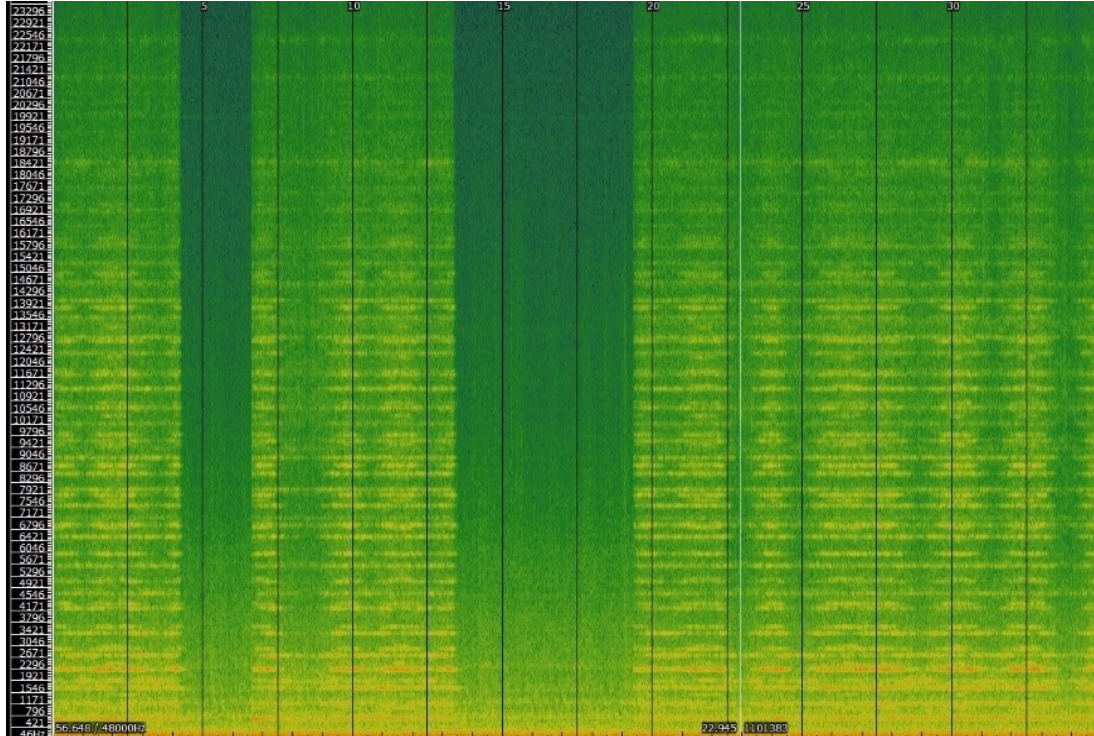


Table of actions - body movement - sounds

Material process	Action	Movement	Part of the body	Direction	Level	Type of action	Sound	Duration depending on scale	Motif writing
Cutting Marble	Placing	Lifting	Core, Arms	Up	High	Fragmented		0'02"	An upward movement of the core and arms for lifting a block of marble
		Landing	Arms	Down	Low	Fragmented	Fragmented	0'03"	A downward movement of the arms, approaching the block slowly on the surface
		Pushing	Arms	Right/Left/Backward	Middle	Continuous	Continuous	0'04"	A horizontal movement of the arms, right and left until placing the block on the back of the machine
	Adjusting	Pushing	Arms	Right/Left	Middle	Fragmented	Fragmented	0'10"	A horizontal movement of the arms, right and left until reaching the position for cutting
		Moving	Legs, Core, Arms	Forward	Middle	Fragmented	Fragmented	0'10"	Walking and pushing the tray of the machine with the arms and then backward movement returning to the initial position for adjusting the piece (pushing might be required again); horizontal movement
Output cut	Cutting	Moving/Pushing	Legs, Core, Arms	Forward	Middle	Continuous	Continuous	0'20"	A horizontal movement, walking and pushing the tray with the block towards the blade
Cutting Wood	Placing	Lifting	Core, Arms	Up	High	Fragmented	Fragmented	0'02"	An upward movement of the arms (and the core if heavy) for lifting a block of wood
		Landing	Arms	Down	Low	Fragmented	Fragmented	0'03"	A downward movement of the arms, approaching the block slowly on the surface
		(Pushing if heavy)	Arms	Right/Left/Forward	Middle	Fragmented	Fragmented	0'05"	A horizontal movement of the arms, right and left until placing the block on the back of the machine
	Adjusting	Moving	Arms	Right/Left/Diagonal/Forward	Middle	Fragmented	Fragmented	0'02"	A horizontal movement of the arms, in diagonal, right/left and forward directions of the block in relation to the blade
Output cut	Cutting	Moving/Pushing (depending on size)	Arms	Forward	Middle	Continuous	Continuous	0'26"	A forward horizontal movement of the arms, pushing the block towards the blade
Welding Steel	Cutting	Moving	Arms	Right/Left/Diagonal/Forward	Middle	Fragmented	Fragmented	0'05"	A horizontal movement of the arms in various directions, that aims to bring the pieces of steel to the guillotine
		Adjusting	Arms	Right/Left/Diagonal/Forward	Middle	Fragmented	Fragmented	0'03"	A horizontal movement of the arms rotating the pieces in various directions
		Cutting	Legs	Down	Low	Fragmented	Fragmented	0'02"	A downward movement of the leg, usually the right one, pressing the pedal of the guillotine
	Welding	Adjusting	Arms	All	Middle	Repetitive	Repetitive	0'10"	A horizontal movement of the arms in all directions for bringing together the pieces of steel in the position for welding
		Welding	Arms	Down	Middle	Repetitive	Repetitive	0'02"	A horizontal/downward movement of the arms, approaching the welder to the steel pieces and pressing the button for welding
Grinding	Grinding	Grinding	Arms	All	Middle	Continuous	Continuous	Depending on surface size	A horizontal movement of the arms in all directions in a back and forth manner
		Rotating	Arms	All	Middle	Fragmented/Repetitive	Repetitive	0'02"	A horizontal movement of the arms in all directions, re-positioning of the object
	Cutting Glass	Placing	Lifting	Core, Arms	Up	High	Fragmented	0'02"	An upward movement of the core and arms for lifting a block of marble
Cutting Glass		Landing	Arms	Down	Low	Fragmented	Fragmented	0'03"	A downward movement of the arms, approaching the block slowly on the surface
		Pushing	Arms	Right/Left/Backward	Middle	Continuous	Continuous	0'04"	A horizontal movement of the arms, right and left until placing the block on the back of the machine
	Adjusting	Pushing	Arms	Right/Left	Middle	Fragmented	Fragmented	0'10"	A horizontal movement of the arms, right and left until reaching the position for cutting
		Moving	Legs, Core, Arms	Forward	Middle	Fragmented	Fragmented	0'10"	Walking and pushing the tray of the machine with the arms and then backward movement returning to the initial position for adjusting the piece (pushing might be required again); horizontal movement
	Grinding Glass	Grinding	Grinding	Arms	All	Middle	Continuous	Continuous	Depending on surface size
	Rotating	Arms	All	Middle	Fragmented		0'02"	A movement of the arms in all directions, re-positioning of the object	
	Placing	Lifting	Core, Arms	Up	High	Fragmented	Fragmented	0'01"	An upward movement of the core and arms for lifting a block of marble
		Landing	Arms	Down	Low	Fragmented	Fragmented	0'01"	A downward movement of the arms, approaching the block slowly on the surface

Process/Procedure

Full technical setup

Workshop equipment

1. Two angle grinders (cutting disc and grinding disc)
2. MIG welder
3. Protection equipment (see risk assessment document below, pp. 29-30)
4. Working bench
5. Steel sheets

Sound equipment

1. Laptop / Desktop Computer
2. Dynamic Microphone (an *Electro-Voice RE20* dynamic cardioid microphone was used for the performance *Process/Procedure*)
3. Audio Interface
4. Stereo or Quad Amplification System and Monitor Speakers

The electronics should be balanced in order to support the workshop sounds, but not to be too quiet or overpowering them. Levels should be adjusted in the performance space (workshop) to ensure a good balance between the processed and live (sculpting) sounds. The loudest sound (this of the grinder) should be considered as a reference for adjusting levels.

Software

Max For Live, Ableton Live (9 or later), *inputPlay 2.1* Patch (Appendix 2: Digital media), Externals.

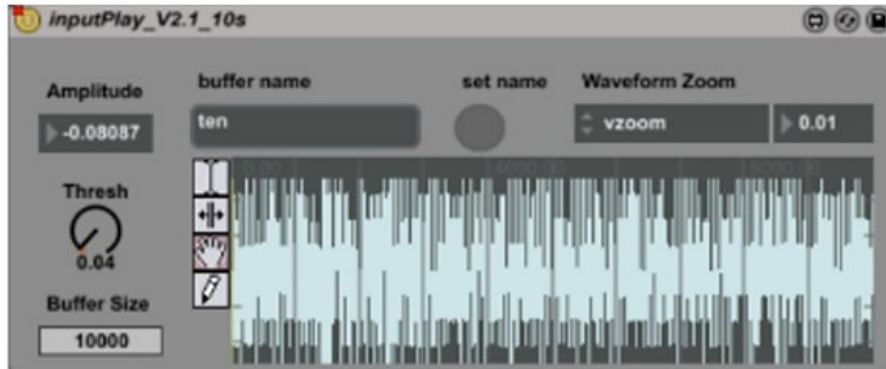
Sound processing externals are required, which should be installed on the computer running the live set. These are: a) Max For Live Externals (AutoRingModulatio and LFO), b) Jonas Obermueller's *jo.Spectral Morph 1.0*, c) Nils Nordmann's *FDC Generator 1.0*, d) David Braun's *Transient Designer 1.01* and e) Ableton Live effects (*Auto Filter, Ping Pong Delay, Grain Delay, EQ Eight*).

Software guide

inputPlay V2.1 guide

This Max For Live patch captures fragments of the live sound during the performance, delays the signal for a select duration and feeds it to sound processing devices in Ableton Live.

The patch needs to be record enabled and have a threshold value more than 0.00. For recording live input in multiple buffer sizes, the name of the buffers needs to be different for each.



Amplitude: Display of amplitude of sound input.

Thresh: Set amplitude threshold sensitivity.

Buffer Size: Set recording and delay duration in milliseconds.

buffer name: Rename buffer to use different buffer sizes in device. Type a new buffer name and click outside the box on the device.

set name: Click once to save the new buffer name.

Waveform Zoom: Display of the waveform of the input signal that gets recorded into the buffer. Change the numeric value to zoom in and out of the waveform and select view modes i.e. 'vzoom' for 'vertical zoom'.



EVENT RISK ASSESSMENT FORM

Activity assessed:

One-off or infrequent events held on School premises

Date, time and brief description of your event here:

Describe nature, extent and outline content of planned event and anticipated number of persons involved (include any significant risks) – use/link additional documents if required

Wednesday 15 November 2017 4.45pm - 5.30pm
This event 'Process / Procedure' is a live performance of sculpture making (welding and grinding steel) and sound.
Please see additional document for further details of this event.

Location (building name/room number/area):

Minto House, research workshop

Name(s) of assessor(s):

Date of this assessment:

Signature (s):

Date of next review:

N.B. Whilst completing this form, your attention is drawn to the guidance available on the HSE website, and specifically at: <http://www.hse.gov.uk/event-safety/running.htm>.

If you require assistance in completing this form, please contact the ECA H&S Officer, Alastair Brown.

Risk assessment document for 'Process / Procedure' performance

Date: Wednesday the 15th of November 2017 at 4.45pm

Where: Research workshop in Minto House, ESALA, Edinburgh College of Art

Organizer: Eleni-Ira Panourgia, e.panourgia@ed.ac.uk

Duration of event: approximately 20 minutes

Brief description of event: This event concerns a live performance of metalworking and sound. This process involves two main actions: welding and grinding steel. It includes noisy periods, which occur from grinding steel. Sounds from the fabrication process are fed into a computer system through microphones in order to get processed and fed back in the workshop space through speakers. What the audience is experiencing are the relationships among: a) the movement and actions realized by the performer (myself); b) the sounds produced by the actions/material/tools-machinery; c) the processed sounds coming from speakers; d) the three-dimensional object that is being fabricated.

Anticipated number of people involved: 15

Hazard 1: Grinding steel - Sparks, dust and noise

Risk: Medium

Precautions:

Myself: a) I am wearing all the associated equipment related to metalworking, including respirator mask (PPE); b) I have cleaned the space of the workshop around my workbench and removed any nearby combustible materials

Audience: a) is informed about the process and hazards; b) has enough distance from the hazardous source – located in a separate area of a balcony over the workshop; c) provide them with ear defenders

Risk following precautions: Low

Hazard 2: Welding steel with a MIG welder - Sparks, fumes and UV light

Risk: Medium

Precautions:

Myself: a) I am wearing all the associated equipment related to metalworking, including a welding mask and respirator mask (PPE); b) I have cleaned the space of the workshop around my workbench and removed any nearby combustible materials

Audience: a) is informed about the process and hazards; b) has enough distance from the hazardous source – located in a separate area of a balcony over the workshop; c) protection screen to cover welding/light source

Risk following precautions: Low

Process / Procedure

Eleni-Ira Panourgia 11-13.09.2018 / 1.30 - 4.30 pm

IMPORTANT INFORMATION!

This performance involves welding steel, which emits UV light.

Please do not enter in the space of the performance without wearing one of the protective masks provided.

NOTICE



**Wear a
welding
mask**

Consent form for interviewees

<p>Consent form</p> <p>'Process / Procedure' performance</p> <p>Eleni-Ira Panourgia</p> <p style="text-align: right;">15 November 2017</p> <p>I consent to all my feedback/interview being incorporated in the PhD thesis or into related publications and I understand that this will be kept anonymous.</p> <p>Name:</p> <p>Signature:</p>
--

The same risk assessment, protection sign and consent form were used for all three performances in 15 November 2017, 24 April 2018 and 11-13 September 2018.

Research workshop

A 3D scanned image of the Architecture Research Workshop at Edinburgh School of Architecture and Landscape Architecture in Minto House, 20-22 Chambers Street, Edinburgh. Scanned by the author in September 2018 with a Leica BLK360 3D Laser Scanner.



Performing 'With'

Poster - programme notes

PROKALO PLUS

ELENI-IRA PANOURGIA 15 NOV 2017

“ 'Process / Procedure' is a performative work of spatial-sonic experience and a multi-layered aesthetic that involves a responsive process of sculpture making and sound. This work is part of my practice-based PhD, which engages compositional and mediation strategies to achieve the combination of sonic and three-dimensional, sculptural modalities. I am interested in developing an understanding of such hybrid morphologies and their potential within my artistic practice. I take a process -and performative- based approach in exploring this subject and I am experimenting with the development of interactive performance set-ups. 'Process / Procedure' centers around the notion of process in relation to actions and their reflection through sculptural material and the sounds produced. What you will experience in this presentation, is a live performance of the work-in-progress. ”



'PROCESS / PROCEDURE' in progress

4.45 - 5.30 pm

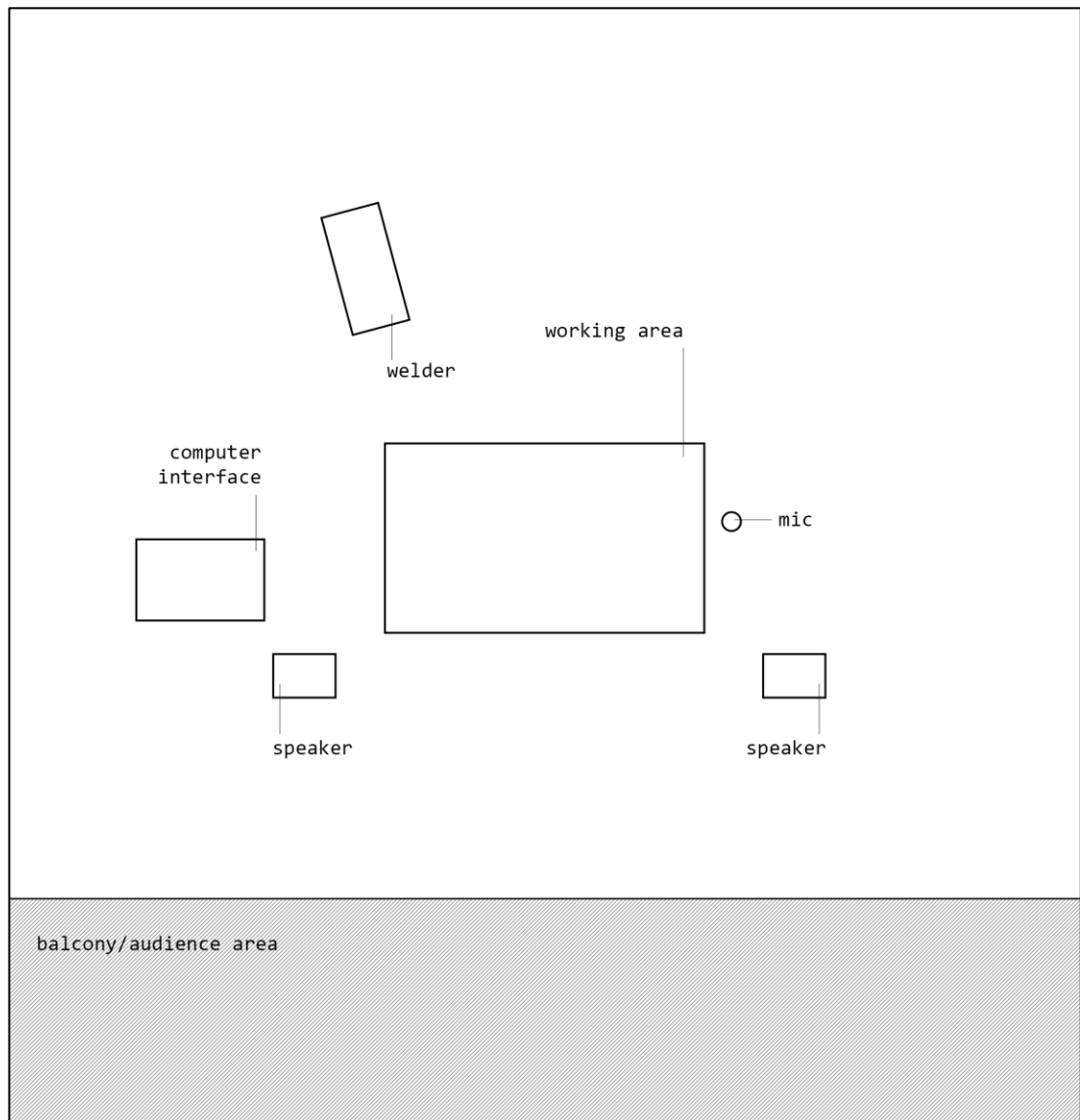
Research (Concrete) Workshop, Minto House
20-22 Chambers Street, Edinburgh EH1 1HT



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prokalō
ESALA Postgraduate Seminar Series

Setup plan



Photos of performance

Photographed by Beichen Yu







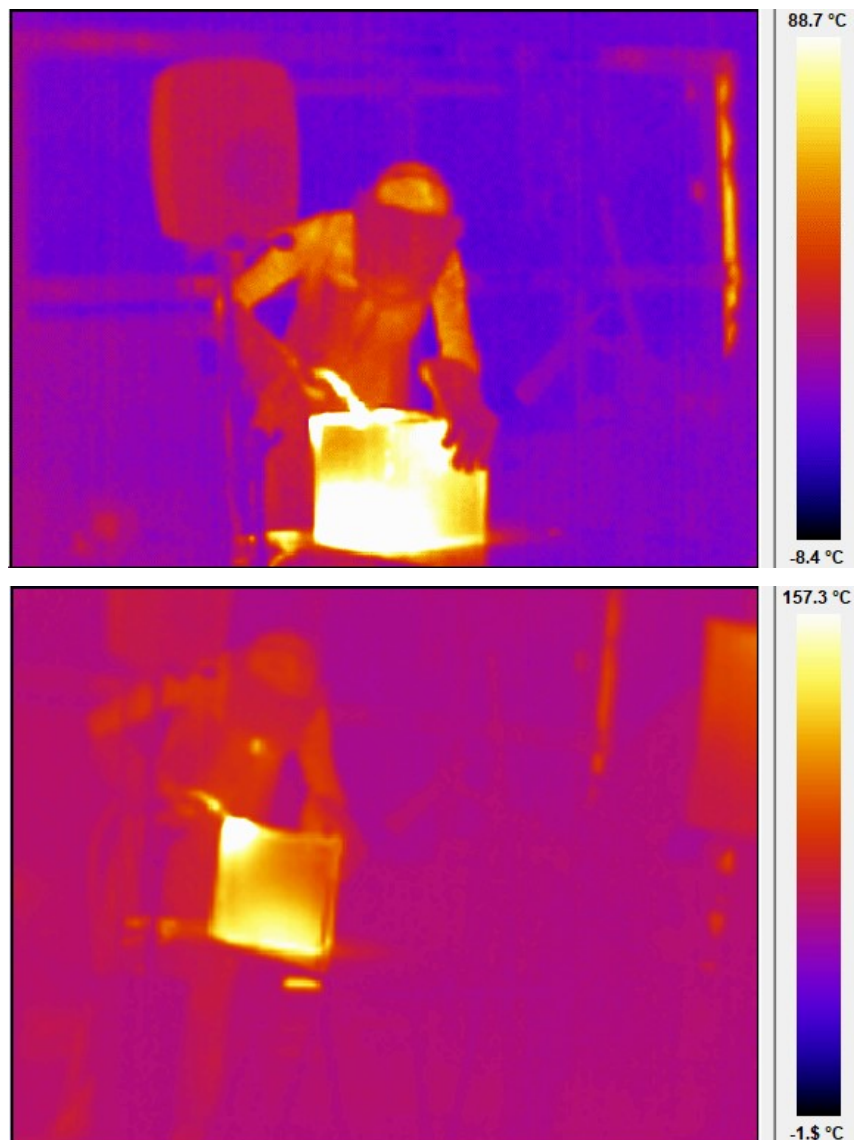


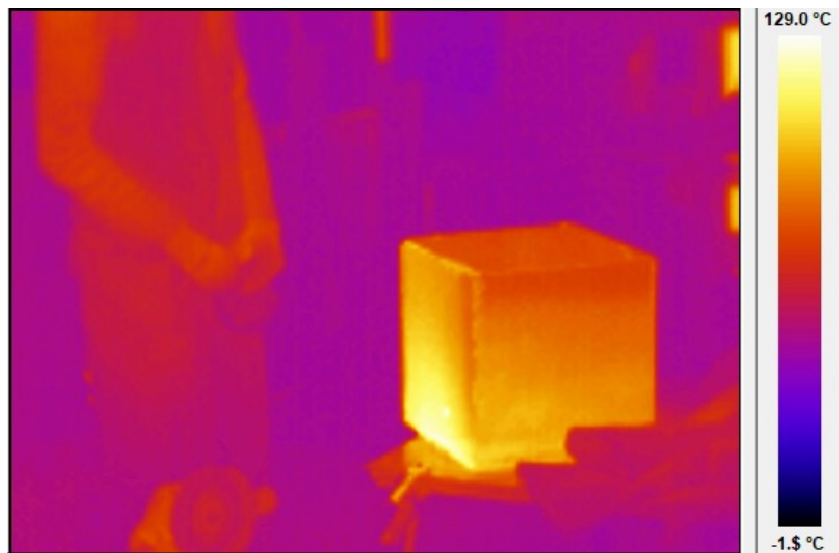
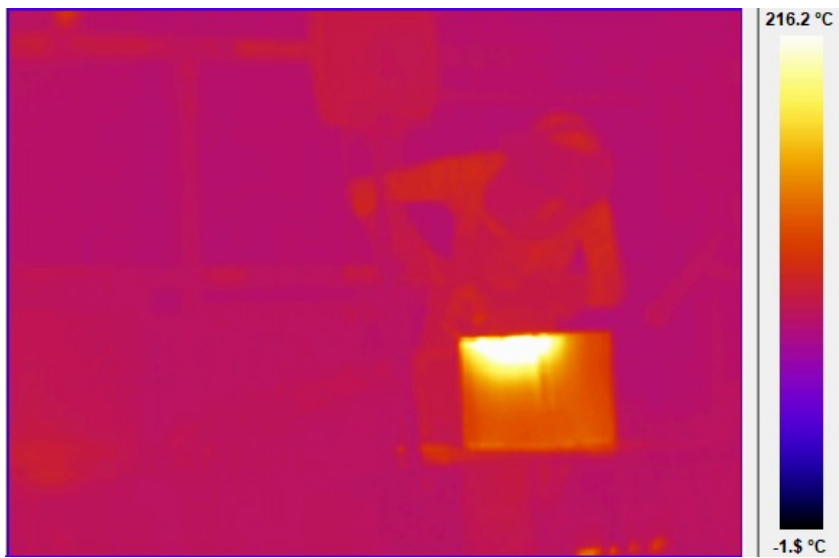
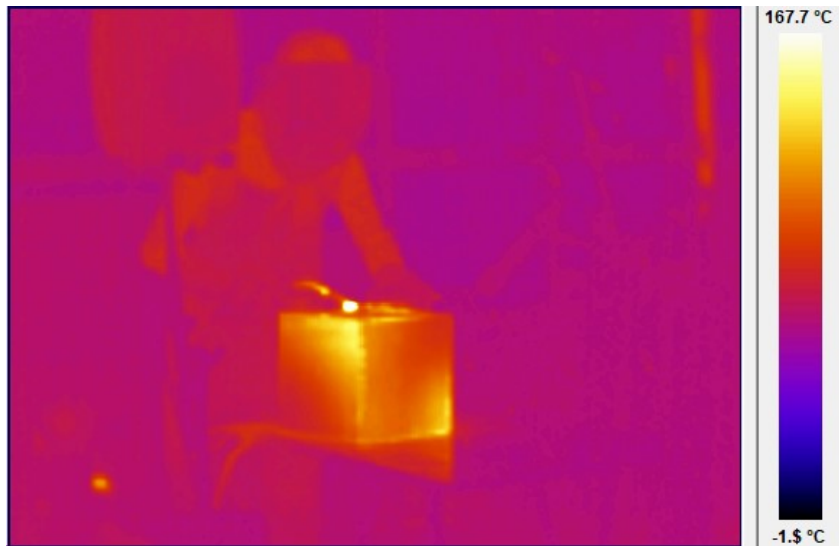


Thermal imaging

Captured by Roxana Karam

The images below have been captured by Roxana Karam using a PCE-TC 3 Hand-held thermal imaging camera during the performance Process/Procedure 'With'. The first two images of welding show the heat all over the object. The third image shows the object cooling after welding. Following, the image of grinding highlights that heat during this process was accumulated closer to the point of contact with the grinder rather than the whole object. The last image shows the moment that object was completed.





Questionnaire for audience

1. What is your understanding of this process?
2. What is your perception of the sound-3D object relationships in this work?
3. How do you understand actions in relation to sounds and the 3D object?

Interviews

B:

1. You were making actions, moves, which informed the system that responded with sound and you responded to it. A feedback system, a cycle. The response rate of the system was different than yours.
2. I like the ambient sound... as if you were creating the sounds through bodily movement, as composing sound through making the object. I was not sure whether it was the sound of the movement, which was triggering the system. I would describe it as a 'sound ecology' that was comprised of individual ecologies in a cyclic, feedback loop.
3. A spatial work in which sound was the main actor... a dialogue between actions-sound-object. Filters were acting like masks. This created a distance with the performance. You get immersed, while distancing. This was a strong aspect of the work. Light and sound relationships also added into that.

A:

1. Interaction of three media (performance, sculpture and sound) partly automated, partly open to randomness, real-time, live. The basis were the media themselves and experimentation with them: that was for me the side of the process.
2. I was wondering whether the processed sound was live generated responding to the sculpture. I thought that this could have been a pre-

recorded thing. I found satisfying the grinding part, which corresponded to the action of smoothing: both the sound and the physical material.

3. There was a strong performative element totally integrated with the processing of the sound and the sculpture. I could notice moments of clear improvisation and the existence of a script behind the performance. Reference and point of attention: a woman doing very heavy manual labour.

N:

1. Sound producing correspondence to what you were doing, the sculpture. The sound was repetitive, so I was able to observe the sounds in relation to what you were doing.
2. The object wasn't there yet, you were making it. It was more about building the object I think. Atmospheric, spatial sounds. The object was sharp, square and made from steel, very industrial, raw-looking object. The sounds were kind of industrial too but more softened, like hearing this process with cushions above your ears – not as sharp as the object was.
3. You would first act and then the sound would respond to it in a way that would feel like a very concentrated zoom into the process. This was emphasized with the sound in that particular moments. The coming together of the welding, the steel, the surface and the actions were in a direct relationship to the process rather than the finalized object. We didn't hear the sound of preparing the steel sheets was absent; the sound which was included in the performance was about the bringing together this specific process rather than the whole making.

K:

1. It was not clear to me at all times, but I could tell when it was changing. I was trying to focus via the ear and not the eye and then I was understanding better what was happening. It was mostly a feeling of

creation, of being present both in time and in space. Smell was very strong – the smellscape. At the beginning it was too strong but then it got me more immersed. The same was with wearing a mask.

2. I could feel the 3D shape being created sonically. From the sound and the object, I could feel space being created. Sometimes I was focusing on the aural and other times on the visual... they were complementing each other. This could be presented as a durational performance. People coming and going would enhance the experience.
3. Your gestures... I could tell that your body was taking a different position in relation to the angle/technique and a change to the process. The gesture was more obvious to perceive through listening. I could understand the sources of sounds. Space created through the object, sonically, but also through the gestures.

A:

1. To make a torsion in reality through which we can exhume the temporality of both sound, and the lived experience of the performance... a pure experimentation of the spatio-hyletic possibilities of space, an invention of voids that investigates what space can do. In both its presence and absence.
2. The cube that you make, to me is not a three-dimensional object, but the cube that you make to me is a four-dimensional object, with no shadow at all, but the shadow is the sound. Your cube to me isn't a residue, it doesn't represent your performance, but your performance is what binds the cube, your performance is the glue. The delay, it makes space. Distance. Makes the space so huge. The space where you are performing, loses its scale. Because we can hear the immediate noise from the welding machine. Then after a while comes the low murmur, as if from far away. Which distorts the audible space around. So perhaps your cube loses its scale, and occupies the whole building where its being made. Because the later sound feels as if it comes from inside the cube.

3. The vectors of your welding hands, the direction that works in the emptiness. And once it is finished, the space inside is locked forever, the space that you borrowed from the infinity of space around you, is now locked without having an access to it. But the only thing that comes from the inside of the cube is the echo, the memory.

A selection of comments:

“A spatial work in which sound was the main actor... a dialogue between actions-sound-object. Filters were acting like masks. This created a distance with the performance. You get immersed, while distancing. This was a strong aspect of the work. Light and sound relationships also added into that.”

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kind of industrial too but more softened, like hearing this process with cushions above your ears."

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"The cube that you make isn't surfaces, its lines. No surface, because the surface was already there. But it was the vectors of your welding hands, the direction that works in the emptiness...But the only thing that comes from the inside of the cube is the echo, the memory."

"You would first act and then the sound would respond to it in a way that would feel like a very concentrated zoom into the process. This was emphasized with the sound in that particular moments. The coming together of the welding, the steel, the surface and the actions were in a direct relationship to the process rather than the finalized object. We didn't hear the sound of preparing the steel sheets was absent; the sound which was included in the performance was about the bringing together this specific process rather than the whole making."

"It was mostly a feeling of creation, of being present both in time and in space. Smell was very strong – the smellscape. At the beginning it was too strong but then it got me more immersed. The same was with wearing a mask."

"I could feel the 3D shape being created sonically. From the sound and the object, I could feel space being created. Sometimes I was focusing on the aural and other times on the visual... they were complementing each other."

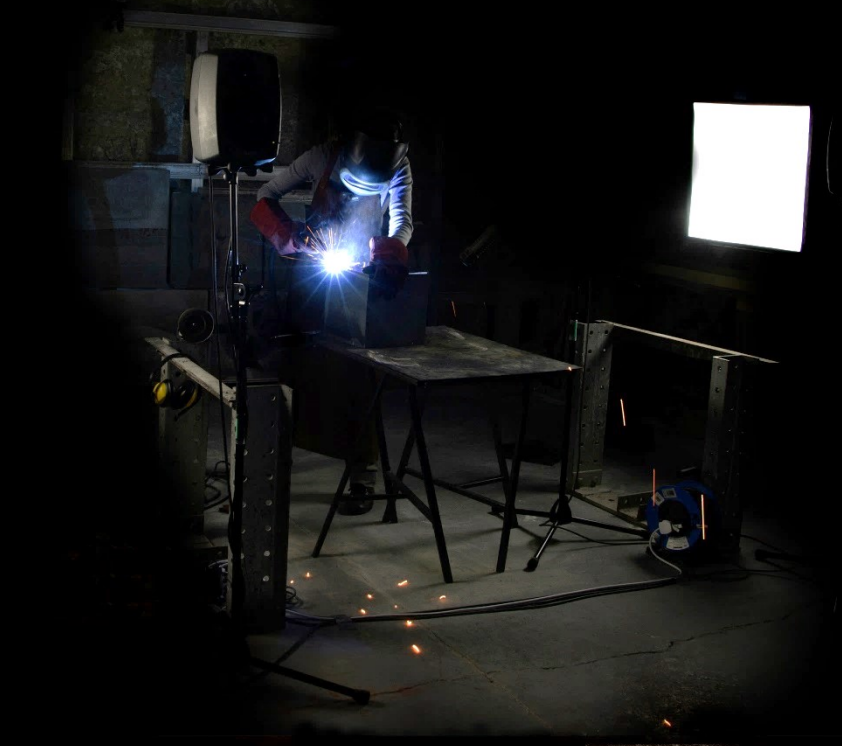
"The gesture was more obvious to perceive through listening. I could understand the sources of sounds. Space created through the object, sonically, but also through the gestures."

Performing 'For'

Poster - programme notes

Process / Procedure Eleni-Ira Panourgia

24 April 2018
4.00 - 7.00 pm



A durational performance that seeks to create a *co-compositional* situation in which physical and sonic material are concurrently produced, rearranged and transformed. Central to this work is the idea of process, which is viewed in relation to actions of sculpture making and their reflection through physical and sonic material manipulation. *Process/Procedure* expresses 'memories' of actions, relationships and events through traces of material transformation.

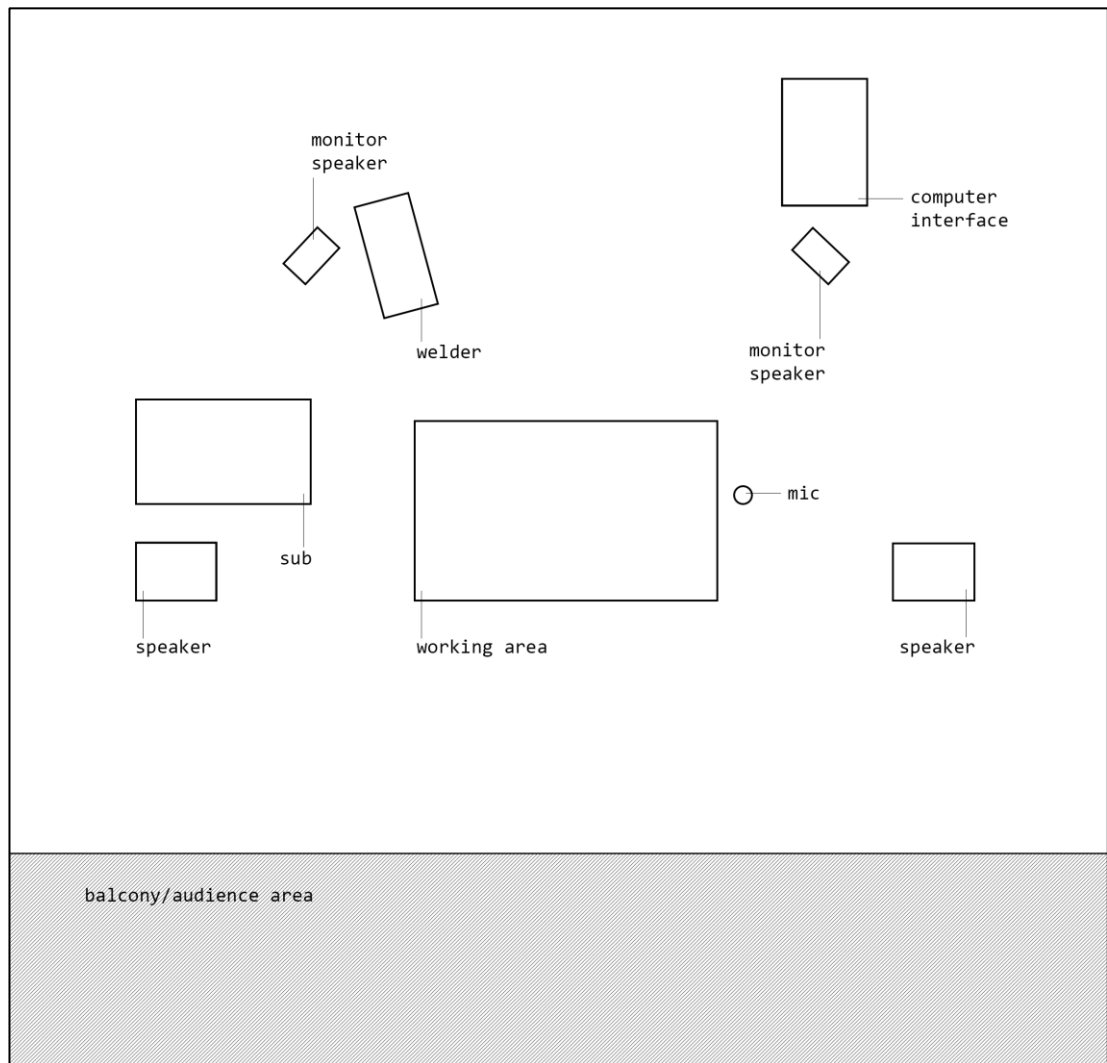
The audience is invited to attend the event for as long as they wish, to leave and return.



THE UNIVERSITY of EDINBURGH
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Research workshop, Minto House
20-22 Chambers Street, Edinburgh EH1 1JZ

Setup plan



Photos of the performance

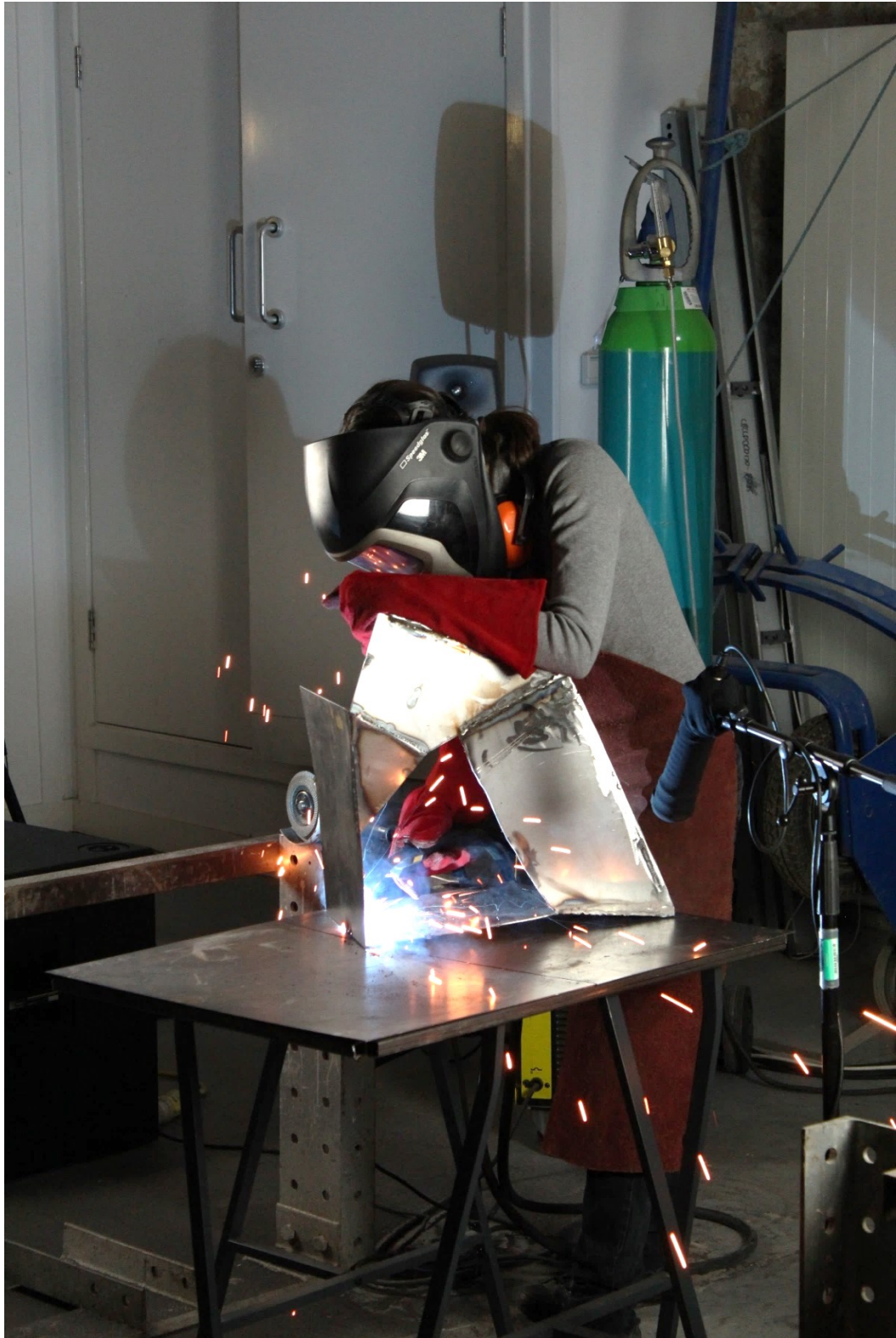
Photographed by Thanos Makrynikolas









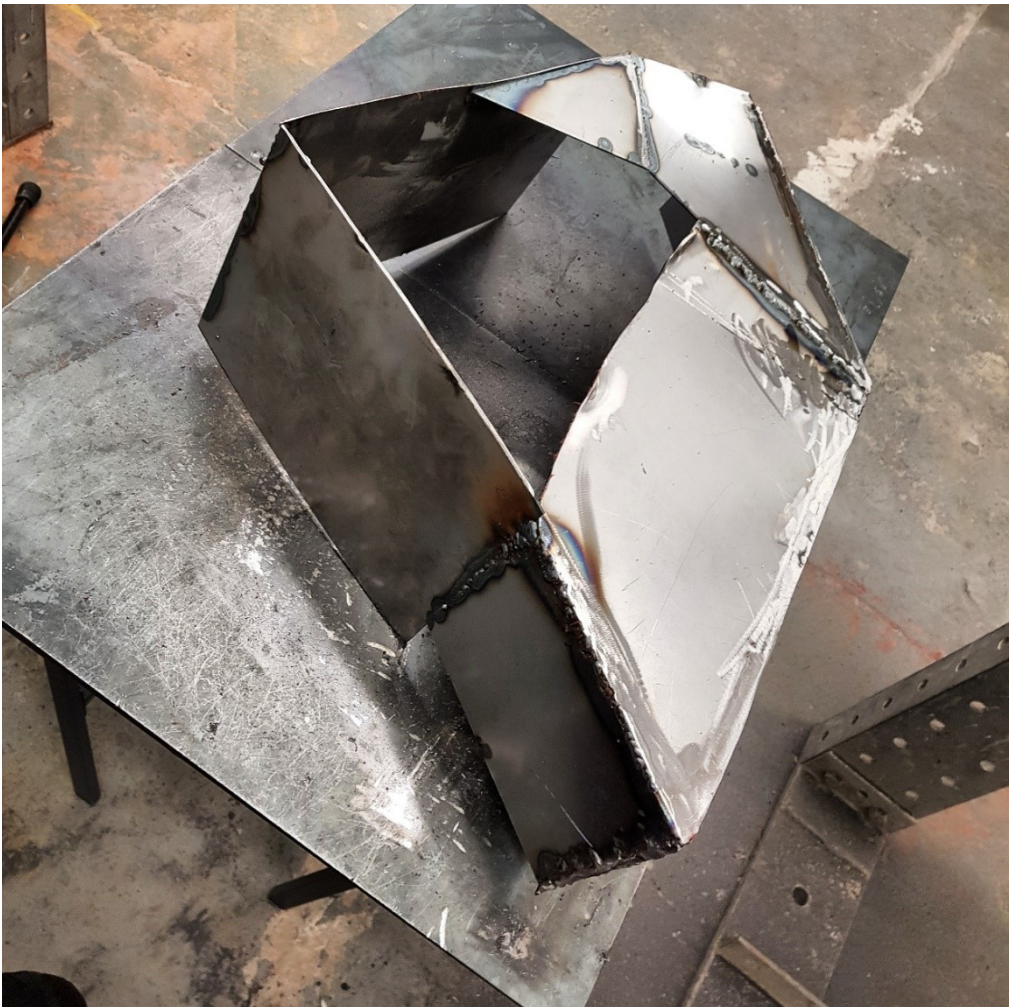




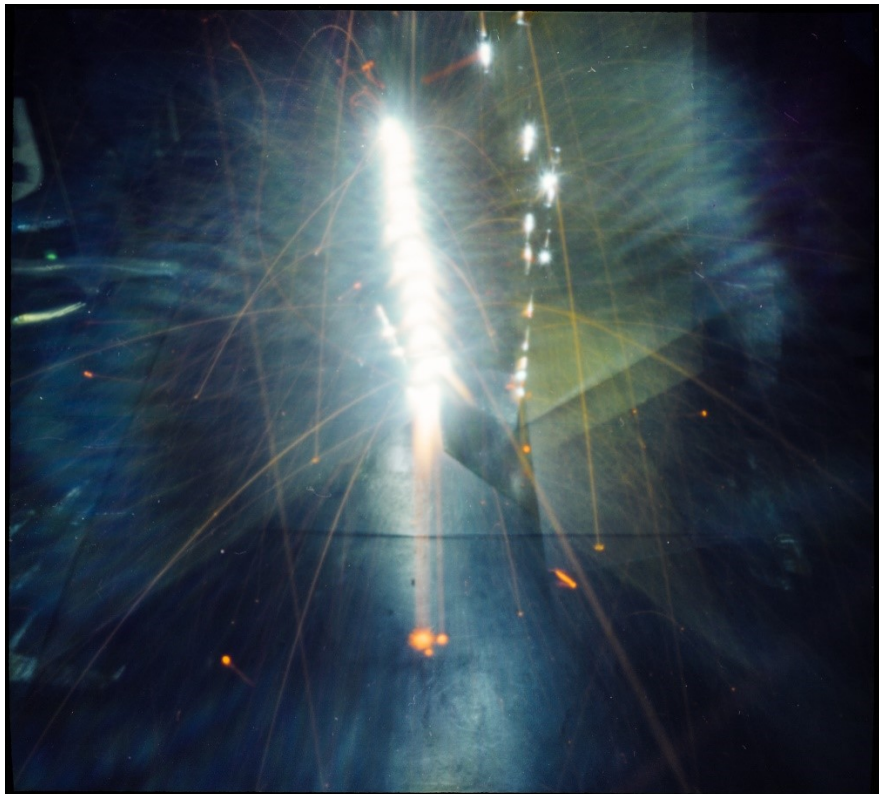
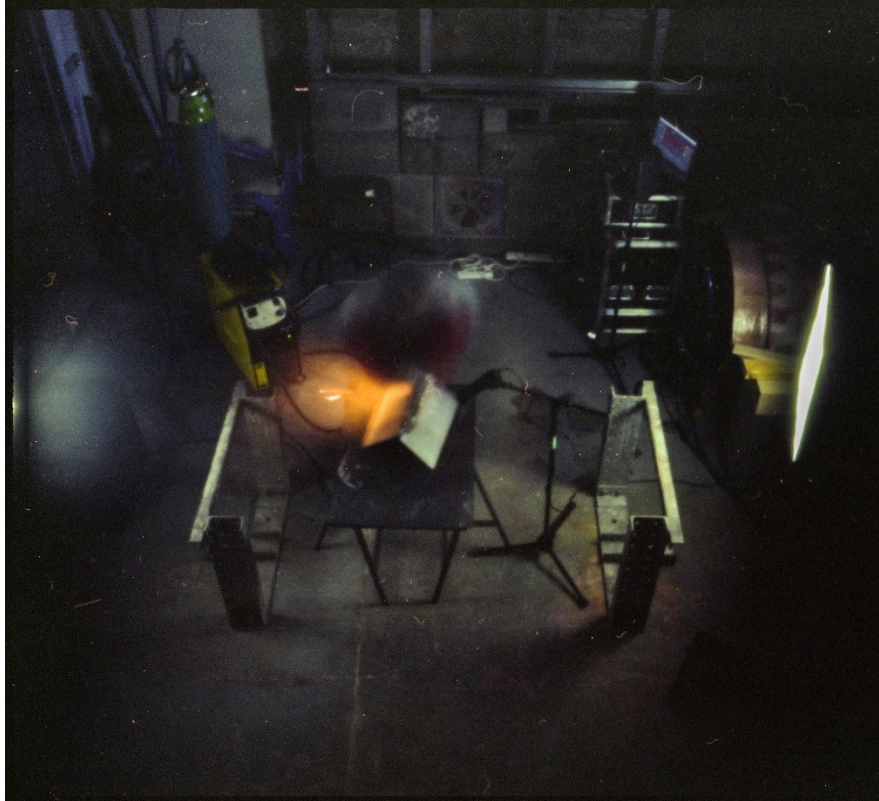
Photos of the object

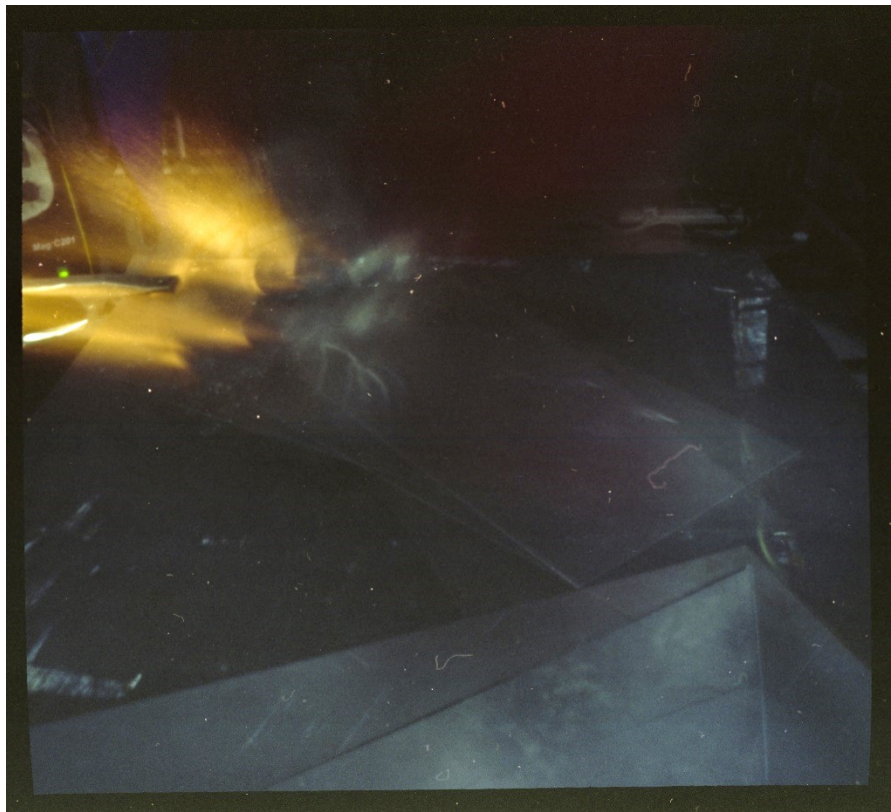
Photographed by Roxana Karam





Photographed by Sam Cornwell with a Noon Pinhole camera and 120 colour film





Questionnaire for audience

1. What is your understanding of this process?
2. What is your perception of the pauses and the time in-between actions?
3. How do you understand material transformation in relation to body movement?

Interviews

R:

1. The sound making as well as physical making affecting one another. The material was metal and the tools were welding and grinding; it was more than just welding and grinding for creating a physical output, it was also the sound of making and the space where it was happening, a workshop... It was very focused on the stages: how you interact with the material and how you develop...stage by stage...how you reflect your understanding of the process to an audience. The space was important, as a place in which this was happening in terms of perceiving both the audio and the visuals. Close my eyes, listen to the sound, understand what you were doing...which is different than how you would look at this process of making without this setup/idea, if you were in a normal workshop.
2. That was important, the pauses...lets the audience absorb what was happening. Where there was a pause, it was not a stop, the sound was still coming through. It was important in terms of breaking the linearity of the process, to create an anticipation of the next step of the performance. The intensity of the action as well as the sound...there was a variation because of the pauses. The timing in-between, both grinding and welding, to keep the balance with sounds of different frequencies...to show that in a normal workshop you would take pauses but also these pauses were intentional within the process: to let everything settle both in the workshop space/materials and in the audience's memories.

3. It is kind of like a dance...when you are working with the material. The pressure changes between your body and the physical material and sound. Transformation of feedback and forces between matter and body. The metal when you were working constantly on it was hot, you could see the light. A process of visual perception of the physical matter...which was nice. It was very obvious with the mask on. You could see the processes and the lights and the colour range of the sparks and the light.

The viewpoint was also very interesting: very different. You usually get to see in human eye view...the bird view gives the perception of positions: where action is happening in terms of space, a more cohesive perception of the focus on multiple things. From human eye view it is usually focusing on one thing. Also the fact that you can see the fumes and the dust moving, you don't only feel it and smell it, you also see it. It is creating different forms; how these are changing and affecting each other. When you see from the glasses, you can see the lights – everything else is dark – you can see your movement through your instrument; the instrument is part of your body.

S:

1. When you make the objects, that kind of making creates sounds...you bring the sounds into the process, the making process, the product and the sound emerge together. Before the performance, I hadn't realized that the process itself can be that interesting for a research. As an architect I focus usually on the object itself, in the future I think we need to understand the design through the processes themselves. Another way to understand the object.

2. At first, I was thinking that when you do an action you focus on this, but after you stopped I started thinking beyond the action itself, about what to anticipate, look at other people's reaction and observe the environment. When you were doing an action I was focusing on the working area and the actions, then I was observing the surrounding environment, the setup, the objects. It follows creation and it is a necessary element, to stop something, a 'waste' of time to

give you ideas and it is a creation time for other things than the objects, it gives audience space for ideas. I started to understand a specific behavior related to the setup and the physical elements of the environment.

3. I think your gestures, the specific gestures related to some specific actions and specific making; the transformation of material was always related to the working area, to your hand, to your focus on the process, your eyes, your perception. Body movement shows some intensity, that you are focusing on the process. Danger from sparks in the performance, the nature of the material, somehow it engaged me to focus on your body movement. When you stopped, your body movement changed. Stopping is somehow related to moving; when you are making something, the range of your body movement is limited to the working area. When you stop you walk in the space, the range becomes bigger. Related to time perception, when you stopped the perception of time changed for me.

K:

1. I was mostly focusing on the visual element, grinding, because it was the most overwhelming... Layers of immersion that were achieved through the sound and the smell...layered experience. I was focusing on the material and looking at the transformation of the material in the beginning, then my attention shifted to the sound.

2. Very theatrical, very abrupt. These were the times when I could concentrate on the sonic part of it. It was the part where imagination took over...I was thinking how the thing is going to transform...what is she going to do next? I was thinking how it looked before and how it could look by the end of the process. Theatricality that gave way to imagination.

3. I could not help but wonder how this would be in the end...how the material would transform. When you were rotating the object... I was first trying to see through your eyes and have your perspective... The theatricality of the

performance and your movement that was very specific ...I was trying to change my perspective of the process according to them. I felt that I was being an experiencer. It is clear, the role of the artist and the role of the audience...the audience is not passive, it is an experiencer. This is more a one-way.

A selection of comments:

“That was important, the pauses... they let the audience absorb what was happening. Where there was a pause, it was not a stop, the sound was still coming through. It was important in terms of breaking the linearity of the process, to create an anticipation of the next step of the performance. The intensity of the action as well as the sound... there was a variation because of the pauses.”

“The pressure changes between your body and the physical material and sound. Transformation of feedback and forces between matter and body. The metal when you were working constantly on it was hot, you could see the light. A process of visual perception of the physical matter...which was nice. It was very obvious with the mask on. You could see the processes and the colour range of the sparks and the light.”

“At first, I was thinking that when you do an action you focus on this, but after you stopped I started thinking beyond the action itself, about what to anticipate, look at other people’s reaction and observe the environment. When you were doing an action, I was focusing on the working area and the actions, then I was observing the surrounding environment, the setup, the objects.”

“To stop... to get yourself ideas, and it is a creation time for other things than the objects, it gives audience space for ideas. I started to understand a specific behaviour related to the setup and the physical elements of the environment.”

“The transformation of material was always related to the working area, to your hands, to your focus on the process, your eyes, your perception.”

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Performing 'At'

Poster - programme notes

Process / Procedure

Eleni-Ira Panourgia 11-13.09.2018 / 1.30 - 4.30 pm

A three-day durational event of *co-composition*, a process during which sculptural and sonic material are concurrently produced, rearranged and transformed. 'Process/Procedure' inhabits the workshop space and expresses 'memories' of actions, relationships and events through traces of material transformation.

The work takes the form of 45 min. of performance plus 15 min. of installation for three hours each day. The audience is invited to attend the event for as long as they wish, to leave and return.



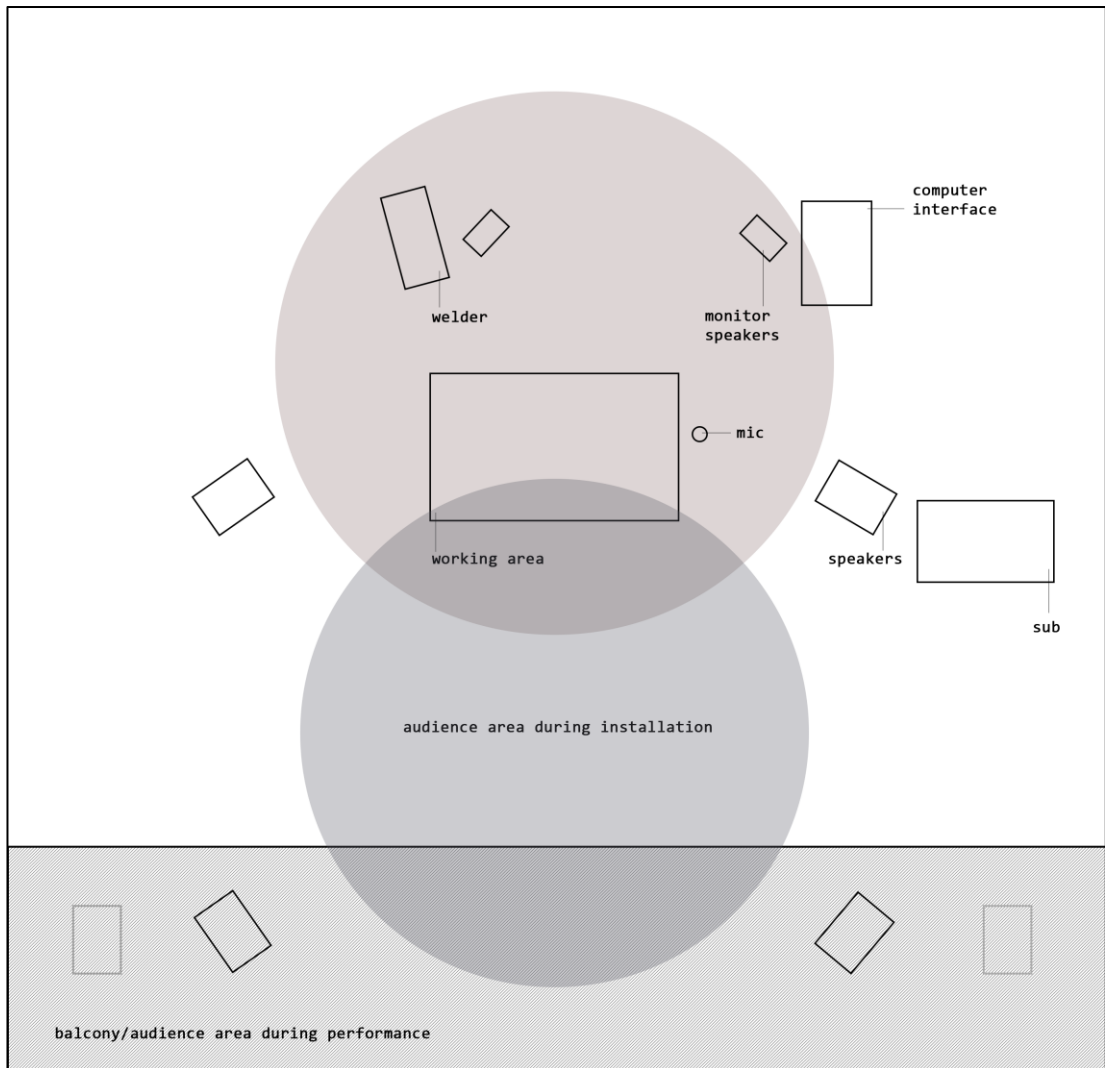
Research Workshop, Minto House, ESALA
20-22 Chambers Street Edinburgh EH1 1JZ

Image produced by Sam Cornwell



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Setup plan



Process / Procedure

Eleni-Ira Panourgia 11-13.09.2018 / 1.30 - 4.30 pm

PROGRAMME

The performance runs in the form of 45' of live show followed by 15' of installation each day.

The audience is invited to attend for as long as they wish, to leave and return.

Hour 1:

1.30-2.15pm live show from balcony area

2.15-2.30pm installation inside the workshop

Hour 2:

2.30-3.15pm live show from balcony area

3.15-3.30pm installation inside the workshop

Hour 3:

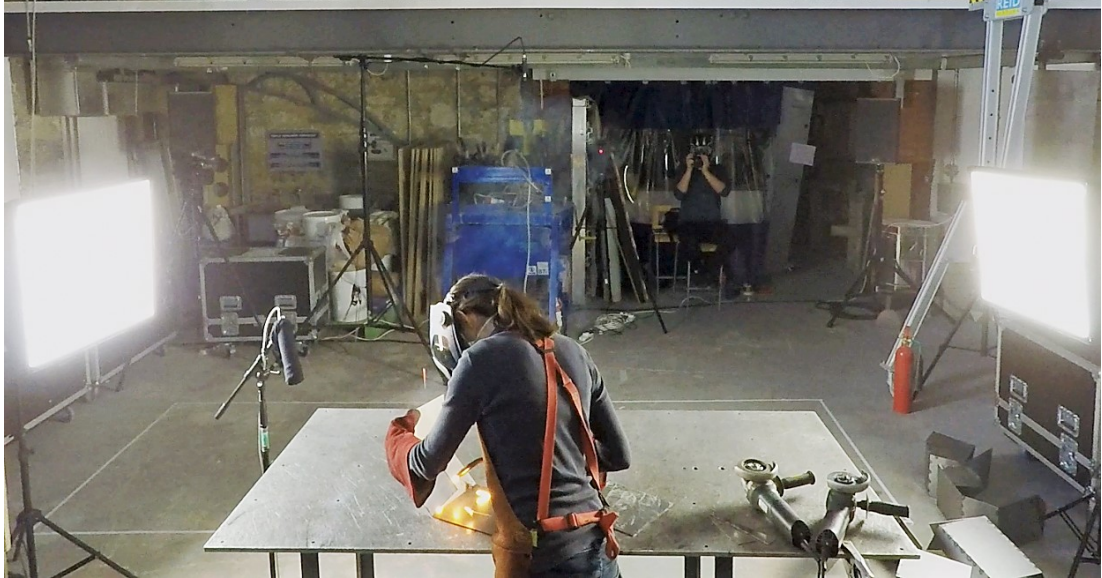
3.30-4.15pm live show from balcony area

4.15-4.30pm installation inside the workshop

Photos of performance-installation

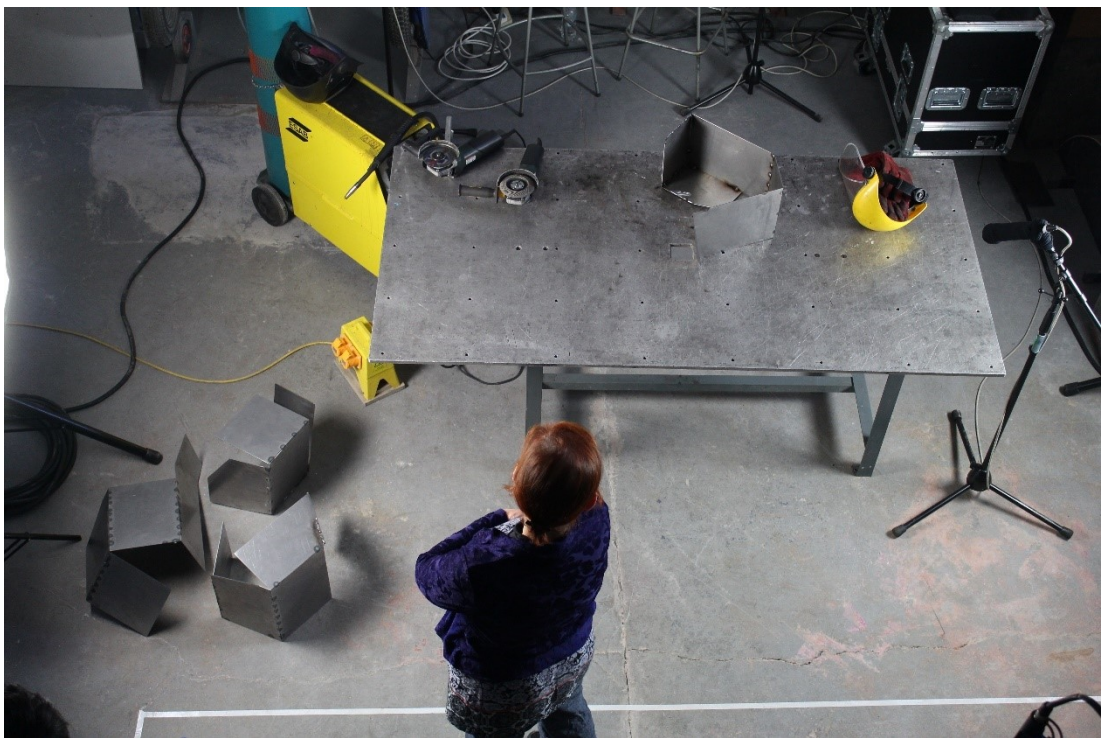
Photographed by Jack Walker



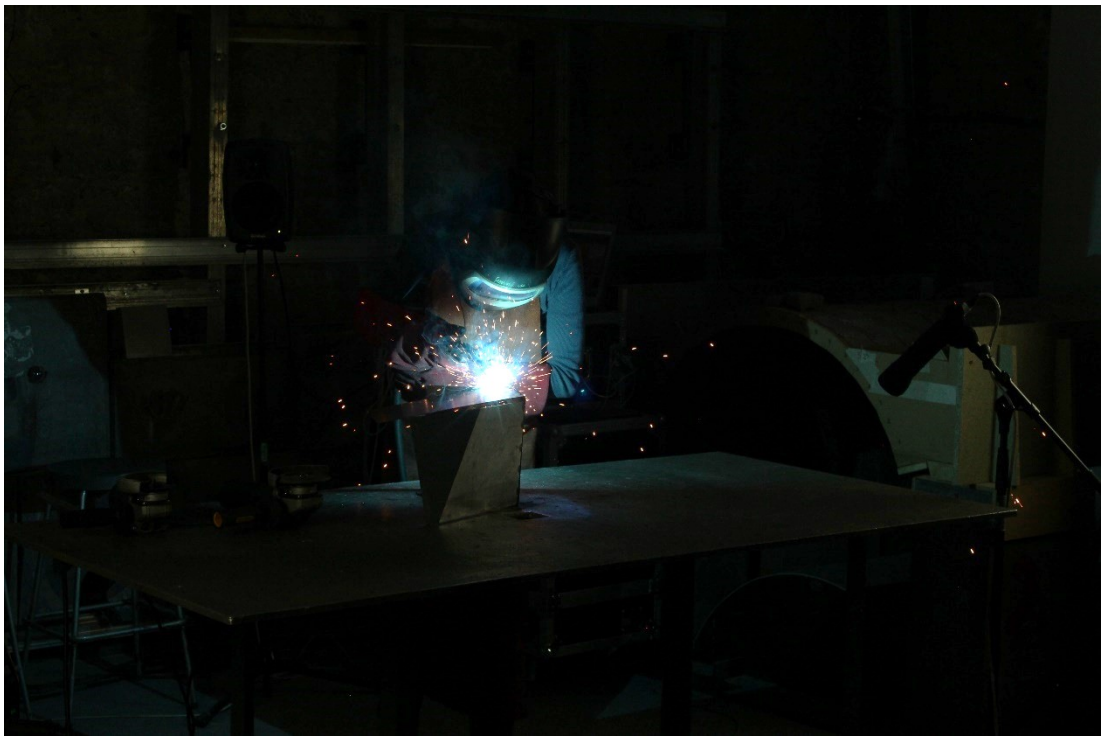










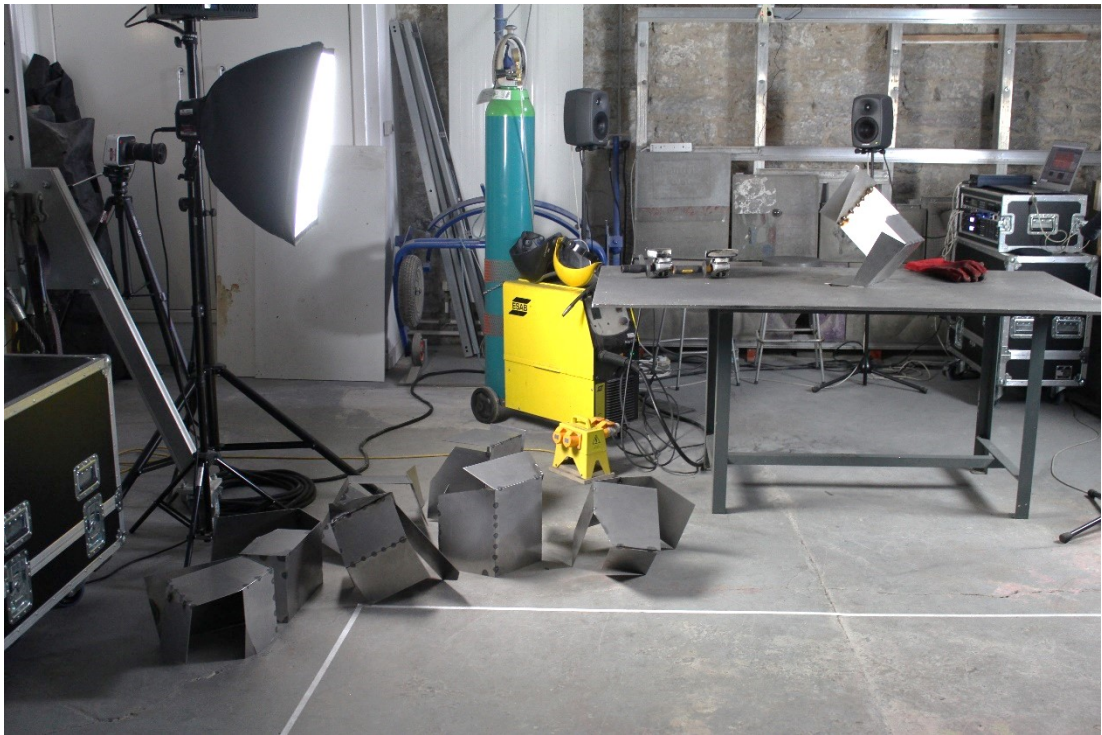




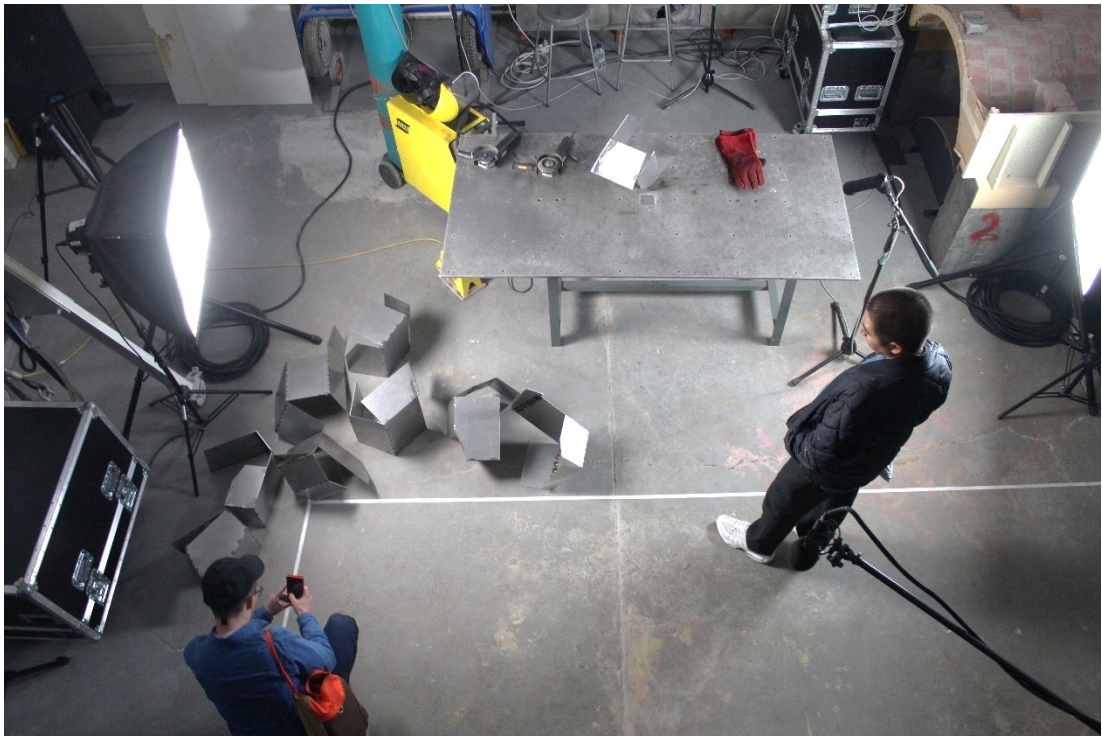








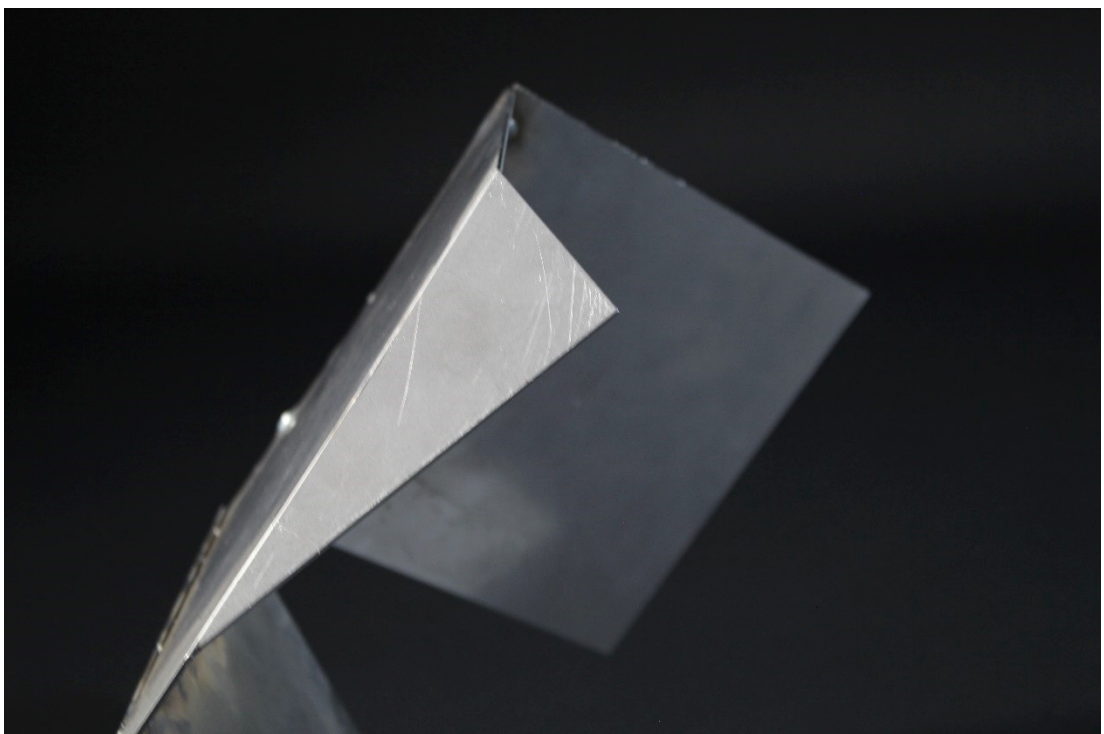


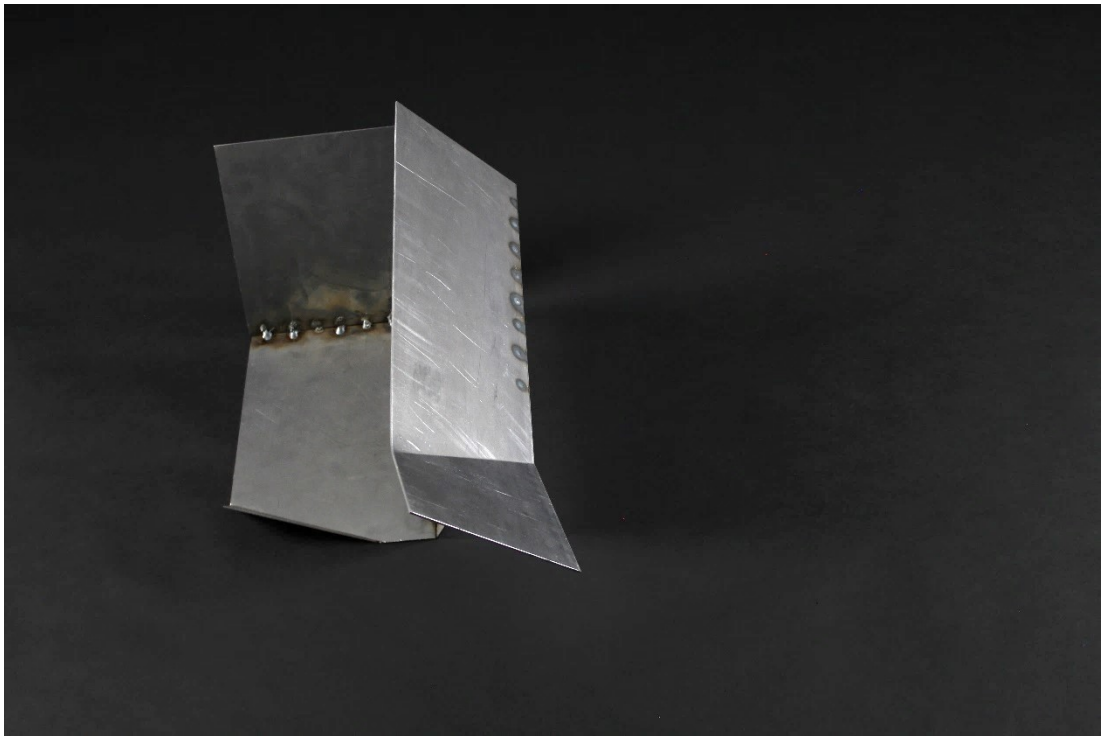
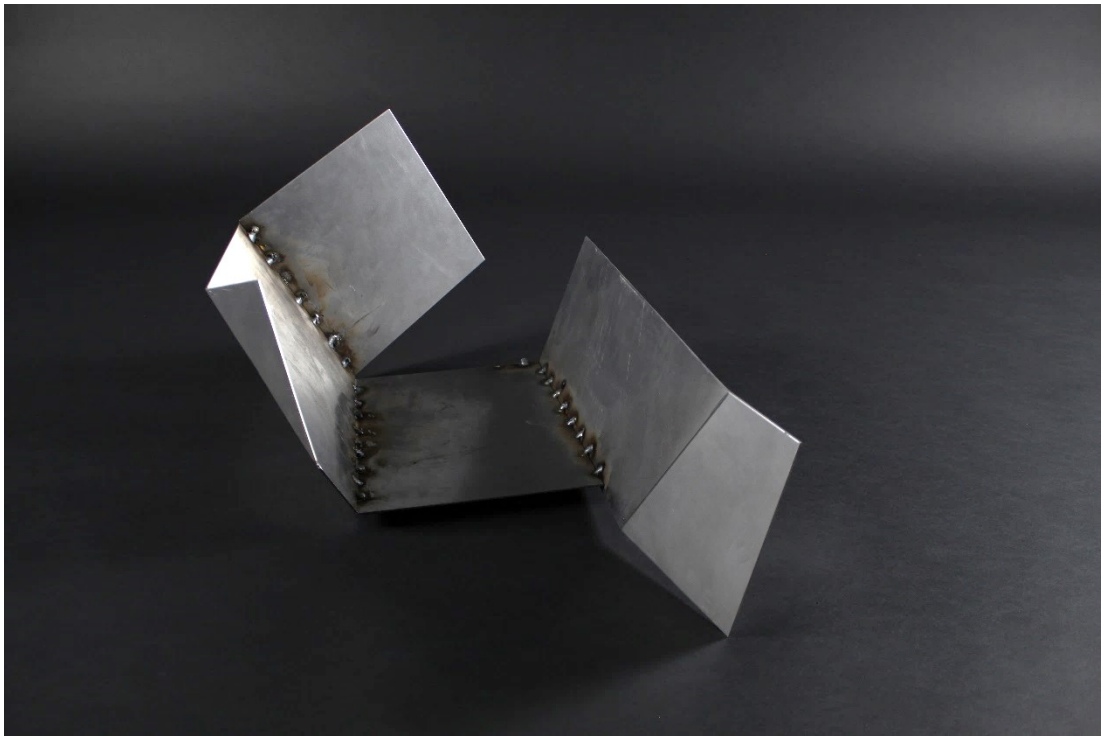


Photos of sculptures

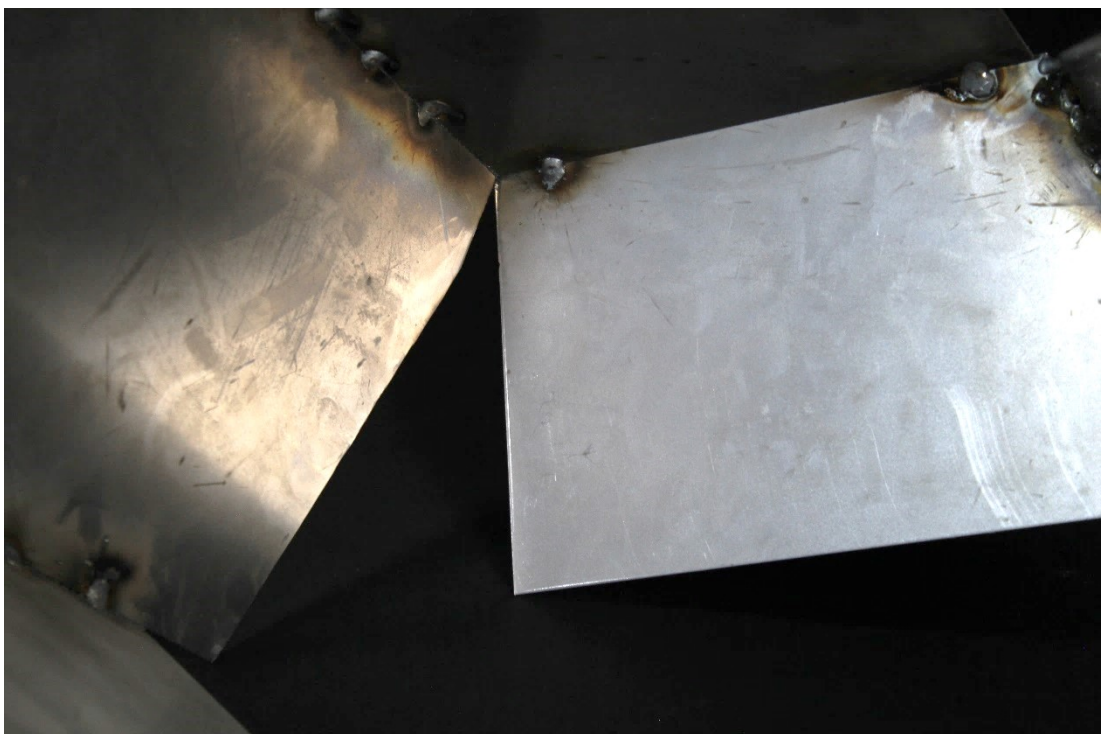
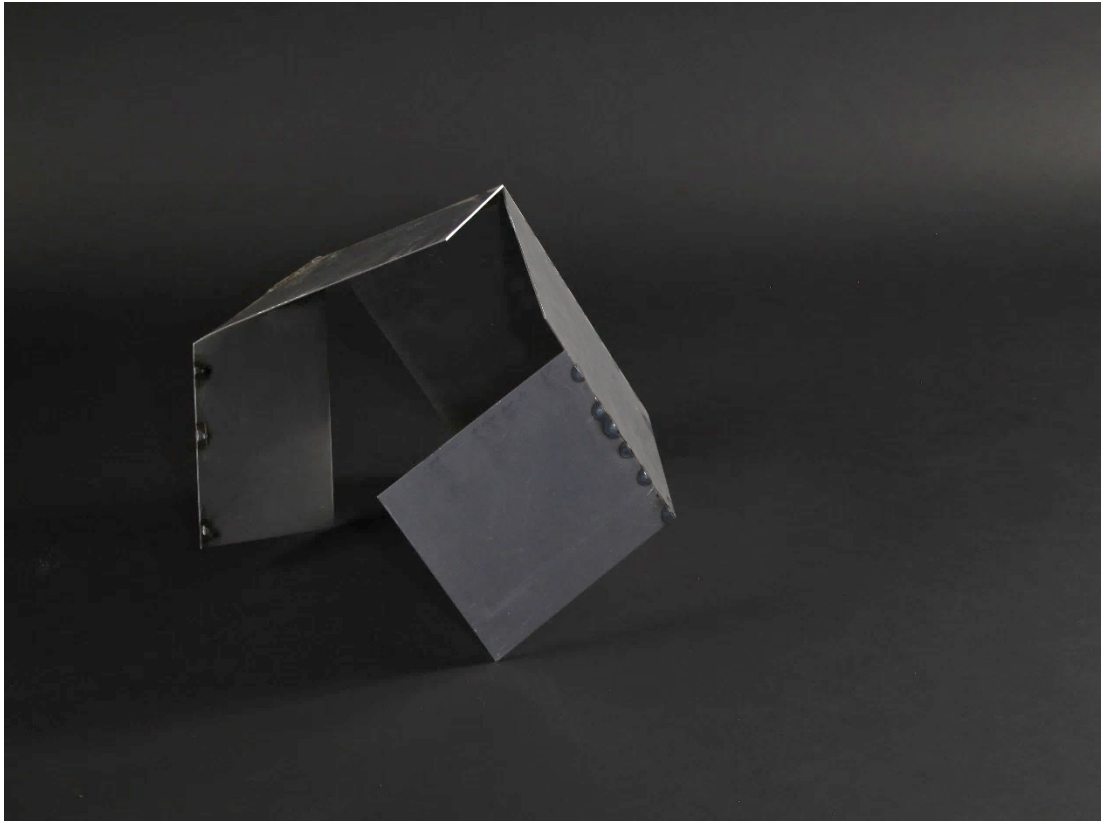
Photographed by Eleni-Ira Panourgia

Day 1 Hour 1

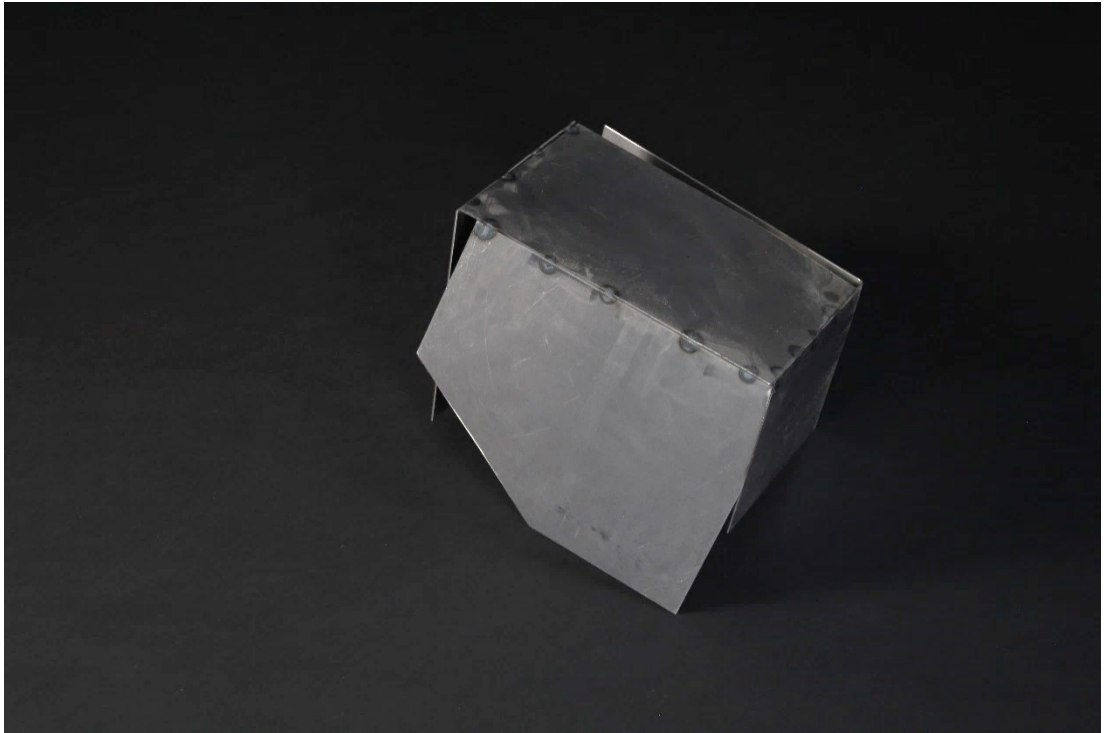




Day 1 Hour 2



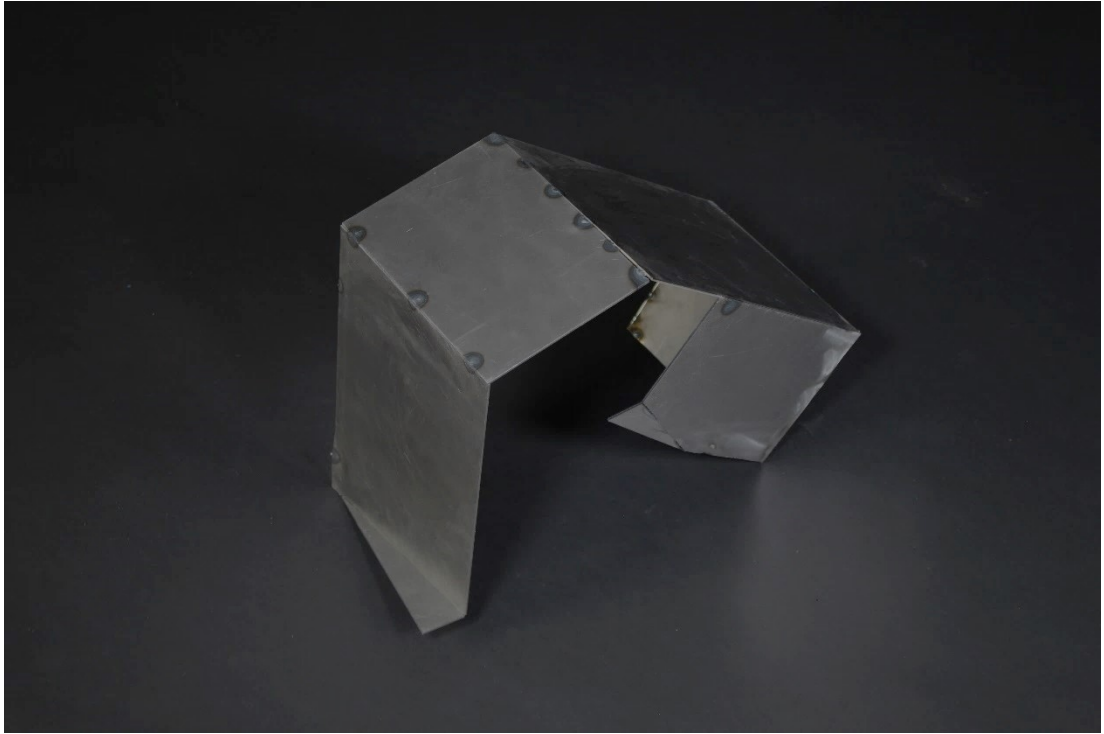
Day 1 Hour 3



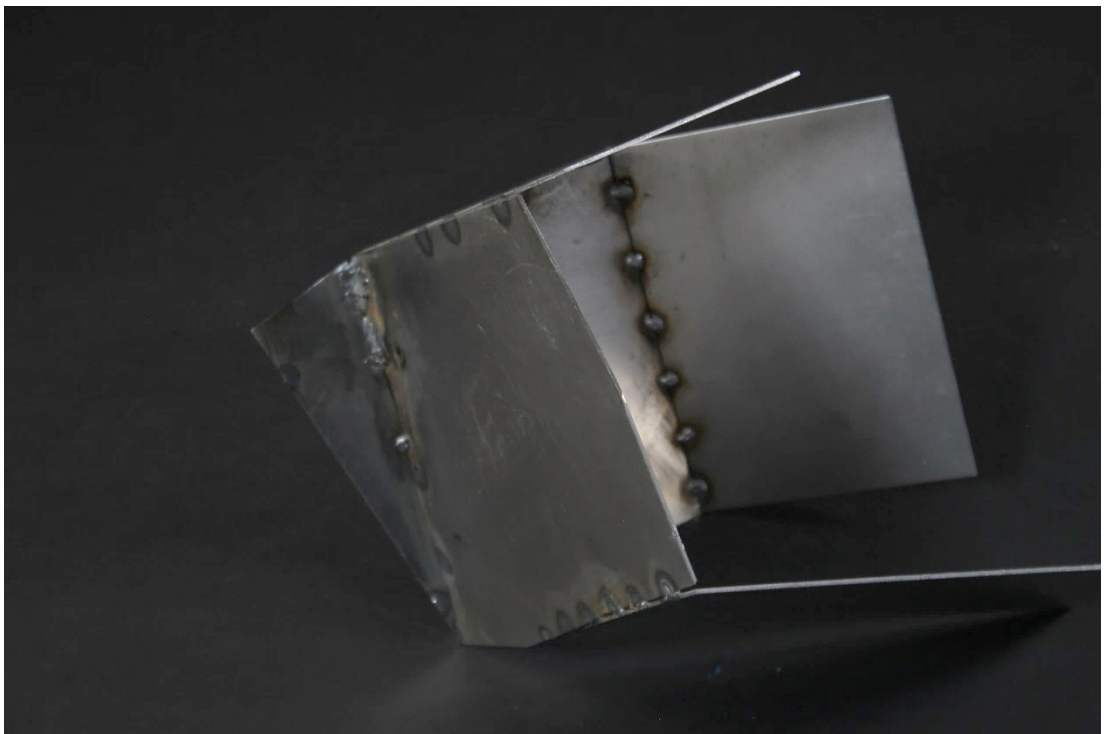
Day 1 all hours

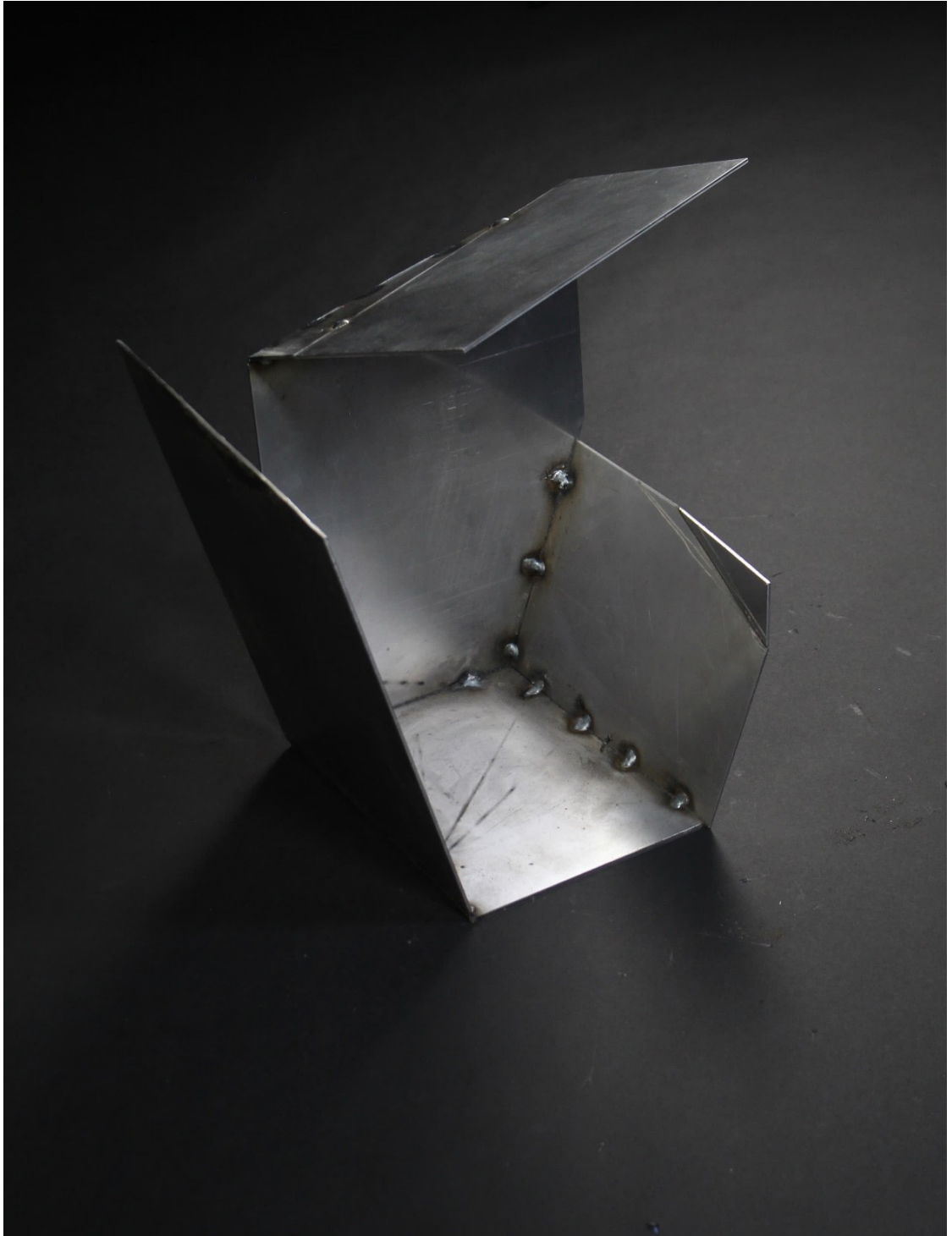


Day 2 Hour 1

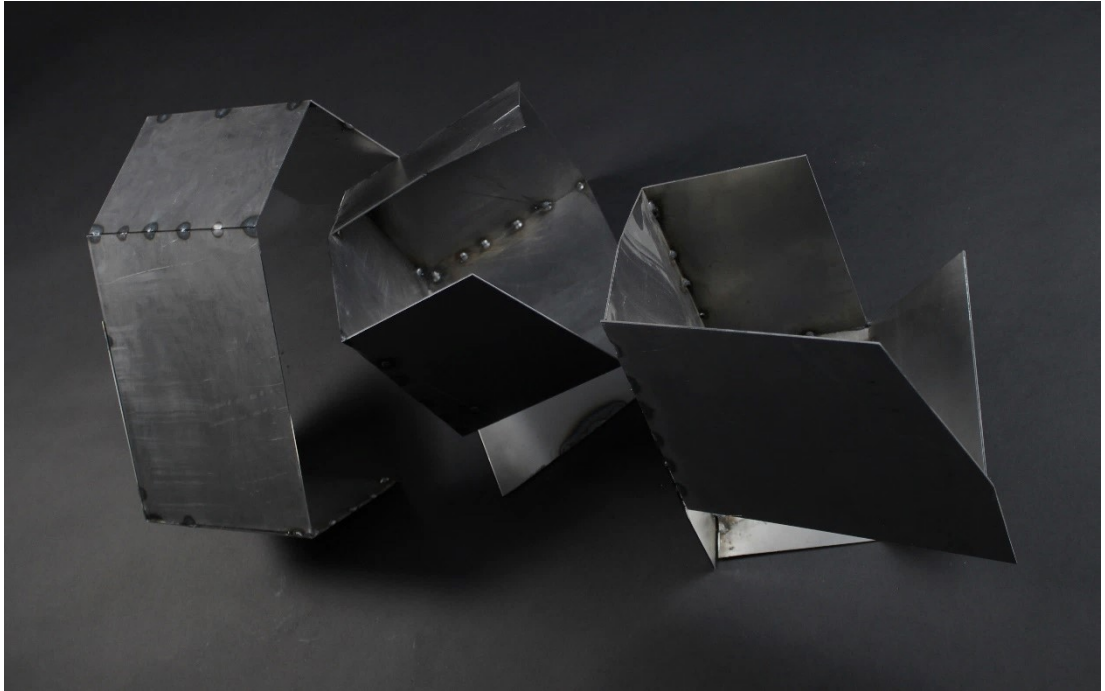


Day 2 Hour 2

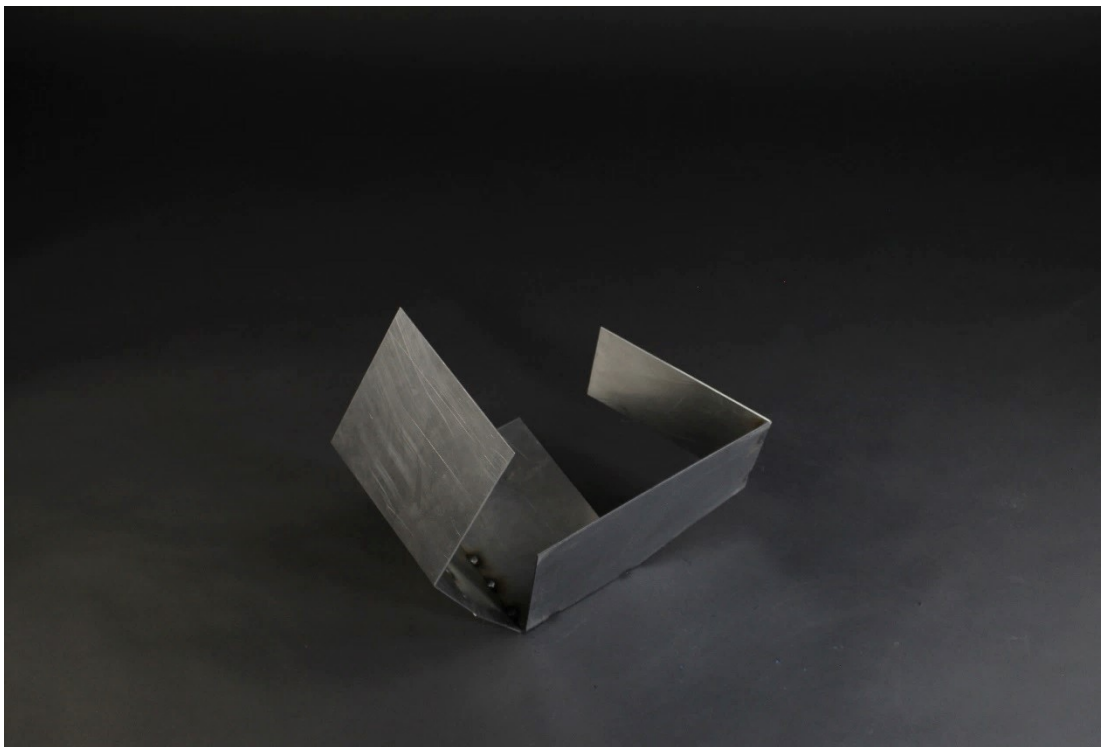
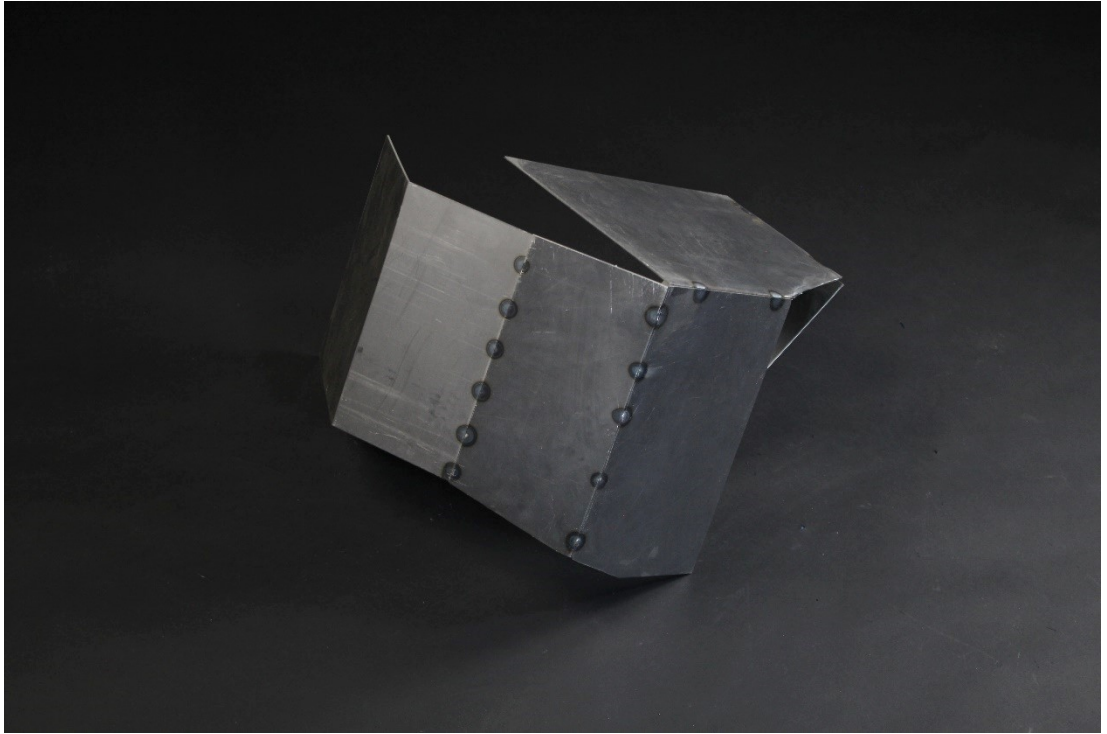




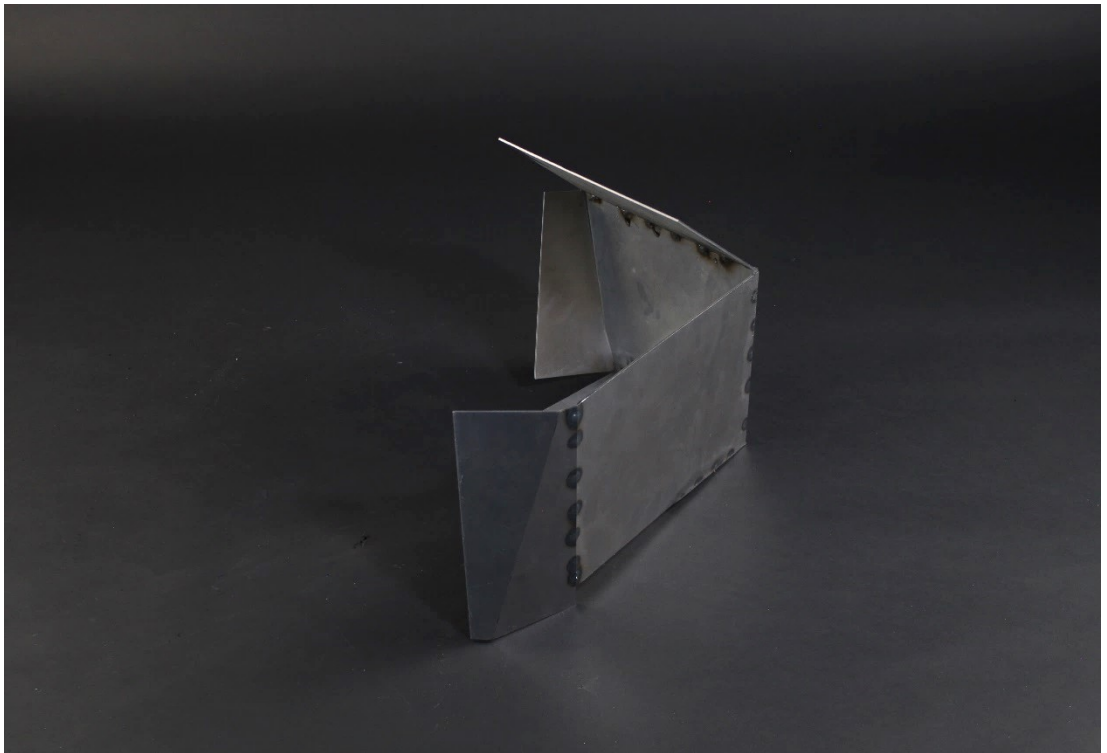
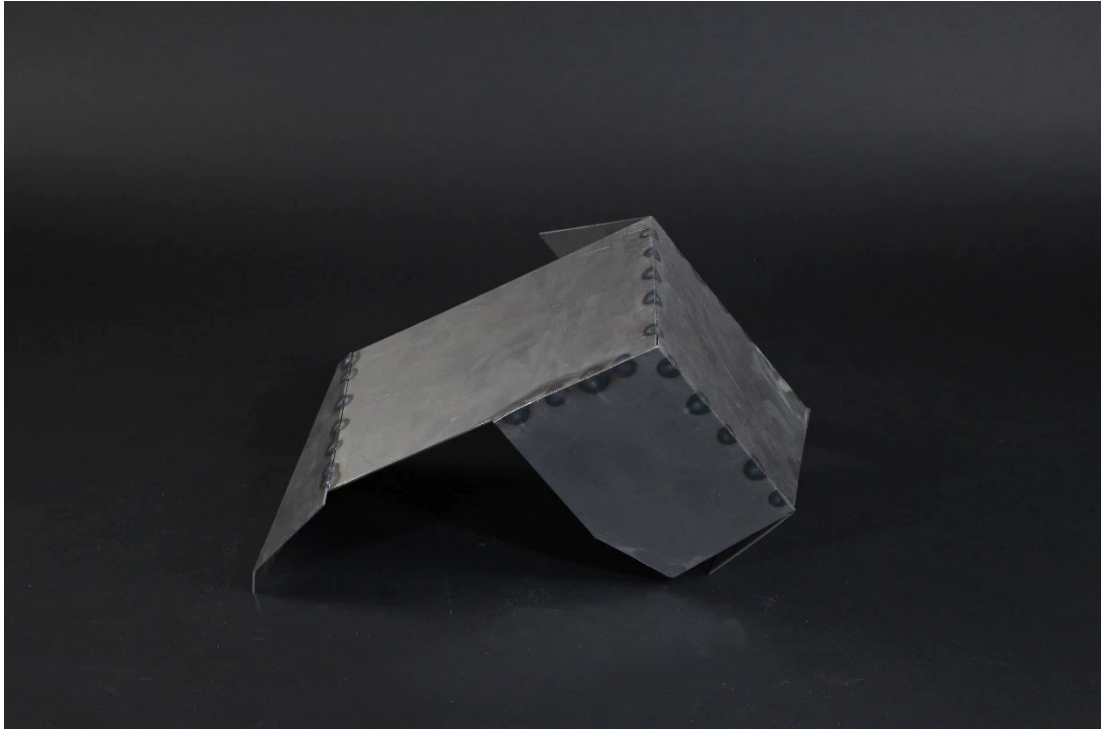
Day 2 all hours



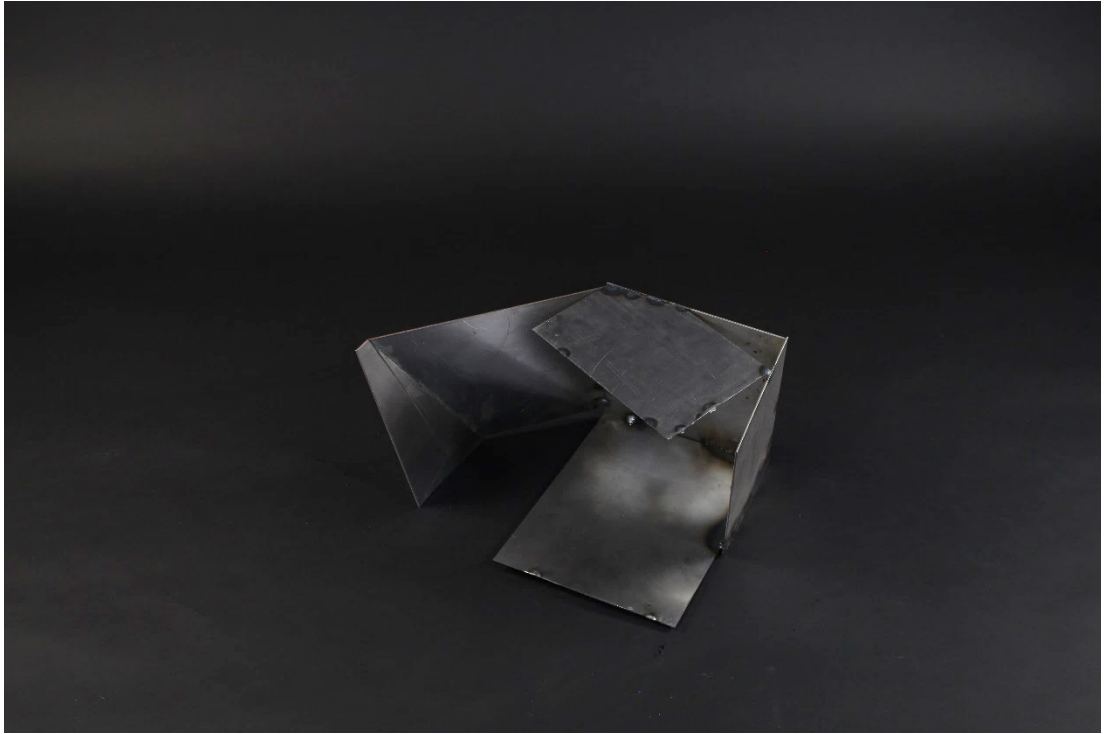
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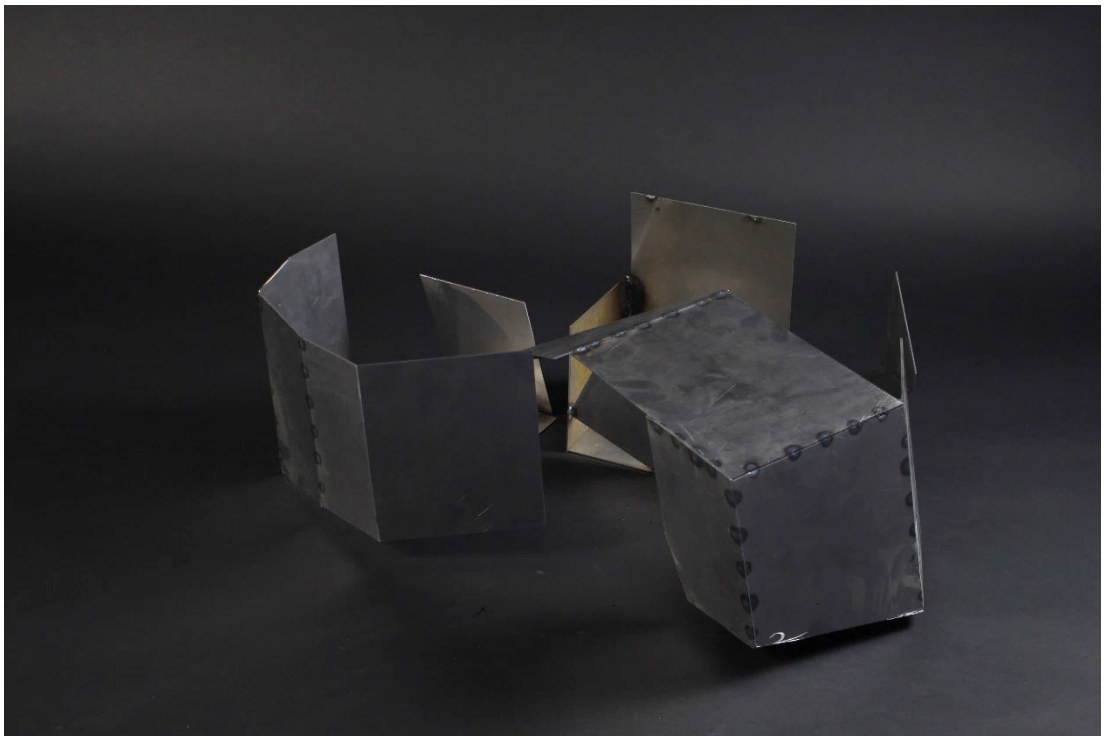
Day 3 Hour 2

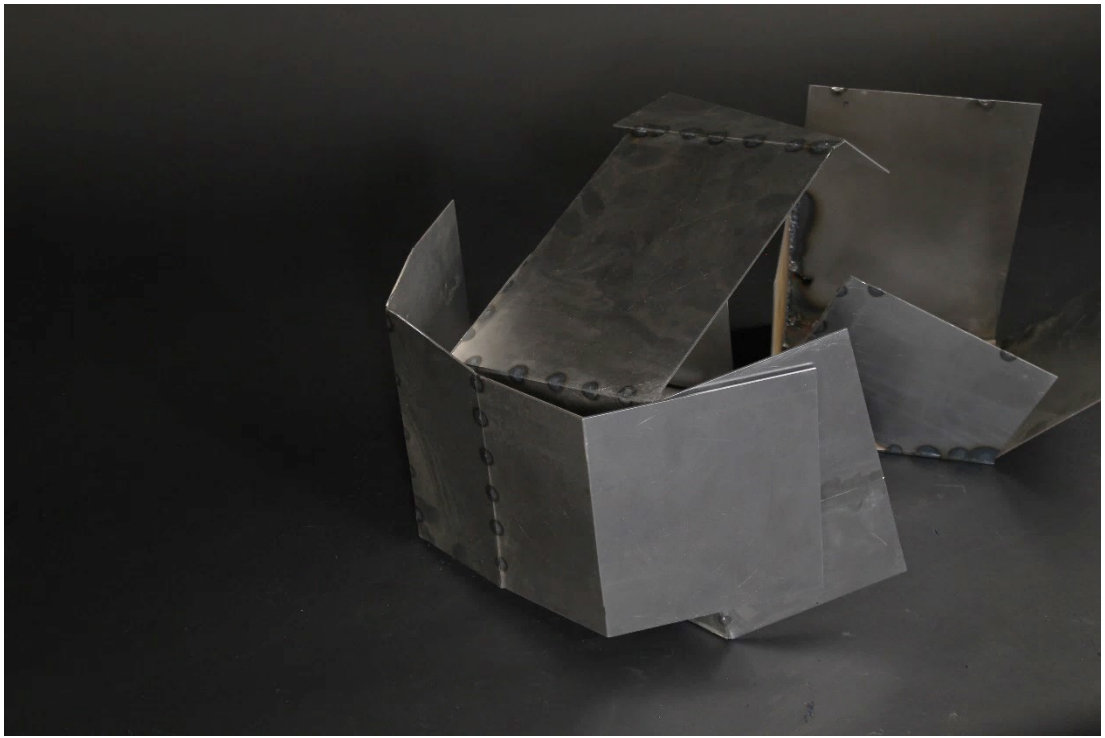


Day 3 Hour 3



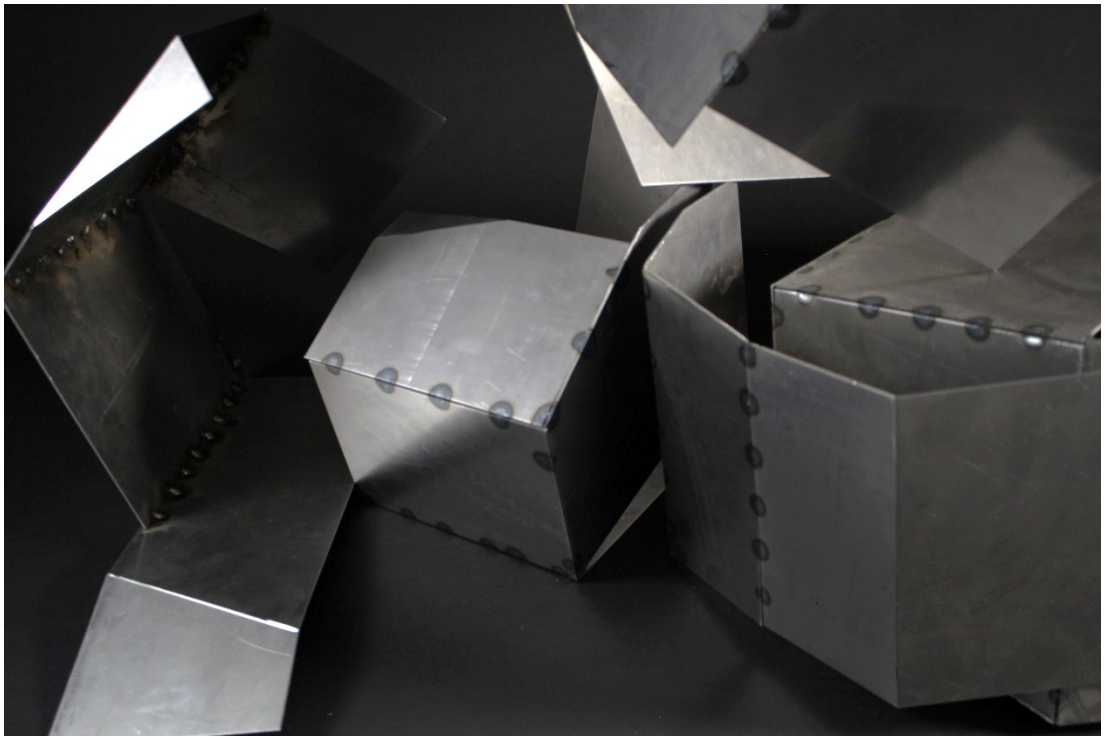
Day 3 all hours

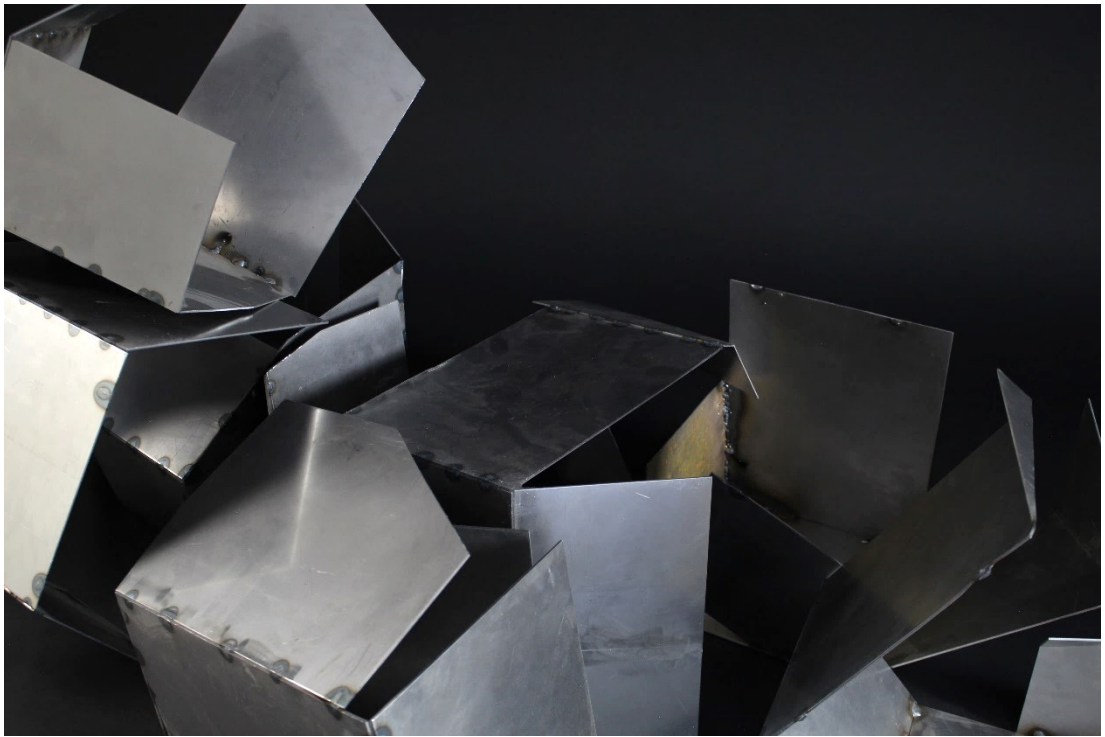
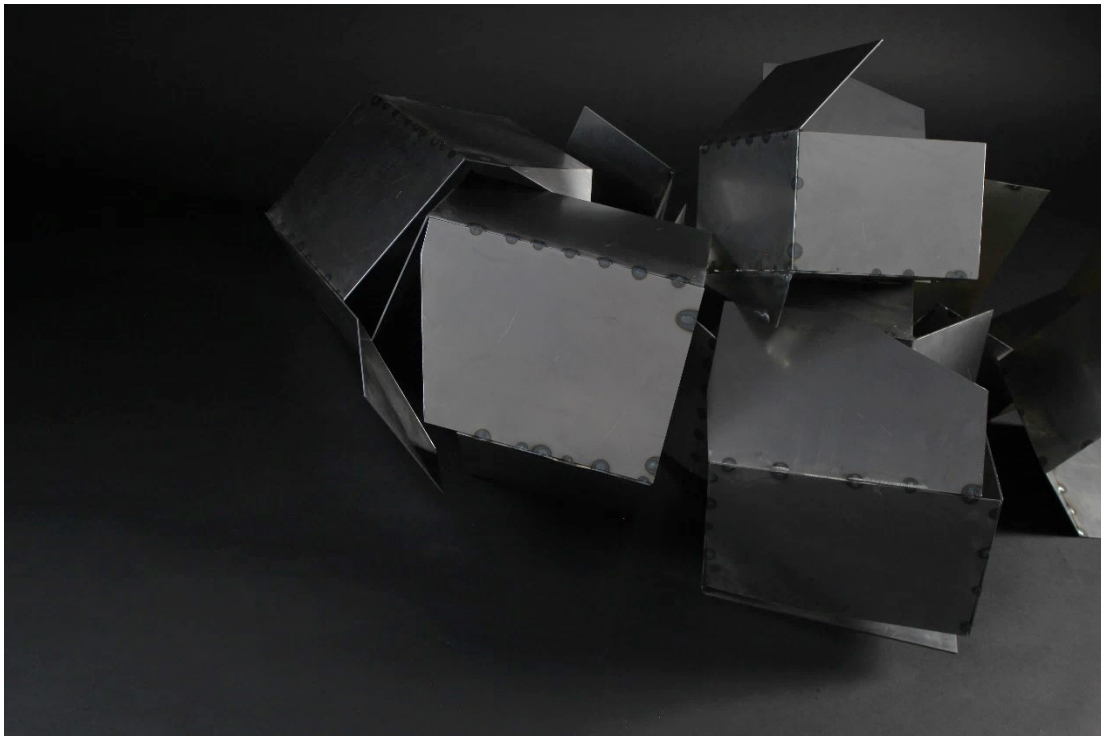




All days/hours







Questionnaire for audience

1. What is your understanding of this work?
2. How do you understand material transformation in relation to the processed sound environment and to actions during the performance?
3. What is your perception of the sculptural objects and sound during the installation time, and what was your experience in the workshop space?

Interviews

J:

1. Combined performance work in which sound is produced alongside a metal sculpture. The placement of audio technology allowed the mechanical sound of the sculptural tools to be transformed in a semi-controlled manner. As you worked upon the sculpture, you were given different opportunities to experiment with sound. Conversely, the production of electronic sound impacted the way in which you were able to continue producing the physical sculpture. The most pronounced component of the work, in my eyes, was the process of producing the work and combining the materials in space. There was an underlying technical aim and artistic procedure that underscored every instance of the performance, which allowed some flexibility and improvisation, but was arranged around a core set of guiding principles and a tightly defined conceptual framework.

2. It was sometimes easy to see the relationships between the sounds produced by your tools and the sounds produced by the loudspeakers. However, the mapping between acoustic and electronic sound material varied significantly throughout single performances, and again throughout multiple iterations of the piece. Furthermore, the impact of the tools on the sound environment seemed to change according to how you interacted with the software on your computer.

3. Two questions here. Firstly, I felt like a single sound event was being structured alongside each single sculpture. Whilst the real-time relationships between the two forms felt quite contingent throughout, and it was often hard to draw out

a clear relationship between the temporal shape of the sound-event and the physical shape of the sculpture, their material existence was married together by the space and time of the performance. Secondly, in the performance, it occasionally seemed like a dramatisation of a sculptural working process. It felt like I was watching you work privately, and that the sounds were attaching some meaning to your personal experience which would be inexpressible by merely watching you make a sculpture. Other times, it felt like the act of making the sculpture was being used as an instrument for musical composition. Given the minimalistic approach to electronic sound production, it did not always feel like expressive sound performance, but more like a form of real-time composition. I think it was both, but it was hard to hold each idea in my head at the same time. I either felt like the sculpture was producing the sounds, or that the sounds were describing and feeding into the sculpture, but it was difficult to feel both things at once. In the installation, I thought more about how each performance produced a different sculpture; it was satisfying to see how they collected into a little group. The sound felt quite ambient and environmental at this point, and seemed more like a thumbnail sketch of the preceding performance.

D:

1. I understand that this performance tackles the concept of process and procedure as a means of creating art and more particularly sculpting. I believe that in this work sculpting is approached both in a physical but also in an immaterial form. These two processes seem inseparable and complementary. The performer through her actions she sculpts the metallic objects, while the algorithm she designed gets a feed of the sonic qualities of her physical sculpting, processes the sounds and forms a sonic environment.
2. I understand that there is material sculpting (the actions) and immaterial sculpting (the sonic generation and processing) which takes place simultaneously.

3. I perceived the sculptural objects as the outcome of an exploratory sculpting process. However, I understand that the sculpting physical process goes in parallel with the sonic generation and processing. The sonic generation and processing is perhaps a sort of invisible sculpting. As a result, the sculptural objects wouldn't exist without the sound, or rather they co-exist with their sonic environment.

R:

1. A performance expressing a dynamic, hybrid process of interacting with materials (mostly metal sheets and processed sounds) experienced through four senses;

Vision: as an audience I was visually engaged with the performer within the workshop space from two viewing points: the balcony (+1 level to the workshop during the performance) and the workshop (during one of the gaps).

Audition: The sound of working with the metal sheets, welding and grinding, as well as projected processed sounds.

Olfaction and Gustation: After staying in the workshop space for about an hour, I could feel a sense of the smell and taste of the metal particles.

2. I experienced the transformation process for the metal sheets through visually seeing the performer's interaction with the material; welding and grinding the sheets individually and together on the edges to form a 3D object- as well as detaching the sheets from the 3D into flat surfaces. Parallel to the visual stimuli from the performer's actions and reactions- the objects transformation, and the welder, grinder sparkles- the sound environment accompanied the process by projecting processed sounds in the workshop environment. The processed sounds were more noticeable during the break time when I went downstairs to see the performing area from the close-up. The soundscape was creating a sense of memory of the material transformation experienced earlier mostly visually from above (bird-eye view). The sound accompanied by the smell of the metal generated a visual memory of the performance as well as situating me in

the environment where the actions have happened. The sound intensity and amplitude projected from the speakers were unexpected and hence increased my curiosity and imagination as I was looking at the metal piece on the performing table as well as the workshop environment.

3. My perception of the sculptural objects and the sound during the installation was based on my position as the viewer above the performance area. The bird-eye view provided a very good panoramic visual spectrum of the workshop space with the performer centered to the view frame. I could see all the movements and actions as well as the material transformation process and the equipment involved. Sparkles from welding and grinding also added another real-time organic motion to the scene which was very interesting in terms of its synchronization with the performer's movements, forces of actions and pauses. The sound was mainly perceived through real-time interactions with the materials during the installation time, but I could hear the projected sound from the speakers as well. The experience in the workshop space was very different from the previous one from the distant above. Being in the workshop space gave a deeper perception of the installation- through experiencing both material and immaterial elements by seeing/hearing- and the whole process which was magnified by the processed soundscape.

A:

1. Welding and manipulating pieces of metal together. Bright lights shed a performance light on an industrial basement space and the tentacles of various pieces of equipment trailed and connected along the edges of the space.

2. The sounds would sometimes be generated suddenly, loudly from the material transformation and the go off like the metal balls in a pinball machine, interact in various ways, with my memory, with my expectations, probably also with the recording and processing... From the machines it would return back to the performance like the pinball coming back towards the paddles at the bottom, demanding action or reaction. The material transformation both sustained and was sustained by the sounds it produced in a strange dialogue between the

actions of the present and the past, sometimes contradicting, sometimes ignoring, sometimes going along with the processed sound.

3. During the installation the perception was of the artist plus objects plus sounds, there was a hypnotic quality of performance and continuous process. Observing the sequences you drift between imagining decisions being made, contesting the choices being acted out in front of you and experiencing the clanging sounds, welding sparks and artist's movements with your senses without conscious judgement. It is an immersing moment, I am concentrated on the actions, sounds, flashes emanating from the space below me, engaged in a commentary, storytelling, unfolding in my head and do not think about my fellow audience.

In entering the workspace you look at the objects as if exploring on the moon: the metal objects are suddenly within arm's reach but mystical, challenging you to attribute meaning to it or not (will the meaning be yours and about you or will you be trying to understand something beyond you-who is it speaking to?-was it created for the artist or may you appropriate it?). You cannot touch it, nor play with it, any stories you might want to weave around it have to be done from a distance and will not change it. It is lonelier and will prompt me to start a conversation with other observers/audience members next to me: I wonder why she did that? What do you think she will do with them next? It also gives the space to imagine-what could this object signify for me?

Research journal excerpts

Below are excerpts of a reflective journal that involved a textual record of my research progress through note taking for capturing my thinking during the stages and highlighting key points of evaluation and analysis of the work:

“Use drawing as means for deciding how to cut the starting block – Triangles are being drawn on three sides of the object. This process is happening in repetition and in layers.

The more I continue the more the object loses its basic geometric character...enclose movement into the geometric object.” 15/09/2015

“What is the role of sonic material in the outcome (sculpture)? Or will it only play a role during the making process?

Understand the parameters of the process and use them as tools for composing.

Hardness of the wood (type of wood), length of cut, height of the wooden block, angle-position of the wooden block in relation to the band saw. These parameters determine the sound produced during the making.

Sequence of sounds as sequence of cuts.” 25/05/2016

“Create different memories of the object with sound.

This could concern the final outcome, the object and derive from the process. It is an important aspect that could be connected to notation of sculpture making through sonic material.

Performative element: music, linear narrative in time that could 'reveal' the making process of a sculpture and at the same time it could act as notation for the making after it is understood.

The one concerns the 'final' outcome and the other the making process.

Use of the continuous prolonged sound for indicating cuts in the band saw? What about the similar process with a different material?

Learn how different techniques and making actions sound like. Know the sounds before I make an object." 26/05/2016

"Decide how to compose on the basis of geometry/shape or sound.

So far I have been composing based on geometry, visually, with the aim to 'break' symmetry. During these series of experiments I will explore the sounds of the making in relation to material, dimensions and my actions. This will contribute to having a sonic perspective of my sculpture making and it will give me the possibility to understand it and compose through sounds.

Compose sculpture with sounds, use starting point sonic material – notated? Use sound as guidance for sculpture making.

Band saw: continuous sound (analyze frequency)

Or: sequence of sounds as sequence of cuts." 27/05/2016

"Work with the recordings using techniques of sampling

What will sampling of recordings offer to the making process? How could this be used as a tool? Raw material (recordings) worked with sampling: what will the equivalent process in sculpture be?

Sampling: using parts of the workshop recordings together for forming a sequence. How could this be related to the making process in sculpture? If I cut some of the samples then they will not be in real time in regards to the making process and the actions. If sonic material will be used as 'instructions' or 'actions' of the sculpture making then its duration would be important.

If I am not concerned with analogies then I could focus on the interpretation of the sonic material recorded during the making process of a sculpture. How I could express actions as music, why is this important?

Passing through a different art form for making a work: is it notation, is it part of the process?" 27/05/2016

"Composing with sounds that will determine sculpture making? Reverse the process?

Know the sounds > relate them to the making process > re-compose other sonic material as starting point > make a sculpture

I do not intent to use my sculptures as notation for composing music as Nathalie Miebach

Gabriel Craig soundforge (2011): Collaboration with the composer Michael Remson: Accompaniment of the actions with percussion instruments. A musical interpretation of some actions but not of a process. Repetition of particular scenes and actions.

What is Wiggli doing with sound?" 28/05/2016

Research blog

A selection of screenshots from the online research blog

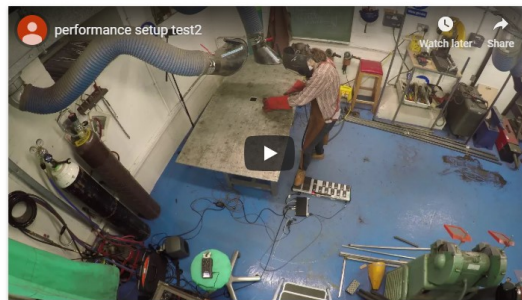
Across sculpture and sound / Eleni-Ira Panourgia



A blog acting as a research journal

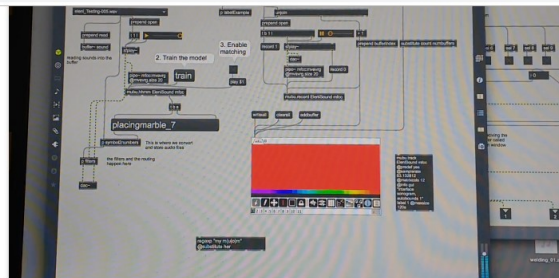
procedure 1 ▶

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1 YEAR AGO #VIDEOS #OCTOBER 2017

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system in Max: sound recognition (machine learning patch MuBu Ircam) and filter application (grain stretch and vocoder)

1 YEAR AGO #VIDEOS #APRIL 2017



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A blog acting as a research journal

Justin Boyd: Sound and Time

'I take...whatever the field recording is, filter it down to a specific set of frequencies and how those frequencies vibrate and resonate another material'

'...[objet trouve] a conversation between materials and place and sound...the sound will be ...the activating element in all of those things'

intrinsic aspect of sound: 'these barrels have their own sound and that sound has been brought together and combined with the sound of the brass bell and then those two things make their own sound together'

use of a brass bell and its sound combined with the processed field recordings

'...that is why I like to take the sounds and filter them and manipulate them...the harmonics of the sounds to resonate with whatever the harmonics are of the natural material'

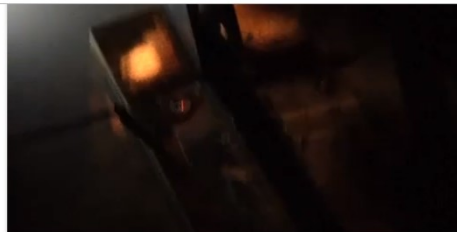
'marriage of object and sound this is where I am really focused now at this point'

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synchronousobjects.osu.edu

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'Single shot video documentation of the screen - the last few minutes. Recorded at Never or Now Festival, Bergen, Jan 2011

Cipher Screen is a live art piece using 2 prepared 16mm film projectors with black film loops and a live sound feed. This work harnesses the mechanisms of film and cinema; the projector, the film material, the darkened room and synchronized sound - creating a live score and a visual and sonic interaction. The constant, reductive physical process applied to the surface of the film loops results in a slow transformation on the screen surface, out of aural and visual darkness builds a cacophonous crescendo of sound and image.

Image - Greg Pope / Sound - John Hegre'

1 YEAR AGO #VIDEOS #REFERENCE WORKS #FEBRUARY 2017 #PERFORMATIVE

or the bus).

Sound processing based on sustained/repeated:

Playing with the 'structure' of the sound events within a produced sound.

Repetition of events within a file: how to adjust regularity? Maybe with sequencing?

To push: repeated sound

To rotate: repeated sound

To place: repeated sound

To cut: sustained sound

To grind: sustained sound

To weld: repeated sound

Example patch:

Sample [live sound or recording] < identification of action/material through spectrogram? < apply processing < new sound < identify new action based on spectrogram < export instruction

Randomization:

Alternate symmetry-repetition.

Within a closed feedback loop, it is very likely to have repetition of events. Inserting a pseudo randomization could allow the avoidance of same events in the loop. What would this random value trigger? It could delay the input, distort it or overlap it with a previous (recorded?) sound.

What issues does this create?

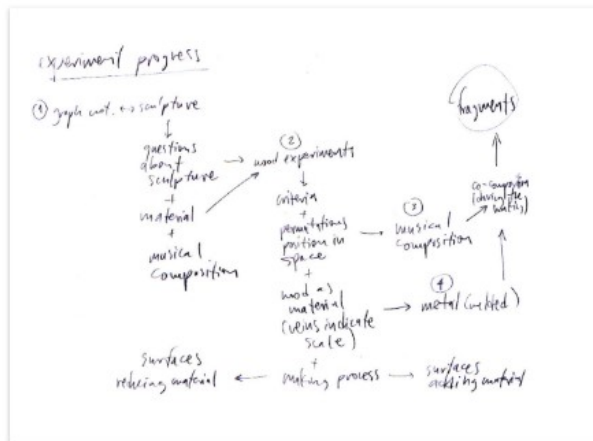
- o How often will it happen and for how long/how will the system recover?
- o Recognition of the new sound by the system – or use it directly without further recognition/processing?

Application: after the recognition of the sound by applying a filter different than this that is predefined.

What sounds do I want to have as outcome?

Turn constant sounds into repeated ones and vice versa. [reverse the machine learning: output actions

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experiment progress diagram

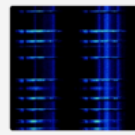
2 YEARS AGO #DIAGRAMS #PHOTOS #JANUARY 2016



A blog acting as a research journal

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December / January research journal

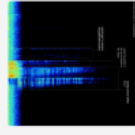


Making - Shimmered Noise
 soundcloud.com

Class syllabus - media and communication
 soundcloud.com

Notes and lecture from
 Introduction, V. (2015) (Ludwig-Maximilians-Universität München, 187 p.22)
 The maximum concentration of 3 Hz is a function of time. An alternative representation is the

patterns in spectrograms with the use of a spectrogram, which is a visualization of the frequency content and amplitude (intensity) and amplitude (volume) of a signal (e.g., a spectrogram) over time.



Methods of spectroscopy
 soundcloud.com

On the development of three-dimensional objects
 https://www.youtube.com/watch?v=...

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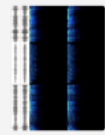
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March 2017

- Conceptual art**
OCTOBER 8, 2021 | Conceptual art
OCTOBER 8, 2021 | Conceptual art
London, New York, Pakistan
p.00-07
Bosnian post-9/11 trauma
Yoko Ono's artwork
Installation for gallery
https://www.eriapenouregia.com/2021/10/08/conceptual-art/
- Final work**
THE SOURCE
Installation for a process art
workshop in a school
with a group of young
children. I and the working with
children workshop in a school
with a group of young children.
https://www.eriapenouregia.com/2021/10/08/final-work/
- Installation and artwork**
OCTOBER 4, 2021 | Computer
Installation (New York, London,
Singapore, London)
"Installation" artwork
https://www.eriapenouregia.com/2021/10/04/installation-artwork/
- Technology**
OCTOBER 2, 2021 | Technology
OCTOBER 2, 2021 | Technology
Further work for being specific
for documentation and
presentation and delivery. I used to
https://www.eriapenouregia.com/2021/10/02/technology/
- Chris Foster - Panel Line Chart**
OCTOBER 1, 2021 | Chris Foster
OCTOBER 1, 2021 | Chris Foster
https://www.eriapenouregia.com/2021/10/01/chris-foster-panel-line-chart/
- RICHARD CHAMBERLAIN**
OCTOBER 1, 2021 | Richard Chamberlain
OCTOBER 1, 2021 | Richard Chamberlain
https://www.eriapenouregia.com/2021/10/01/richard-chamberlain/
- Sound and art in David Ar**
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https://www.eriapenouregia.com/2021/10/01/sound-and-art-in-david-ar/
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OCTOBER 1, 2021 | Ann Wendrop-Ansenig
https://www.eriapenouregia.com/2021/10/01/ann-wendrop-ansengi/

February 2017

- Standing, sitting, moving**
FEBRUARY 2, 2017 | Standing, sitting, moving
FEBRUARY 2, 2017 | Standing, sitting, moving
https://www.eriapenouregia.com/2017/02/02/standing-sitting-moving/
- Impulse - new work**
FEBRUARY 2, 2017 | Impulse - new work
FEBRUARY 2, 2017 | Impulse - new work
https://www.eriapenouregia.com/2017/02/02/impulse-new-work/
- Impulsed playing and**
FEBRUARY 2, 2017 | Impulsed playing and
FEBRUARY 2, 2017 | Impulsed playing and
https://www.eriapenouregia.com/2017/02/02/impulsed-playing-and/
- New artwork - artwork**
FEBRUARY 2, 2017 | New artwork - artwork
FEBRUARY 2, 2017 | New artwork - artwork
https://www.eriapenouregia.com/2017/02/02/new-artwork-artwork/
- Process art**
FEBRUARY 2, 2017 | Process art
FEBRUARY 2, 2017 | Process art
https://www.eriapenouregia.com/2017/02/02/process-art/
- Adjusting sounds of space**
FEBRUARY 2, 2017 | Adjusting sounds of space
FEBRUARY 2, 2017 | Adjusting sounds of space
https://www.eriapenouregia.com/2017/02/02/adjusting-sounds-of-space/
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FEBRUARY 2, 2017 | Themed Music Art and
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FEBRUARY 2, 2017 | Music, Time - 1. January, the
FEBRUARY 2, 2017 | Music, Time - 1. January, the
https://www.eriapenouregia.com/2017/02/02/music-time-1-january-the/

January 2017

- MAKING TRANSPARENT CONTOUR**
JANUARY 2, 2017 | Making Transparent Contour
JANUARY 2, 2017 | Making Transparent Contour
https://www.eriapenouregia.com/2017/01/02/making-transparent-contour/
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JANUARY 2, 2017 | Sculpture - making work
JANUARY 2, 2017 | Sculpture - making work
https://www.eriapenouregia.com/2017/01/02/sculpture-making-work/
- MAKING TRANSPARENT - Sound**
JANUARY 2, 2017 | Making Transparent - Sound
JANUARY 2, 2017 | Making Transparent - Sound
https://www.eriapenouregia.com/2017/01/02/making-transparent-sound/

Appendix 2: Multi-media files index

USB contents

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'01_Sounding Stile_interval method_dotted halves.wav' [sound, 0'07"]
'02_Sounding Stile_interval method_quarters.wav' [sound, 0'08"]
'03_Sounding Stile_serial method.wav' [sound, 0'08"]
'04_Sounding Stile_serial method_loop.wav' [sound, 0'40"]
'05_My sculpture_interval method.wav' [sound, 0'07"]

Folder '2.2.1 Actions in sound'

'06_Making_steel_audio.wav' [sound, 1'34"]

Folder '3.2.1 Of Blocks'

'07_woodtype1_animation_rotation with sounds.mov' [video, 1'25"]
'08_woodtype2_animation_rotation with sounds.mov' [video, 1'46"]
'09_woodtype3_animation_rotation with sounds.mov' [video, 1'12"]

Folder '3.3.1 Sculptural spectrograms'

'10_placing marble.wav' [sound, 0'02"]
'11_adjusting marble.wav' [sound, 0'11"]
'12_adjusting marble detail.wav' [sound, 0'04"]
'13_cutting marble.wav' [sound, 0'26"]
'14_marble making process.mp4' [video, 12'14"]
'15_steel cutter.wav' [sound, 0'08"]
'16_steel cutter single.wav' [sound, 0'02"]
'17_welding multiple.wav' [sound, 0'31"]
'18_welding single.wav' [sound, 0'01"]
'19_grinding steel.wav' [sound, 0'35"]
'20_grinding rotating steel single.wav' [sound, 0'08"]
'21_steel making process.mov' [video, 1'49"]
'22_glass cube_preparation stage.mp4' [video, 8'22"]
'23_cutting glass.wav' [sound, 1'26"]
'24_cutting glass.mp4' [video, 5'34"]
'25_grinding glass.wav' [sound, 0'56"]
'26_grinding glass.mp4' [video, 1'32"]

Folder '4.1 Actions (Processed sound samples)'

Subfolder 'Multiple material_with Ircam AudioSculpt'

'27_adjusting marble detail_AS_Freqshift -3500hz.wav' [sound, 0'04"]
'28_adjusting marble_AS_TimeStretch faster x10.wav' [sound, 0'01"]
'29_cutting glass_AS_freqshift 1000hz.wav' [sound, 1'26"]

'30_grinding glass_AS_MultiBandFilter_Pass 200hz.wav' [0'56"]
'31_grinding steel_AS_SpectralBreakPointFilter_-63hz at 4300_+2hz at
4700.wav' [sound, 0'35"]
'32_grinding steel_AS_TimeStretch slower x20.wav' [sound, 5'11"]
'33_grinding steel_AS_TimeStretch slower x20_grain delay_pitch shift.wav'
[sound, 8'16"]
'34_welding multiple_AS_TimeStretch slower x3.wav' [sound, 1'17"]
'35_welding multiple_AS_TimeStretch slower x11.wav' [sound, 10'20"]
'36_welding multiple_AS_TimeStretch_faster x10.wav' [sound, 0'03"]
'37_welding single_AS_TimeStretch slower x25.wav' [sound, 9'50"]
'38_welding single_AS_TimeStretch_slower x10_Freqshift 2000hz.wav'
[sound, 0'12"]
'39_welding single_AS_slower x10_Cross-synthesis_grinding.wav'
[sound, 0'12"]
'40_welding single_AS_TimeStretch_slower x10_Freqshift 2000hz_Cross-
synthesis_welding single faster x10.wav' [sound, 0'12"]

Subfolder 'Steel_with Ableton Live devices'

'41_grinding detail_EQ_PingPong_GrainDelay_FilterDelay.wav'
[sound, 0'11"]
'42_grinding_Freqshift_PingPong_GrainDelay.wav' [sound, 0'14"]
'43_grinding_Grain Delay_Resonance.wav' [sound, 0'29"]
'44_grinding_lowpass_MBandPass.wav' [sound, 0'23"]
'45_grinding_lowpass_tal-dub.wav' [sound, 0'23"]
'46_grinding_MRingModulator.wav' [sound, 0'16"]
'47_grinding_rptl_MTremolo.wav' [sound, 0'23"]
'48_welding_AUDelay.wav' [sound, 0'24"]
'49_welding_altverb 7.wav' [sound, 0'38"]
'50_welding_Grain Delay.wav' [sound, 0'31"]
'51_welding_Overdrive_PingPong_Vocoder-noise.wav' [sound, 0'27"]

'52_cutting wood_Max MSP grainstretch.wav' [sound, 0'27"]
'53_AudioSculpt samples_combined materials 1.wav' [sound, 3'00"]
'54_AudioSculpt samples_combined materials 2.wav' [sound, 1'34"]
'55_Ableton Live samples_steel_combined actions.wav' [sound, 2'03"]
'56_cutting wood_sequence 1.wav' [sound, 0'18"]
'57_cutting wood_sequence 2.wav' [sound, 0'56"]

Folder '4.1.1 Digital interactions'

'58_Digital interactions_Rotating-Resizing-Splitting.mp4' [video, 0'53"]
'59_Digital interactions_Granular approach.mp4' [video, 1'19"]
'60_Digital interactions_Distortion-Reshaping.mp4' [video, 0'54"]

Folder '4.2.1 Marble sounds'

'61_marble sounds.mp4' [video, 0'32"]

Folder '5.1 Interfaces'

'62_Rehearsal with foot pedal controller.mp4' [video, 1'31"]
'63_inputPlay.amxd' [max for live patch]
'64_Rehearsal with inputPlay.mp4' [video, 9'53"]
'65_inputPlay_V2.1_guide.jpg' [image]
'66_inputPlay_V2.1_5s.amxd' [max for live patch]
'67_inputPlay_V2.1_10s.amxd' [max for live patch]
'68_inputPlay_V2.1_15s.amxd' [max for live patch]
'69_inputPlay_V2.1_20s.amxd' [max for live patch]

Folder '5.2 Process-Procedure 'With''

'70_Process - Procedure teaser.mp4' [video, 0'14"]
'71_Process-Procedure 'With'_Trailer.mp4' [video, 3'00"]
'72_Process-Procedure 'With'_Full performance.mp4' [video, 14'19"]
'73_Live sound.wav' [sound, 17'32"]
'74_Processed sound.wav' [sound, 15'47"]
'75_Metaphanies trailer.m4v' [video, 0'45"]

Folder '5.3 Process-Procedure 'For''

'76_Process-Procedure 'For'_20-minute overview.mp4' [video, 20'00"]
'77_Process-Procedure 'For'_Mask view.mp4' [video, 0'25"]
'78_Environment sound_Hour 1.wav' [sound, 60'02"]
'79_Environment sound_Hour 2.wav' [sound, 59'57"]
'80_Environment sound_Hour 3.wav' [sound, 46'17"]
'81_Processed sound.wav' [sound, 166'03"]
'82_Input mic_Hour 1.wav' [sound, 60'02"]
'83_Input mic_Hour 2.wav' [sound, 59'57"]
'84_Input mic_Hour 3.wav' [sound, 55'26"]
'85_Sound details.txt' [text file]

Folder '5.4 Process-Procedure 'At''

'86_Process-Procedure 'At'_Rehearsal.mp4' [video, 45'29"]
'87_Process-Procedure 'At'_Overview.mp4' [video, 23'05"]
'88_Process-Procedure 'At'_Day 2.mp4' [video, 180'00"]
'89_Process-Procedure 'At'_Overview_Day1 Hour1 (5').mp4' [video, 5'09"]
'90_Sound files details.docx' [word document]
'91_mic+processed_day1hour1_stereo.wav' [sound, 44'48"]
'92_installationmix_day1hour1_stereo.wav' [sound, 15'00"]
'93_mic+processed_day1hour2_stereo.wav' [sound, 45'20"]
'94_installationmix_day1hour2_stereo.wav' [sound, 15'00"]
'95_mic+processed_day1hour3_stereo.wav' [sound, 45'29"]
'96_installationmix_day1hour3_stereo.wav' [sound, 15'00"]

Subfolder '97_surround mix in 5.1_mic+processed_day1hour1 and installationmix_day1hour1' [same files as above in 5.1 & mix details.docx]

Subfolder '3D scan'

- '98_detail back side.jpg' [image]
- '99_detail front.jpg' [image]
- '100_detail side.jpg' [image]
- '101_detail side1.jpg' [image]
- '102_detail front1.jpg' [image]
- '103_detail below.jpg' [image]
- '104_detail front2.jpg' [image]
- '105_detail back.jpg' [image]
- '106_detail side2.jpg' [image]
- '107_detail side3.jpg' [image]
- '108_detail.jpg' [image]

Appendix 3: Published material and research activities

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SPECTROGRAM DATA AS SYSTEM FOR MAKING SCULPTURE

Topic: Art, Music

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Abstract

This paper proposes a method for making generative art in the form of a system based on an interdisciplinary approach combining sculpture and sound. I will explore the possibility of using data from the spectral analysis of sounds as instructions for making sculpture. Inspired by Sol LeWitt's principles and ideas for the creation of generative art as system and Francis Halsall's definition of a 'system's identity' (Halsall, 2008, p. 27), I am investigating ways for creating a new system that will allow the articulation of the above idea. Furthermore, combining Tom Johnson's (2015) system for composing music after LeWitt's sculpture *Incomplete Open Cubes* and Oscar Wiggli's sculptural and musical work, I will focus on how sequences of sound material could be related to a sculpture. Based on Denis Smalley's *spectromorphology* as 'a descriptive tool based on aural perception' (Smalley, 1997, p. 107), I will analyze sound samples recorded from the workshop during the making and I will focus on their connection to the sculptor's gestures. In this paper, Smalley's 'ideas of onset (how something starts), continuant (how it continues) and termination (how it ends)' (Smalley, 1997, p. 115) will be reconsidered from a sculptural perspective (Figures A and B). Through the realization of a series of practical experiments, I will discuss: a) how actions of making sculpture could be reflected through sound, b) what kind of variations of spectra could inform different actions, c) how different materials could affect the sound samples and d) how the actions of making sculpture could be predefined as sequences through sound material in a systematized way, producing generative outcomes.

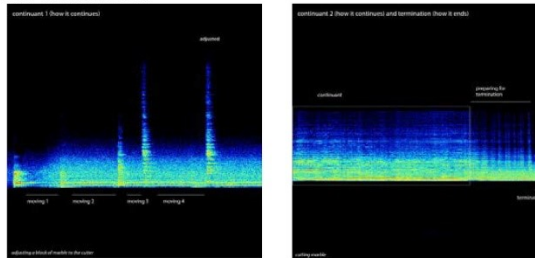


Figure A (left): Spectral analysis of the sound recording during the action of adjusting a block of marble in the cutter by moving it.

Figure B (right): Spectral analysis of the sound recording during the action of cutting.

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Key words: sculpture, sound, spectromorphology, systems, process

Main References:

- [1] Denis Smalley, "Spectromorphology: Explaining sound-shapes", *Organised Sound*, 2(2), 107-126, 1997
- [2] Matthias Frehner and Jochen Hesse (Eds.), "Oscar Wiggli: Körper, Raum, Klang", Benteli, Bern, 2007
- [3] David Hirst, "From Sound Shapes to Space-Form: Investigating the relationships between Smalley's writings and works", *Organised Sound*, 16(1), 42-53, 2011
- [4] Francis Halsall, "Systems of art : Art, history and systems theory", Peter Lang, Bern, 2008

Spectrogram Data as System for Making Sculpture

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Abstract

This paper proposes a method for making generative art in the form of a system based on an interdisciplinary approach combining sculpture and sound. I will explore the possibility of using data from the spectral analysis of sounds as instructions for making sculpture. Inspired by Sol LeWitt's principles and ideas for the creation of generative art as system and Francis Halsall's definition of a 'system's identity', I am investigating ways for creating a new system that will allow the articulation of the above idea. Furthermore, combining Tom Johnson's system for composing music after LeWitt's sculpture *Incomplete Open Cubes* and Oscar Wiggli's sculptural and musical work, I will focus on how sequences of sound material could be related to a sculpture. Based on Denis Smalley's *spectromorphology* as 'a descriptive tool based on aural perception', I will analyze sound samples recorded from the workshop during the making and I will focus on their connection to the sculptor's gestures. In this paper, Smalley's 'ideas of onset (how something starts), continuant (how it continues) and termination (how it ends)' will be reconsidered from a sculptural perspective. Through the realization of a series of practical experiments, I will discuss: a) how actions of making sculpture could be reflected through sound, b) what kind of variations of spectra could inform different actions, c) how different materials could affect the sound samples and d) how the actions of making sculpture could be predefined as sequences through sound material in a systematized way, producing generative outcomes.

1. Introduction

The aim of this study is the exploration of a generative method for making sculpture, based on recordings of the sounds generated from the actions of making sculpture and their spectrogram analysis. It also discusses ways to explore and understand sculpting through the sounds generated during making and their 'structure', as defined by the composer Denis Smalley [9]. The energy of the sculptor's gestures, whether these are manually executed or with the use of machines, could be traced through sound recordings during the making process. Exploring the sound material of a sculptor's making process could provide us with information and an understanding of the process itself that we could not otherwise have.

At this point, I will introduce the type of sculpture that my examples will include. Defining the outcome before the making process is an important factor as this will determine the type of actions needed to be realized in order to achieve this. For both examples presented, the intention is to make a three-dimensional minimalist object (*Figures 1 & 2*). Simplicity of shape will contribute to having clear steps during the making process. In the first example, through cutting marble and in the second through welding steel. Each object represents a series of decisions regarding sequence.



Figure 1. Object in marble.



Figure 2. Object in steel.

2. Starting points

2.1 System art and generative processes

The art historian Francis Halsall's definition of the identity of a system includes a focus on its functions [4]. As he mentions, '...through the use of function(s) (rather than structure) as the criteria for identity, the system can retain its recognisable and distinct identity over time even though its structure may have adapted and evolved' [4]. The sculptor Sol LeWitt mentions that the process of making of a work of art is realized either based on decisions made at each stage or through a system that controls these decisions [8]. Following Halsall's approach of functions within a system such as LeWitt's, I investigate ways for creating a new generative system based on functions, which will have analytical and generative purposes within sculptural and sound contexts.

2.2 Composition of sculpture and sound materials

Tom Johnson's system for composing music after Sol LeWitt's sculpture *Incomplete Open Cubes* is a compositional method that uses a system for making sculpture as a starting point [6]. The aim of Johnson's method is to use the function of the initial system by LeWitt in a musical context. He worked with sequences for exploring relationships among chords, which he later formed into a chain. His final outcome was generated through the chain and had the form of a loop [6]. Tom Johnson's approach could be an important example of a system that is functioning across sound material, musical harmonies in his case, and sculpture. The sculptor and composer Oscar Wiggli, has developed methods for composing music based on his sculptures and vice versa [2, 3, 7]. He has invented his own form of musical symbols that are usually comprised of video prints of his sculptures, lithography prints, his drawings called *Sound Lavis*, his *Dessin-Reliefs* and *Sound-Reliefs* as well as verbs that describe stages of the making process. *Figure 3* shows Wiggli's graphic and verbal score for his composition *AVELEK* (1994), a video-print-collage that represents sound material as a sequence [2]. Furthermore, Wiggli has created a system for organizing his sound material in which every sound corresponds to a technique from the making process of his sculptures [3]. Oscar Wiggli's structures originate from his two-dimensional and three-dimensional works and are used as musical symbols based on which he composes his sound material [7]. In this paper, I will attempt the reverse: to make sculpture based on sequences of sound material.

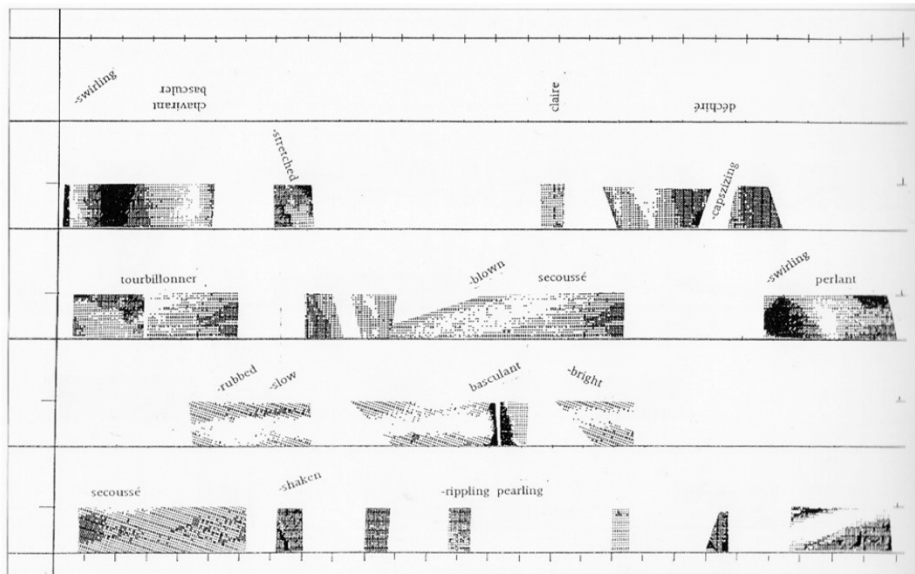


Figure 3. Oscar Wiggli, 'Partition graphique-verbale pour la composition AVELEK', 1994

2.3 Spectromorphology: an analytical tool

Spectromorphology was first introduced by the composer Denis Smalley who defines it as '...an approach to sound materials and musical structures which concentrates on the spectrum of available pitches and their shaping in time' [9]. The composer David Hirst analyzing Smalley's work, underlines that spectromorphological approach concerns sound material of spectral kind, whose source cannot be easily identified [5]. One of Denis Smalley's 'fundamental strategies', concerning 'multi-level focus and the experience of the temporal unfolding of structure, is *gesture*' [9]. It is 'concerned with action directed away from a previous goal or towards a new goal; it is concerned with the application of energy and its consequences; it is synonymous with intervention, growth and progress, and can rise from its energetic profile that could have been caused, and its spectro-morphology will provide evidence of the nature of such a cause' [9]. Following this, I will explore the idea of the connection of the making process of a sculptural object and its sounds through the concept of *gesture*.

Smalley speaks of 'three morphological archetypes at the source of instrumental sounds: the attack-impulse, the attack-decay, and the graduated continuant' [9]. He mentions specific notation symbols for each of them that represent 'three linked temporal phases: onset, continuant, and termination' [9]. In this paper, I will focus on the three temporal phases in relation to the actions of making sculpture. Smalley refers to them 'as models for structural functions' that allow to insert morphological ideas within structure (Figure 4) [9]. Smalley further discusses that the onset group (how a sound starts) concerns the initiation of sound material and could vary from the downbeat, to 'anacrusis' and to 'the less specific emergence' [9]. The continuant group (how a sound continues) has a wider range of possibilities such as the 'maintenance', 'prolongation', 'statement' and 'transition' [9]. These terms are showing that the 'continuant function is not neutral: time cannot stand still, and real stasis is not possible', as Smalley mentions. As for the termination group (how a sound

ends), it includes concepts such as this of 'plane' as 'arrival', 'a goal of what has come before' [9].

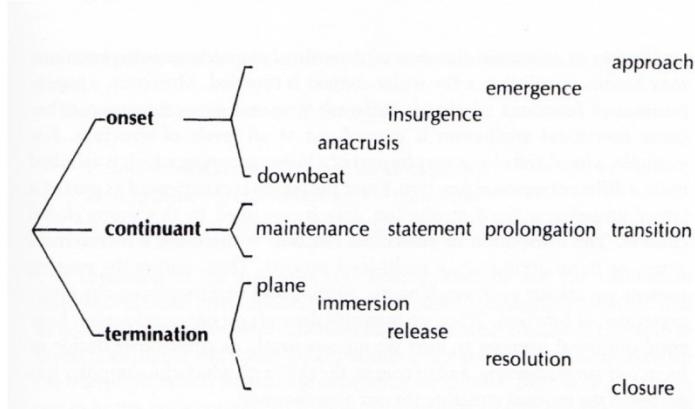


Figure 4. Smalley's structural functions.

3. Methodology

3.1 The process of making

As mentioned in the introduction, examples will be derived from two different making processes each using different material: marble and steel. The point of departure of this exploration will be these two processes of making sculpture: cutting marble in an electrically operated marble cutter and welding sheets of steel. Working with two different materials and techniques could contribute to showing how different materials could affect the sound samples, the making process and finally, the generative outcome of this study. Recording audio and filming the above two processes will allow to realize an analysis of the sound recordings based on concepts of spectromorphology, while having video material as a visual reference concerning gestures. For the visual analysis and editing of spectra, two software programs are used: Ircam Audiosculpt and Sonic Visualiser [1].

3.2 Concepts of spectromorphology

Samples from each action of making will be used to identify the three temporal phases: onset, continuant and termination as discussed by Denis Smalley [9, 10]. This analysis is intended to show how actions of making sculpture in each material differ. It will explore how gestures are happening and highlight how actions of making sculpture can be reflected through sound: what kind of structures of spectra could inform different actions. Actions will be studied as they are happening in time and how they contribute to the transformation of materials.

3.3 Generative processes

Using the structures identified based on the concepts of spectromorphology as mentioned above, I will explore the possibility of ordering them into sequences. Based on Smalley's examples of 'hypothetical *function chains*' [9] (Figure 5) I will create potential sequences of sounds for predefining actions of making sculpture. Smalley's function chains concern the interpretation of functions and as we can see in Figure 5, they can happen in multiple stages. For instance, Smalley's second example is happening in three stages (Figure 5b). Based on Wiggli's graphic scores such as this in Figure 3 and Smalley's 'hypothetical *function chains*' [9], I will explore how my example of sound sequence could generate from new, sculptural objects through actions.

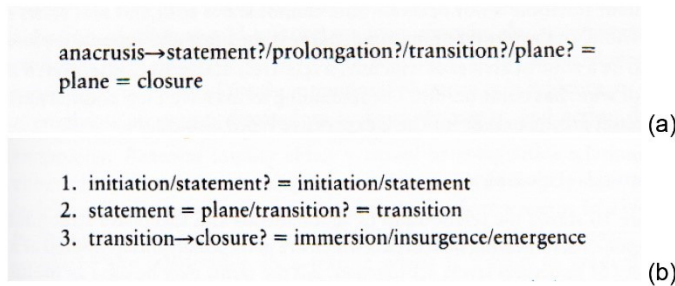


Figure 5. Denis Smalley's examples of 'hypothetical function chains'

4. Experimentation

4.1 Materials, techniques and actions

Both objects have a similar shape (Figures 1 & 2). Their difference lies in the material and in the fact that the marble object is solid, whereas the metallic hollow. This is not only related to materiality but also to the method according to which they are made. The process of cutting a block of marble uses three types of actions: placing the marble on the cutter (Figure 6), adjusting the marble in relation to the blade (Figure 7) and finally, cutting (Figure 8). Placing the marble involves lifting, landing and pushing the marble on the track slider of the machine. Adjusting includes moving and pushing the marble until it is on the right position for cutting in relation to the blade. Cutting happens by pushing the block of marble towards the blade. This sequence of actions is happening for each cut. The object is formed by a sequence of cuts.



Figure 6. Placing marble.



Figure 7. Adjusting marble.



Figure 8. Cutting marble.

To create the metallic object, I need to initially cut the sheets in the guillotine (Figure 9) in the shape of each side of the object, weld them together (Figure 10) and then grind the edges (Figure 11). Cutting the sheets in the electrically operated guillotine requires rotating and adjusting them before each cut. Welding includes holding the pieces together and rotating the object as it is being built. This action is happening in a repetitive manner across the edges of the object. Grinding is executed with an electrically operated grinder being moved back and forth for removing extra material from welding, rotating the object for completing

this process in all its edges (*Figure 12*). In this process, actions are happening in a single sequence: cutting all sides, welding all sides, grinding all sides. Conversely, in marble's making process, the sequence of actions (placing, adjusting, cutting) happens multiple times.



Figure 9. Cutting steel in the guillotine.



Figure 10. Welding steel.



Figure 11. Grinding steel.



Figure 12. Rotating the object.

4.2 Sound recordings and spectrogram analysis

Images from the spectrogram analysis of the sound recordings from both making processes are presented below (*Figures 13-19*). They were analyzed with Sonic Visualiser [1]. They include a time ruler and a sound frequency column on the left part of the image. A description follows based not only on the spectrograms but also on the recordings and the video documentation:

Concerning the making process in marble, *Figure 6* shows the action of placing the marble on the track slider of the marble cutter. As we can see from the spectrogram (*Figure 13*), there is a sound lasting for almost 0.5s before 1s, which is then repeated more intensely before 2s. It is the sound of placing the marble on the metal track slider. *Figure 14* shows the spectrogram of adjusting the marble by moving and pushing it and each time it is on a potential position for cutting, it is being tested by bringing it closer to the operating blade until they are in contact (*Figure 7*). Before 1s we can see the initiation of the operation of the blade, followed by moving the piece of marble that produces sound before 3s and before 6s

and testing its position with the blade in 7s and again after 10s. *Figure 8*, illustrates the action of cutting marble in the machine. As we can observe in the spectrogram (*Figure 15*), there are no obvious changes, the sound continues in the same way throughout the sample until before 20s when it gradually moves towards termination. Concerning the intensity of the sound during the action of cutting (*Figure 15*), the energy at this stage is much greater than at the other two (*Figures 13 & 14*).

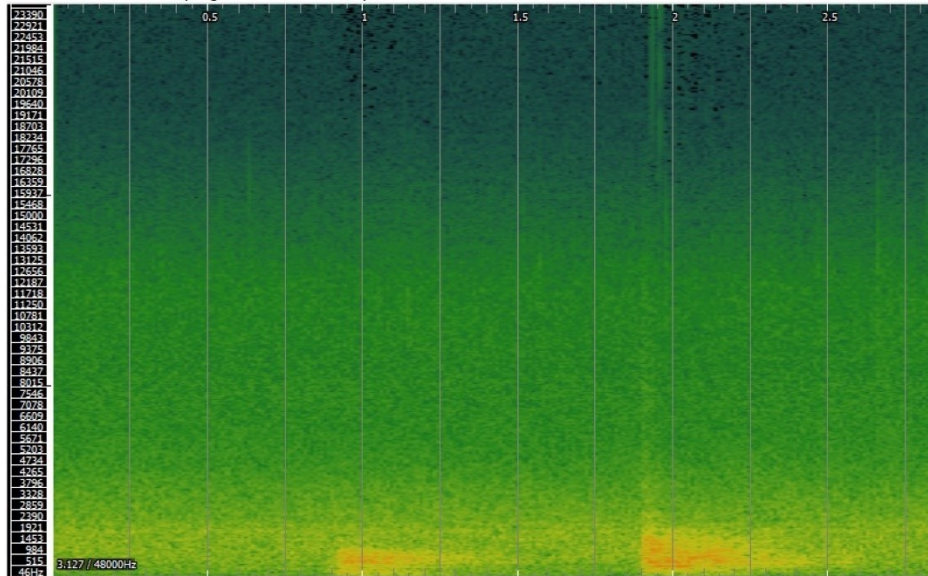


Figure 13. Spectrogram of 'placing marble on the machine'.

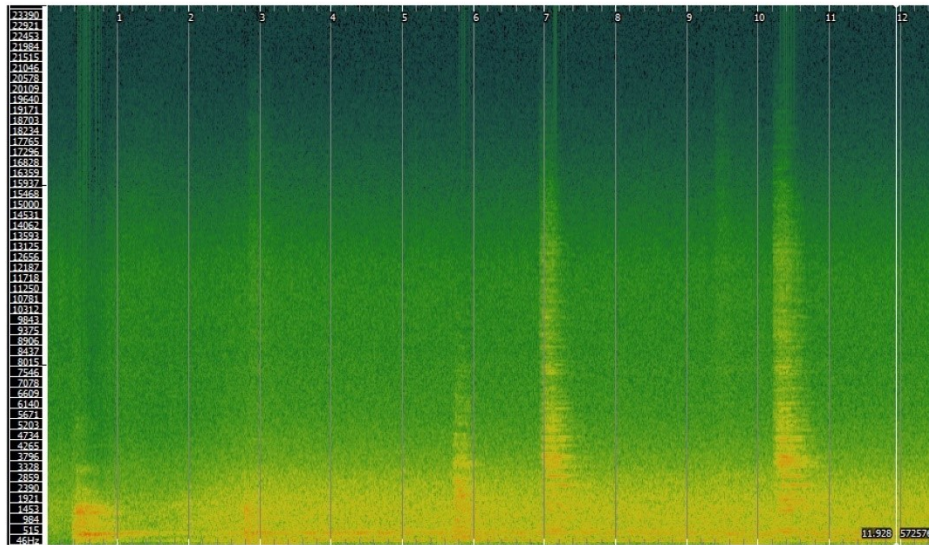


Figure 14. Spectrogram of 'adjusting marble in relation to the blade'.

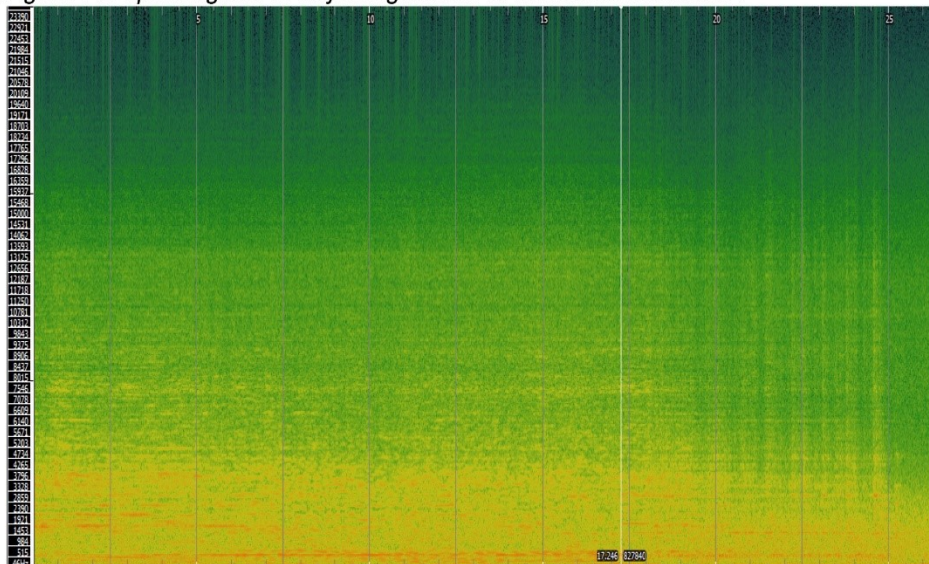


Figure 15. Spectrogram of 'cutting marble'.

Regarding the making process in steel, *Figure 9* illustrates the action of cutting the sheets in the electric guillotine. In the spectrogram (*Figure 16*) after 6s, sound is produced from the action of adjusting the sheet prior to cutting. This action is evolving in steps, followed by cutting and pieces falling on the ground after cutting. *Figure 17* shows the spectrogram of the action of welding (*Figure 10*) that is happening in a rhythmic manner. *Figure 18*, depicts the

spectrogram of grinding (*Figure 11*). Starting at around 10.500Hz and 16.000Hz respectively, we can see two lines that represent the sound of the disc of the grinder. The fluctuation of the lines indicates their changing of frequency as for example, between 5s and 8s. This depends on the contact of the grinder to the material. In 8s-12s there is a repetitive activity due to the back and forth movement that is happening during grinding. *Figure 12* concerns the action of grinding and rotating the object. The difference with the previous action lies in the line that occurs in the spectrogram (*Figure 19*) from the sound of the disc of the grinder. Its fluctuation is now more intense. Additionally, parts such as in 3s-5s, 8s-9s, 12s-13s and 15s-18s show the sound from the rotation of the object. The most intense action of this process is grinding (*Figures 18 & 19*), in which energy is greater than cutting in the guillotine or welding. Comparing the spectra of the two materials can be used to explain material characteristic. For marble, the first two actions are not as intense and their sound spectra are not continuous (*Figures 13 & 14*). The action of cutting (*Figure 15*) involved continuous sound. Regarding steel, the first two actions (*Figures 16 & 17*) are not continuous either but more intense than the first ones in marble (*Figures 13 & 14*). Grinding steel has similar spectrograph (*Figure 18*) to cutting marble (*Figure 15*) but it is again more intense and involves repetitive parts due to the back and forth movement of the grinder. Following this, selecting a material is also selecting sound spectra.

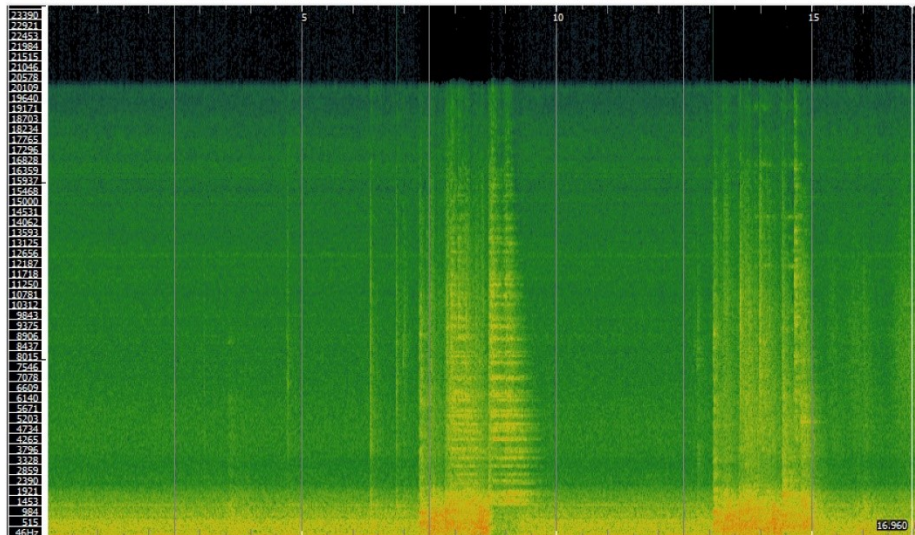


Figure 16. Spectrogram of 'cutting steel sheets in the guillotine'.

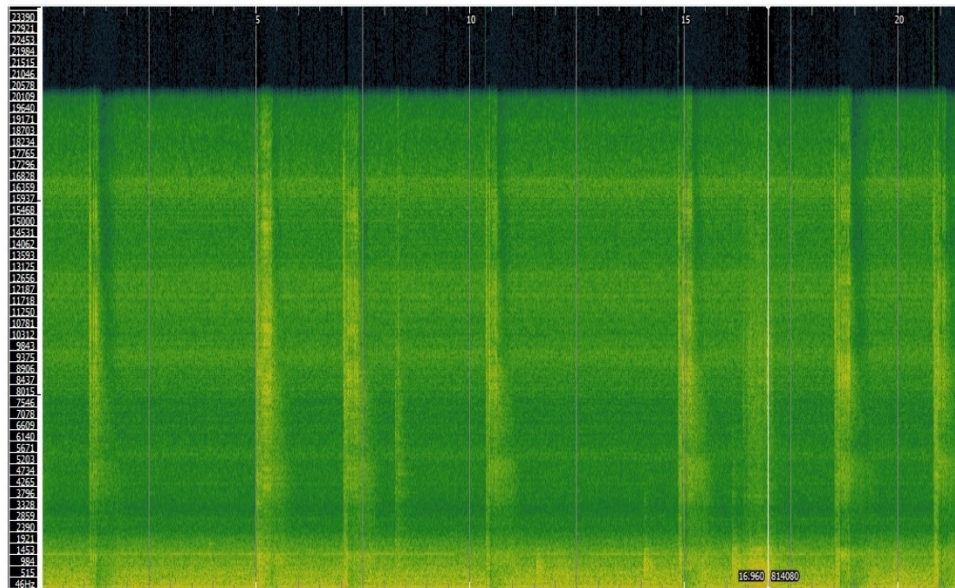


Figure 17. Spectrogram of 'welding'.

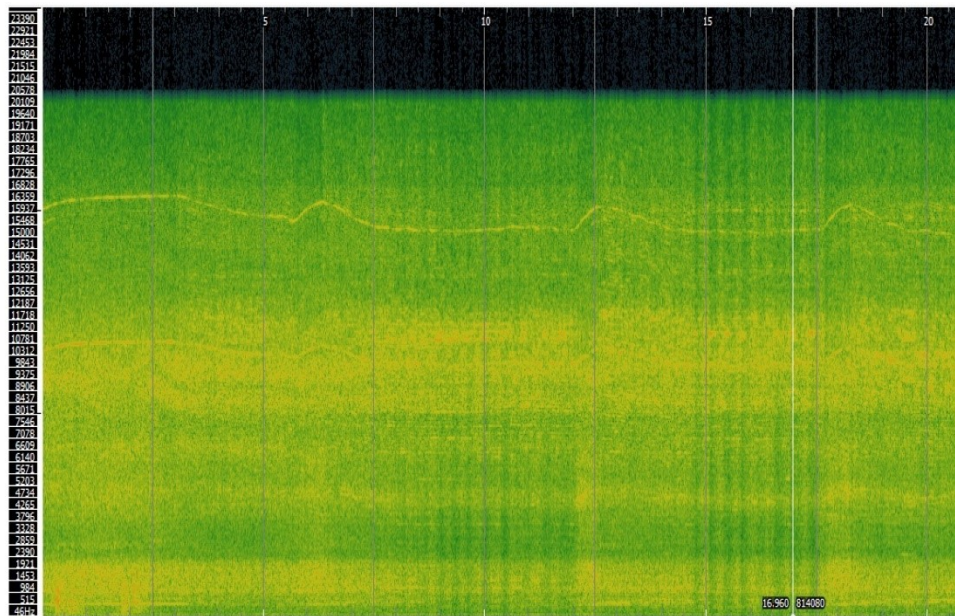


Figure 18. Spectrogram of 'grinding steel'.

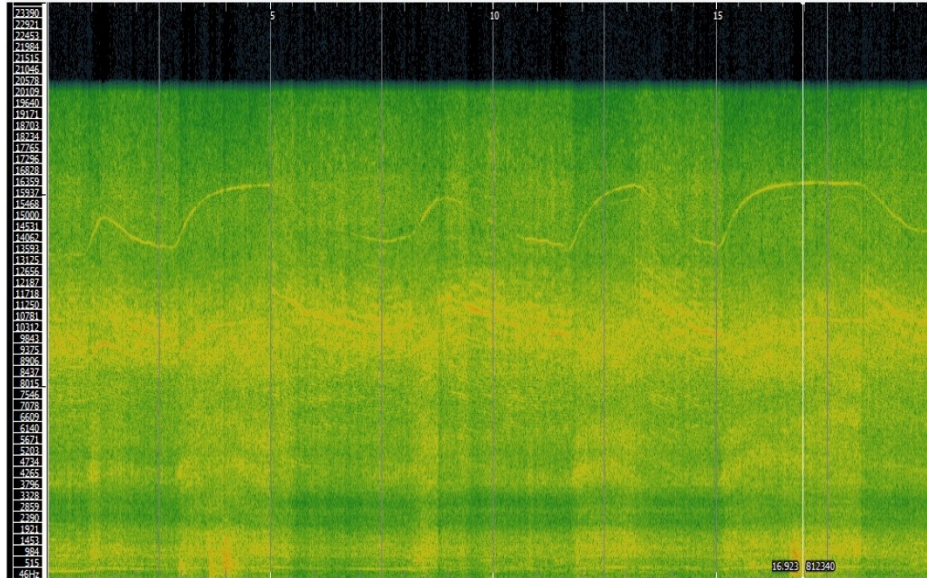


Figure 19. Spectrogram of 'grinding and rotating'.

4.3 Structures

Analyzing more profoundly the above spectrograms, I aim to identify and interpret sound structures as well as their relation with concepts of spectromorphology. Initially, there is the issue of the type of structures, the way they could function within sequences and their impact to the outcome. At this point, it is worth mentioning that multiple levels of analysis seem to exist: firstly, there is a sequence that is comprised of actions, then in a lower level I am identifying structures within actions [10]. The reason for this type of analysis is that it could create links among materials, actions and sounds.

Figure 20 relates the action of placing marble (Figure 6) to Smalley's 'onset (how it starts)' [9, 10] and shows how it is structured. The two main sound events of this action are enclosed in the rectangles. The onset is being considered as the start of the sequence 'placing, adjusting and cutting'. It concerns an action that is happening in stages: lifting, placing, moving. Figure 21 illustrates an action that includes three stages: 'moving, placing and testing' until the object is adjusted, which is related to the continuant phase [9, 10]. We can see that between the above mentioned stages there is always the action of moving. The spectrogram (Figure 22) of cutting marble in the machine does not include any remarkable patterns as it continues in the same way it started. What is obvious on its spectrogram analysis is the gradual termination as the blade crosses the material, cutting off the piece. If we consider all three actions together then placing marble could be the onset as 'downbeat', adjusting could be a continuant such as 'transition' along with part of cutting as 'prolongation', followed by a gradual termination, a 'closure' [9] (Figure 4).

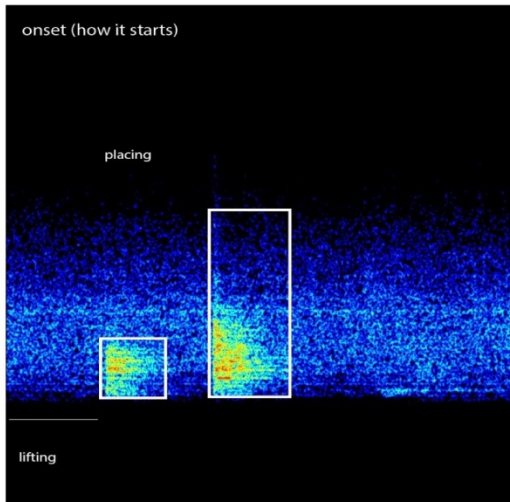


Figure 20. *Placing marble: structure.*

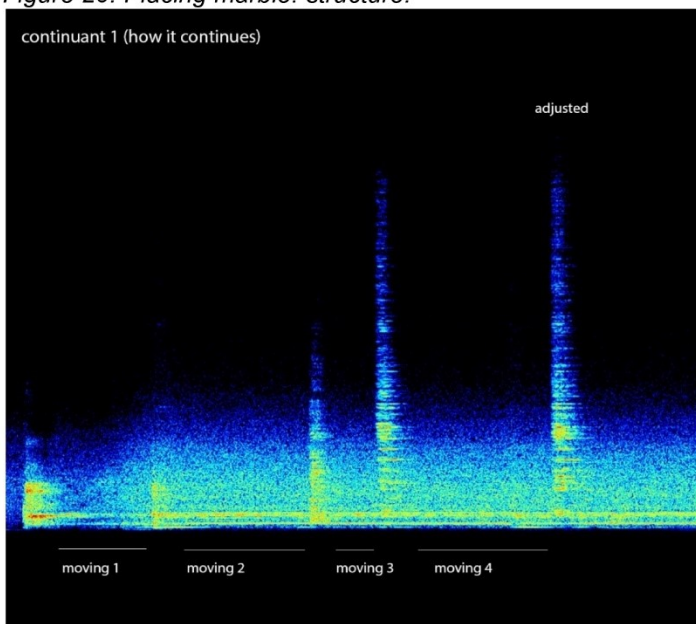


Figure 21. *Adjusting marble: structure.*

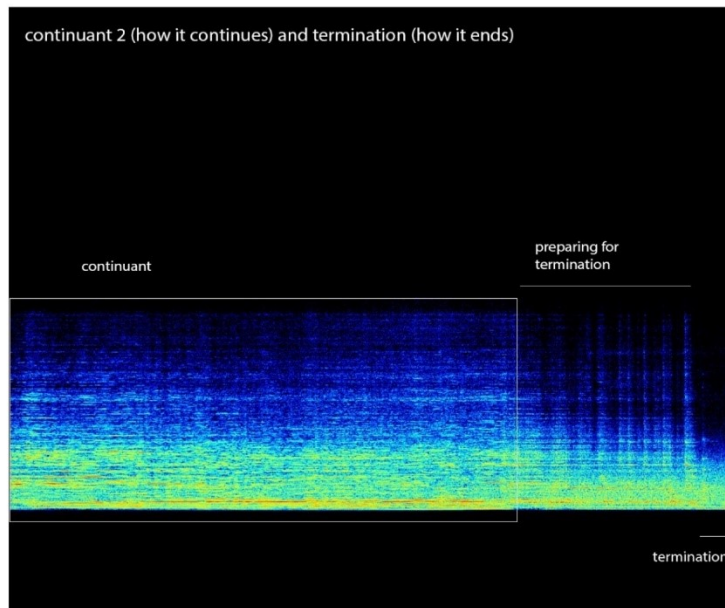


Figure 22. Cutting marble: structure.

Figure 23 illustrates part of the spectrogram of cutting steel sheets in the guillotine. The three rectangles show three different parts, actions within the action of cutting: adjusting, pressing the pedal and cutting/pieces falling. This could act both as an 'initiation' onset with the action of adjusting the sheets and as a 'transition' continuant with the actions of pressing the pedal and cutting/pieces falling. *Figure 24* relates the action of welding to a continuant that is happening in a repetitive manner. Based on Smalley's terms, it could be a 'prolongation' [9, 10]. As in the action of adjusting the marble in *Figure 21*, between each sound of welding there is a pause while rotating, which creates a specific rhythmic pattern. *Figure 25* shows the action of grinding that is happening through a back and forth movement with pauses in between. The pauses of the main action concern observing the process for adjusting the grinder appropriately. Distancing the grinding disc from the object has as consequence the loss of contact with the material and the change of its sound. This can be observed in the spectrogram (see the two rectangles) (*Figure 25*). It could also be characterised as a 'prolongation'. *Figure 26* concerns another continuant: grinding and rotating the object. The difference to the previous sample is the action of rotating that creates another type of sound in the recording. Its structure is very similar to this of grinding (*Figure 25*) but the additional action of rotating/moving produces an extra sound.

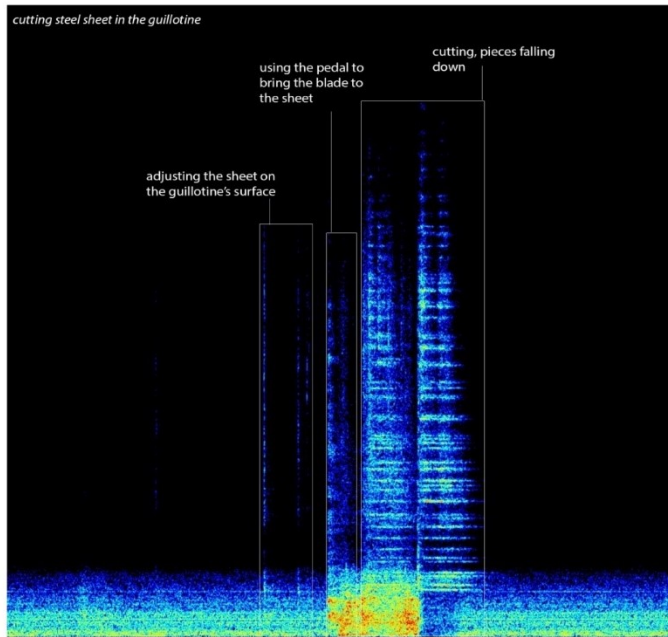


Figure 23. Cutting steel sheets in the guillotine: structure.

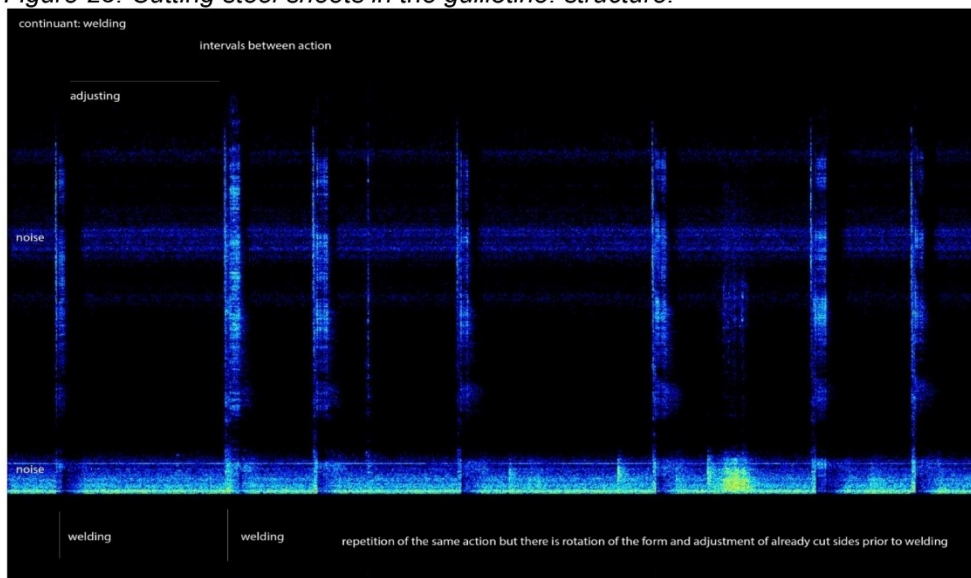


Figure 24. Welding: structure.

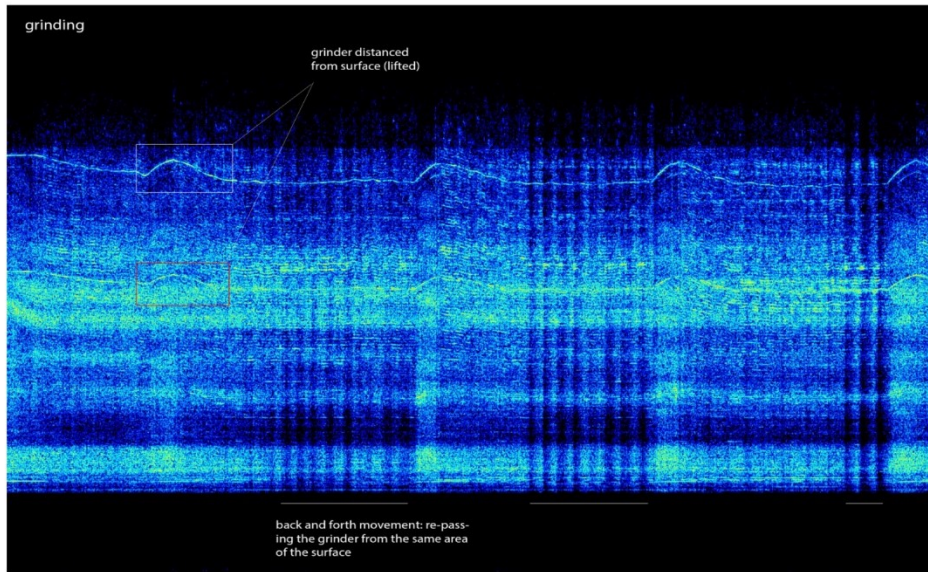


Figure 25. Grinding steel: structure.

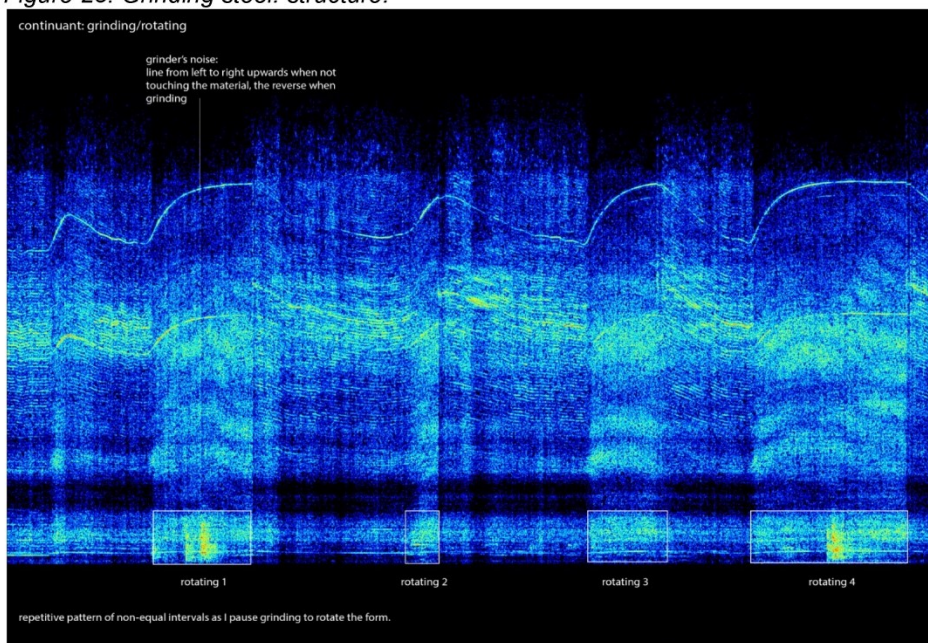


Figure 26. Grinding steel and rotating the object: structure.

Overall, categorizing the sound samples according to their 'structural function' [9, 10] contributes to understanding the connection of sculptural gestures and sound material (Figures 27 & 28). So far, we have encountered three types of sounds occurring from:

repetitive actions somehow regular such as welding, continuous such as cutting, and fragmented such as adjusting. The intensity of sounds can be traced through the spectrograms. For instance, cutting the marble or welding and grinding steel are much more intense than loading and setting the piece.

placing (onset) < lifting, placing, moving

adjusting (continuant) < moving, placing, pushing/testing

cutting (continuant/termination) < pushing/cutting

Figure 27. Smalley's structural functions - marble making process

cutting < adjusting/moving (onset) pedal/cutting (continuant)

welding (continuant) < adjusting/moving, welding

grinding (continuant) < moving/rotating, grinding

Figure 28. Smalley's structural functions - steel making process

4.4 Sequences: a generative process

In this part I will discuss how the structures analyzed in paragraph 4.3 could be used as new sequences in an order that would inform the making process of a sculptural object. Could sound material from actions be used for different materials and making processes? Wiggli's sequences of verbs that represent actions are used for the generation of sound material [3] (*Figure 29*). Making potential sequences with the samples of actions from the analysis above could be a first approach to a generative process. Following Tom Johnson's method concerning LeWitt's work [6], I will use the function of the initial sequences in a sound context.

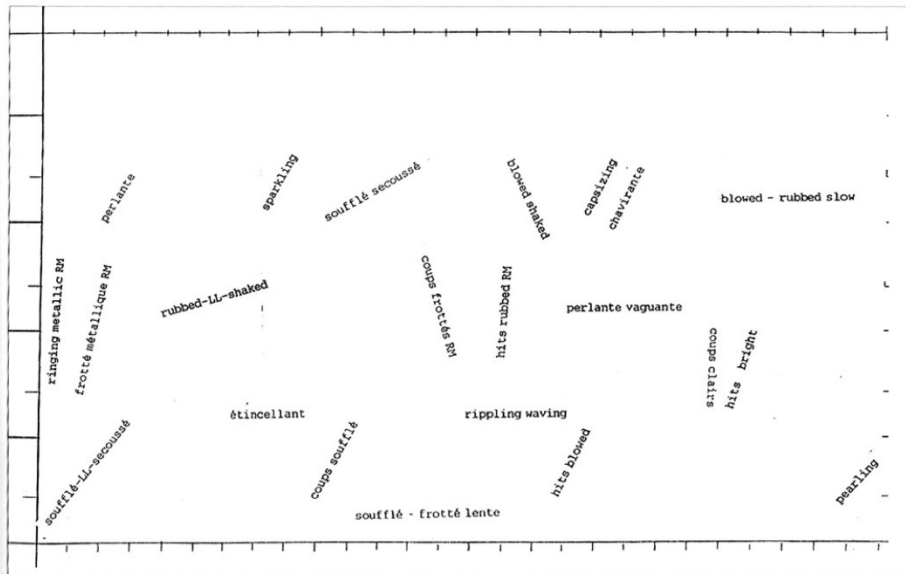


Figure 29. Oscar Wiggli, 'Partition verbale pour la composition "RESEMBLANCES ET MIROITEMENTS"', 1994

The potential verbal/sound sequences will explore relationships among actions. Spectrograms and their analysis in paragraphs 4.2 and 4.3 reveal the already existing sequences and structures of sound material during the making of a sculpture in marble and steel. The aim of the potential sequences is to be able to generate a sculptural outcome. This will be the main function of my system, which according to Halsall's definition [4] will be recognizable at all times. For achieving this, the order of each action within the sequence needs to be taken into consideration. A potential sequence could be: lifting/placing, welding, adjusting and grinding. Due to the action of welding, this process will have to concern metal. The spectrogram of this potential sequence is presented in Figure 30 with material from the initial processes. Onsets, continuants and terminations could determine the progress of each potential sequence. In this sequence, I have used placing as an onset, welding as a 'prolongation' continuant, adjusting as a 'transition' continuant and grinding as another 'prolongation'.

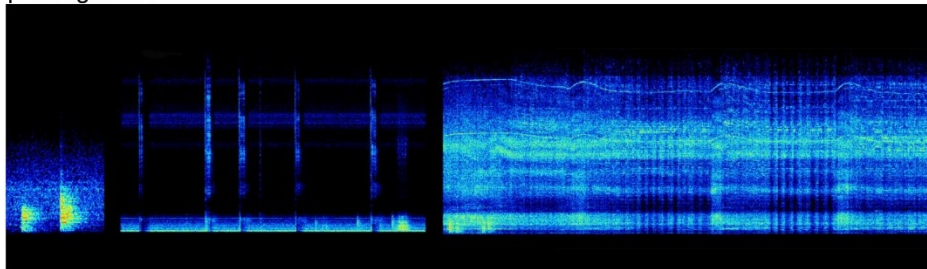


Figure 30. Potential sequence: placing, welding, adjusting, grinding.

5. Discussion and Conclusion

The observation of the spectrograms of the sound recordings, contributed to identifying how a sound starts, continues and ends. Concerning different actions, these three phases were visualized in a different manner, creating different structures. They are either repeated as they initially appear, changing during repetition or happening only once during the action. This analysis offered a deeper understanding of the process of making, providing an alternative method for combining sculpture making and sound material through sequences. The sound is a memory of the process that may not always be evident on the object itself. The process of grinding for example, eliminated the evidence of welding, which in itself adds to the final expression of the object on a not material manner. The object then represents a sequence of sound spectra. The representation of sound sequences through spectrograms is not to be mistaken for notation. My intention is to use them as means for analyzing and understanding sound structures visually.

A first issue that arises from the potential sequence is duration. I have used the duration of the spectrograms from the initial processes analyzed in this study. Different duration of actions could have different sculptural outcomes. There are actions that could last longer depending for example, on the size of the object. Using Smalley's concepts, I am able to classify the various actions through sound but this needs to be further studied also concerning the energy and the intensity of actions. Furthermore, material creates other issues in the process as for example, welding is not possible when working with marble. Each material has its own sound sequence depending on actions and their intensity. In this study the consequence of material choice in sculpture is reflected through sound.

This paper is part of my continuous study and a first approach of using spectromorphological thinking in relation to the context of sculpture in a systematized way. Further exploration of other concepts introduced by Smalley and analyzed by Hirst needs to be undertaken for reaching a more profound analysis of the samples from the making processes. Additionally, it is necessary to address the issues mentioned above and to test potential sequences practically, by making sculptural objects according to them. This might lead to new questions regarding this generative process as well as the sculptural outcome and materials used.

Acknowledgements

I would like to thank Nikos and Alexandros Georgiou who provided assistance and expertise and for letting me use the equipment in their Marble Workshop in Athens.

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Figures

Figure 1. *Object in marble*. Panourgia, E., 2016.

Figure 2. *Object in steel*. Panourgia, E., 2016.

Figure 3. Oscar Wiggli, '*Partition graphique-verbale pour la composition AVELEK*'. From *Oscar Wiggli: Corps, Espace, Son*, p.250, by Frehner, M. & Hesse, J. (eds.), 2007, Bern: Benteli.

Figure 4. *Smalley's structural functions*. From "Spectro-morphology and Structuring Processes" in S. Emmerson (ed.) *The language of electroacoustic music* (pp.61-93), p.85, by Smalley, D., 1986, Basingstoke: Macmillan.

Figure 5. *Denis Smalley's examples of 'hypothetical function chains'*. From "Spectro-morphology and Structuring Processes" in S. Emmerson (ed.) *The language of electroacoustic music* (pp.61-93), pp.86-87, by Smalley, D., 1986, Basingstoke: Macmillan.

Figure 6. *Placing marble*. Panourgia, E., 2016.

Figure 7. *Adjusting marble*. Panourgia, E., 2016.

Figure 8. *Cutting marble*. Panourgia, E., 2016.

Figure 9. *Cutting steel in the guillotine*. Panourgia, E., 2016.

Figure 10. *Welding steel*. Panourgia, E., 2016.

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Figure 12. *Rotating the object*. Panourgia, E., 2016.

Figure 13. *Spectrogram of 'placing marble on the machine'*. Panourgia, E., 2016.

Figure 14. *Spectrogram of 'adjusting marble in relation to the blade'*. Panourgia, E., 2016.

Figure 15. *Spectrogram of 'cutting marble'*. Panourgia, E., 2016.

Figure 16. *Spectrogram of 'cutting steel sheets in the guillotine'*. Panourgia, E., 2016.

Figure 17. *Spectrogram of 'welding'*. Panourgia, E., 2016.

Figure 18. *Spectrogram of 'grinding steel'*. Panourgia, E., 2016.

Figure 19. Spectrogram of 'grinding and rotating'. Panourgia, E., 2016.

Figure 20. Placing marble: structure. Panourgia, E., 2016.

Figure 21. Adjusting marble: structure. Panourgia, E., 2016.

Figure 22. Cutting marble: structure. Panourgia, E., 2016.

Figure 23. Cutting steel sheets in the guillotine: structure. Panourgia, E., 2016.

Figure 24. Welding: structure. Panourgia, E., 2016.

Figure 25. Grinding steel: structure. Panourgia, E., 2016.

Figure 26. Grinding steel and rotating the object: structure. Panourgia, E., 2016.

Figure 27. Smalley's structural functions - marble making process. Panourgia, E., 2016.

Figure 28. Smalley's structural functions - steel making process. Panourgia, E., 2016.

Figure 29. Oscar Wiggli, 'Partition verbale pour la composition "RESEMBLANCES ET MIROITEMENTS", 1994. From Oscar Wiggli: *Corps, Espace, Son*, p.251, by Frehner, M. & Hesse, J. (eds.), 2007, Bern: Benteli.

Figure 30. Potential sequence: placing, welding, adjusting, grinding. Panourgia, E., 2016.

ARTICLE

Digital interactions: Sound and three-dimensional forms

Eleni-Ira Panourgia,^a Finbar Wheelaghan^b and Xue Yang^c

This article discusses a prototype that explores the simultaneous manipulation of three-dimensional digital forms and sound. Our multi-media study examines the aesthetic affordances of tight parameter couplings between digital three-dimensional objects and sound objects based on notions of process and user-machine interaction. It investigates how effective cohesion between visual, spatial and sonic might be established through changes perceived in parallel; what Michel Chion refers to as 'synchresis'. Drawing from Mike Blow's work *On the Simultaneous Perception of Sound and Three-Dimensional Objects* and processual art, this prototype uses computer technology for forming and mediating a creative practice involving 3D animation, sound synthesis, digital signal processing and programming. Our practice-based approach entails the rendering of a three-dimensional digital object in Processing whose form changes over time according to specific actions. Spatial data is sent via Open Sound Control (OSC) to Max MSP in real time, where sound is synthesised and then manipulated. Sonic parameters such as amplitude, spectral density/width and timbre are controlled by select spatial parameters from the three-dimensional object. Sound processing is realised based on the changing of the three-dimensional object in time through basic actions such as splitting, distorting, cutting, shattering and rotating. We use digital technology to look beyond basic synchronisation of sound and vision to a more complex cohesion of percepts, based on changes to myriad sonic and visual parameters experienced concurrently.

Keywords: synchresis; interactivity; cross-modality; sound synthesis; 3D animation

Introduction

This research is based on a prototype designed in the Digital Media Studio Project Masters course 'Developing Multidimensional Objects' supervised by Eleni-Ira Panourgia at Edinburgh College of Art. The focus of the course was on the development of multidimensional objects mainly by combining digital media that involve visual/spatial dimensions and sound. The aim of this ongoing research project is to explore coherent ways for the simultaneous manipulation of three-dimensional digital objects and sound and to explore how objects that combine such modalities are perceived. Having a three-dimensional object inform the character of a given sound might result in two perceptual objects, which may seem disconnected to the observer. Instead, we are striving to form and maintain a cohesion between sonic and visual as changes in each are experienced at the same time.

Crossing such modalities allows for working in environments that provide more sensory and perceptual possibilities for the making of works of art (Blow 2014). This also creates important challenges concerning the modalities themselves, as well as on how they can be simultaneously perceived. We have developed a hybrid creative tool that brings together visual, spatial and sound material. The centre of our approach is on exploring new creative processes and "perceptual relations", as it is discussed by Mike Blow (2014, 6). We are focused on material

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manipulation from a digital yet action-based approach that strongly exists in the work of the sculptors Oscar Wiggli and Richard Serra. We are interested in actions and the way they inform processes of making as they bring changes to the material, which in their turn introduce a temporal characteristic to the three-dimensional objects.

Background

The background of this study draws on the one hand from theories of synchresis and perception and on the other hand, from creative practices and theories of process and processual art, as well as works that combine visual, spatial and sonic, including 3D animation, sound synthesis and digital signal processing.

Synchresis and perception

Michel Chion introduces synchresis as “the spontaneous and irresistible weld produced between a particular auditory phenomenon and visual phenomenon when they occur at the same time. This join results independently of any rational logic” (Chion 1994, 18). In his definition Chion mentions that synchresis it is a “forged” word that comes from the combination of synchronism and synthesis. He further states that synchresis exists as a result of congruent sonic and visual movements, which binds their forms together (Chion 1994). Synchresis may be perceived via a sequence of discrete events, such as the coincidental blinking of image and sound, or through a continuous event, where changes are perceived on a continuum. Mike Blow relates the act of perceptual bonding by pattern recognition to Gestalt principles of proximity, which infer that we automatically seek out a formal congruency between sonic and visual; it is this which results in a cohesion of percepts (Blow 2014).

Through the temporal alignment of changes to forms that we see and hear we associate the location of the combined object with its visual component; we consider the sound to have emitted from the image we see, which may be on-screen, even if the sound in fact came from a loudspeaker on the other side of the room. Charles Spence documents perceptual crossovers between visual and sonic and argues that the basis for some, such as connecting pitch and amplitude with size, may be the result of the natural resonant properties of materials (Spence, 2011).

Following this, causality is embedded in the phenomenon of synchresis and is at the center of the perceptual bonding we are concerned with. It is restrictive, as to break free of this causal link is to lose what Chion terms “added value” (Chion 1994, 5). In his own definition, Chion describes this value as the enhancement that sound can offer in a visual experience so that “expression ‘naturally’ comes from what is seen, and is already contained in the image itself” (Chion 1994, 5). Blow reconsiders Chion’s “added value” as “the space between” the senses resulting from their “interaction” (Blow 2014, 7). We are interested in exploring the limits of this link as “a temporal cross-modal reinforcer” (Blow 2014, 54).

It is the necessity of change over time which makes synchresis an essentially temporal phenomenon. Blow draws attention to the term “weld” that Chion uses in his synchresis definition for “creating a single, new, combined perceptual event” (Blow 2014, 54). Blow considers how a sound could reinforce or change the characteristics of an object, means for the cohesive use of sounds and objects within a single work of art, and the cognitive results that are derived from such outcomes. He thus reconsiders the notion of synchresis from a three-dimensional point of view, an approach that is central in our research and upon which we seek to expand. In this case, space combines with time to form more complex perceptual relationships. For example, a blinking dot on a screen which remains static in space does not provide us with the same scope for interesting sound-visual couplings as if the dot were perceived to also be moving through two-dimensional or three-dimensional space. Our prototype features three-dimensional digital objects as the addition of depth provides a greater range of spatial-to-sound relationships to exploit.

Three-dimensional objects and sound

The combination of three-dimensional objects and sound in this project was approached from a process and action-based perspective. This entailed not only the mapping of parameters of the one modality to the other, but also the use of similar methods for working with both together. Mike Blow's work *Bleigiessen* focuses on the actions applied to a solid material and the sounds produced during the making. Based on Richard Serra's works *Splashing* and *Verb List*, Blow "traces" movement and time of the changes applied to the solid material through sound (Blow 2014, 26). Another important example is the work of Oscar Wiggli, who considers his sculptures and sound compositions together and uses similar making process in both forms. In this way, Wiggli's creative process in sculpture also exists in his sound compositions (Bosquet et al. 1995). Working with such a "parallelism" of visual, spatial and sound materials, Oscar Wiggli places both three-dimensional objects and music in "ephemeral space" (Kunstmuseum Bern 2007, under "Body – Space – Sound").

Such ephemerality is present in the digital works of Davide Quayola and Candace Sisman, which involve 3D design and sound. Sisman focuses on producing work that combines different modalities across sound, visuals and space, and also on the way such hybrid forms are perceived. Sisman's work *NOISEFLOOR*, which he also refers to as "Data Sculpture", concerns a three-dimensional digital form that was developed based on the sound's frequency and duration (Kaplangi 2014). This three-dimensional object is then used as the point of departure for further designing sound and animation. Quayola's *time-based sculptures* are in a dialogue with sound mainly depending on their manner of unfolding in virtual space (Quayola n.d.). He develops systems for manipulating his material based on algorithms, which he characterises as "...a synthesizer that I calibrate in order to achieve what I consider to be the 'richest' image" (Shipwright 2016). Works such as *Flexure*, combine form, texture and sound with actions such as twisting and contorting. In this way, Quayola works with digital gestures across visuals and sound, which we seek to reconsider from a process-based point of view. Both examples bring aspects of solid material objects to digital objects in relation to sound and movement, which informs the way we are approaching parameter coupling and aesthetic decisions.

Process

The movements that occur in our objects happen as a result of specific actions, which create simultaneous changes to the form of the shape and sound. When referring to such changes we are interested in the notion of process as a creative practice. We are looking at changes which occur as a result of actions applied to the objects. An important example of such actions is Richard Serra's *Verb List Compilation: Actions to Relate to Oneself*. This list includes the infinitives of verbs and possible contexts for the manipulation of materials (McShine and Cooke 2007; Friedman 2011). According to Serra, the *Verb List* can function "as a way of applying various activities to unspecified materials" for working on pieces in relation to the verbs "physically in a space" (Serra 2013). The *Verb List*'s focus on actions and processes influenced our approach on the action-based manipulation of our material as well as from a conceptual point of view. Using verbs that indicate how material is being worked, we are looking at applying these actions in both visual/spatial and sonic modalities. The difference here is that the actions are applied through digital means and not with physical manipulation.

Ursula Damm mentions that the main aspects of both process and processual art are "the action, the activity and the performance" (Damm 2017). According to Damm, processual art differs in the introduction of such actions in systems whose operation can happen in various levels of autonomy. In our project the actions are being processed in a system programmed by the artist. The process is then controlled by the system, which releases our artistic intention to the world. We can observe similarities between the concept of process and the term *procedural* as it is applied in the digital design and computing communities, particularly in videogame design. Andy Farnell defines

procedural audio as “sound qua process, as opposed to sound qua product” (Farnell 2007, 1). He further states that “procedural audio is non-linear, often synthetic sound, created in real time according to a set of programmatic rules and live input” (Farnell 2007, 1).

In the case of this study, rather than representing processes with sounds which are pre-rendered as audio recordings and simply triggered to coincide with an action such as a tearing action with a tearing sound effect, we are binding the parameters of sonic objects to spatial parameters and modifying those objects in real-time through digital signal processes. Combining the above mentioned aspects of process art, processual art and procedural audio, we aim to interpret these processes sonically.

Verbs that are used to describe each process tend to pertain inherently to visual space rather than sound. For instance, we understand how to rotate a visual object with little need for interpretation. However, when applying these verbs to sound they become metaphorical. How do we rotate a sound? A sound designer's interpretation is likely to be different to that of a composer or even from another sound designer. This makes our approach different to that of Richard Serra, whose interpretation of processes is direct and primarily concerned with the material and visual domain. Our chosen couplings are derived therefore partly from personal preference. Other interpretations draw on acoustic phenomena relating to the reflective properties and behaviors of objects and spaces, which adheres to Spence's consistent cross-modal correspondences. Some focus on connections established through media practices such as animation, while some others explore more oblique mappings of spatial to sonic. Our objective is to use digital technology to establish ways in which to experiment with these couplings and processes.

Digital design

We have designed a digital three-dimensional object and mapped select spatial parameters from said object to sonic parameters of a synthesised sound, so that as processes are applied to the visual object in real time, a relative action is applied to the sound. This results in simultaneous changes over time and a fusion in their perceived forms. The primary cross-modal couplings we explored for this study were: width and length with spectral range; width and length with loop/grain length; spatial volume with amplitude; three-dimensional object rotation with audio phase; rotation with grain position and multiplicity with polyphony.

In terms of developing the digital three-dimensional objects and transforming them into particular shapes, Processing was used along with the PeasyCam library so as to drag and view the objects from any angle (Feinberg 2013). Interaction with the objects was achieved with the computer's mouse. The study employs Max MSP as its sound design platform, interfaced with Processing in real time via Open Sound Control (OSC). Max MSP provides a workspace of elementary synthesis tools which allowed us to create and map multiple highly nuanced, customisable parameter couplings and to control their curves and severity. Our prototypes explore two methods of synthesis, granular and subtractive. These methods are manipulated alongside a three-dimensional model via processes of reshaping, rotating, splitting and distorting. Experiments have been performed at the audio stage, with a variety of sound parameters linked with a base set of visual parameters.

Prototypes

Prototype 1 explores mappings of a three-dimensional cube with sonic parameters of a sustained tone generated via two pulse-wave oscillators¹. The cube is rotated upon horizontal movement of a mouse. As the cube rotates the

¹<https://www.youtube.com/watch?v=2L-q4-HLu3o>

oscillators are detuned, creating a shift in phase and a perceivable rotation in the sound. More specifically, it generates complex, minute sonic movements, which amount more to a shifting in texture than a complete change in form. As the rotation of the object stops, the oscillators revert to their original frequencies and a *freezing* of both visual and sonic objects can be perceived. Acceleration is considered so that the faster the rotation, the more severe the detuning of the oscillators, creating a tight connection between user interaction and perception of three-dimensional rotation and sonic movement.

Spatial width or narrowness of the cube, which is controlled using vertical mouse movement, is coupled with spectral width of the tone; as the shape becomes thinner a high pass filter is applied to sound. Here we observe some parity between the application of these adjectives in the context of both modalities. The words *thinness* and *width* are often applied to describe both audio spectra and physical three-dimensional objects. Just as Spence posits that certain cross-modal correspondences exist as a result of real-world acoustic behaviors, for example the correlation between object size and pitch and spectral range (Spence 2012), we might explain the quality of this coupling as such. The phase to rotation pairing in this prototype illustrates movement in sound at a micro or textural level.

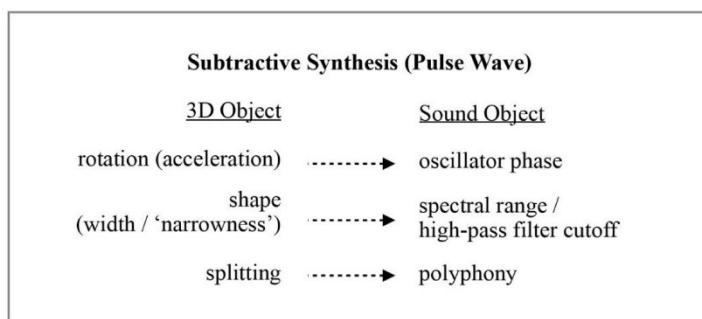


Figure 1: Parameter mappings of Prototype 1
Source: generated by the authors

Prototype 2 explores the same three-dimensional shape and actions as prototype 1, manipulated instead alongside a granular synthesiser applied to a vocal recording². Here we observe an oblique mapping of percepts in the form of a link between grain length and object length. This coupling explores the forging of a temporal to spatial relationship; as we perceive the grain or audio loop becoming smaller in time we perceive the three-dimensional object narrowing. We track the sound's repetition and perceive around it a form, which develops as the grain size reduces. We simultaneously connect this with the form we observe as the three-dimensional shape narrows in space. Prototype 2 also exhibits a further example of a coupling informed by real-world acoustic behavior, where a low pass filter is applied to the audio signal in parallel with rotation, to create an occlusion effect. Every half rotation of the shape results in a top-down linear diminution in spectral range, a phenomenon we might expect to experience if the sound was emitting from two opposing faces of the cuboid. It is interesting to note that, alternatively, if the direction is reversed and a high-pass filter sweep is used, we still perceive sound and visual

² <https://www.youtube.com/watch?v=l-USpCCyRo>

objects as one, instinctively forging the undulating form in the sound with the form created by the perceived depth of the object as it swings past our point of view.

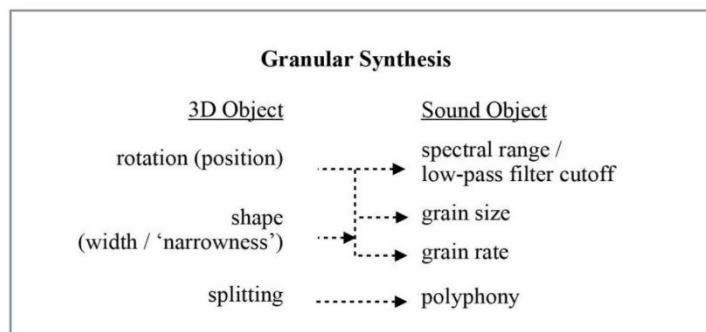


Figure 2: Parameter mappings of Prototype 2
Source: generated by the authors

Both prototypes exhibit a uniform interpretation of the action of splitting, translating it to polyphony, where frequencies above the main frequency are chosen arbitrarily and new voices instantiated upon the click of the mouse. This approach is unsatisfactory as it comes from a traditionally musical interpretation of multiplicity. The process is also discreet, as the action occurs instantaneously. An animation of the split appearing from nowhere and widening gradually, with the severity and speed of the split controlled by user input, might have resulted in a more interesting study of this particular action. This will be revised in future iterations.

The action of distorting was explored in a further prototype³ in which an object is transformed from one basic shape into another, specifically, a sphere into a cube. We observe in the sound object a detuning of tones in tandem with the visual transformation. The cube eventually separates into component planes, at which point we observe a complete opening of a low-pass filter. This, as a result, gives the impression that the sound originates from inside the cube.

In some cases, direct, linear relationships between spatial and sonic parameters were found to be less congruent than curved relationships, in the examination of perceptual interplay and synchresis. Bonds which relate to real-world acoustic phenomena seem primed to result in synchresis. These bonds, which we have explored by redrawing curves or by inverting shapes and forms also prove to be robust. Works like Quayola's and Sinigaglia's *Flexure* challenge this robustness, juxtaposing mismatched sonic and visual objects in semi-sync, while exhibiting and exploiting synchresis. Our work isolates and scrutinises this phenomenon, testing its limits further in myriad directions across studies, such as the connection of temporal and spatial domains of repetition and looping with shape and size. Processes drawing from the manipulation of three-dimensional objects are integrated through this study into sonic thinking. In terms of processuality, actions are transferred to the design of the prototypes through parameter mapping, while the output depends not only on the mapping itself but also on the input of the user.

³ <https://www.youtube.com/watch?v=jWOx9kcFFMg>

Conclusion and further development

Over the course of this study we have developed methods for sonic and spatial parameter coupling. Our prototypes explored the simultaneous combination of three-dimensional objects and sound in several ways, while maintaining congruency between percepts and achieving added value. To create a constantly evolving multi-sensory experience, these prototypes spoke for concurrent transformation of three-dimensional forms through listening. This work achieved an action-based digital approach that allowed precise and direct mapping of parameters of the transformation of both modalities. It went beyond sonic-to-spatial translations such as in Sisman's work *NOISEFLOOR*, by introducing a method of digital sound manipulation through a succession of actions that formed processes, which allowed to shape this material and expand their possibilities both visually and sonically.

Challenges faced by this exploration were present primarily in the interfacing of technologies, specifically the mapping of spatial to sonic parameters across platforms. This required the isolation of visual characteristics as variables in Processing, to then be passed on to Max/MSP, which we achieved with mixed success. Limited access to aesthetic parameters embedded in geometric functions meant that couplings from some of the more complex actions, such as distorting, produced less nuanced relationships between parameters, while also limiting user interactivity and the visual design. With the ability to isolate more 3D parameters as variables, we would be able to generate more dynamic shape-to-sound relationships and expand this exploration toward more complex structures.

Further development of the study will extend parameter mappings to design features such as colour, focus, texture, translucency and overlay, as well as sonic parameters such as spatialisation, multichannel mixing, wave-shaping and frequency modulation. Future work may also experiment with additional actions, such as shattering, rolling, stretching and tearing, and look at how this work could function in alternative setups such as in installation or performance environments. Finally, the study's focus on process might be expanded by incorporating new forms of user-machine interaction, with the use of sensors. All of the above may lead to a deeper understanding of the research question.

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Research activities

Field trips

January 2017 undertook advanced professional training in AudioSculpt software by IRCAM in Paris, France.

February 2016 undertook archival research in Paul Sacher Foundation and in Tinguely Museum in Basel, Switzerland.

March 2015 attended: a) 'Other Harmony' MaMuX seminar in IRCAM, b) *Solaris* multimedia performance show by Dai Fujikura and Saburo Teshigawara, a coproduction of Théâtre des Champs-Élysées, Opéra de Lille, Opéra de Lausanne and IRCAM-Centre Pompidou, and c) 'Rencontre avec Saburo Teshigawara' lecture at the House of Culture of Japan in Paris, France.

List of publications

Journal articles and conference proceedings

Katerina Talianni, Eleni-Ira Panourgia, Jack Walker, and Roxana Karam. 2018. "**Editorial**", *Airea: Arts and Interdisciplinary Research*, issue 1, 1-2. doi: 10.2218/airea.2748.

Eleni-Ira Panourgia, Finbar Wheelaghan and Xue Yang. 2018. "**Digital interactions: Sound and three-dimensional forms**", *Airea: Arts and Interdisciplinary Research*, issue 1, 3-10, doi: 10.2218/airea.2732.

Eleni-Ira Panourgia and Jing Zhao. 2018. "**SoundMapp - Participatory design in museum space**", *The International Journal of the Inclusive Museum* 11 (1): 27-35, doi:10.18848/1835-2014/CGP/v11i01/27-35.

Eleni-Ira Panourgia & Jing Zhao. 2017. "**A Participatory Music Journey in Museum Space**", in Program booklet of the Twelfth International Conference on the Arts in Society 14–16 June 2017 at the American University of Paris, France. Published by Common Ground Research Networks, Champaign, Illinois, 2017, p.107.

Eleni-Ira Panourgia. 2016. "**Spectrogram Data as System for Making Sculpture**", in Proceedings of the GA2016 19th Generative Art Conference, Florence, Italy, pp. 179-199, ISBN 9788896610312.1.

Selected shows

2018

Eleni-Ira Panourgia, "Process / Procedure: performance-installation", Research Workshop of Minto House, ESALA, University of Edinburgh.

Cinetopia: Plastic Man & Grey to Blue, Gallery 23 - Film Sessions, Edinburgh, UK.

Hidden Door Festival, as part of The Hidden Door Festival presents The Jesus and Mary Chain, Leith Theatre, Edinburgh International Festival, Edinburgh, UK.

Nautilus vol.2 Festival of Arts, 'Golden Ratio' Cultural Association, Keratea of Attica, Greece.

Group Exhibition 'RSA Open Exhibition of Art 2018', The Royal Scottish Academy of Art and Architecture, Edinburgh, UK.

Group Exhibition 'Materiality', RAFT Research Group, Tent Gallery, Edinburgh, UK.

Group Exhibition 'Trading Zone', Talbot Rice Gallery, Edinburgh, UK.

Eleni-Ira Panourgia, "Process / Procedure: durational", Research Workshop of Minto House, ESALA, University of Edinburgh.

Eleni-Ira Panourgia, "Enclosure", acousmatic composition, WISWOS, Celebrating Women in Sound at Goldsmiths, the Great Hall of Goldsmiths, University of London

Group Exhibition 'Impact through Design 2018', M.F. Husain Art Gallery, Jamia Millia Islamia, New Delhi, India.

2017

Eleni-Ira Panourgia, "Process / Procedure", Prokalo seminar series, Research Workshop of Minto House, ESALA, University of Edinburgh.

Nautilus Festival of Arts, 'Golden Ratio' Cultural Association, Keratea of Attica, Greece.

Group Exhibition 'Impact through Design 2017', M.F. Husain Art Gallery, Jamia Millia Islamia, New Delhi, India.

2016

Group Exhibition 'Impact through Design - An Exhibition', M.F. Husain Art Gallery, Jamia Millia Islamia, New Delhi, India.

Eleni-Ira Panourgia, "Fantasia", composition for small orchestra, Edinburgh Composers' Orchestra, Reid Concert Hall, Edinburgh.

Group Exhibition 'Leave No Trace', Tent Gallery, Edinburgh, UK.

2015

Group Exhibition 'Research-in-progress' during Edinburgh International Festival, Sculpture Court, Edinburgh College of Art, University of Edinburgh.

Group Exhibition, Syn Festival, Edinburgh, UK.

Talks

Jun 27, 2018 "Reach IV, V and VI: Making sculpture with concrete formwork", RAFT Materiality Symposium, Tent Gallery, University of Edinburgh.

Feb 19, 2018 "From intangible to tangible", '3D Blockchain' workshop, Festival of Creative Learning, University of Edinburgh.

June 16, 2017 "A Participatory Music Journey in Museum Space", 12th International Conference on the Arts in Society, The American University of Paris, France.

May 31, 2017 "Digital interactions: Sound and three-dimensional forms", SIREN: Arts and Digital Practices Conference 2017, University of Edinburgh.

Dec 16, 2016 "Spectrogram data as system for making sculpture", GA2016 - 19th GENERATIVE ART CONFERENCE in Florence, Italy.

Dec 7, 2016 "Identifying limitations of methods in interdisciplinary research", in SIREN seminar series 2016/17, University of Edinburgh.

Feb 15, 2016 "Introduction to Materials", 'Creative Material Play' workshop, Innovative Learning Week, University of Edinburgh.

Nov 25, 2015 Postgraduate Research Methods Symposium, Edinburgh College of Art, University of Edinburgh.

Teaching at Edinburgh College of Art

Digital Media Studio Project Masters course, supervising the project 'Developing Multidimensional Objects' 2016/17 and 2017/18 provided me with the opportunity to use my research for framing teaching content and explore new possibilities of the topic³.

Masters-to-PhD mentoring scheme, supervised research proposals of potential PhD candidates 2017/18 in Art, Design and Music.

Creative Music Technology Undergraduate course that complements composition, sound recording and other audio technology courses with new techniques for basic principles in electronic music production through theoretical, creative and practical work in sampled and composed projects, 2018/19.

³ Examples of student work and the project brief can be found at:

<https://dmsp.digital.eca.ed.ac.uk/blog/multidimensionalobjects2017/2017/05/01/submission-2-2/>
<https://dmsp.digital.eca.ed.ac.uk/blog/multidimensionalobjects2018/category/submission-2/> [both accessed 12 November 2018]

Music on Screen Masters course, audiovisual relationships in film, gaming and video works, 2016/17, 2017/18 and 2018/19.

Organisation and reviewing

Apr 2018 Contributor

Edinburgh CitySounds, University of Edinburgh

Mar 2018 Co-organizer

DataVisFest on (In)equality and Inclusion, University of Edinburgh, DataFest Edinburgh

Feb 2018 Co-organizer

3D Blockchain workshop during the Festival of Creative Learning, University of Edinburgh

Since Oct 2017 Reviewer

The International Journal of the Inclusive Museum

Since Jun 2017 Co-founder, co-editor and manager

Airea: Arts and Interdisciplinary Research Journal
Edinburgh University Library Open Journals

Dec 2016 - May 2017 Co-organizer

- sIREN Conference: Arts and Digital Practices 2017
- Conference workshops with Trevor Wishart (Institute of Sonology) "Sound Loom / Composers Desktop Project"; Kristina Andersen (STEIM, Amsterdam) "Hypothetical Instruments"; Chris Speed and Bettina Nissen (ECA, Design Informatics) "Re-imagining the city as a value platform".

Since Jun 2016 Co-founder and co-organizer

sIREN (student-led Interdisciplinary Research Network)
sIREN research workshops and seminar series

Since 2016 Contributor

Rethinking Concrete Formwork research project
ESALA, Edinburgh College of Art

Feb 2016 Co-organizer

- 'Creative Material Play' workshop during the Innovative Learning Week, University of Edinburgh
- Showcase of 'Creative Material Play' workshop and outcomes in the Interactive Space of TEDxUniversityofEdinburgh 2015/16
- Exhibition of 'Creative Material Play' outcomes in Mathew Gallery at Minto House, University of Edinburgh

Awards and grants

2018 Devolved Researcher Funding from Edinburgh College of Art, University of Edinburgh for organizing a series of research workshops and shows during Dialogues Festival.

2018 Student Experience Grant, University of Edinburgh for organizing a series of research workshops and shows during Dialogues Festival.

2017 Festival of Creative Learning Fund from the Institute of Academic Development, University of Edinburgh for organizing the '3D Blockchain' workshop.

2017 Principal's Go Abroad Fund, University of Edinburgh for presenting in The Arts in Society Conference in Paris, France.

2017 Researcher-led Initiative Fund from the Institute of Academic Development, University of Edinburgh for organizing the Arts and Digital Practices Conference.

2017 Devolved Researcher Funding from Edinburgh College of Art, University of Edinburgh for organizing the Arts and Digital Practices Conference.

2016 Digital Scholarship Training Fund from CAHSS, University of Edinburgh for undertaking the two-day Advanced course of AudioSculpt in IRCAM, Paris, France.

2016 Postgraduate Research Expenses Grant from Edinburgh College of Art, University of Edinburgh for presenting in GA2016 Conference in Florence, Italy.

2016 Researcher-led Initiative Fund from the Institute of Academic Development, University of Edinburgh for organizing monthly seminar series and a conference in interdisciplinary research for the academic year 2016/2017.

2016 3-year Doctoral Scholarship from the Onassis Foundation, Scholarship Program for Hellenes.

2016 Devolved Researcher Funding from Edinburgh College of Art, University of Edinburgh for establishing sIREN (student-led Interdisciplinary REsearch Network).

2016 Postgraduate Research Expenses Grant from Edinburgh College of Art, University of Edinburgh for undertaking archival research in Paul Sacher Foundation in Basel, Switzerland.

2016 Edinburgh Award from the University of Edinburgh.

2016 Leadership Award from the University of Edinburgh.

2016 Three nominations of the 'Creative Material Play' workshop in the Innovative Learning Week awards as the 'Most Creative,' 'Most Experimental' and 'Most Impact', University of Edinburgh.

2016 Innovative Learning Week Fund from the Institute of Academic Development, University of Edinburgh for organizing 'Creative Material Play' workshop.

2015 1-year Doctoral Grant from the A.G. Leventis Foundation.

2015 Postgraduate Research Expenses Grant from Edinburgh College of Art, University of Edinburgh for attending 'Other Harmony' MaMuX seminar in IRCAM, Paris, France.