# How to Stop Sound: Creating a Light Instrument and 'Interruption' a piece for the Mimerlaven, Norberg Festival 2015.

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## Abstract

During an electronic music performance it is common to see light and sound interacting electronically in many different ways. From sound and light shows, whereby light reacts to sound, to generated visuals projected onto a screen behind the performer. We asked the question what if we could convert sound to light and back again and control sound in its light forms? Inspired by the huge acoustic of the Mimerlaven at the Norberg festival, myself and Laurits Esben Jongejan built a 'Light Instrument' that allowed us to interrupt sound using light forming the basis of our piece 'Interruption'.

## Author Keywords

NIME, Sound to light, Light to sound, Multimodal, Light control, Norberg festival, Electroacoustic composition.

## ACM Classification

C.0 [General] Hardware/software interface, C.5.3 [Microcomputers] Portable devices, D.2.6 [Programming Environments] Graphical Environments, H.5.2 [User Interfaces] Input devices and strategies, H.5.5 [Information Interfaces and Presentation] Sound and Music Computing.

## 1. Introduction

The main outcome of the course MME2015 Integrated Information Design at Malardalen University was to create an electronic musical instrument, compose and perform at the Norberg electronic music festival. We designed an instrument that used light to disrupt sound and composed and performed a piece, entitled 'Interruption', on the main stage in the Mimerlaven building. We used Arduino hardware and Max 4 Live software as the basis of the instrument allowing us to create a light instrument that controlled the amplitude of sound with very low latency. The instrument was inspired by the long acoustic response of the Mimerlavern, and would allow us to interact with the room's acoustic using light and sound. The piece itself was constructed of field recordings made in the building and recordings of a bowed violin. Using light as a main part of the instrument our work built on installations such as LINE [1] and the musical interface Light Matrix [2].

### 1.1 The Mimerlaven

The site of the festival is an old mineral mine with several buildings. The choices of building were the large Mimerlaven, the disused workshop ('Kraftwerk') and the option of an outdoor installation somewhere on the festival site. On the first day of the course we were allowed to explore the huge, 30 meter high Mimerlaven. The building is truly awe inspiring with a high ceiling which gives a long reverb time of 7 seconds.

The industrial history of the building is evident from the many pipes, cables and chains around the interior of the building.

## 2. Design Concept

With these initial ideas inspired by the Mimerlavern we refined them until we found a concept, which we could combine with sound. The idea of interruption appealed as we felt that both the life of the building had been interrupted and also that sound itself within the building could be stopped to allow us to take advantage of the long seven-second-reverb time. If we could interrupt the sound then we could create a piece that would be constructed from the buildings reverberant characteristic.

Combined with the idea of interruption was that of light. As the building was so dark, with no natural light, we felt that light itself is rare in the space, with the building being lit only partially for performances. Light would allow us to create a visual performance that could be seen in the darkness.

From there we came up with the idea of changing sound to light, and back again, so that somehow we could interrupt and disrupt sound with light.

### 2.1 Light Instrument

'The idea of designing for appropriation almost seems like an oxymoron: "plan for the unexpected". However, whilst you cannot design for the unexpected, you can design so that people are more likely to be able to use what you produce for the unexpected' [5].

The transference of sound to light and back would allowed us to create deviations and unexpected consequences using mirrors, LED lights and the movement of the light emitters and receivers themselves. In musical terms it would be possible to improvise with our instrument. Completely stopping the sound and thus allowing the Mimerlavern to sing would be achieved by stopping the light, this connection between sound and light could be made by an audience.

### 2.2 Early Prototype

The early prototype for this instrument was constructed using an Arduino Uno board, a breadboard for connecting electronic components to the Arduino and a laptop running an instance of Maxuino in Ableton Live. Maxuino is a Max 4 Live patch that allows interfacing between the Arduino and Ableton. In terms of the Light Instrument this meant it converted amplitude of an Ableton channel output to LED brightness and conversely photocell voltage to the amplitude of an Ableton group channel. We successfully converted the amplitude of an audio signal to light, emitted from a blue LED; the light was then picked up by a photocell.

"[w]hen people are tinkering, they are constantly trying out ideas, making adjustments and refinements, then experimenting with new possibilities, over and over and over." [6]

The tinkering process allowed us to test the parameters of what we were doing. It allowed us to calibrate the light instrument in low levels and to a great extent it formed the basis of our composition. It also allowed the introduction of external light sources such as the bike light LEDs that can be seen in the video of the piece [7]. These acted like a square wave, alternating between off and on, or the two LEDs would alternately flash. We also experimented with CDs to reflect light into the photodiode and other disruptive materials such as plastic cut out shapes to create gradual changes in light level.

## 3. Sound Design

We decided that the original sound materials themselves would be generated from the building. We took field recordings from the space a week before the performance. During the field recording session a storm forced rain down the central pipe. This resonated the whole space with white noise and the results were used in the finished piece at 7'20''.

Recording a bowed violin in a hotel room and layering the individual notes to create a chord created the string sound. We left most of the recordings with little processing, instead we allowed the Mimerlavern to 'play' the sounds with a long reverb time. The string sound would be interrupted by the photocell sensor and cut off completely if there was no light. The percussive mechanical sounds generated from the Mimerlavern would control the light source and thus the amplitude of the string sound.
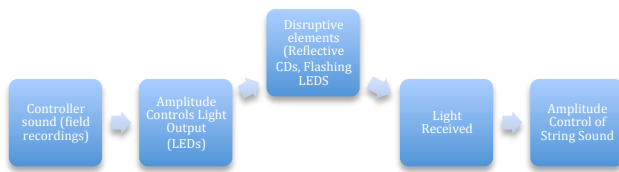


Figure 1: Signal flow of the Light Instrument.

## 3.1 Composition

Once the light instrument had come close to completion we tried various means of playing it. Using flashing LEDs, CDs, bubble wrap and cutout plastic we explored the sound world we created using the instrument to cut or boost the string sound by adding or cutting the amount of light getting to the photocell.

The field recordings were laid out in cells on a Novation Launchpad midi controller and different combinations were tried out whilst using the light instrument. We noticed short staccato sounds and sounds containing a high dynamic range were particularly effective at controlling the amplitude of the string sound and they also provided more of a direct audio/visual link to the brightness of the blue output LEDs.

Once the rough layout of the piece had been agreed we spent a number of hours improvising and practicing with the instrument. This process also allowed us to finalize the composition itself and give it some structure. Towards the end of the process we also added a pitch changing photocell which would shift the pitch of the string sound down a maximum of a two full tones, using a granular pitch shift, when placed near the light source. This worked well and was relatively easy to implement within Ableton using a granular delay for the pitch shifting.

## 4. Conclusion

The Arduino platform allows fast development of an instrument from initial idea, through prototyping to final concept in a very short amount of time. Before the project neither myself nor Laurits had much experience of working with the Arduino. Importantly the low latency of the system allows close interaction between performer and sound, even when converting sound to the light domain and back again. Further investigation in converting sound to light and allowing disruption of sound in the light domain is worth investigating particularly when used in the realm of synthesis and the author plans to develop more instruments based around the idea of light as both actuator and controller.

## 5. REFERENCES

[1] Kobori Daisuke, Kagawa Kojiro, Lida Mokoto and Chuichi Araka, LINE: Interactive Sound and Light Installation. Proceedings of the 2006 International Conference on New Interfaces for Musical Expression (NIME06), Paris, France.

[2] Pak, Jonathan, The Light Matrix: An Interface for Musical Expression and Performance. Proceedings of the 2006 International Conference on New Interfaces for Musical Expression (NIME06), Paris, France.

[3] http://norbergfestival.com/about/

[4] Harvey, David (1996) Justice, Nature and the Geography of Difference, Oxford: Blackwell

[5] Dix, Alan, Designing for Appropriation. (2007) http://alandix.com/academic/papers/HCI2007-appropriation/, Lancaster University, Lancaster, LA1 4WA.

[6] Resnick, M. & Rosenbaum, E. (2013). Designing for tinkerability. In M. Honey & D. Kanter (Eds.), Design, make, play: Growing the next generation of STEM innovators (pp. 163- 181). New York: Routledge.

[7] R.Lindell, T. Koray, J. Schaeffer, R. Morten. MATERIALITY for MUSICAL EXPRESSION: an Approach to Multidisciplinary Syllabus Development for NIME. Proceedings of the 2016 International Conference on New Interfaces for Musical Expression (NIME16), Brisbane, Australia.

## 6. Appendix

Audio of the performed piece 'Interruption': https://soundcloud.com/quip/interuption-ben-eyes-and-laurits-esben-jongejan
Video of the performance of 'Interruption' at Norberg: https://www.youtube.com/watch?v=EIcuVONRAZI

*NIME'16,* July 11-15, 2016, Griffith University, Brisbane, Australia.